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The QM Rule in the Nice and Lisbon Treaties: Future Projections

Dan S. Felsenthal
School of Political Sciences, University of Haifa, Israel
(eMail: dfelsenthal@poli.haifa.ac.il)

Moshé Machover
Department of Philosophy, King's College, London, UK
(eMail: moshe.machover@kcl.ac.uk)

Abstract We analyse the projected future evolution of the distribution of voting power and related quantities under the qualified majority (QM) decision rule for the Council of Ministers of the EU, prescribed by the Nice and Lisbon Treaties. Our projections are based on the demographic changes forecast by EUROSTAT (EUROPOP2008) for the period stretching from the year 2008 to the year 2061. We use a method similar to the one we used in Felsenthal and Machover (2001, 2004a, 2004b, 2007).

1. Introductory Remarks

The Treaty of Lisbon, amending the Treaty on European Union and the Treaty Establishing the European Community, was signed in Lisbon by all 27 EU members on 13 December 2007. The aim of the treaty, as stated in its preamble, is '... to complete the process started by the Treaty of Amsterdam and by the Treaty of Nice with a view to enhancing the efficiency and democratic legitimacy of the Union and to improving the coherence of its action.'[1] Purportedly towards this aim, the treaty incorporates a new qual-

[1] See Official Journal of the European Union, Vol. 50, Notice No. 2007/C306/ 17 December 2007, p. 3.

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ified majority (QM) decision rule for the EU Council of Ministers (CM).[2] Since the treaty has been ratified by all EU members, this rule, as cited below, is due to take effect not earlier than 1 November 2014 and not later than 31 March 2017. Until then, the QM rule contained in the Nice Treaty (EU document CONFER 4820/00) will remain in force. The new rule states:

> The Treaty on European Union shall be amended [such that]...
> 17) An Article 9c shall be inserted:
>
> *Article 9c*
>
> 1. The Council shall, jointly with the European Parliament, exercise legislative and budgetary functions. It shall carry out policy-making and coordinating functions as laid down in the Treaties.
>
> 2. The Council shall consist of a representative of each Member State at ministerial level, who may commit the government of the Member State in question and cast its vote.
>
> 3. The Council shall act by qualified majority except where the Treaties provide otherwise.
>
> 4. As from 1 November 2014, a qualified majority shall be defined as at least 55% of the members of the Council, comprising at least 15 of them and representing Member States comprising at least 65% of the population of the Union.
>
> A blocking minority must include at least four Council members, failing which the qualified majority shall be deemed attained.
>
> The other arrangements governing the qualified majority are laid down in Article 205(2) of the Treaty on the Functioning of the European Union.
>
> 5. The transitional provisions relating to the definition of the qualified majority which shall be applicable until 31 October 2014 and those which shall be applicable from 1 November 2014 to 31 March 2017 are laid down in the Protocol on transitional provision.[3]

This decision rule depends *explicitly* on the size of population of the member-states. Thus, the number and composition of coalitions able to pass or block a decision of the CM, as well as the voting powers of the

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[2] This rule was first adopted at the Brussels IGC, 17–18 June 2004 (See EU document CIG 85/04), and was included in the proposed EU Constitution, which failed to be ratified and was abandoned. Subsequently, the same rule was confirmed on 23 June 2007 by the Council of the European Union (the 'EU Summit'), also held in Brussels. (See EU Document 11177/1/07 REV 1).

[3] See Official Journal of the European Union, Vol. 50, Notice No. 2007/C306/ 17 December 2007, p.18. Article 9c contains four additional clauses which we have not cited here as they are not directly pertinent to this article.

member-states (and other related quantities) will be automatically affected by demographic changes. Strictly speaking, it is not a single fixed rule, but a variable rule that depends not only on the number of member-states but also on their changing populations. Formally, the same holds also for the Nice QM rule, which is currently in force. However, as we showed in Felsenthal and Machover (2001), the effect of the population clause in the latter rule is rather insignificant if not negligible.[4] So the new QM rule is the the first in the history of the EU whose functioning can be affected *significantly* by changes in population size.[5]

In the present paper we describe and analyse the effects on the distribution of voting powers and related quantities that would result from the demographic changes forecast by EUROSTAT (EUROPOP2008) for the period stretching from the year 2008 to the year 2060.

We confine ourselves exclusively to the distribution of voting power within the CM. We express no view as to the importance of this issue in the general governance of the EU or to the future of the EU. For differing views on these questions, see e.g. Nurmi (2008) and Widgrén (2008).

We did the computations of voting powers for the years 2008– 14 at three-year intervals, and for the years 2015–60 at five-year intervals, using EUROSTAT (EUROPOP2008) population forecasts. Our calculations for 2008, 2011 and 2014 are done under the Nice QM rule, whereas from 2015 we assume the new Lisbon Treaty rule.

For simplicity we assume that the current EU membership of 27 states will be unchanged throughout this period.

We find that the clause excluding blocking coalitions with less than four members rules out during the period 2015–60 only 10–12 coalitions of three member-states, whose populations comprise more than 35% of the total, and therefore would otherwise be able to block. In 2015 there are 10 such coalitions, namely:

{Germany, UK, France},
{Germany, UK, Italy},
{Germany, UK, Spain},
{Germany, UK, Poland},
{Germany, France, Italy},

[4] The main – and dominant – clause in the Nice QM rule assigned voting weights to the member-states; these weights took account of population sizes as they were at the time (2000), but were to remain fixed henceforth.

[5] In view of this fact it is rather strange that – as far as we know – the EU does not have a uniform definition of the 'population' of each member-state, and a legally binding procedure ascertaining its size at synchronized regular intervals.

{Germany, France, Spain},
{Germany, France, Poland},
{Germany, Italy, Spain},
{Germany, Italy, Poland},
{UK, France, Italy}.

From 2020 onwards there is an additional (11th) such coalition: {UK, France, Spain}. As of 2025 the coalition {Germany, Italy, Poland} is expected to consist of fewer than 35% of the EU population, so between 2025 and 2040 there are expected to be again only 10 three-member coalitions comprising more than 35% of the EU population. As of 2045 the coalition {Germany, France, Poland} is expected to consist of fewer than 35% of the EU population, but because the coalitions {UK, Italy, Spain} and {France, Italy, Spain} are expected to comprise more than 35% of the EU population, the total number of three-member coalitions comprising more than 35% of the EU population is expected to be again 11 during the period 2045–55. This total number is expected to grow to 12 as of 2055 when the coalition {UK, France, Poland} is expected to comprise more than 35% of the EU population.

We have taken these exceptional coalitions into account in our calculations; but in any case their effect on voting powers and related quantities is negligible.

The results of our calculations are presented in the Appendix which consists of seven tables. The general structure of these tables is described in Section 3. The meaning of the various measures and parameters presented in the tables is outlined in Section 2. Our conclusions are presented in Section 4.

2. Explanations

In this section we explain the meaning of the measures used in the following two sections and the criteria used in our assessment of QM decision rules. Our method here is largely the same as in Felsenthal and Machover (2004a), where the reader can find some further explanatory details.

2.1 *Voting Power: Absolute, Relative and Negative*

Each of the three series of values ψ, β and γ conveys information on a different aspect of voting power.

Penrose's measure ψ is an objective measure of *absolute* a priori voting power; its value for a given voter quantifies the amount of influence over the

outcomes of divisions that the voter derives from the decision rule itself.

Thus, if the value of ψ for a member-state is higher under decision rule $\mathscr{U}$ than under $\mathscr{V}$, it follows that the position of that member-state is objectively better – in the sense of having more influence – under $\mathscr{U}$ than under $\mathscr{V}$. The importance of ψ for comparing the position of a given voter under different decision rules is not sufficiently appreciated even by some academic commentators.

Politicians are obviously interested in comparing the *relative* position of their country with those of other member-states, especially ones whose populations are close in size to their own. As far as we know, they do not employ the precise scientific measure of a priori relative voting power, the Banzhaf index β, which is obtained from ψ by normalization. Instead, they look at the voting weights, which can give a rough – and often quite imprecise – idea about relative voting power.

Another aspect of voting power in which politicians are keenly interested is negative or blocking power – the ability to help block an act that they oppose. Of course, this does not mean that they have more than a vague notion as to how to quantify this power.

Absolute voting power, as measured by ψ, is the voter's ability to help secure a favourable outcome in a division. This can be resolved into two component parts: the power to help secure a positive outcome, approval of an act that the voter supports; and the power to help secure a negative outcome, blocking of an act that the voter opposes. These two components are quantified by the Coleman measures γ^* and γ, respectively. From a purely objective, disinterested viewpoint, both are equally important; and indeed ψ is a symmetric combination of γ^* and γ.[6] However, for rather obvious political reasons, EU practitioners are much more concerned about negative voting power than about its positive counterpart.[7]

So in this article we present all three sets of data about the QM rules under consideration: ψ as an objective measure of absolute voting power; as well as β and γ, which quantify aspects of voting power that are of particular concern to practitioners.

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[6] In fact, ψ is their *harmonic mean*. For further details see Felsenthal and Machover (1998, pp. 49–51).

[7] For reasons of internal national politics, a government normally considers it more important to be able to block a CM act that it opposes than to secure approval of an act it favours. Also, a government that finds itself in a position where it would be able to block a CM act may use this as a bargaining chip: agree to vote for the act in exchange for concession on matters that may or may not be related to that act.

2.2 *Democratic Legitimacy*

The CM can be regarded as the upper tier of a two-tier decision-making structure: if we assume that each minister votes in the CM according to the majority opinion in his or her country, then the citizens of the EU are seen as indirect voters, voting via their respective representatives at the CM. The criteria considered under the present heading are *equitability* and *adherence to majority rule*. These address different aspects of the functioning of the CM as the upper tier of the two-tier structure.

As explained elsewhere (see Felsenthal and Machover, 1998, pp. 66–67), a perfectly equitable decision rule for the CM – in the sense of equalizing the indirect a priori voting powers of all EU citizens across all member-states – would give each member-state voting power proportional to the square root of its population size. (This is Penrose's Square-Root Rule.) So under such a decision rule the value β_i of β for member-state i would equal

$$\hat{\beta}_i := \frac{\sqrt{p_i}}{\sum_{j=1}^{27} \sqrt{p_j}},$$

where p_i is the population of member-state i. The Quotient is defined as the actual value of β divided by the 'equitable ideal' $\hat{\beta}$. In other words, the value Q_i of the Quotient for member-state i is

$$Q_i := \frac{\beta_i \sum_{j=1}^{27} \sqrt{p_j}}{\sqrt{p_i}}.$$

The amount by which the Quotient for a given member-state exceeds or falls short of 1 indicates the amount by which the voting power of this member-state exceeds or falls short of what it should have got under an equitable distribution of the same amount of total voting power.

In order to assess the degree to which a given rule is equitable, we therefore gauge how close its 27 β values are to the ideal presented by the corresponding $\hat{\beta}$ values. For this purpose we use three synoptic parameters. All three are given in percentage terms – hence the coefficient 100 in their definitions:

D This is the widely used *index of distortion*. It is defined as:

$$\mathrm{D} := 100 \sum_{i=1}^{27} \frac{|\beta_i - \hat{\beta}_i|}{2}.$$

The smallest possible value of D is 0 and its greatest possible value is 100. The *smaller* the value of D, the closer the overall fit between the β_i and $\hat{\beta}_i$.

$\max|\mathrm{d}|$ *Maximal relative deviation*. It is defined as:

$$\max|\mathrm{d}| := 100 \max_i |Q_i - 1|.$$

$\mathrm{ran}(\mathrm{d})$ *Range of relative deviations*. It is defined as:

$$\mathrm{ran}(\mathrm{d}) := 100(\max_i Q_i - \min_i Q_i).$$

D is a measure of the *overall* discrepancy between the 27 β values and the corresponding $\hat{\beta}$ values. Thus it can serve as a measure of the overall equitability of the decision rule in question. On the other hand $\max|\mathrm{d}|$ and $\mathrm{ran}(\mathrm{d})$ quantify the most extreme *individual* deviations of the given rule from equitability.

We now turn to our criterion of adherence to majority rule. In any non-trivial two-tier decision-making structure it can happen that the decision at the upper tier (in our case: the CM) goes against the majority view of the lower-tier indirect voters (in our case: the citizens of the EU at large). In a case where this happens – that is, the CM approves an act that is opposed by a majority of EU citizens, or blocks an act that is supported by a majority of the citizens – the margin by which the majority that opposes the decision exceeds the minority that supports it is the *majority deficit* of this decision. In a case where the majority of citizens support the CM decision the majority deficit is 0. The majority deficit can be regarded as a random variable (taking only non-negative integer values), whose distribution depends on the decision rule of the CM. The mean value (mathematical expectation) of this random variable is the *mean majority deficit* (MMD).[8] The larger the MMD, the further the CM decision rule is from the majoritarian ideal.

2.3 *Efficiency*

The criteria we consider under this heading address the functioning of the CM as a decision-making body in its own right rather than as part of a two-tier structure.

The [absolute] sensitivity of a decision rule is the sum of the voting powers (as measured by ψ) of all members of the CM. It measures the degree to which the CM collectively is empowered as a decision-making body, the ease with which an average member can make a difference to the outcome of a division. It is thus a good indicator of efficiency.

[8] For details, see Felsenthal and Machover (1998, pp. 60–61).

The *relative sensitivity index*, denoted by S, measures the sensitivity of the given rule on a logarithmic scale, on which $S = 0$ holds for the least sensitive rule (unanimity) with the same number of voters, and $S = 1$ holds for the most sensitive rule (the ordinary majority rule) with that number of voters.[9]

The second criterion under the present heading is that of *compliance*. A direct measure of this is Coleman's 'power of the collectivity to act', which is simply the a priori probability A of an act being approved rather than blocked.

A measures the compliance of a decision rule, the ease with which a positive outcome is approved. But it is often instructive to look at its reverse, so to speak: the resistance of a decision rule to approving an act. A convenient measure of this is the *resistance coefficient* R.[10] For proper decision rules, the least value of R is 0 (attained for a simple majority rule with an odd number of voters) and its maximal value is 1 (attained by the unanimity rule).

Finally, we also present for each of the 13 years under consideration the a priori betting odds against an act being approved by the CM. These odds are just a modified form of A.

Note that A, R and the betting odds should not be interpreted too literally. Clearly, the CM does not vote on acts at random. Before an act is tabled for a formal vote at the CM, it goes through a preparatory process of bargaining and successive modification, until a point is reached where its approval is normally a foregone conclusion. What A, R and the betting odds actually measure is the average ease or difficulty of the preparatory process and the brevity or length of the time it may be expected to take.

3. Presentation of Results

The results of our calculations, presented in the Appendix, are organized as follows.

All our results are in the form of 13-term time series, consisting of data for the years 2008, 2011, 2014, and then for 2015–2060 at five-year intervals: 2015, 2020, ..., 2060. The values for 2008, 2011 and 2014 are calculated under the Nice QM rule; those from 2015 on are calculated under the QM rule of the Lisbon Treaty.

Tables 1–4 present, for each member-state and date, the respective values of four quantities: ψ (psi), β (beta), γ (gamma) and Quotient. The meaning

[9] For further details see Felsenthal and Machover (1998, p. 61).
[10] For further details see Felsenthal and Machover (1998, p. 62).

of these quantities is the same as in our previous papers (Felsenthal and Machover, 2001, 2004a, 2004b, 2007). We recapitulate their explanation above, in Section 2.

Table 5 presents a synoptic comparison of various global properties – equitability, conformity to majority rule, sensitivity, efficiency – of the decision rules operating at each of the 13 dates. For a brief explanation of the parameters used for this comparison, see Section 2.

Table 6 presents the EUROSTAT population data and forecasts. This table is copied from `http://tinyurl.com/6kj56m`.

Finally, Table 7 – derived directly from Table 6 – gives the rank-order of the member-states according to population size for each of the 13 dates of the latter table.

4. Analysis of the Results

First let us address the changes between 2008 and 2015. These are essentially the same as those described in our report (Felsenthal and Machover, 2007) in which we compared the Nice rule with the rule that is now incorporated in the Lisbon Treaty. Although in Felsenthal and Machover (2001) we assumed the 2006 population data for both rules – rather than the 2008 forecast for the former and the 2015 forecast for the latter – the overall picture is the same. Let us summarize these changes.

Our projections show that all member-states will have in 2015 under the Lisbon Treaty rule more absolute voting power (as measured by ψ) than in 2008 under the Nice rule, but the increase is very uneven, not to say erratic.

The *relative* position (as measured by β) of the four largest (France, Germany, Italy, UK) and six smallest (Cyprus, Estonia, Latvia, Luxembourg, Malta, Slovenia) member-states will improve considerably, and that of Denmark will improve very slightly. The relative position of all other member-states will be worsened; the greatest loss of relative power will be sustained by Poland, followed by Hungary and the Czech Republic. The smallest loss will be experienced by Finland and Slovakia.[11]

As for blocking power, γ, Malta will gain slightly; all other member-states will lose blocking power, but the extent of loss is again very uneven.

From Table 4 we can see that, by the yardstick of Penrose's Square-Root Rule, the voting-power distribution in 2015 will be considerably less equitable than in 2008. As can be seen from this table under the 2015 column, the two most egregious cases are: on the one hand Malta, which will have

[11] In fact Denmark, as well as Finland and Slovakia, will experience the smallest change in β, and consequently in their equitability Quotient.

135.2% more than its fair share; and on the other hand Portugal, which will have 17.15% too little.

From Table 5 we observe that the Lisbon Treaty QM rule is quite efficient: it has a relatively high value of Coleman's index A (the a priori probability of approving an act rather than blocking it) and a correspondingly low resistance R. In betting terms, this means that the a priori odds against approval of an act will be approximately 34 to 5 in 2015 and subsequently 336 to 49. This is a very considerable improvement compared to the Nice rule, which is extremely (and dangerously) inefficient.

With respect to sensitivity (S) and mean majority deficit (MMD), the Lisbon Treaty QM rule is also a definite improvement compared to the Nice rule.

Now let us turn to the period 2015–60. As can be seen in Table 6, according to EUROSTAT forecasts the total EU population will continue to grow until 2035, reaching its maximal size of 520.6 million. Beginning in 2040, the total EU population decreases gradually, reaching its smallest size of 505.7 million in 2060, with the steepest drop of 5.27 million occurring between 2055 and 2060. But different groups of countries will undergo quite distinct demographic changes.

The populations of all ten Eastern European and Baltic EU member-states decreases steadily throughout the period 2008–60. The steepest decrease (in both absolute and relative terms) among these countries is experienced by Poland which is expected to lose 6.9 million people (18.3%) between 2008 and 2060.

Among the remaining EU member-states, relatively significant decreases in populations are expected to occur in Germany and Italy, while relatively significant increases are expected to occur in France and the United Kingdom.

As a result of these different population changes in individual countries, the rank-order according to population size of only nine EU members (Finland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Poland, Romania, and Spain) will remain unchanged during the entire period 2008–60. The rank-order of the remaining 18 EU members is expected to change at least once during this period (cf. Table 7).

The ψ, β and γ values for the various member-states during the period 2015–60 are of course consistent with both the absolute and relative sizes of their respective populations. Thus, for example, the values of these three measures for Malta are smaller than those of any other EU member in any given period because Malta's population size ranks 27 in all periods. However, the changes from one period to the next are quite small.

Finally, as can be observed from Table 5, the changes from one period to the next during 2015–60 of each of the synoptic parameters are very small and insignificant.

Conclusions

Not surprisingly, our computations show that the main changes in voting power and related quantities will occur in the change-over from the Nice QM rule to the QM rule of the Lisbon Treaty, which in our projection will have taken place between 2008 and 2015. From 2015 on the changes – due entirely to demographic trends – are relatively small.

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Appendix

This Appendix consists of seven tables.

Table 1 — ψ Values by Country and Year

Country	2008	2011	2014	2015	2020	2025
Austria	0.012988	0.012988	0.012988	0.043489	0.043485	0.043985
Belgium	0.015474	0.015474	0.015474	0.048533	0.048649	0.049091
Bulgaria	0.012988	0.012988	0.012988	0.041041	0.040462	0.040225
Cyprus	0.005251	0.005251	0.005251	0.027819	0.028011	0.028312
Czech Rep.	0.015474	0.015474	0.015474	0.047321	0.047053	0.047121
Denmark	0.009160	0.009160	0.009160	0.037401	0.037463	0.037654
Estonia	0.005251	0.005251	0.005251	0.028635	0.028616	0.028912
Finland	0.009160	0.009160	0.009160	0.036994	0.036866	0.037258
France	0.032688	0.032688	0.032688	0.153603	0.154926	0.156792
Germany	0.032688	0.032688	0.032688	0.193354	0.190137	0.187819
Greece	0.015474	0.015474	0.015474	0.049341	0.049244	0.049287
Hungary	0.015474	0.015474	0.015474	0.046310	0.045857	0.045743
Ireland	0.009160	0.009160	0.009160	0.036386	0.036866	0.037654
Italy	0.032688	0.032688	0.032688	0.146465	0.146003	0.146144
Latvia	0.005251	0.005251	0.005251	0.030471	0.030426	0.030509
Lithuania	0.009160	0.009160	0.009160	0.032734	0.032447	0.032662
Luxembourg	0.005251	0.005251	0.005251	0.026998	0.027202	0.027508
Malta	0.003957	0.003957	0.003957	0.026792	0.026797	0.027115
Netherlands	0.016691	0.016691	0.016706	0.059931	0.059884	0.060161
Poland	0.031163	0.031163	0.031163	0.091485	0.088740	0.086665
Portugal	0.015474	0.015474	0.015474	0.048128	0.048248	0.048500
Romania	0.017888	0.017888	0.017888	0.069123	0.067860	0.066979
Slovakia	0.009160	0.009160	0.009160	0.036994	0.037065	0.037062
Slovenia	0.005251	0.005251	0.005251	0.030268	0.030226	0.030308
Spain	0.031164	0.031164	0.031164	0.121403	0.123819	0.125610
Sweden	0.012988	0.012988	0.012988	0.045502	0.045857	0.046337
UK	0.032688	0.032688	0.032688	0.152719	0.155145	0.158323

Table 1 — ψ Values by Country and Year (cont.)

Country	2030	2035	2040	2045	2050	2055	2060
Austria	0.043682	0.043757	0.043676	0.043584	0.043632	0.043653	0.043701
Belgium	0.048693	0.049053	0.049057	0.049039	0.049189	0.049143	0.049507
Bulgaria	0.039432	0.038828	0.038460	0.038082	0.037835	0.037571	0.037466
Cyprus	0.028344	0.028512	0.028884	0.029030	0.029438	0.029618	0.029910
Czech Rep.	0.046379	0.046025	0.045718	0.045222	0.045072	0.044721	0.044589
Denmark	0.037493	0.037686	0.037709	0.037714	0.037835	0.037926	0.038182
Estonia	0.028736	0.028705	0.028884	0.029030	0.029254	0.029437	0.029551
Finland	0.037106	0.037113	0.036964	0.036978	0.036924	0.037029	0.037286
France	0.157868	0.159586	0.161329	0.162820	0.164277	0.165857	0.167787
Germany	0.184027	0.180880	0.177720	0.174274	0.171378	0.168279	0.165769
Greece	0.048884	0.048486	0.048315	0.047951	0.047760	0.047555	0.047406
Hungary	0.045030	0.044514	0.044233	0.043764	0.043632	0.043294	0.043169
Ireland	0.037689	0.038065	0.038275	0.038635	0.038926	0.039363	0.039791
Italy	0.145472	0.145682	0.145933	0.145970	0.145742	0.145258	0.144639
Latvia	0.030102	0.030240	0.030206	0.030328	0.030355	0.030344	0.030631
Lithuania	0.032218	0.032146	0.032089	0.031998	0.032005	0.031982	0.032078
Luxembourg	0.027365	0.027549	0.027939	0.028102	0.028338	0.028531	0.028826
Malta	0.026972	0.027163	0.027374	0.027544	0.027785	0.027984	0.028284
Netherlands	0.059489	0.059205	0.058607	0.058026	0.057493	0.056963	0.056915
Poland	0.083438	0.080810	0.078312	0.076061	0.074410	0.073120	0.072544
Portugal	0.048114	0.048106	0.048131	0.047951	0.047760	0.047731	0.047758
Romania	0.064921	0.063545	0.062273	0.060878	0.059575	0.058503	0.057423
Slovakia	0.036529	0.036355	0.036216	0.036052	0.036014	0.035763	0.035672
Slovenia	0.030102	0.030240	0.030393	0.030328	0.030535	0.030523	0.030812
Spain	0.126278	0.127218	0.128344	0.129239	0.129945	0.130198	0.129960
Sweden	0.046188	0.046215	0.046277	0.046314	0.046506	0.046673	0.047056
UK	0.160443	0.163180	0.165700	0.168355	0.171378	0.174274	0.177542

Table 2 — 100β Values by Country and Year

Country	2008	2011	2014	2015	2020	2025
Austria	3.0924	3.0924	3.0923	2.5444	2.5469	2.5666
Belgium	3.6843	3.6843	3.6842	2.8394	2.8494	2.8645
Bulgaria	3.0924	3.0924	3.0923	2.4011	2.3699	2.3472
Cyprus	1.2502	1.2502	1.2501	1.6276	1.6406	1.6521
Czech Rep.	3.6843	3.6843	3.6842	2.7686	2.7559	2.7496
Denmark	2.1809	2.1808	2.1808	2.1882	2.1942	2.1972
Estonia	1.2502	1.2502	1.2501	1.6753	1.6760	1.6871
Finland	2.1809	2.1808	2.1808	2.1643	2.1592	2.1741
France	7.7828	7.7828	7.7825	8.9866	9.0740	9.1491
Germany	7.7828	7.7828	7.7826	11.3131	11.1363	10.9596
Greece	3.6843	3.6843	3.6842	2.8867	2.8842	2.8760
Hungary	3.6843	3.6843	3.6842	2.7094	2.6859	2.6692
Ireland	2.1809	2.1808	2.1808	2.1288	2.1592	2.1972
Italy	7.7827	7.7827	7.7825	8.5690	8.5514	8.5278
Latvia	1.2502	1.2502	1.2501	1.7827	1.7821	1.7802
Lithuania	2.1809	2.1808	2.1808	1.9151	1.9005	1.9059
Luxembourg	1.2502	1.2502	1.2501	1.5795	1.5932	1.6051
Malta	0.9422	0.9422	0.9422	1.5675	1.5695	1.5822
Netherlands	3.9740	3.9740	3.9775	3.5063	3.5074	3.5105
Poland	7.4198	7.4198	7.4195	5.3524	5.1975	5.0571
Portugal	3.6843	3.6843	3.6842	2.8158	2.8259	2.8301
Romania	4.2591	4.2591	4.2589	4.0441	3.9746	3.9084
Slovakia	2.1809	2.1808	2.1808	2.1643	2.1709	2.1626
Slovenia	1.2502	1.2502	1.2501	1.7709	1.7703	1.7685
Spain	7.4199	7.4199	7.4197	7.1028	7.2521	7.3296
Sweden	3.0924	3.0924	3.0923	2.6621	2.6859	2.7038
UK	7.7828	7.7828	7.7825	8.9349	9.0869	9.2385
Total	100.0003	99.9998	100.0003	100.0009	99.9999	99.9998

Table 2 — 100β Values by Country and Year (cont.)

Country	2030	2035	2040	2045	2050	2055	2060
Austria	2.5680	2.5756	2.5737	2.5740	2.5772	2.5811	2.5794
Belgium	2.8626	2.8874	2.8908	2.8961	2.9054	2.9057	2.9221
Bulgaria	2.3182	2.2855	2.2663	2.249	2.2348	2.2214	2.2113
Cyprus	1.6663	1.6783	1.7021	1.7144	1.7388	1.7512	1.7654
Czech Rep.	2.7266	2.7092	2.6940	2.6707	2.6623	2.6442	2.6318
Denmark	2.2042	2.2183	2.2221	2.2273	2.2348	2.2424	2.2536
Estonia	1.6894	1.6897	1.7021	1.7144	1.7279	1.7405	1.7442
Finland	2.1815	2.1846	2.1782	2.1838	2.1810	2.1894	2.2007
France	9.2809	9.3937	9.5066	9.6157	9.7033	9.8065	9.9033
Germany	10.8188	10.6471	10.4725	10.2922	10.1228	9.9497	9.7842
Greece	2.8738	2.8540	2.8470	2.8318	2.8210	2.8118	2.7980
Hungary	2.6473	2.6202	2.6065	2.5846	2.5772	2.5598	2.5480
Ireland	2.2157	2.2406	2.2554	2.2817	2.2992	2.3274	2.3486
Italy	8.5522	8.5753	8.5994	8.6206	8.6085	8.5886	8.5371
Latvia	1.7697	1.7800	1.7800	1.7911	1.7930	1.7941	1.8079
Lithuania	1.8941	1.8922	1.8909	1.8897	1.8905	1.8910	1.8933
Luxembourg	1.6087	1.6216	1.6464	1.6596	1.6738	1.6870	1.7014
Malta	1.5857	1.5989	1.6131	1.6267	1.6412	1.6546	1.6694
Netherlands	3.4973	3.4849	3.4535	3.4269	3.3960	3.3680	3.3593
Poland	4.9053	4.7567	4.6147	4.4920	4.3952	4.3233	4.2818
Portugal	2.8286	2.8316	2.8362	2.8318	2.8210	2.8222	2.8188
Romania	3.8166	3.7404	3.6695	3.5953	3.5189	3.4590	3.3893
Slovakia	2.1475	2.1400	2.1341	2.1291	2.1273	2.1146	2.1054
Slovenia	1.7697	1.7800	1.7910	1.7911	1.8036	1.8047	1.8186
Spain	7.4238	7.4884	7.5629	7.6325	7.6754	7.6981	7.6707
Sweden	2.7154	2.7203	2.7270	2.7352	2.747	2.7596	2.7774
UK	9.4323	9.6052	9.7642	9.9426	10.1228	10.3042	10.4791
Total	100.0002	99.9997	100.0002	99.9999	99.9999	100.0001	100.0001

Table 3 — γ Values by Country and Year

Country	2008	2011	2014	2015	2020	2025
Austria	0.32060	0.32060	0.32060	0.17047	0.17073	0.17190
Belgium	0.38196	0.38196	0.38196	0.19024	0.19100	0.19185
Bulgaria	0.32060	0.32060	0.32060	0.16087	0.15886	0.15720
Cyprus	0.12961	0.12961	0.12961	0.10905	0.10997	0.11065
Czech Rep.	0.38196	0.38196	0.38196	0.18549	0.18474	0.18416
Denmark	0.22610	0.22610	0.22610	0.14660	0.14708	0.14716
Estonia	0.12961	0.12961	0.12961	0.11224	0.11235	0.11299
Finland	0.22610	0.22610	0.22610	0.14501	0.14474	0.14561
France	0.80686	0.80686	0.80686	0.60209	0.60826	0.61276
Germany	0.80687	0.80687	0.80687	0.75790	0.74650	0.73402
Greece	0.38196	0.38196	0.38196	0.19341	0.19334	0.19262
Hungary	0.38196	0.38196	0.38196	0.18153	0.18004	0.17877
Ireland	0.22610	0.22610	0.22610	0.14262	0.14474	0.14716
Italy	0.80686	0.80686	0.80686	0.57411	0.57323	0.57115
Latvia	0.12961	0.12961	0.12961	0.11944	0.11946	0.11923
Lithuania	0.22610	0.22610	0.22610	0.12831	0.12739	0.12765
Luxembourg	0.12961	0.12961	0.12961	0.10583	0.10680	0.10750
Malta	0.09768	0.09768	0.09768	0.10502	0.10521	0.10597
Netherlands	0.41199	0.41199	0.41238	0.23492	0.23511	0.23512
Poland	0.76923	0.76923	0.76923	0.35860	0.34840	0.33870
Portugal	0.38196	0.38196	0.38196	0.18865	0.18943	0.18954
Romania	0.44155	0.44155	0.44155	0.27095	0.26643	0.26176
Slovakia	0.22610	0.22610	0.22610	0.14501	0.14552	0.14484
Slovenia	0.12961	0.12961	0.12961	0.11865	0.11867	0.11845
Spain	0.76925	0.76925	0.76925	0.47587	0.48613	0.49090
Sweden	0.32060	0.32060	0.32060	0.17836	0.18004	0.18109
UK	0.80686	0.80686	0.80686	0.59862	0.60912	0.61874

Table 3 — γ Values by Country and Year (cont.)

Country	2030	2035	2040	2045	2050	2055	2060
Austria	0.17207	0.17244	0.17214	0.17199	0.17199	0.17203	0.17164
Belgium	0.19181	0.19331	0.19335	0.19352	0.19390	0.19367	0.19444
Bulgaria	0.15533	0.15301	0.15158	0.15028	0.14914	0.14806	0.14715
Cyprus	0.11165	0.11236	0.11384	0.11456	0.11604	0.11672	0.11747
Czech Rep.	0.18270	0.18138	0.18019	0.17845	0.17767	0.17624	0.17513
Denmark	0.14769	0.14851	0.14862	0.14883	0.14914	0.14946	0.14996
Estonia	0.11320	0.11312	0.11384	0.11456	0.11532	0.11601	0.11606
Finland	0.14617	0.14626	0.14568	0.14592	0.14555	0.14593	0.14644
France	0.62187	0.62890	0.63584	0.64252	0.64757	0.65363	0.65899
Germany	0.72492	0.71282	0.70045	0.68772	0.67556	0.66318	0.65106
Greece	0.19256	0.19107	0.19042	0.18922	0.18827	0.18741	0.18619
Hungary	0.17738	0.17542	0.17434	0.17270	0.17199	0.17062	0.16955
Ireland	0.14846	0.15001	0.15085	0.15246	0.15344	0.15513	0.15628
Italy	0.57305	0.57411	0.57516	0.57602	0.57450	0.57245	0.56807
Latvia	0.11858	0.11917	0.11905	0.11968	0.11966	0.11958	0.12030
Lithuania	0.12691	0.12668	0.12647	0.12627	0.12616	0.12604	0.12599
Luxembourg	0.10780	0.10856	0.11012	0.11090	0.11171	0.11244	0.11321
Malta	0.10625	0.10705	0.10789	0.10870	0.10952	0.11028	0.11109
Netherlands	0.23434	0.23331	0.23098	0.22898	0.22663	0.22449	0.22354
Poland	0.32868	0.31846	0.30865	0.30015	0.29332	0.28816	0.28492
Portugal	0.18953	0.18958	0.18970	0.18922	0.18827	0.18811	0.18757
Romania	0.25574	0.25042	0.24543	0.24023	0.23484	0.23056	0.22553
Slovakia	0.14390	0.14327	0.14274	0.14227	0.14197	0.14094	0.14010
Slovenia	0.11858	0.11917	0.11979	0.11968	0.12037	0.12029	0.12101
Spain	0.49744	0.50134	0.50584	0.51000	0.51223	0.51310	0.51042
Sweden	0.18194	0.18212	0.18239	0.18277	0.18332	0.18394	0.18481
UK	0.63202	0.64306	0.65307	0.66436	0.67556	0.68680	0.69730

Table 4 — Quotient Values by Country and Year

Country	2008	2011	2014	2015	2020	2025
Austria	1.0306	1.0299	1.0289	0.8462	0.8443	0.8468
Belgium	1.0859	1.0824	1.0791	0.8309	0.8291	0.8282
Bulgaria	1.0762	1.0905	1.1037	0.8603	0.8655	0.8732
Cyprus	1.3493	1.3245	1.2996	1.6815	1.6441	1.6098
Czech Rep.	1.1020	1.1045	1.1064	0.8319	0.8310	0.8330
Denmark	0.8966	0.8973	0.8978	0.9009	0.9029	0.9013
Estonia	1.0396	1.0485	1.0558	1.4178	1.4332	1.4584
Finland	0.9114	0.9117	0.9114	0.9045	0.9071	0.9067
France	0.9519	0.9493	0.9465	1.0919	1.0969	1.0994
Germany	0.8260	0.8310	0.8359	1.2173	1.2080	1.1970
Greece	1.0584	1.0582	1.0585	0.8296	0.8307	0.8305
Hungary	1.1184	1.1266	1.1340	0.8356	0.8361	0.8381
Ireland	0.9986	0.9724	0.9509	0.9221	0.9094	0.9063
Italy	0.9705	0.9702	0.9704	1.0688	1.0683	1.0667
Latvia	0.7985	0.8087	0.8177	1.1701	1.1896	1.2083
Lithuania	1.1437	1.1573	1.1694	1.0302	1.0370	1.0537
Luxembourg	1.7321	1.7105	1.6897	2.1263	2.1014	2.0725
Malta	1.4149	1.4150	1.4142	2.3521	2.3515	2.3679
Netherlands	0.9440	0.9452	0.9468	0.8349	0.8355	0.8348
Poland	1.1563	1.1633	1.1690	0.8446	0.8260	0.8101
Portugal	1.0878	1.0860	1.0845	0.8285	0.8301	0.8299
Romania	0.8853	0.8931	0.9003	0.8571	0.8526	0.8484
Slovakia	0.9030	0.9070	0.9104	0.9044	0.9063	0.9141
Slovenia	0.8457	0.8471	0.8488	1.2032	1.2082	1.2145
Spain	1.0608	1.0438	1.0313	0.9840	0.9932	0.9976
Sweden	0.9818	0.9777	0.9737	0.8370	0.8378	0.8361
UK	0.9566	0.9537	0.9500	1.0891	1.0978	1.1044

Table 4 — Quotient Values by Country and Year (cont.)

Country	2030	2035	2040	2045	2050	2055	2060
Austria	0.8427	0.8411	0.8371	0.8346	0.8331	0.8321	0.8290
Belgium	0.8278	0.8232	0.8187	0.8152	0.8126	0.8070	0.8052
Bulgaria	0.8776	0.8794	0.8850	0.8904	0.8968	0.9035	0.9123
Cyprus	1.5834	1.5590	1.5478	1.5272	1.5180	1.4996	1.4845
Czech Rep.	0.8310	0.8309	0.8304	0.8263	0.8267	0.8243	0.8244
Denmark	0.8998	0.9016	0.9001	0.8995	0.8989	0.8971	0.8949
Estonia	1.4763	1.4911	1.5130	1.5329	1.5526	1.5714	1.5837
Finland	0.9094	0.9116	0.9107	0.9142	0.9125	0.9139	0.9149
France	1.1074	1.1123	1.1171	1.1220	1.1243	1.1277	1.1292
Germany	1.1889	1.1773	1.1663	1.1552	1.1455	1.1348	1.1238
Greece	0.8250	0.8252	0.8224	0.8174	0.8144	0.8130	0.8108
Hungary	0.8383	0.8362	0.8373	0.8346	0.8362	0.8341	0.8339
Ireland	0.8988	0.8956	0.8884	0.8853	0.8787	0.8770	0.8733
Italy	1.0697	1.0714	1.0729	1.0750	1.0743	1.0740	1.0703
Latvia	1.2212	1.2476	1.2644	1.2877	1.3039	1.3198	1.3467
Lithuania	1.0613	1.0750	1.0886	1.1019	1.1160	1.1301	1.1461
Luxembourg	2.0320	2.0050	1.9958	1.9754	1.9578	1.9393	1.9218
Malta	2.3746	2.4018	2.4327	2.4616	2.4887	2.5115	2.5354
Netherlands	0.8294	0.8249	0.8175	0.8126	0.8065	0.8001	0.7967
Poland	0.7936	0.7783	0.7639	0.7522	0.7441	0.7400	0.7414
Portugal	0.8272	0.8252	0.8234	0.8194	0.8143	0.8134	0.8115
Romania	0.8386	0.8307	0.8236	0.8153	0.8067	0.8018	0.7961
Slovakia	0.9150	0.9204	0.9270	0.9339	0.9425	0.9468	0.9540
Slovenia	1.2241	1.2405	1.2574	1.2667	1.2854	1.2966	1.3176
Spain	1.0065	1.0116	1.0178	1.0236	1.0275	1.0307	1.0286
Sweden	0.8336	0.8305	0.8279	0.8248	0.8212	0.8169	0.8137
UK	1.1153	1.1238	1.1304	1.1384	1.1453	1.1515	1.1563

Table 5 — Synoptic Comparison

Year	D	max$\lvert d\rvert$	ran(d)	MMD	S	A	R	Odds
2008	4.7118	73.2	93.4	8037	0.858	0.020	0.959	49:1
2011	4.6931	71.0	90.2	8084	0.858	0.020	0.959	49:1
2014	4.6813	69.0	87.2	8125	0.858	0.020	0.959	49:1
2015	7.5633	135.2	152.3	5368	0.945	0.128	0.745	34:5
2020	7.6182	135.2	152.3	5040	0.945	0.127	0.745	336:49
2025	7.6546	136.8	154.0	5413	0.945	0.128	0.744	34:5
2030	7.8467	137.5	158.1	5446	0.944	0.127	0.746	336:49
2035	8.0014	140.2	157.9	5452	0.944	0.127	0.746	336:49
2040	8.1769	143.3	161.4	5450	0.944	0.127	0.746	336:49
2045	8.3401	146.2	164.9	5446	0.944	0.127	0.746	336:49
2050	8.4675	148.9	167.6	5428	0.944	0.127	0.746	336:49
2055	8.5628	151.2	171.1	5406	0.944	0.127	0.746	336:49
2060	8.5938	153.5	173.0	5371	0.944	0.127	0.745	336:49

Table 6 — Population Forecast of Present EU Members (1000s)

Country	2008	2011	2014	2015	2020	2025
Austria	8,334	8,439	8,538	8,570	8,723	8,866
Belgium	10,656	10,844	11,016	11,070	11,322	11,547
Bulgaria	7,642	7,527	7,419	7,382	7,188	6,974
Cyprus	795	834	874	888	955	1,017
Czech Rep.	10,346	10,417	10,480	10,497	10,543	10,516
Denmark	5,476	5,530	5,577	5,591	5,661	5,736
Estonia	1,339	1,331	1,325	1,323	1,311	1,292
Finland	5,300	5,356	5,412	5,429	5,501	5,549
France	61,876	62,921	63,896	64,203	65,607	66,846
Germany	82,179	82,098	81,919	81,858	81,472	80,907
Greece	11,217	11,347	11,450	11,476	11,556	11,575
Hungary	10,045	10,011	9,976	9,964	9,893	9,790
Ireland	4,415	4,709	4,971	5,052	5,404	5,673
Italy	59,529	60,233	60,784	60,929	61,421	61,683
Latvia	2,269	2,237	2,209	2,200	2,151	2,095
Lithuania	3,365	3,324	3,287	3,275	3,220	3,158
Luxembourg	482	500	517	523	551	579
Malta	410	415	420	421	427	431
Netherlands	16,404	16,548	16,679	16,717	16,896	17,069
Poland	38,116	38,080	38,073	38,068	37,960	37,612
Portugal	10,617	10,773	10,908	10,947	11,108	11,224
Romania	21,423	21,287	21,148	21,103	20,834	20,484
Slovakia	5,399	5,411	5,423	5,427	5,432	5,402
Slovenia	2,023	2,039	2,050	2,053	2,058	2,047
Spain	45,283	47,301	48,924	49,381	51,109	52,101
Sweden	9,183	9,364	9,533	9,588	9,853	10,094
UK	61,270	62,340	63,424	63,792	65,683	67,543
Total	495,393	501,216	506,232	507,727	513,839	517,810

Table 6 — Population Forecast of Present EU Members (1000s) (cont.)

Country	2030	2035	2040	2045	2050	2055	2060
Austria	8,988	9,075	9,122	9,138	9,127	9,088	9,037
Belgium	11,745	11,906	12,033	12,125	12,194	12,247	12,295
Bulgaria	6,753	6,535	6,330	6,129	5,923	5,710	5,485
Cyprus	1,072	1,121	1,167	1,211	1,251	1,288	1,320
Czech Rep.	10,420	10,288	10,158	10,036	9,892	9,722	9,514
Denmark	5,808	5,858	5,882	5,890	5,895	5,903	5,920
Estonia	1,267	1,243	1,221	1,202	1,181	1,159	1,132
Finland	5,569	5,557	5,521	5,481	5,448	5,422	5,402
France	67,982	69,021	69,898	70,553	71,044	71,442	71,800
Germany	80,152	79,150	77,821	76,249	74,491	72,621	70,759
Greece	11,573	11,575	11,567	11,531	11,445	11,301	11,118
Hungary	9,651	9,501	9,352	9,213	9,061	8,898	8,717
Ireland	5,881	6,057	6,221	6,381	6,531	6,654	6,752
Italy	61,868	61,995	62,002	61,777	61,240	60,413	59,390
Latvia	2,033	1,970	1,913	1,858	1,804	1,746	1,682
Lithuania	3,083	2,998	2,912	2,825	2,737	2,645	2,548
Luxembourg	607	633	657	678	697	715	732
Malta	432	429	424	419	415	410	405
Netherlands	17,208	17,271	17,226	17,085	16,909	16,740	16,596
Poland	36,975	36,141	35,219	34,257	33,275	32,244	31,139
Portugal	11,317	11,395	11,452	11,475	11,449	11,373	11,265
Romania	20,049	19,619	19,161	18,679	18,149	17,584	16,921
Slovakia	5,332	5,231	5,115	4,993	4,859	4,712	4,547
Slovenia	2,023	1,992	1,958	1,921	1,878	1,830	1,779
Spain	52,661	53,027	53,290	53,409	53,229	52,701	51,913
Sweden	10,270	10,382	10,470	10,565	10,672	10,780	10,875
UK	69,224	70,685	72,009	73,282	74,506	75,647	76,677
Total	519,943	520,655	520,101	518,362	515,302	510,995	505,720

Table 7 — Country by Population Rank by Year

Country	2008	2011	2014	2015	2020	2025
Austria	15	15	15	15	15	15
Belgium	10	10	10	10	10	10
Bulgaria	16	16	16	16	16	16
Cyprus	25	25	25	25	25	25
Czech Rep.	12	12	12	12	12	12
Denmark	17	17	17	17	17	17
Estonia	24	24	24	24	24	24
Finland	19	19	19	19	19	19
France	2	2	2	2	3	3
Germany	1	1	1	1	1	1
Greece	9	9	9	9	9	9
Hungary	13	13	13	13	13	14
Ireland	20	20	20	20	20	18
Italy	4	4	4	4	4	4
Latvia	22	22	22	22	22	22
Lithuania	21	21	21	21	21	21
Luxembourg	26	26	26	26	26	26
Malta	27	27	27	27	27	27
Netherlands	8	8	8	8	8	8
Poland	6	6	6	6	6	6
Portugal	11	11	11	11	11	11
Romania	7	7	7	7	7	7
Slovakia	18	18	18	18	18	20
Slovenia	23	23	23	23	23	23
Spain	5	5	5	5	5	5
Sweden	14	14	14	14	14	13
UK	3	3	3	3	2	2

Table 7 — Country by Population Rank by Year (cont.)

Country	2030	2035	2040	2045	2050	2055	2060
Austria	15	15	15	15	14	14	14
Belgium	10	9	9	9	9	9	9
Bulgaria	16	16	16	17	17	18	18
Cyprus	25	25	25	24	24	24	24
Czech Rep.	12	13	13	13	13	13	13
Denmark	18	18	18	18	18	17	17
Estonia	24	24	24	25	25	25	25
Finland	19	19	19	19	19	19	19
France	3	3	3	3	3	3	2
Germany	1	1	1	1	2	2	3
Greece	9	10	10	10	11	11	11
Hungary	14	14	14	14	15	15	15
Ireland	17	17	17	16	16	16	16
Italy	4	4	4	4	4	4	4
Latvia	22	23	23	23	23	23	23
Lithuania	21	21	21	21	21	21	21
Luxembourg	26	26	26	26	26	26	26
Malta	27	27	27	27	27	27	27
Netherlands	8	8	8	8	8	8	8
Poland	6	6	6	6	6	6	6
Portugal	11	11	11	11	10	10	10
Romania	7	7	7	7	7	7	7
Slovakia	20	20	20	20	20	20	20
Slovenia	23	22	22	22	22	22	22
Spain	5	5	5	5	5	5	5
Sweden	13	12	12	12	12	12	12
UK	2	2	2	2	1	1	1