Casting Your Vote in ESA

– Now and in the Future

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The voting rules applied in ESA's delegate bodies are defined in its Convention. Article XI.6(d) states that, unless otherwise provided for under the Convention, the majority rule is a simple majority of Member States represented and voting. The Convention provides for numerous derogations to this principle: unanimity, two-thirds majority, simple majority of all ESA Member States, and two-thirds majority of the Participating States representing two-thirds of the contributions (so-called 'double two-thirds majority'). The latter, applied within ESA in only a very limited number of cases, represents an element of weighted voting, which means a deviation from the pure one-country one-vote principle.

Weighted voting is also applied in other international organisations, such as the UN Security Council, the International Monetary Fund, the World Bank and the European Bank for Reconstruction and Development. In the space sector, in Intelsat, Eutelsat and Inmarsat, which were formed as intergovernmental organisations and are currently in the final phases of privatisation, the investment shares of its members constitute a voting weighting factor. In the Council of the European Union, the Qualified Majority Vote (QMV), which is the most frequent modality, implies a weighted system in which votes are attributed to each Member State roughly according to its population.

A discussion within ESA on its voting rules, and in particular on strengthening elements of weighted voting, was last held in 1998 in the framework of reflections on how to improve the Agency's efficiency and decision-making process. No firm conclusions were reached at that time, but the discussion might attract new attention when concrete steps towards enlargement of the Agency – perhaps to more than 20 Member States – are undertaken. Such a discussion, which would be driven by political considerations, could however

profit from a better understanding of the statistical properties and implications of potential alternative voting rules.

In order to provide some 'technical' insight in this respect, here we assess current and alternative voting rules for ESA in terms of their 'efficiency', defined as the probability that a vote has a positive outcome, and the voting power of Member States, defined as the statistical significance of a Member State's voting behaviour for the outcome of the vote. Particular attention is paid to the influence of an increasing number of Member States on these parameters. The statistical approach applied is based on the theoretical foundation of voting-power analysis and follows the methodology pursued when analysing the proposed voting reforms that were discussed at the EU Summit in Nice (F) in December 2000. The conclusions reached have been complemented by an analysis of the practical voting behaviour of ESA's Council from 1999 to 2001.

Current and Potential Alternative Voting Rules: What Lies behind Weights

The choice of alternative voting systems explored here has been driven by the concern to preserve the element of equitability represented by the one-State, one-vote rule. Thus, voting systems based exclusively on proportional – weighted – representation have only been investigated for comparative purposes.

A weighted voting system is one where different participants have different numbers of votes. A country's weight might depend on its population (as in the EU's voting system), its GNP, or other parameters (e.g. financial contributions), justifying giving each country a different influence over the outcome of a vote.

The weighted voting systems considered here include the EU current and potential (Nice Treaty) systems adapted to ESA specificities, as well as voting systems based on combinations of simple and two-thirds majority rules applied to a two-tier voting configuration (one-country, one-vote + weighted vote). They have been analysed for the current 15 Member States, for 17 Member States (present Members plus Greece and Luxembourg) and for 21 Member States (present Members plus Greece, Luxembourg, Poland, Romania, the Czech Republic and Hungary).

The nine different scenarios assessed, including for comparative purposes the current ESA voting systems, are:

– *Current ESA voting systems*

1. Simple majority of Member States

The European Union's current voting system and the one provided for in the Treaty of Nice have been adapted to ESA specificities by considering contributions instead of populations as the most appropriate basis for determining the allocation of weights. In the EU's Council, weighted votes are attributed to each Member State roughly according to their populations: more populous states have greater weights. But there is no strict proportionality: the ratio of weight to population is higher for the smaller Member States and lower for the most populous ones. A proposed resolution is approved if the total weight of those voting for it equals or exceeds a certain threshold. Following the same criteria, the Treaty of Nice is intended to readjust institutional equilibrium by fixing afresh the weights and the threshold in view of progressive enlargement from 15 to 27 Members.*

Keeping the present weighted voting formula in the EU's Council as new Members join would make it harder to pass a motion because the number of possible majorities capable of blocking a given proposal increases faster than the number capable of approving it. Therefore, dealing with this problem was considered a priority during the Nice Intergovernmental Conference in December 2000. The Treaty of Nice, which foresees the new weighting distribution in the accompanying table, is not yet in force as it still needs to be ratified by referendum in Ireland. If ratified, this modified voting system will replace the current one from 1 January 2005.

The weights for ESA Member States as derived from adapting to ESA the weighting methodology applied in the EU are shown in the accompanying table. The minimum and maximum weights are the same as in the EU voting systems, in order to facilitate comparison.

* The projected contributions from potential new Member States are based on Gross National Product (GNP), applying the ratio of average GNP to the average contributions of the present 15 ESA Member States.

Countries	Weights			
	EU current	EU adapted to ESA	EU Nice T	EU Nice T adapted to ESA
D	10	10	29	29
UK	10	5	29	15
F	10	10	29	29
I	10	8	29	27
E	8	5	27	13
NL	8	4	13	9
GR	5	3	12	7
B	5	5	12	14
P	5	2	12	5
S	5	3	10	7
A	4	3	10	6
DK	3	3	7	6
FIN	3	3	7	5
IRL	3	2	7	4
L	2	4	4	4
CH		4		10
N		3		6
PL			27	12
RO			14	7
CZ			12	7
H			12	6

2. Two-thirds majority of Member States
3. Two-thirds of the contributions representing two-thirds of Member States.

– *Combinations of contributions* and number of Member States:*
4. Simple majority of contributions representing a simple majority of Member States
5. Two-thirds of contributions representing a simple majority of Member States
6. Simple majority of the contributions representing two-thirds of Member States.

– *The EU's weighted voting system adapted to ESA (see accompanying panel):*
7. The EU's current weighted voting system
8. The one provided for in the Treaty of Nice.

– *Voting systems based exclusively on proportional representation:*
9. Simple majority of contributions.

* The contributions considered for the calculations are the 2001 totals. They reflect the distribution of contributions over the last 5 years, as the shares indicated in the annual budgets have remained relatively stable.

Evaluating the Efficiency of a Voting Rule

Assuming that N Member States vote either 'yes' or 'no' (no abstentions), there are 2^N different combinations of voting results. For 15 Member States, therefore, there are 32 768 possible combinations. The choice of voting rules applied determines how many of the combinations are 'winning combinations', i.e. those that result in a positive outcome to the vote. On this basis, the 'efficiency' of a voting rule, i.e. the chance that the vote has a positive outcome, can be measured as the *ratio of winning combinations to the total number of combinations.*

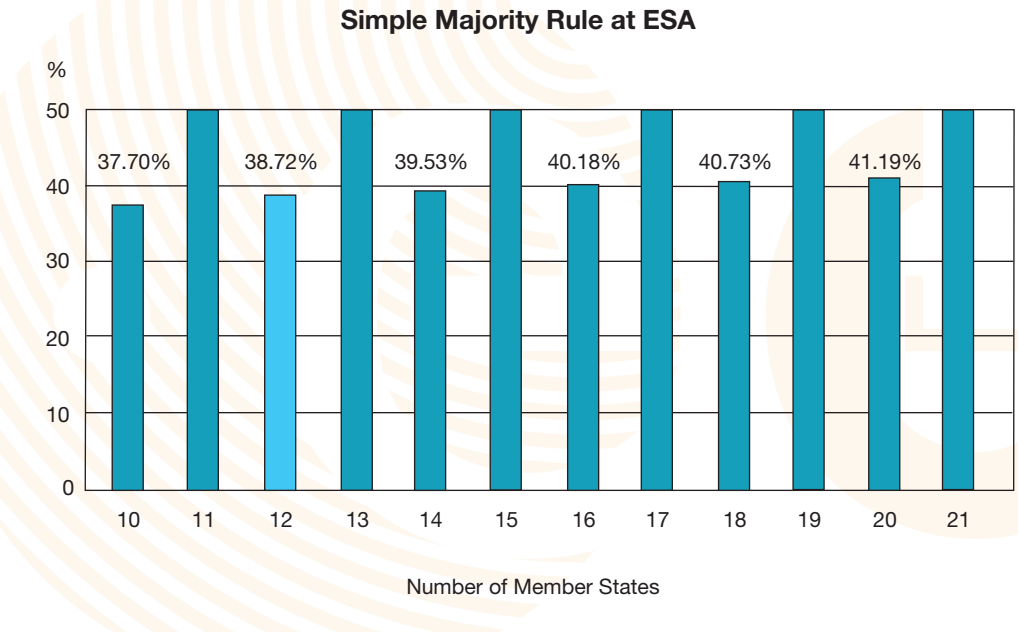
Such a voting-rule efficiency is obviously not a quality criterion, which justifies per se the preference of one voting rule to another. Although it is theoretically easier to achieve a simple majority than a two-thirds majority, since the efficiency with the simple-majority rule is higher than with the two-thirds-majority rule, there is good reason to prefer the two-thirds-majority rule in cases where a wider consensus between Member States is regarded as necessary to pass a decision. The extreme case is the requirement for unanimity. Although the statistical probability of unanimity is close to zero – as there is only one winning combination out of all the possible combinations of votes – unanimity is a widely established voting rule.

The voting-rule efficiency defined above does, however, allow the comparison of voting rules in terms of the statistical probability of producing positive voting results, as well as the study of the influence of an increasing number of voters.

As shown in graph 1**, the efficiency of the simple majority of all Member States rule is always 50% for an odd number of countries, but is lower for an even number. In the latter case, the existence of 'neutral' coalitions – where half of the countries vote 'yes' and half 'no' – lowers the number of winning coalitions and therefore the efficiency. It might be surprising at first sight that for an even number, the actual efficiency depends on the number of Member States. This is due, however, to the fact that the share of neutral coalitions in the overall number decreases as the number of Member States increases.

The influence of the number of Member States on the efficiency of a voting rule is even more striking for the two-thirds-majority rule, as is apparent in graph 2. The overall trend of decreasing efficiency with increasing number of Member States can be illustrated with the example of flipping a coin: for 3 coins, in 50% of the cases either 2 or all 3 coins show heads. For 15 coins, the likelihood of finding at least 10 coins showing heads is obviously much less than 50%. Also, under the two-thirds-majority voting rule, the evolution of efficiency is not linear with the number of

Graph 1



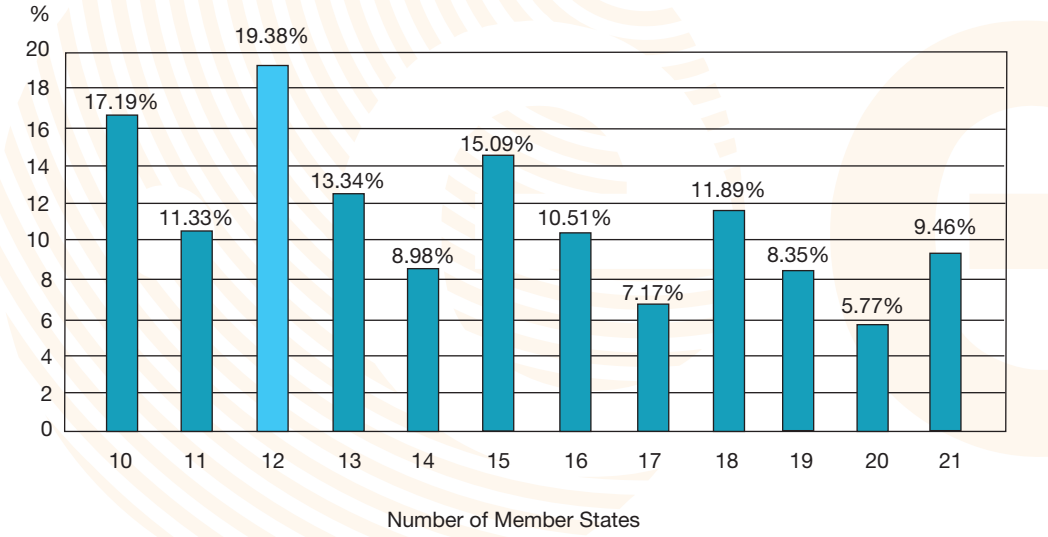
** ESA moved directly from 11 to 13 Member States because Austria and Norway entered the Agency as full members at the same time.

countries, i.e. it is higher with 21 voters than with 14, but varies monotonically by groups of three.

The probability of the ESA Council passing a randomly selected decision under the current and the alternative voting schemes is shown in graph 3.

It is also surprising that the simple-majority rule applied to a one-country, one-vote system (scenario 1) or to a purely weighted system (scenario 9) results in the same 50% efficiency level. In other words, *the efficiency of the simple-majority rule is independent of the distribution of weights per country.*

Graph 2



As is to be expected, the 'dual-simple-majority' decision rule, i.e. a simple majority of Member States representing a simple majority of contributions (scenario 4), is clearly superior in efficiency terms to voting rules that include a two-thirds majority (scenarios 2,3, 5 and 6). It also exhibits very little sensitivity to an increase in the number of Member States, which means it could constitute a long-lasting voting system by being able to accommodate potential future enlargements.

Compared to the 'dual-simple-majority' rule, the increase in the threshold on contributions from simple-majority to two-thirds-majority – while requiring a simple majority of Member States (scenario 5) – almost halves the likelihood of passing a randomly selected proposal. However, this decision rule still maintains a stable efficiency level in an ESA with 21 Member States.

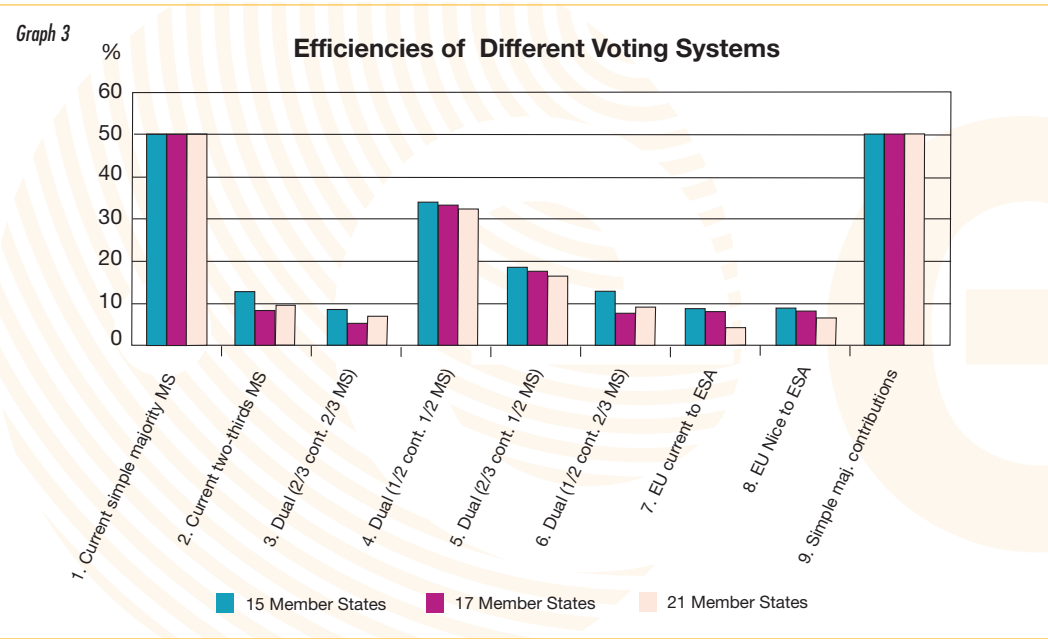
The decision rules including a two-thirds majority of Member States (scenarios 3 and 6) show a high dependency of efficiency on the number of Member States. An increase from 15 to 17 almost halves the efficiency !

The European Union's actual and potential weighted voting systems, when adapted to ESA, display efficiencies that are comparable to those of the existing ESA voting systems (scenarios 2 and 3), the adaptation of the 'Nice Treaty' system providing slightly better efficiencies than the adapted 'current EU system'.

Evaluating the Voting Power of Member States

A voter's power under a given decision rule is defined as the amount of influence that the voter has over the outcome of the vote. It is a measure of *the probability that the given voter can be critical to the final outcome of the vote* or, in other words, that the voter can reverse the outcome by reversing his/her vote. Hence, the more powerful a voter is, the more often the outcome goes the way he/she votes. Such

Graph 3



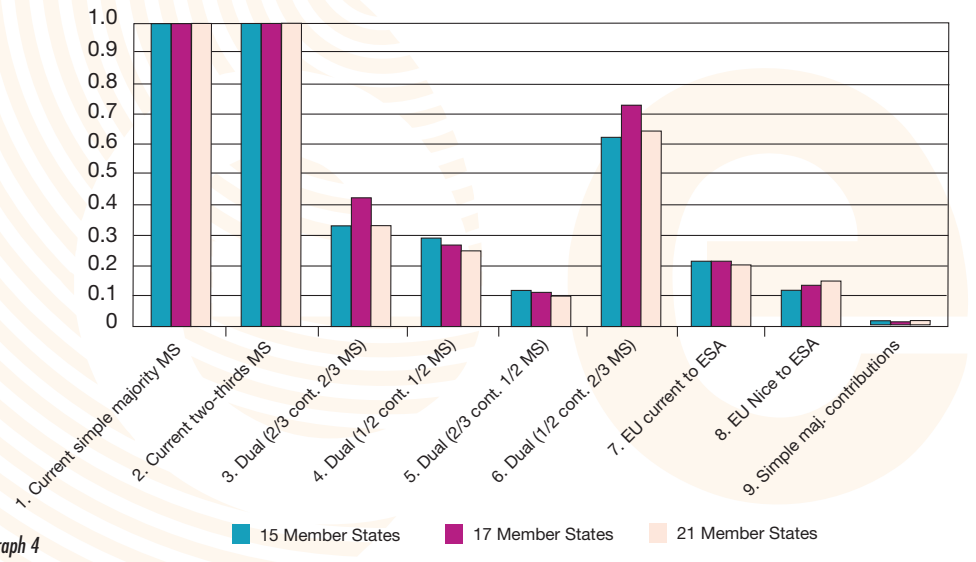
voting power is a purely mathematical parameter, independent of real-life factors like the ability to persuade or to convince other voters. Such factors might result in a much higher 'de facto' influence over the outcome of the vote than the statistical voting power alone indicates.

Of the voting schemes investigated, the one under which all Member States have the highest probability of being crucial to the final outcome is the dual-simple-majority rule, whereas under the double two-thirds-majority rule this probability decreases sharply*.

ratio of relative voting powers is 1 because the voting weights of all Member States are equal. Of the dual-majority schemes, the voting rule based on two-thirds of Member States and a simple majority of contributions (scenario 6) is the one displaying the least disparity in terms of voting power, while under the voting rule requiring two-thirds of contributions and a simple majority of Member States (scenario 5), the amount of influence exerted by the 'weakest' Member State over the outcome is low, amounting to about only 10% of that of the 'strongest' voter.

on an equal footing, while the second introduces a correspondence between the voting power and contribution level of a Member State, thus favouring the big contributors, avoiding their being out-voted by the smaller ones. Achieving the right balance between these elements is essential to arrive at a scheme acceptable to all Member States. However, even a purely weighted voting rule (as scenario 9) attains such a balance if the weights are chosen satisfactorily for all Member States. This could be achieved by applying weights that are not strictly proportional to contribution levels, in the same way that the weights in the EU system are not strictly proportional to the actual population levels.

Ratios of Relative Voting Power between Weakest and Strongest Member States



Graph 4

A picture of the relative voting power distribution of Member States for each of the assessed voting systems is given in graph 4 by comparing the ratios of power between the least and most influential Member States: the lower that ratio is, the larger is the difference between their relative voting powers.

As is to be expected, under (non-weighted) one-country one-vote rules, the

From the graphs 3 and 4 above, it transpires that the combination of the different yardsticks – efficiency of voting systems and their sensitivity to enlargement trends together with the voting power of Member States – points to the dual simple majority as the most acceptable scheme for ESA on both efficiency and political-acceptability grounds. It also represents a long-term solution in that it could accommodate further ESA enlargement.

All dual schemes combine the element of 'one-country, one-vote' with the element of weighted voting. The first element puts small and large contributors

Voting Practice in ESA: Majorities Required and Obtained

In order to determine the empirical efficiency of the ESA voting system, regarded as the Council's actual ability to act, decision items proposed to the ESA Council – excluding ministerial Councils – over a three-year period (1999-2001) were analysed. The results were compared with the theoretical efficiencies of each of the required majorities as defined above.

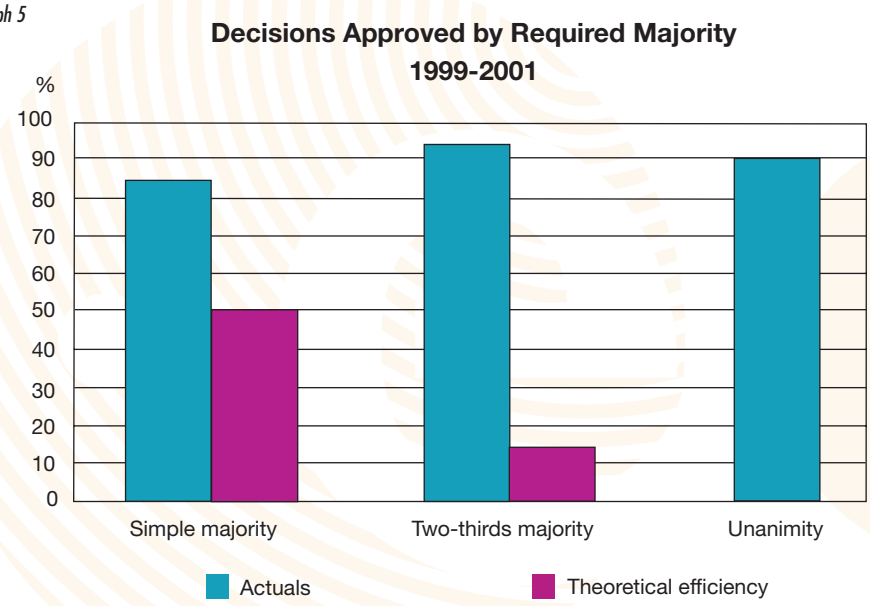
The analysis shows that the most commonly applied voting rule in the ESA Council is a two-thirds majority, applying to 44.4% of the decision items during the period, compared with 34.1% requiring a simple majority and 21.5% unanimity.

In term of the final outcome of decisions taken from 1999 to 2001, 89.6% of Council decision items were approved, 8.2% were rejected and 2.2% were withdrawn from the agenda. Of the items rejected, about half were required to be approved by a simple majority.

It should be underlined that, in practice, disregarding the majority required, Member States tend to seek unanimity. In fact, 60.7% of all decision items were

* As an example, under the dual-simple-majority scheme, France could reverse the outcome by reversing its vote in 38% of the cases, but only in 16% of the cases under the double two-thirds majority rule.

Graph 5



finally approved with unanimity, whereas only one-third actually required unanimous approval.

Based on the results obtained for each of the required majorities in the Council during the period 1999-2001, we can compare the actual percentage of proposals approved by the required majority and the theoretical efficiency of the voting rule (see graph 5).

It must, of course, be remembered that the theoretical efficiency is a mathematical parameter, which does not take into account the fact that the Executive does not propose random measures, or that coalitions of Member States do not form randomly around any proposal. In practice, therefore, the likelihood of a positive outcome under the three voting rules applied – simple majority, two-thirds majority, and unanimity – is considerably higher than the statistics predict.

Conclusion and Prospects

This analysis of the decision-making efficiency of the current ESA voting system has shown that – from a statistical point of view – the Agency's projected enlargement would not significantly affect the ability of Member States to approve a given measure. For the two-thirds-majority rule in particular, future enlargements would only moderately lower decision-making efficiency. Moreover, voting practice in Council shows that the empirical efficiency of the system is high and the agreement of all Member States to a given proposal is generally pursued and achieved.

Based on the results of our statistical analysis, ESA's potential enlargement would not require the introduction of alternative voting rules to maintain the Council's efficiency to act. The main concern is to construct a decision-making system that remains efficient and democratically legitimate for an enlarged Agency with up to 21 members. At the same time, the distribution of power, which represents the key to political acceptability, should be satisfactory for each incumbent Member State.

Our analysis of combinations of simple and two-thirds majority rules applied to a two-tier vote configuration (number of Member States + votes weighted on contributions) shows that the dual-simple-majority rule (simple majority of the contributions representing a simple majority of Member States) best combines high efficiency and a 'fair' distribution of voting power. This voting system would also represent a long-lasting reform as its efficiency and voting power distribution is rather insensitive to future ESA enlargements.

Examination of the recent voting behaviour of Council shows that its efficiency to act is significantly higher than statistical analysis predicts. In practice, the ESA Executive seeks to make proposals that are likely to be accepted by Council. The existence of subordinate bodies providing for a process not only of refining proposals, but also of consensus-building before an actual decision is sought, also explains the high level of voting efficiency in Council. The impact of future enlargement on voting efficiency is therefore expected to materialize not so much in statistical effects due to the larger number of voters, but rather in the increased complexity of reaching consensus, which is fundamental to the practical voting efficiency.

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