THE NUMBER OF NATIONS REVISITED: ENDOGENOUS BORDER FORMATION WITH NON-UNIFORM POPULATION DISTRIBUTIONS[1]

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Abstract

The endogenous border formation model of Alesina and Spolaore (1997) has received a lot of attention in the economics community. In a nutshell, one of its central messages is that in a democratic world in equilibrium there is an inefficiently large number of nation states. This result, however, is obtained under very specific assumptions like a uniform population distribution and no population mobility. In this paper, I generalize the AS model allowing for population distributions other than the uniform distribution. Since this generalization is accompanied by forfeiting the tractability in closed form, I calculate the equilibria by means of numerical computation. It shows that the above-mentioned result is highly sensitive to the choice of population distribution and that the model shows four different regimes depending on the chosen distribution. The behaviour implied by the AS model with uniform population distribution is rather the exception than the rule.

Keywords: Size of Nations, Endogenous Border Formation, Computational Economics

JEL Codes: F50, H40

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1. Introduction

In the past century national borders have been redrawn to an enormous extent. More than 140 of the currently existing 193 nation states[3] have emerged by gaining sovereignty since 1900. Obviously, dramatic political events like the two World Wars, the collapse of the USSR and the decline of colonialism were major driving forces in this process. Still, there is desire for independence in many regions all around the world where people raise their voice and aim for more independence either peacefully or by means of force. Considering these developments, the assumption of a fixed nation state as basic unit of (macro) economic analysis seems problematic.

Although these issues traditionally belong to the realm of political science, a recent economic literature addresses questions regarding the process of political disintegration as well. The most prevalent of these approaches models national border formation dependent on a trade-off in the provision of public goods (Alesina and Spolaore 1997). In this model, Alesina and Spolaore are able to derive a number of very general statements concerning the formation of nation states. However, these results are obtained under very specific assumptions like a uniform population distribution, perfect correlation between an individual's location and her preferences and the exclusion of population mobility. The present paper builds on the work of the latter model and tries to generalize the obtained results particularly with regard to the population distribution.

In the following section I present a short overview of the existing economic literature on secession and integration with a special focus on the basic model of Alesina and Spolaore (1997) (AS henceforth) and some of its extensions. In Section 3 I introduce some generalizations into the framework regarding the population distributions while the consequences of this modification will be investigated in Section 4. The last two sections of the paper focus on the possible implications of the obtained results on the existing literature and some speculations on promising future research directions.

[3] I am aware of the conceptual shortcomings resulting from the lack of adequate definitions of terms like jurisdiction, nation, state and nation-state and their interchangeable use in most of the relevant literature in political economics. In the context of international relations, this point was made forcefully by Cederman (1997). While further elaboration on this topic would justify an article for its own, for the purpose of this paper I will stick with the blurry use of these concepts and use these terms interchangeably.

2. Existing Literature

In the last twenty years political economists became more and more interested in analytically exploring and modelling several aspects of nation state formation utilizing various approaches. Bolton et al. (1996) provide a survey on the existing economic literature until the mid-1990s while Ruta (2005) summarizes recent advances in the field. Friedman (1977) was one of the first economists providing an analytical answer to the question of the size of nations. In his model he assumes a world of dictators that leads to a configuration of countries such that their joint revenue received from taxes on trade is maximized. Bolton and Roland (1997) provide a model in which individuals are allowed to vote for unification and secession of nations, thus representing an idealized democratic world. Their study concentrates on the influence of regional income disparities and preferences over fiscal policy (i.e. redistribution policies) on the break-up of nations. However, the model assumes two regions facing the possibility to unify as exogenously given.

A number of studies in the late 1990s are loosely based on Hotelling's (1929) location model. In this kind of model agents are uniformly distributed on a line and their position on this line represents their location and/or preferences. Casella and Feinstein (2002) tackle the problem of political (dis-)integration by utilizing a variation of Hotelling's location model to represent the voters' heterogeneity of preferences over the provision of public goods and investigate the relationship between the formation of markets and the formation of jurisdictions. Wittman (2000) utilizes a very similar but comparably richer approach and models the preferential and the spatial dimensions separately. His framework also encompasses a simple production function – thus, being able to analyse the interactions between the polity and the market – as well as an explicit formulation of coercion by means of an extortion function. These additional mechanisms, however, force him to compare only the relative sizes of two states.

The seminal work of Alesina and Spolaore (1997) has probably received the most attention in this area so far. Also starting from a location model loosely based on Hotelling's approach they describe the equilibrium number and sizes of jurisdictions endogenously. In the AS model the size of a nation state is determined by a basic trade-off in the provision of tax financed public goods. Larger nation states are able to provide the public good (e.g. governmental services) at a lower per capita cost. However, the larger the nation state the more difficult it is to satisfy the demands of the more heterogeneous electorate by majority voting on the location/type of the public good. In the AS model, individuals are uniformly

distributed on the segment *[0, 1]* representing the world. The world consists of at least one country and each country has to provide a single public good – its government - which is financed by taxes on its residents. In return, these residents can take advantage of their country's and only their country's public good. The resulting utility is decreasing linearly with the distance between the individual and the government. For the sake of simplicity, it is assumed that in a given country every agent has to pay the same amount of taxes.

A benevolent social planner who wishes to maximize the sum of all individuals' utilities partitions the world into N^* countries, where the socially optimal number of countries N^* is given by

(1) $$N^* = \sqrt{ga/4k}.$$

The socially optimal number of nation states is rising in the utility *g* generated by the public good and in the parameter *a*, which weights the utility loss from distance to government. At the same time, N* is declining in the cost *k* of the public good. Because of the assumption of a uniform population distribution, all the nations are of the same size and the social planner locates each government in the middle of its country.[4]

However, the socially optimal number of nations N^* does not coincide with the stable number of nations in a democratic model world. In a world without a benevolent social planner, individuals are allowed to decide on national borders according to a number of straight forward behavioural rules. Furthermore, it is assumed that the location of a country's government is decided by majority rule after the national borders are established. These assumptions then lead to a democratic equilibrium number of nation states N_A given by

(2) $$N_A = \sqrt{ga/2k}$$

Like in the social planner solution, in this equilibrium solution all nation states are of the same size and each government is located in the middle of its country (once again as a consequence of the uniform distribution).

[4] For details regarding the derivation of this and the following results, the reader is referred to Alesina and Spolaore (1997) or Alesina and Spolaore (2003).

To sum up, given a uniform population distribution, the stable number of nations in democratic equilibrium N_A is always larger than the social optimum N^*, since

(3) $$\sqrt{ga/2k} > \sqrt{ga/4k}$$

This result is presented in figure 1, where the two expressions are graphed as functions of the utility parameter g.[5] For any given value of $g > 0$, there are more jurisdictions in the democratic equilibrium than in the social planner case.[6]

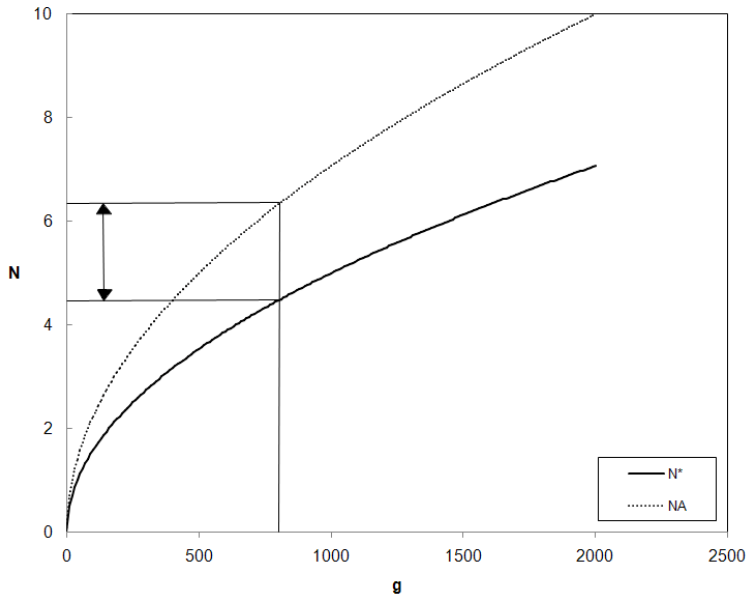

Figure 1: Social planner solution and democratic equilibrium solution as functions of utility *g*

Regarding the three central results of the AS model[7], the proposition that "in equilibrium one generally observers an inefficiently large number of countries" is of immediate relevance for my purpose and the only proposition that follows directly from the calculations above. The remaining two propositions will not be treated in this paper, although it cannot be ruled out that neither of them is affected as well by the consequences of the proposed extension to the model.

[5] For figure 1, parameters were set at *a=0.8* and *k=8.0.*

[6] Obviously, visualization by means of continuous functions is not quite adequate for integer entities like nation states. This choice was rather guided for reasons of clarity of representation.

[7] The three central results of the AS model are:

- "democratization leads to secessions"
- "in equilibrium one generally observes an inefficiently large number of countries"
- "the equilibrium number of countries is increasing in the amount of economic integration." (Alesina and Spolaore 1997).

The model presented above clearly is just a first crude attempt to grasp the phenomenon under investigation. Several authors have tried to refine the basic framework in one or another way. Staal (2004) focuses on making public spending and taxation[8] exogenously dependent on the size of the countries and confirms the results of Alesina and Spolaore (1997). Etro (2006) endogenously determines the size of public spending and derives optimal solutions for the size of nations and their respective public spending together. His conclusions are not unambiguously in favour of the original AS results. Alesina and Spolaore (2006) extend the model to investigate the role of international conflicts and defence spending on the size and number of nations.

Shortcomings

The list of objections to the AS model in this section is by no means complete but rather tries to emphasize some of the more pressing drawbacks. Its originators are well aware of many of these shortcomings and give an extensive roadmap for model improvement (Alesina and Spolaore 2003, pp. 221-223).

The AS Model has been criticised for some of its rather strong assumptions which have been justified for reasons of mathematical tractability in closed form. First, there is perfect correlation between the geographical location and the individuals' preferences, which in turn implies perfect sorting of the population in terms of preferences. However, this simplification rules out the investigation of isolated minority groups in the first place. Empirical studies by Easterly and Levine (2001) show a rather fractal income distribution while Easterly and Levine (1997) as well as Alesina et al. (2003) point out how ethnic, linguistic and religious diversity affects economic growth of a country. So considering the distribution of the population regarding attributes like income, ethnicity and language may well yield valuable insights.

Considerable objection was also raised against the idea of marginal border adjustment. The AS model lets an individual living at the border between two countries decide which jurisdiction it belongs to. Because there is no population mobility, in such situations borders

[8] In fact, the amount of tax each individual has to pay is already defined exogenously dependent on the size of the respective country in the original AS model, since it is given by the quotient of public good cost *k* over population size *s*. In the case of uniform population distribution (as applied in the AS model), the population size coincides with the territorial size of the country.

adjust marginally around the border individuals. In fact, border changes impose very high fixed cost which in turn might be the most important reason why they occur only in the way of discrete non-linear steps rather than infinitesimally small ones.
As Drazen (2000) correctly notes,

"the marginalist approach may be sometimes relevant for localities like cities or counties. They will make marginal adjustments in their borders for purely economic reasons by absorbing an unincorporated area or (more rarely) giving up a small area to another city or county. At the national level, making marginal adjustments for economic reasons, as opposed to political or socio-ethnic reasons, does not seem especially descriptive of reality." (p. 727)

Additionally, the static approach to equilibrium analysis inherent in this model poses questions on the methodological adequacy of the problem at hand. Since state formation and secession are clearly dynamic long run phenomena contingent on historical events, this theory is able to derive conclusions only within a comparably stable and stylised context.

Another major point of criticism concerns the distribution of individuals. In the AS model the population is distributed uniformly. A direct consequence of this assumption is that - no matter which institutional setting is investigated (dictatorship, democracy, benevolent social planner) – in any given solution all countries are of the same size. Obviously this result doesn't live up with a comparison against real world data. In fact, country size in terms of population is distributed extremely asymmetrically with relatively few large countries and a large number of very small nation states. Various extensions to the basic AS model deal with openness and international trade, conflict situations and possible power constellations in economic and political supranational institutions. The assumption of a uniform population distribution and therefore countries of equal size seem hard to justify considering these extensions. This paper is a first step in analyzing the consequences of introducing jurisdictions of different size by means of non-uniform population distributions.

3. Non-Uniform Population Distributions

In the basic AS model, the utility function of individual *i* residing in country *x* is given by

(4) $$U_{ix} = g(1 - al_{ix}) + y - t_{ix},$$

y denoting exogenous private income, l_{ix} representing the distance between individual *i*'s location and the location of the government of country *x* and t_{ix} measuring the amount of tax individual *i* has to pay to finance the government of country *x*. Since every inhabitant of country *x* has to pay the same amount of tax, t_{ix} can be expressed by

(5) $$t_{ix} = \frac{k}{p_x},$$

where p_x, the population size of country *x*, is given by

(6) $$p_x = F(b^x) - F(b_x).$$

F(.) is the cumulative distribution function of the population distribution and b^x (b_x) denotes the upper (lower) border of country *x* on the *[0, 1]*-segment. Note that in the case of the uniform distribution expression (6) simplifies to $p_x = b^x - b_x$, which is the formal representation of the fact that territorial size and population size of country x coincide in the basic AS model.

Rewriting expression (4) in a more general way yields

(7) $$U_{ix} = g(1 - a|i - m_x|) + y - \frac{k}{p_x},$$

where the distance l_{ix} is expressed explicitly as the absolute value of the difference between the location of individual *i* (also denoted as *i*) and the location m_x of the government of country *x*. In the social planner case, m_x is chosen to maximize total population utility. In

democratic equilibrium, however, it is given by the median position of country *x*.[9] The median of country *x* is determined by

$$(8) \qquad m_x = F^{-1}\left[\frac{1}{2}\left(F(b_x) + F(b^x)\right)\right].$$

$F^{-1}(.)$ is the inverse function of $F(x)$, so that $F^{-1}(F(x)) = x$. Assuming a uniform population distribution, expression (8) simplifies to $m_x = \frac{1}{2}(b_x + b^x)$.

As the above elaborations already indicate, the introduction of a non-uniform distribution into the AS framework results in the loss of tractability in closed form, mostly since this modification leads to the dissolution of identity between territorial size and population size of a country.

Because my method of investigation is numerical computation, any alternative distribution has to offer a comparably simple cumulative distribution function. A desirable property of the candidate distribution is versatility in terms of being capable of representing a lot of different scenarios. In the ideal case, these scenarios also contain the uniform distribution employed in the original model in order to validate the obtained results against the existing work. These requirements seriously limit the available range of functions. The Beta-distribution, which is a generalization of the uniform distribution, is out of the question due to its rather complicated form. So I turned to a distribution suggested by Kumaraswamy (1980). This double-bounded distribution takes the following form:

$$(9) \qquad f(x;a,b) = abx^{a-1}\left(1-x^a\right)^{b-1}$$

$$(10) \qquad F(x;a,b) = 1-\left(1-x^a\right)^b$$

The parameters *a* and *b* are shape parameters, *x* has a range of *[0, 1]*. For parameter values *a=1* and *b=1* the functions simplify to the uniform distribution. As can be seen in figure 2, this distribution allows for a variety of different shapes apart from the uniform distribution depending on the chosen shape parameters *a* and *b*.

[9] This result is a direct consequence of the application of majority voting and makes use of the Median Voter Theorem.

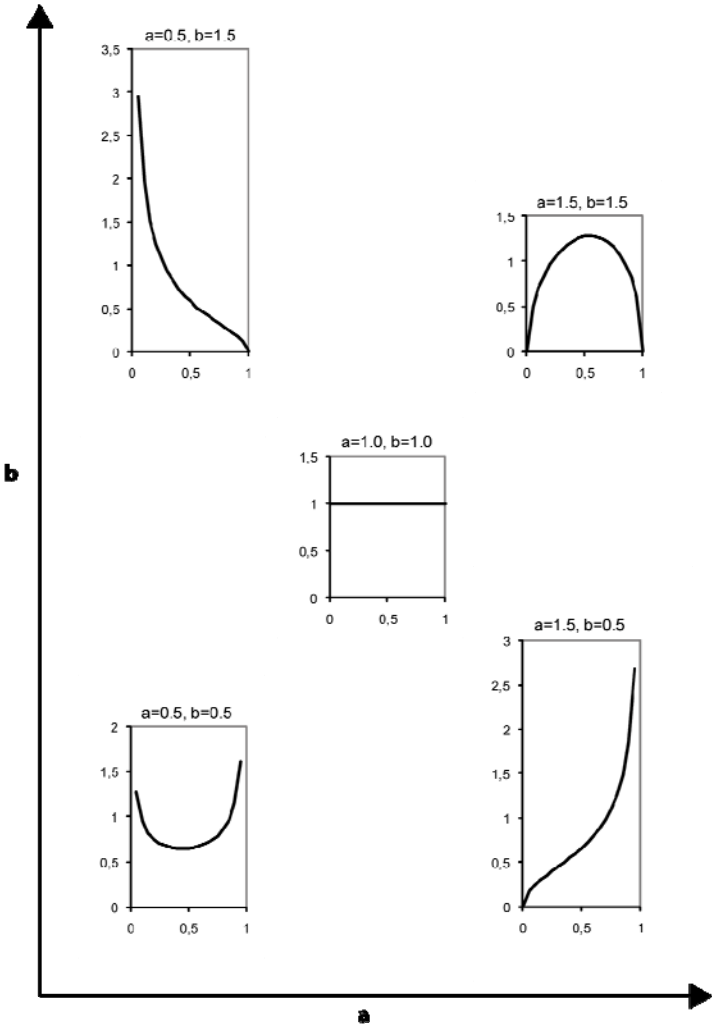

Figure 2: Density functions of the Kumaraswamy distribution for various sets of shape parameters

The Social Planner Solution

Analytically, the problem of the social planner remains the same as in the case with uniform population distribution. However, as already mentioned, the introduction of non-uniformity brings about the loss of a number of simplifications and the problem is no longer solvable in closed form. Particularly, the social planner problem, which originally has the following form

$$\max \int_0^1 U_i \, di \tag{11}$$

turns to

(12) $$\max \int_0^1 U_i f(i) di.$$

Since the population is no longer uniformly distributed, the utility in every location on the *[0, 1]*-segment has to be weighted with the population size in this particular location, which is given by *f(.)*, the density function of the population distribution.

I bypass the loss of tractability in closed form by exhaustively searching the possible configurations of nations (and locations of the public good) for a given set of the model parameters *y, k, g, a* and *l* and evaluating the configuration which maximizes the average utility of the population. Because this task is computationally very demanding, I am only able to present results for a comparatively small range of parameter values. Nevertheless, this is sufficient for detecting qualitative changes in the model behaviour.

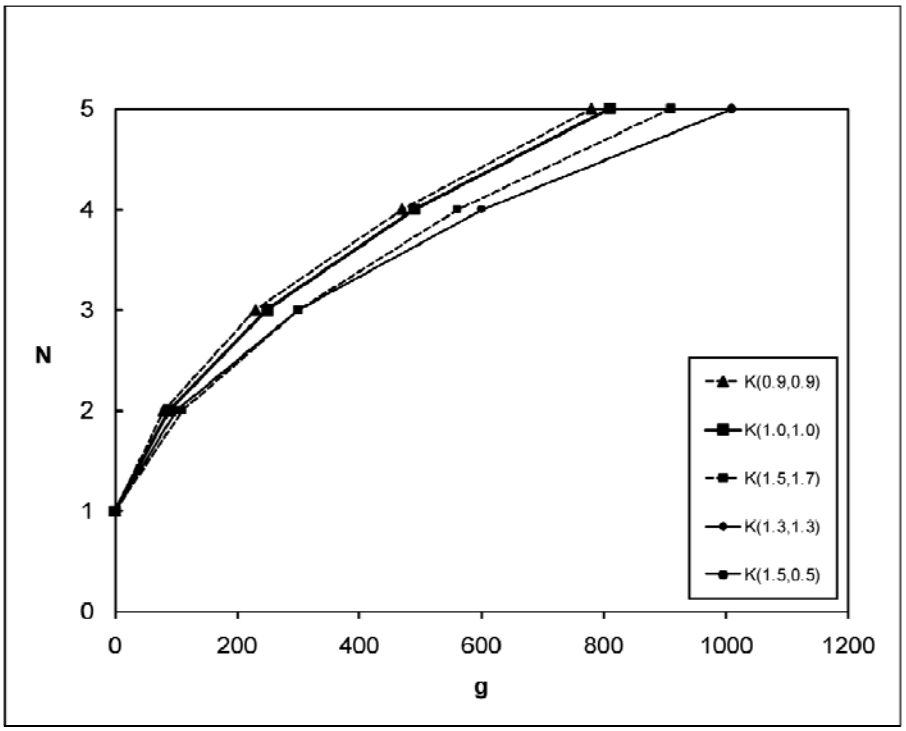

Figure 3: The social planner solution N^* as function of utility *g* for various population distributions

Figure 3 shows the calculations[10] for parameter values *y=50, a=0.8, k=8.0* and different values of *g* as a function of *g*[11]. The bold line represents the corresponding values of the

[10] The results of the calculations are represented by the points in the diagram. The connecting lines are only used for visual clarity. The points mark the lowest possible value of *g* under which the number of nation states *N(g)* yields the highest utility.

uniform distribution, i.e. *K(1.0, 1.0)*[12]. As can be seen, given a value of *g* the optimum solution leads to more countries the smaller the values of the shape parameters are and vice versa to a smaller number of countries for higher values of shape parameters.

The Democratic Equilibrium

For the evaluation of democratic equilibria I calculate the stability conditions[13] for all possible configurations. A democratic equilibrium requires all individuals living at the border between two countries to be indifferent about which country to belong to. In order to be a *stable* equilibrium as well, small perturbations of this equilibrium (i.e. small border changes) must not lead to a different outcome but instead the system immediately has to converge to the pre-shock equilibrium. Since the location of the public good is decided by majority voting in each country, I can make use of the median voter theorem and assume that each such public good is located at the position of the median voter in each country.

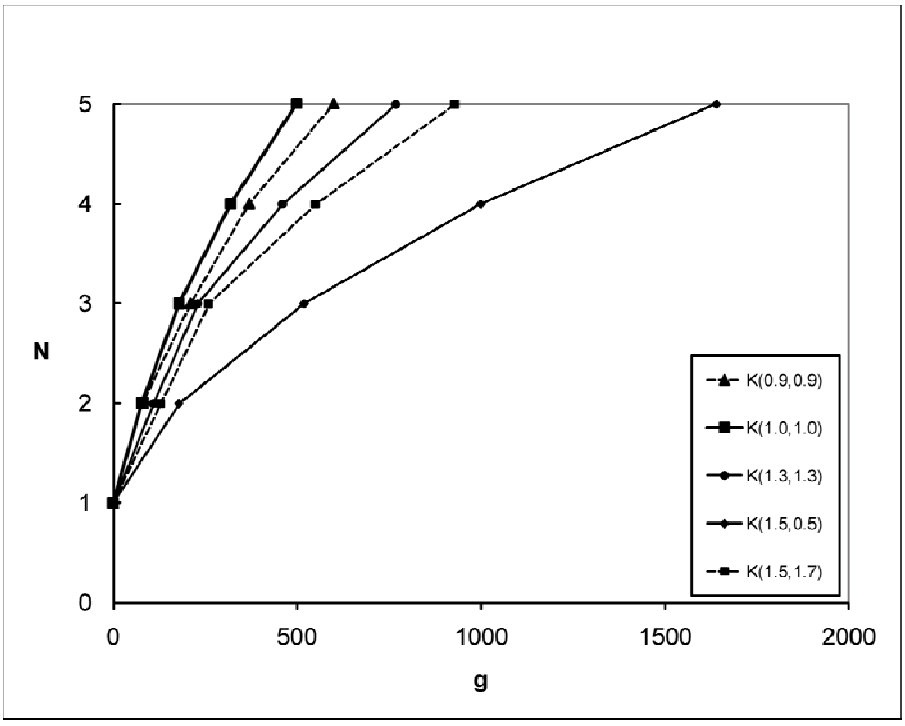

Figure 4: The democratic equilibrium solution N_A for various population distributions as function of utility *g*

[11] The choice of parameter values may seem arbitrary, but since the high level of abstraction in this model renders empirical validation nearly impossible, this choice was only guided by the requirement to generate solutions up to *N=4* in a comparatively low range of parameter g. This, in turn, is a concession to run time issues resulting from the computational complexity of the social planner solution.

[12] I will use the notation *K(a,b)* for the Kumaraswamy Distribution with shape parameters *a* and *b*.

[13] For this purpose, I employ the stability conditions of *RULE A* from the original AS model (Alesina and Spolaore 1997).

Figure 4 shows the results of the calculations[14] with the same parameter values as in figure 3. No matter what values the shape parameters take, it can be said that in general the stable number of nations is smaller than in the uniform case (represented by the bold line once again). While the deviations from the benchmark case with uniform distribution was rather small regarding the optimum number of nations, the border stable equilibrium tends to react much stronger to changes in the underlying population distribution.

4. Comparison of Results

Given the artificial nature of the model itself, it would not be sensible to derive quantitative conclusion. Nevertheless, these results allow for decisive qualitative conclusions when compared with another. In the following graphs, I therefore compare the social planner solution and the democratic equilibrium solution for the various population distributions investigated above with the results of the original AS model. As will be seen, four different model behaviours can be sorted out.

Case 1: Confirmation of the AS model

Comparison of the case of *(a, b) = (0.9, 0.9)* yields a confirmation of the results of the original AS model with uniform population distribution. This rather minor deviation from the uniform case *(a, b) = (1.0, 1.0)* only slightly changes the stable solution and the efficient solution, thereby not altering the qualitative behaviour of the model. Still, the stable number of nations is larger than the efficient number of nations for all values $g > 0$. A look at figure 5 reveals the details.

[14] Again like in Figure 3, the actual results are represented by the points. In this case, they represent the lowest possible value of g that yields an stable configuration of $N(g)$ nation states.

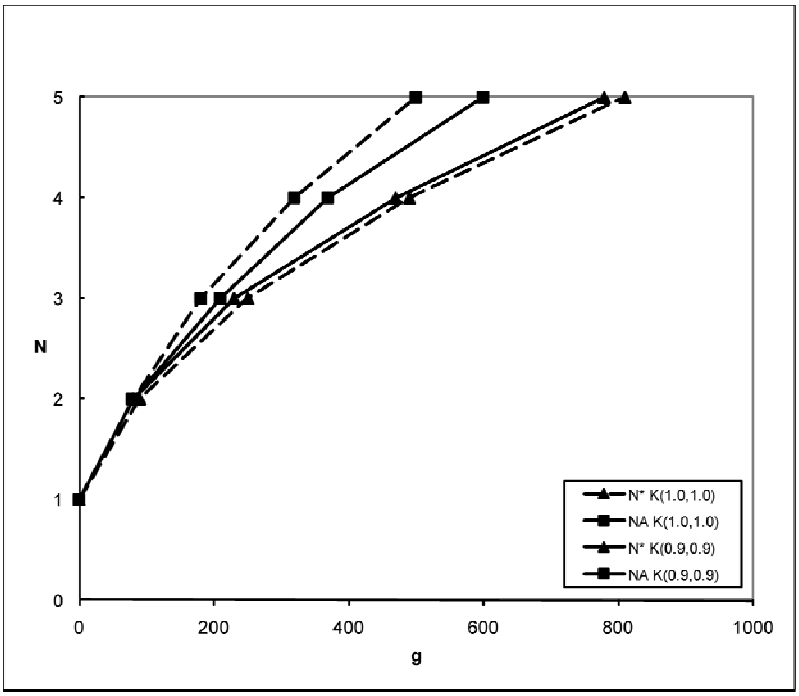

Figure 5: Results of the uniform distribution compared with *K(0.9, 0.9)*

The solutions of the model with uniform distribution (i.e. *K(1.0, 1.0)*) are represented by the points connected by dashed lines, while the solutions of the *K(0.9, 0.9)*-distribution are shown by the points connected by solid lines. Triangular points represent the social planner solution, rectangular points stand for the border stable equilibrium solutions. The general result is very similar to the case of the uniform distribution, namely, that in equilibrium the stable number of nations is larger than the socially optimal number of nations, i.e. there are too many nations in equilibrium. But the extent of the difference between social planner solution and border stable equilibrium is smaller. Nevertheless, this finding confirms the stability of the results obtained by Alesina and Spolaore regarding *minor deviations* from the uniform population distribution.

Case 2: Ambiguous outcome with 1 intersection

The picture changes, however, when the shape parameters are altered a little bit more. For the values *(a, b) = (1.3, 1.3)*, the outcome is neither clearly in favour nor strictly against the results derived from the original AS model. As figure 6 shows, the social planner solution intersects with the equilibrium solution at about *g = 200* and it depends on the exact value of parameter g, whether the stable number of nations is larger than the efficient number of nations or vice versa.

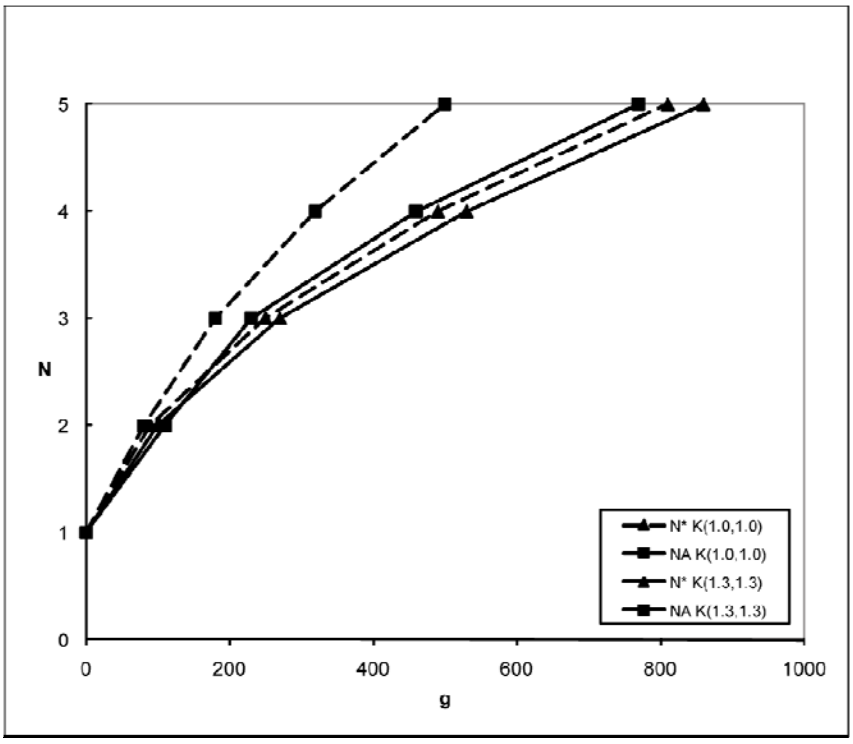

Figure 6: Results of the uniform distribution compared with *K(1.3, 1.3)*

Case 3: Ambiguous outcome with 2 intersections

An even more puzzling outcome results for instance with shape parameters *(a, b) = (1.5, 1.7).* As figure 7 shows, this time there is not only one intersection point, but there are two of them. Now, the basic result that the stable number of nations is larger than the efficient number of nations is valid only within a certain value range of parameter *g*. If *g* is higher or lower than this range, then the results are reversed again.

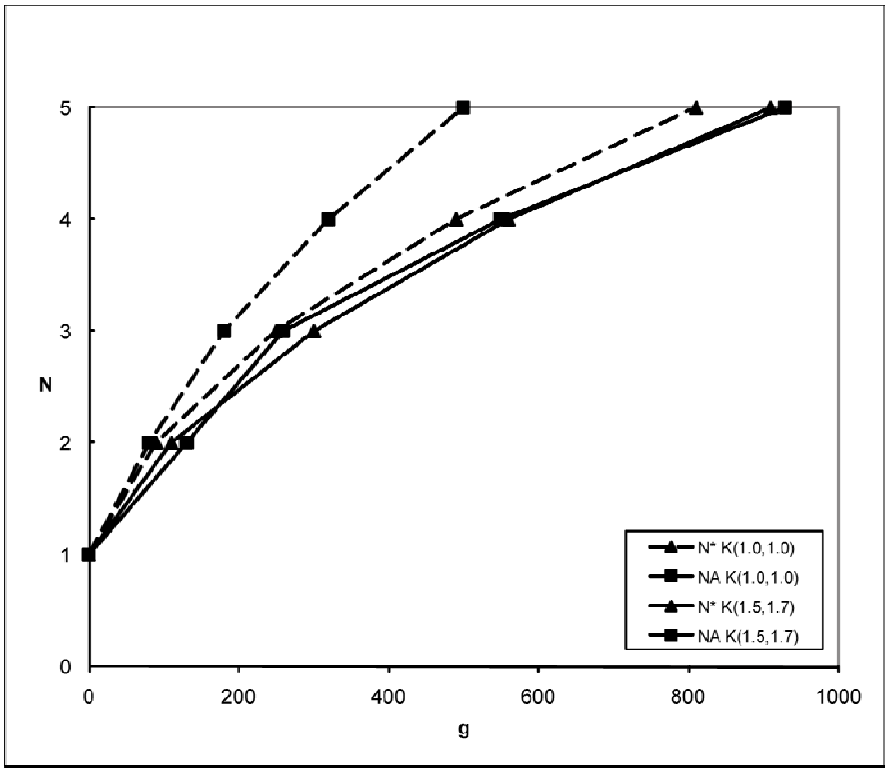

Figure 7: Results of the uniform distribution compared with *K(1.5, 1.7)*

Case 4: Complete rejection of the AS model

The final case I want to illustrate is the complete reversal of the AS results. For certain values of the shape parameters, the efficient number of nations is larger than the stable number of nations, thus contradicting the statement of the AS model with uniform population distribution. As can be seen in figure 8, in the case of the *K(1.5, 0.5)*-distribution, the socially optimal number of nations is larger than the border stable number of nations, which contradicts the basic message stated by the uniform case of the AS model.

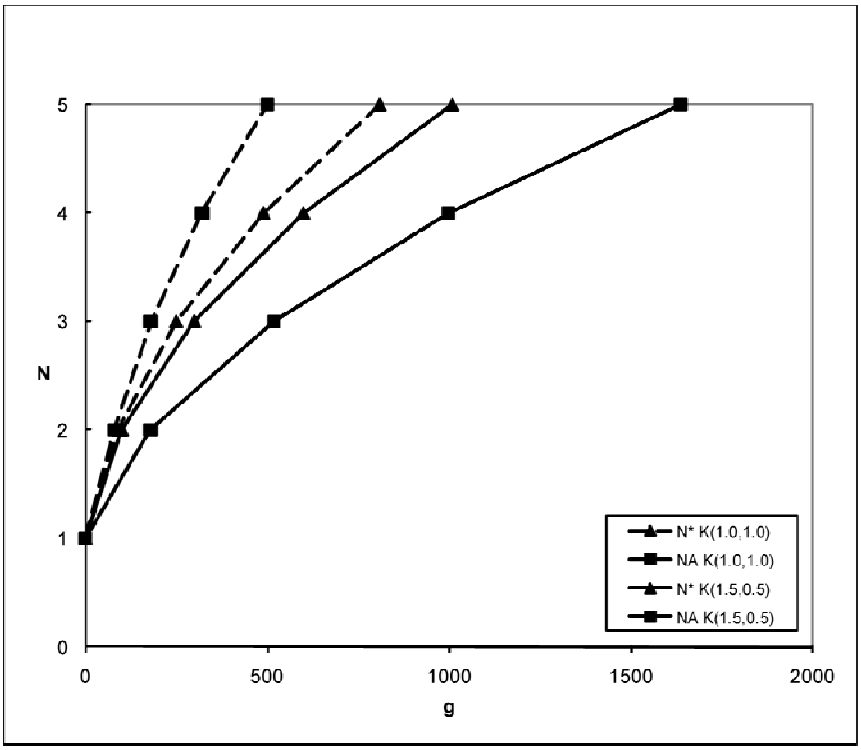

Figure 8: Results of the uniform distribution compared with *K(1.5, 1.7)*

These examples have clearly shown that the qualitative behaviour of this framework crucially depends on the choice of the population distribution. For shape parameter values close to 1, the same propositions obtain as in the uniform case. However, by further deviating from the benchmark uniform case, the model changes its qualitative behaviour. We have seen that in the cases of *K(1.3, 1.3)* and *K(1.5, 1.7)*, no globally valid conclusions on the relationship between the efficient solution and the stable solution can be drawn. Finally, at shape parameter values *a=1.5* and *b=0.5* the proposition derived from the uniform model is even reversed and in equilibrium there are "too few" nation states compared to the socially optimal case.

Until here, I have only shown a comparably small number of cases yielding different results. To get the bigger picture of the dependence of model behaviour on the choice of the population distribution, figure 9 shows the outcomes for a great number of population distributions with shape parameters *a* and *b* ranging from *0.1* to *2.0*.

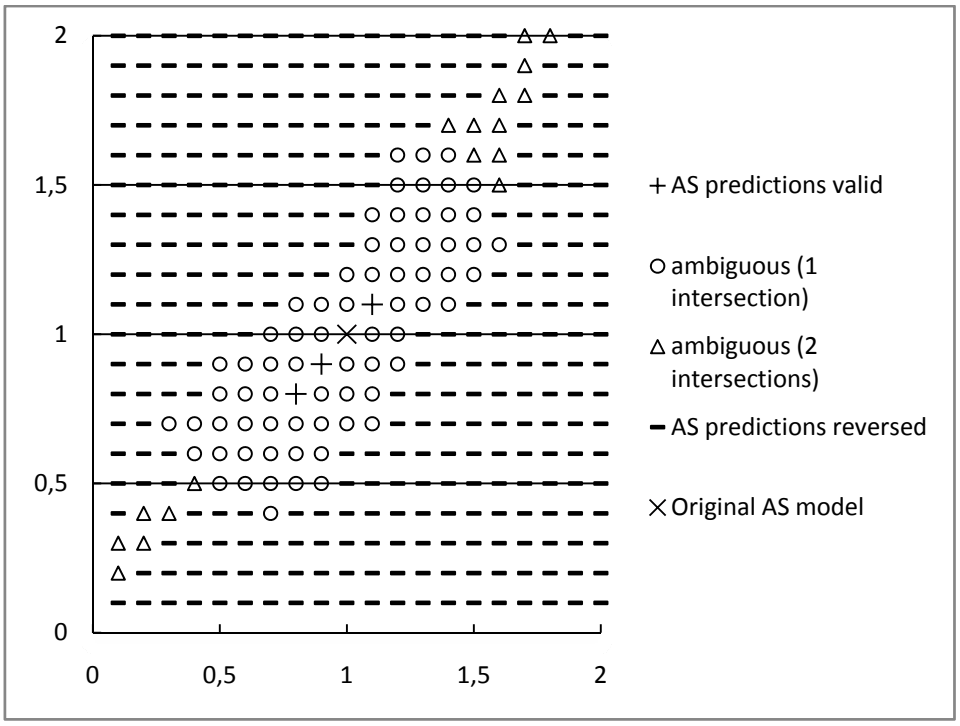

Figure 9: Model behavior for the state space of shape parameters a, b

The values for shape parameter *a* are recorded on the x-scale, the values for shape parameter *b* on the y-scale. The point in parameter space corresponding to the uniform population distribution (and therefore also corresponding to the results of Alesina and Spolaore) is marked by the X at *(1, 1)*. As can be seen by the plus-signs, the predictions of the AS model only hold in a very small surrounding area of the uniform population distribution (case 1). For slightly larger deviations from the uniform case, the model adapts a different behaviour characterized by the intersection of the social planner solution and the stable solution (case 2). Going even farther away from the center of the diagram, the model finally reverts its behaviour in most of the investigated cases (marked by the minus-signs) (case 4). An additional type of model behaviour can be found in the lower left and the upper right region of the parameter space. The cases marked by the triangle-signs characterize situations where the social planner solution and the stable solution have two intersections (case 3).

While these results still represent a very selective view on possible parameter constellations, they suffice to show that the model behaviour is highly sensitive to the chosen population distribution and serve as existence prove for outcomes completely different from the ones proposed by the original AS-model with uniform population distribution.

The following section will elaborate on the implications of the lack of robustness of the AS model and propose a different approach to the issue.

5. Implications

As has been shown in the previous section, the results derived from the AS framework are strictly dependent on the choice of the distribution. Obviously, this model is not very robust to variations of some of its assumptions.

Clearly, the results derived from the uniform distribution case make some sense. If, for instance, you take a look at the many small nation states, it seems at least somewhat plausible that these states are operating at an inefficiently low scale. Furthermore, if you consider that some of these small nations are still subject to secession ambitions – therefore potentially leading to even smaller states – as documented by the efforts of Curacao or St. Martin to become independent[15], the prediction of the AS model that in equilibrium there are more nation states than in the social optimum seems like a very accurate description of real world processes.

However, these results are derived under very strict and artificial assumptions. Especially the uniform size distribution of nation states seems troublesome because it leads to results with nation states of equal size. Though, by relaxing the assumptions regarding the population distribution and therefore allowing for states of different sizes, the proposition holds only in a very limited range of distributions for shape parameters close to the uniform case. In all other cases, the model behaviour is ambiguous or even opposed to the results of the original model.

So, the dilemma of the AS model is that if you employ highly simplifying assumptions, the results do in fact make sense to some degree. However, if you try to allow for a more adequate picture of real world processes (in the present case nation states of heterogeneous sizes) and choose less simplifying assumptions, these sensible results vanish.

Considering the extensions of the model concerned with international conflict or the formation of international federations, the question at hand is, whether not incorporating heterogeneous state sizes is a valid simplification for capturing the driving forces of these

[15] The Economist, May 26th 2007, p. 58.

phenomena. I doubt the validity of this abstraction for both issues are determined by the interaction patterns of a few very large actors and a majority of comparably small ones. This fact clearly limits the explanatory power of the AS model regarding the description and understanding of international political dynamics. Related models concerned with international unions (e.g. Alesina, Angeloni and Etro 2001a, 2001b, 2005) suffer from the same limiting assumptions like identical nation state. Although these models haven't been tested yet, it seems likely that the results obtained in this literature are dependent on these assumptions as well.

While the treatment at hand represents a first generalization of the underlying distribution assumptions that allows for nation states of different sizes, more realistic multimodal population distributions are still missing in the picture. Non-linear modelling approaches like agent based modelling (ABM) seem to be the method of choice in this case. Not only would ABM allow for more flexibility regarding population distributions, but other drawbacks of the AS model (e.g. introduction of population mobility) could be tackled as well.

Furthermore, empirical investigation would be necessary in order to single out those forms of distributions which prevail in reality. Thereafter, validation of the obtained results would be possible. However, in the face of the high abstraction level of this framework, it seems hard to come up with a sound empirical strategy.

6. Conclusion

Without a doubt, the AS model serves as a starting point for a better understanding of the complex issues at hand, but there is still much research to do in order to grasp them in a more adequate way. To accomplish this task I propose a different approach. In my opinion a comparative static approach with marginal border adjustments cannot do justice to the issue of secession and unification. Border changes happen in discrete non-linear steps and are subject to a number of dynamic influences. It is to be doubted if a mathematical model driven by the self-interested decisions of single individuals is the right method to tackle this collective problem.

A more promising way to pose and answer questions is by employing non-linear modelling methods like agent-based modelling. This approach allows for the formulation of the issues

by means of complex adaptive systems. These systems are able to exhibit non-linearities as well as path-dependent behaviour which I believe to be relevant elements in the context of this topic. Cederman's (1997) work, for instance, seems particularly promising. He develops a number of non-equilibrium models on the emergence of states and nations by utilizing this method which resulted in a number of valuable insights. However, like most work originating in the political sciences, he neglects the interplay between politics and economics in the process of secession and unification and reduces the agents' motivation to conquest. On the other hand, existing work in the economics literature focuses solely on economic issues like public good provision and tax collection.

It is my belief that neither of these approaches is fully capable of handling the issues tackled in this paper. In fact, I believe that interdisciplinary social science research is necessary to gain deeper insights in many hot issues related to the problem. The role of the nation state in a unified Europe, the ongoing trend for secessions in many parts of the world and the challenges of so-called failed states like the Iraq in the aftermath of the U.S. invasion show impressively that there is a pressing need for a theory which can substantially improve our knowledge about the role of the nation state in the international political economy.

Clearly, the presented results reflect work in progress. Nevertheless, I think that the work on this topic so far deserves further investigation in many directions, since the central insight of Alesina and Spolaore (1997) has turned into common sense among many economists. Yet, as the treatment at hand has shown, their model is heavily influenced by the appropriate choice of distribution function and not able to describe situations that differ from the highly artificial setting of uniform population distributions and symmetric nation states. In the face of the many problems related to the role of the nation state it would be urgent to put forward a new and improved theory that manages to integrate political, economic and cultural factors that accompany the issue of secession and unification.

References

Alesina Alberto, Ignazio Angeloni, and Federico Etro, "The Political Economy of International Unions", *NBER Working Paper,* 2001a.

Alesina Alberto, Ignazio Angeloni, and Federico Etro, "Institutional Rules for Federations",

NBER Working Paper, 2001b.

Alesina Alberto, Ignazio Angeloni, and Federico Etro. "International Unions", *The American Economic Review*, 95:602-615, 2005.

Alesina Alberto, Arnaud Devleeschauwer, William Easterly, Sergio Kurlat, and Romain Wacziarg. "Fractionalization". *Journal of Economic Growth*, 8:155–194, 2003.

Alesina Alberto and Enrico Spolaore. "On the number and size of nations". *The Quarterly Journal of Economics*, 112:1027–1056, 1997.

Alesina Alberto and Enrico Spolaore. *The Size of Nations.* MIT Press, 2003.

Alesina Alberto and Enrico Spolaore. "Conflict, Defense Spending And The Number Of Nations". *European Economic Review*, 50:91-120, 2006.

Bolton Patrick and Gérard Roland. "The breakup of nations: A political economy analysis". *The Quarterly Journal of Economics*, 112:1057–1090, 1997.

Bolton Patrick, Gérard Roland, and Enrico Spolaore. "Economic theories of the break-up and integrations of nations". *European Economic Review*, 40:697–705, 1996.

Casella Alessandra and Jonathan S. Feinstein. "Public goods in trade: On the formation of markets and political jurisdictions". *International Economic Review*, 43:437–462, 2002.

Cederman Lars-Erik. *Emergent Actors in World Politics: How States and Nations Develop and Dissolve.* Princeton University Press, 1997.

Downs Anthony. *An Economic Theory of Democracy.* Harper & Row, 1957.

Drazen Allan. *Political Economy in Macroeconomics.* Princeton University Press, 2000.

Easterly William and Ross Levine. "Africa's growth tragedy: Policies and ethnic divisions". *The Quarterly Journal of Economics*, 112:1203–1250, 1997.

Easterly William and Ross Levine. "What have we learned from a decade of empirical research on growth? it's not factor accumulation: Stylized facts and growth models". *World Bank Economic Review*, 15:177–219, 2001.

Etro Federico. "Political geography". *Public Choice*, 127:329-351, 2006.

Friedman David. "A theory of the size and shape of nations". *Journal of Political Economy*, 85:59–77, 1977.

Hotelling Harold. "Stability in Competition". *Economic Journal*, 39:41-57, 1929.

Kumaraswamy Poondi. "A generalized probability density function for double-bounded random processes". *Journal of Hydrology*, 46:79–88, 1980.

Ruta Michele. "Economic theories of political (dis)integration". *Journal of Economic Surveys*, 19:1–21, 2005.

Spolaore Enrico. “National Borders and the Size of Nations” in Barry Weingast and Donald Wittman (eds.). *Oxford Handbook of Political Economy*. 2006.

Staal Klaas. “Country Size and Public Good Provision”. *Tinbergen Institute Discussion Paper No. 26*, 2004.

Wittman Donald. “The Wealth and Size of Nations”. *Journal of Conflict Resolution,* 44:868-884, 2000.