# DEMOGRAPHIC CHANGES AND PRINCIPLES OF THE FAIR DIVISION

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**Abstract**

*Principles of the allocation of parliamentary seats for member states in the European parliament should be characterized by a stability on account of demographic changes. Slight modifications of the population numbers in individual countries cannot lead the proportion of the division to changes. For this reason appointing the scope of demographic changes which aren't leading to changes of the parliament is a significant task. In the article this problem is being analysed with reference to classic rules of the proportional division.*

**Key Words:** *demographic, fair division, inequality*

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## 1. INTRODUCTION

There are a number of historically approved methods employed in division of goods. The oldest and the most recognizable of these is the Aristotelian principle of proportional division. The notion of proportional division (simple fair division), historically speaking, is derived from the problem of mandate distribution in collegiate bodies. In the ideal, most desirable circumstances, each mandate is associated with identical number of votes. In practice, however, such a situation is highly improbable, due to indivisibility of this particular type of goods. If a given group of voters is awarded with a fractional share of mandate, this fraction needs to be rounded off – up for some groups, and down for others. Consequently, several alternative methods of distribution were devised with the aim of approximating the ideal proportional distribution. These methods are typically based on a notion of quota, defined as a product of total number of mandates and the share of a given group of voters in total population.

The most widely employed methods of proportional division are formed in relation to democratic tradition of the United States. The first postulate of this type was formulated by Alexander

Hamilton, Secretary of State in George Washington's cabinet. Hamilton postulated that each group of voters be given an integral value of its quota, with the remaining mandates (if any), distributed equally between the groups that are represented by the highest fractional value of their quota. Another popular approach is the so-called divisor principle. Methods based on this principle work under the assumption that the population of each voting party is divided by the same positive value (divisor), resulting in artificial quota. Subsequently, each party is awarded with quota rounded off to an integral number. If the resulting number of seats is higher (lower) than assumed, the whole operation is reapplied using a larger (lower) divisor. The most popular and the most widely used methods of this type are: Jefferson's (with artificial quota rounded down), Adams' (rounded up) and Webster's (with artificial quota rounded off to the nearest integral).

## 2. DEFICIENCIES OF PROPORTIONAL DIVISION METHODS

First of all, criticism of proportional distribution methods emphasizes three classical apportionment paradoxes. The first such paradox is the *Alabama paradox*. It is related to the situation when increasing the total number of seats, at an unchanged number of party representatives, results in a decrease of this party's share compared with previous vote season. Another such paradox, *population paradox*, takes place when a group with rapid increase of population gains seats at the cost of population group with slower growth. The third deficiency of proportional division is the *failure to follow the quota rule*, observed when a particular method results in lower apportionment of seats in relation to its quota rounded down or higher than its rounded up quota. Of the methods described above, only the Hamilton method is prone to Alabama and population paradoxes, while divisor methods generally fail to follow the quota rule (Young, 2003).

Moreover, proportional division methods do not perform well in case of large disproportion in the population count of individual parties. This may result in small populations having no representation whatsoever. In some situations, this solution is not acceptable, a good example being the distribution of seats in the European Parliament.

## 3. DISTRIBUTION OF SEATS IN THE EUROPEAN PARLIAMENT – A DEGRESSIVE PROPORTIONALITY

The European Parliament is one of the most important institutions of the European Union based on representation of member states. Principles of seat distribution in The EP have changed with subsequent EU enlargement stages. Due to large disproportion of population between individual member states, no proportional method can be employed in seat distribution. This is also a result of natural intention of the European community to offer fair representation to all members. Consequently, any solution that would result in elimination or marginalization of particular member states would not prove acceptable. Such risk would need to be faced when any of the existing proportional methods were employed. In extremity, i.e. after employing the Jefferson method, Germany would be represented by 122 seats, while Malta and Luxemburg would end up with no representation at all. In the light of the above, another approach to apportionment was postulated, one that would prevent the risk described above. The postulate was expressed in Article 9 A paragraph 2 of the Treaty of Lisbon. The article states that: *"The European Parliament shall be composed of representatives of the Union's citizens. They shall not exceed seven hundred and fifty in number, plus the President. Representation of citizens shall be degressively proportional, with a minimum threshold of six members per Member State. No Member State shall be allocated more than ninety-six seats."* (Treaty of Lisbon, 2010).

The Treaty, however, fails to define the term of degressive proportionality. Some indicators to the meaning intended by the authors can be found by analyzing the content annexed to the draft of European Parliament resolution. Two conditions formulated therein may prove helpful in deriving the intentions of the legislators in this respect. The first, referred to as the principle of fair division, states that the larger the population of a Member State, the greater its entitlement to a large number of seats. The other condition, referred to as the principle of relative proportionality, holds that *the larger the population of a country, the more inhabitants are represented by each of its Members of the European Parliament*. (Lamassoure, Severin, 2007).

In a formal approach, this means that if $n$ represents the number of Member States, $l_i$ – population of $i$ member, and $m_i$ – the number of mandates offered to the Member State, then the relation of $l_1 > l_2 > \cdots > l_n$ results in the following inequality functions:

$$m_1 \geq m_2 \geq \cdots \geq m_n \qquad \text{and} \qquad \frac{l_1}{m_1} > \frac{l_2}{m_2} > \cdots > \frac{l_n}{m_n}.$$

There are many postulates that satisfy the above conditions. Consequently, there are many potential seat distribution patterns. The most extreme and straightforward approach is the equal distribution, resulting in each Member State having equal representation of seats. Such an approach, however, would lead to biased overrepresentation of small states, not to mention the fact that it is in distinct contradiction with another postulate presented in the above EP resolution, which states that *"the minimum and maximum numbers set by the Treaty must be fully utilised to ensure that the allocation of seats in the European Parliament reflects as closely as possible the range of populations of the Member States."* (Lamassoure, Severin, 2007). The opposite pole of extremity is represented by proportional division methods, with the aforementioned set of deficiencies.

The present composition of the European Parliament does not satisfy the principles of degressive proportionality, since it was formulated before the ratification of the Treaty of Lisbon. The approach postulated by Committee on Constitutional Affairs members Lamassoure and Severin does indeed fulfill the requirements of degressive proportionality, but at the same fails to provide a solution for the problem of methodological clarity. The authors themselves admit that future postulates should aim to provide more explicit guidelines to be used in future expansions of the European Union, to avoid further political disputes over representation of national interests.

Another important problem is the lack of stability in respect to the composition of the European Parliament, evident even at relatively small demographic shifts. The authors of the draft of EP resolution state that a clear, comprehensible and transparent system must also be applicable to future changes in the size of the populations of the Member States without substantial new negotiations (Lamassoure, Severin, 2007). However, they do not take into account the fact that even with assumed constant composition of EU member states, small demographic changes may have a critical effect on the fundamental principle of degressive proportionality. The method of seat distribution postulated in the annex to the draft of EP resolution of 2007 fails to satisfy the requirements of degressive proportionality even for demographic data of 2009. Consequently, this may result in new distribution of seats, with all associated problems and risks. Prolonged negotiations undermine the principle of EU solidarity, giving way to debates over particular national interests. This, in turn, may result in obstruction or postponing of some projects important

to the community as a whole. In this context, it may be advisable to postulate introduction of a new criterion, that of stability, to narrow down the range of acceptable solutions and, in consequence, provide more resistance to demographic shifts.

## 4. THE MEASURE OF STABILITY OF DEGRESSIVELY PROPORTIONAL DISTRIBUTION

Definition of degressively proportional division results in inequality

$\frac{l_i}{m_i} > \frac{l_{i+1}}{m_{i+1}}$ for $i = 1,\ldots,n-1$. Hence, $S_i = \frac{m_i l_{i+1}}{m_{i+1} l_i} < 1$.

Consequently, stability of degressively proportional division may be formulated as follows: the division should remain constant under small demographic shifts, while at the same time satisfying the inequality $S_i < 1$.

Given an ordered sequence of population $l_1 > l_2 > \cdots > l_n$ and the corresponding sequence of seats $m_1 \geq m_2 \geq \cdots \geq m_n$ that satisfies the inequality of $S_i < 1$ for every index $i$, it can be observed that for $m_i = m_{i+1}$, any changes to the number of population $l_i$, $l_{i+1}$ will not affect the requirement $S_i < 1$. The obvious conclusion to this is the fact that equal distribution is degressively proportional. Another obvious and important conclusion is the fact that the only significant pairs to affect the division are the pairs of member states for which $m_i > m_{i+1}$. It is evident that as the value of $S_i$ approaches one, the direction of inequality is more prone to shift. When that happens, even the relatively insignificant change of population count of member states $i$, $i$+1 violates the principle of degressive proportionality.

The above considerations show that stability of degressively proportional division is related to the number of seats and population count of all pairs of neighboring member states (in monotonic order against the total population of all EU member states). The definitional requirement of satisfying the inequality $S_i < 1$ leads to conclusion that the most stable divisions in this sense are those based on equal distribution, since demographic changes in this case do not affect the degressive proportionality. This method of apportionment, however, violates the postulate of varied number of seats, as expressed in the aforementioned annex to the draft resolution of EP. This, in turn, leads us to another, possibly most important conclusion that for the purpose of stability evaluation based on $S_i$, index, only those pairs of member states are relevant, for which $m_i > m_{i+1}$.

## 5. STABILITY COEFFICIENT OF DEGRESSIVELY PROPORTIONAL DIVISION

In the light of the above considerations, the following measure of demographic stability of degressively proportional division may be postulated:

***SD*** = max $S_i$,

where maximum is calculated only for such indexes $I$ that satisfy the inequality

$m_i > m_{i+1}$ .

**Table 1. Postulated methods of European Parliament seat divisions (based on 2006 population reports)**

| Country | Population (thous.) | Present term | $S_i$ | R | $S_i$ | P | $S_i$ | LS | $S_i$ |
|---|---|---|---|---|---|---|---|---|---|
| Germany | 82438 | 99 | **1.051** | 96 | 0.929 | 96 | 0.884 | 96 | 0.991 |
| France | 62999 | 72 | | 79 | 0.996 | 83 | 0.995 | 74 | 0.972 |
| Great Britain | 60393 | 72 | | 76 | 0.986 | 80 | **1.011** | 73 | 0.986 |
| Italy | 58752 | 72 | **1.073** | 75 | 0.947 | 77 | 0.972 | 72 | 0.993 |
| Spain | 43758 | 50 | | 59 | 0.971 | 59 | 0.989 | 54 | 0.923 |
| Poland | 38157 | 50 | 0.858 | 53 | 0.883 | 52 | 0.92 | 51 | 0.875 |
| Romania | 21610 | 33 | 0.998 | 34 | 0.952 | 32 | 0.93 | 33 | 0.959 |
| Netherlands | 16334 | 25 | 0.774 | 27 | 0.919 | 26 | 0.885 | 26 | 0.805 |
| Greece | 11125 | 22 | | 20 | | 20 | **1** | 22 | |
| Portugal | 10570 | 22 | | 20 | | 19 | | 22 | |
| Belgium | 10511 | 22 | | 20 | **1.027** | 19 | **1.029** | 22 | |
| Czech Rep. | 10251 | 22 | | 19 | | 18 | | 22 | |
| Hungary | 10077 | 22 | **1.097** | 19 | 0.948 | 18 | 0.951 | 22 | 0.988 |
| Sweden | 9048 | 18 | 0.967 | 18 | 0.967 | 17 | 0.971 | 20 | 0.962 |
| Austria | 8266 | 17 | | 17 | 0.992 | 16 | 0.996 | 19 | 0.986 |
| Bulgaria | 7719 | 17 | 0.919 | 16 | 0.865 | 15 | 0.811 | 18 | 0.973 |
| Denmark | 5427 | 13 | | 13 | | 13 | | 13 | |
| Slovak Rep. | 5389 | 13 | | 13 | | 13 | **1.057** | 13 | |
| Finland | 5256 | 13 | 0.868 | 13 | 0.946 | 12 | 0.874 | 13 | 0.868 |
| Ireland | 4209 | 12 | | 11 | 0.889 | 11 | 0.889 | 12 | |
| Lithuania | 3403 | 12 | **1.012** | 10 | 0.749 | 10 | 0.749 | 12 | 0.899 |
| Latvia | 2295 | 8 | 0.997 | 9 | 0.982 | 9 | 0.982 | 9 | 0.982 |
| Slovenia | 2003 | 7 | 0.783 | 8 | 0.767 | 8 | | 8 | 0.895 |
| Estonia | 1345 | 6 | | 7 | 0.664 | 8 | 0.651 | 6 | |
| Cyprus | 766 | 6 | | 6 | | 7 | | 6 | |
| Luxemburg | 469 | 6 | **1.036** | 6 | 0.864 | 7 | **1.007** | 6 | 0.864 |
| Malta | 405 | 5 | | 6 | | 6 | | 6 | |
| Total | 492975 | 736 | | 750 | | 751 | | 750 | |
| ***SD*** | | | | | | | | | **0.993** |

R – Ramirez, P – Pukelsheim, LS – Lamassoure and Severin
Source: own research.

It is worth noting that, on the one hand, the stability coefficient ***SD*** should not approach one, since this would result in rapid change of Parliament composition and other associated problems. On the other hand, it should not assume too low value, as this would result in drastic misrepresentation of population ratios of individual member states and pose a risk of approaching the equal division. One may, obviously, envisage a situation when ***SD*** approaches unity, and yet the division remains stable. This may occur if the majority of $S_i$ are low, while ***SD*** value is influenced by only a few pairs of neighboring member states, assuming that population count of member state $i$ is lower than that of member state $i + 1$.

Table 1 presents selected postulates of seat division. The first one, obtained using the parabolic method, was suggested by Spanish statistician Victoriano Ramirez Gonzales (Ramirez, Palomarez, Marquez, 2006). The second proposal, calculated using the method of proportionality shift, was postulated by Friedrich Pukelsheim, professor of mathematics at Augsburg University (Ramirez, Palomarez, Marquez 2006). The third proposal is based on the postulates of Lamassoure and Severin, discussed above. $S_i$ coefficients were calculated for each of the above postulates.

Boldface was used in Table 1 for those $S_i$ coefficients that exceed unity. Hence, neither Ramirez' nor Pukelsheim's postulate satisfy the requirement of degressive proportionality. On the other hand, the seat distribution pattern postulated in the draft authored by Lamassoure and Severin does satisfy the requirement of degressive proportionality, yet cannot be considered stable in the sense suggested in this paper. This may be observed by analyzing demographic changes up to the year 2009. Table 2 presents $S_i$ coefficients calculated for the latter proposal, based on population reports of 2006 and 2009.

**Table 2. $S_i$ coefficients calculated for the Lamasoure and Severin proposal (based on population reports of 2006 and 2009)**

| Country | Lamassour Severin | $S_i$ 2006 | $S_i$ 2009 | Country | Lamassour Severin | $S_i$ 2006 | $S_i$ 2009 |
|---|---|---|---|---|---|---|---|
| Germany | 96 | 0.991 | **1.018** | Austria | 19 | 0.986 | 0.961 |
| France | 74 | 0.972 | 0.971 | Bulgaria | 18 | 0.973 | **1.003** |
| Gr. Britain | 73 | 0.986 | 0.988 | Denmark | 13 | | |
| Italy | 72 | 0.993 | **1.018** | Slovak R. | 13 | | |
| Spain | 54 | 0.923 | 0.881 | Finland | 13 | 0.868 | 0.905 |
| Poland | 51 | 0.875 | 0.871 | Ireland | 12 | | |
| Romania | 33 | 0.959 | 0.973 | Lithuania | 12 | 0.899 | 0.9 |
| Netherlands | 26 | 0.805 | 0.807 | Latvia | 9 | 0.982 | **1.011** |
| Greece | 22 | | | Slovenia | 8 | 0.895 | 0.879 |
| Belgium | 22 | | | Estonia | 6 | | |
| Portugal | 22 | | | Cyprus | 6 | | |
| Czech Rep. | 22 | | | Luxemburg | 6 | 0.864 | 0.838 |
| Hungary | 22 | 0.988 | **1.015** | Malta | 6 | | |
| Sweden | 20 | 0.962 | 0.95 | Total | 750 | | |

Source: own research.

**Table 3. Postulated division and verification of *SD* coefficient stability in relation to the present composition of the European Parliament (based on 2009 data and Eurostat forecasts for 2010 and 2015 (Population projections, 2010)**

| Country | Postulated | 2009 | $S_i$ | 2010 | $S_i$ | 2015 | $S_i$ |
|---|---|---|---|---|---|---|---|
| Germany | 86 | 82002 | 0.978 | 82145 | 0.950 | 81858 | 0.978 |
| France | 69 | 64351 | | 62583 | | 64203 | |
| Gr. Britain | 69 | 61635 | | 61984 | | 63792 | |
| Italy | 69 | 60045 | 0.940 | 60017 | 0.958 | 60929 | 0.999 |
| Spain | 56 | 45828 | 0.896 | 46673 | 0.879 | 49381 | 0.830 |
| Poland | 52 | 38136 | 0.916 | 38092 | 0.910 | 38068 | 0.901 |
| Romania | 32 | 21499 | 0.944 | 21334 | 0.952 | 21103 | 0.975 |
| Netherlands | 26 | 16486 | 0.935 | 16503 | 0.938 | 16717 | 0.939 |
| Greece | 19 | 11260 | | 11307 | | 11476 | |
| Belgium | 19 | 10750 | | 10784 | | 11070 | |
| Portugal | 19 | 10627 | | 10723 | | 10947 | |
| Czech Rep. | 19 | 10468 | | 10394 | | 10497 | |
| Hungary | 19 | 10031 | | 10023 | | 9964 | |
| Sweden | 19 | 9256 | | 9306 | | 9588 | |
| Austria | 19 | 8355 | | 8405 | | 8570 | |
| Bulgaria | 19 | 7607 | 0.810 | 7564 | 0.814 | 7382 | 0.846 |
| Denmark | 17 | 5511 | | 5512 | | 5591 | |
| Slovak Rep. | 17 | 5412 | | 5407 | | 5427 | |
| Finland | 17 | 5326 | 0.888 | 5337 | 0.919 | 5429 | 0.989 |
| Ireland | 16 | 4450 | 0.803 | 4614 | 0.771 | 5052 | 0.692 |
| Lithuania | 15 | 3350 | 0.779 | 3337 | 0.777 | 3275 | 0.775 |
| Latvia | 13 | 2261 | | 2247 | | 2200 | |
| Slovenia | 13 | 2032 | 0.779 | 2034 | 0.775 | 2053 | 0.762 |
| Estonia | 11 | 1340 | 0.818 | 1333 | 0.846 | 1323 | 0.923 |
| Cyprus | 8 | 797 | 0.826 | 821 | 0.803 | 888 | 0.785 |
| Luxemburg | 6 | 494 | 0.838 | 494 | 0.837 | 523 | 0.805 |
| Malta | 6 | 414 | | 414 | | 421 | |
| Total | 750 | 499723 | | | | | |
| **SD** | | | **0.978** | | | | |

Source: own research.

**Table 4. Postulated division and verification of *SD* coefficient stability in relation to the composition of the European Parliament following EU expansion by three new member states: Croatia, Macedonia and Turkey (based on 2009 data and Eurostat forecasts for 2010 and 2015)**

| Country | Postulated | 2009 | $S_i$ | 2010 | $S_i$ | 2015 | $S_i$ |
|---|---|---|---|---|---|---|---|
| Germany | 64 | 82002 | 0.915 | 82145 | 09140 | 81858 | 0.923 |
| Turkey | 61 | 71517 | | 71595 | | 71987 | |
| France | 61 | 64351 | | 62583 | | 64203 | |
| Gr. Britain | 61 | 61635 | | 61984 | | 63792 | |
| Italy | 61 | 60045 | 0.913 | 60017 | 0.930 | 60929 | 0.969 |
| Spain | 51 | 45828 | 0.903 | 46673 | 0.886 | 49381 | 0.837 |
| Poland | 47 | 38136 | 0.883 | 38092 | 0.877 | 38068 | 0.868 |
| Romania | 30 | 21499 | 0.920 | 21334 | 0.928 | 21103 | 0.951 |
| Netherlands | 25 | 16486 | 0.899 | 16503 | 0.902 | 16717 | 0.903 |
| Greece | 19 | 11260 | | 11307 | | 11476 | |
| Belgium | 19 | 10750 | | 10784 | | 11070 | |
| Portugal | 19 | 10627 | | 10723 | | 10947 | |
| Czech Rep. | 19 | 10468 | | 10394 | | 10497 | |
| Hungary | 19 | 10031 | | 10023 | | 9964 | |
| Sweden | 19 | 9256 | | 9306 | | 9588 | |
| Austria | 19 | 8355 | | 8405 | | 8570 | |
| Bulgaria | 19 | 7607 | 0.918 | 7564 | 0.923 | 7382 | 0.959 |
| Denmark | 15 | 5511 | | 5512 | | 5591 | |
| Slovak Rep. | 15 | 5412 | | 5407 | | 5427 | |
| Finland | 15 | 5326 | 0.895 | 5337 | 0.926 | 5429 | 0.997 |
| Ireland | 14 | 4450 | | 4614 | | 5052 | |
| Croatia | 14 | 4435 | 0,881 | 4430 | 0,879 | 4405 | 0,867 |
| Lithuania | 12 | 3350 | 0.900 | 3337 | 0.898 | 3275 | 0.896 |
| Latvia | 9 | 2261 | | 2247 | | 2200 | |
| Macedonia | 9 | 2049 | | 2053 | | 2073 | |
| Slovenia | 9 | 2032 | 0.848 | 2034 | 0.843 | 2053 | 0.829 |
| Estonia | 7 | 1340 | 0.694 | 1333 | 0.719 | 1323 | 0.783 |
| Cyprus | 6 | 797 | | 821 | | 888 | |
| Luxemburg | 6 | 494 | 0.838 | 494 | 0.838 | 523 | 0.805 |
| Malta | 6 | 414 | | 414 | | 421 | |
| | 750 | 577724 | | | | | |
| | | | **0.920** | | | | |

Source: own research.

The solution postulated by Lamassoure and Severin did not stand the test of time, proving demographically unstable. Table 2 does not provide ***SD*** coefficient value, since it exceeds unity. As for the $S_i$ coefficient, unity threshold was exceeded for five pairs of member states, out of six displaying the highest $S_i$ value. As a result, for the sake of demographic stability of the division, it may be advisable to maintain the lowest possible value of coefficients in those cases, where population growth is forecasted. On the other hand, it is advisable to maintain maximum diversity, due to disproportions in population count of individual member states. Table 3 presents an exemplary division of seats that satisfies the above postulates.

As shown in Table 3, the ***SD*** coefficient value is high, amounting to 0.978. However, this value is based on $S_i$ calculated for the pair of Germany and France which, according to Eurostat forecasts, will decrease with time. As such, it will not present the risk of destabilization. The remaining $S_i$ coefficient values are low enough to warrant that the six-year forecasts do not bring the ***SD*** coefficient value above unity.

Another important issue, not addressed in detail in this paper, is the problem of potential changes in EP composition resulting from future expansions of the European Union. Assuming that the total number of EP seats remains unchanged, one can arrive at strikingly different apportionment results. This is due to the fact that Turkey, one of the candidates for accession, is a country of high population. If Turkey gains the status of EU member state, then in line with the present requirement of minimum 6 seats and in line with the postulate of stability, the representation of top population member states would be a third less than the present maximum. Table 4 shows a proposal of such division under the assumption of European Union being enlarged by three states, namely Croatia, Macedonia and Turkey. As seen in the table, the demographic stability, as warranted by the forecasts up to 2015, was obtained at the cost of reducing maximum number of seats to 64, as well as reduced diversity, since as many as 8 member states are represented by the same number of seats, with the count of different representation figures established at 13.

## 6. CONCLUSIONS

The present composition of the European Parliament does not meet the postulate of degressive proportionality. The Lamassoure and Severin proposal, on the other hand, is burdened with the deficiency of being demographically unstable. The comparison of 2007 and 2009 population reports alone shows that the division postulated in the annex of the draft EP resolution is not degressively proportional. To avoid the risks and perturbations associated with frequent apportionment changes, it may be advisable to seek new solutions that take into account potential demographic changes in the EU. However, maintaining the stability of division may affect the diversification of membership representation. This is due, on the one hand, to stability of fair division, and, on the other hand, on the relatively large disparity of population counts among the candidate states.

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