ON THE NUMBER AND SIZE OF NATIONS*

ALBERTO ALESINA AND ENRICO SPOLAORE

This paper studies the equilibrium determination of the number of countries in different political regimes, and in different economic environments, with more or less economic integration. We focus on the trade-off between the benefits of large jurisdictions and the costs of heterogeneity of large and diverse populations. Our model implies that (i) democratization leads to secessions; (ii) in equilibrium one generally observes an inefficiently large number of countries; (iii) the equilibrium number of countries is increasing in the amount of economic integration.

I. INTRODUCTION

In the last few years national borders have been redrawn to an extent that is rather exceptional for modern peacetime history. On the one hand, several countries[1] have disintegrated (the former Soviet Union, Yugoslavia, and Czechoslovakia), and in other countries movements for regional autonomy or even independence have gained larger support (Canada, Spain, France, and Italy, for example). On the other hand, Germany has reunified, and the European Union is moving toward economic integration and, to a much lesser extent, to some form of political integration. On balance, one can detect a tendency toward political separatism with economic integration. Recent border changes have been often accompanied by the democratization process that has swept the world.

This paper proposes a simple politico-economic model to address several questions concerning the number and size of countries. We model country formation as a result of a specific trade-off between the benefits of large political jurisdictions and the costs of heterogeneity in large populations. We are particularly interested in the relationship between the equilibrium number of countries, democratization, and economic integration. Our main findings can be summarized in three points:

1. Democratization leads to secessions: one should observe fewer countries in a nondemocratic world than in a democratic one.

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1. Throughout this paper we use the words "country," "nation," and "political jurisdiction" interchangeably.

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2. The democratic process leads to an inefficiently large number of countries. Namely, when countries are formed through a democratic process, more countries are created than with a social planner who maximizes world average utility. It is generally not possible to enforce, by majority rule, redistributive schemes that can sustain the efficient number of countries.

3. The equilibrium number of countries is increasing with the amount of international economic integration.

Relatively few economists have provided formal models of country formation. Friedman [1977] argues that countries are shaped by rulers in order to maximize their joint potential tax revenues, net of collection costs. Buchanan and Faith [1987] study how the option of secession places an upper limit on the tax burden that a ruling majority can impose on the minority. Casella and Feinstein [1990], and Casella [1992] study the relationship between economic and political integration.[2] Bolton and Roland [1997] present a model in which secessions are costly, but a majority might vote for a secession in a regional referendum because the median voter's benefits from the expected change in redistribution policy after the secession outweigh the efficiency loss. What distinguishes our paper from these previous contributions is our emphasis on questions of optimality and stability of the equilibrium number of countries in different politico-economic regimes.

This paper is organized as follows: Section II presents the basic model and discusses the assumptions. Sections III derives the social planner solution. Section IV defines and characterizes the equilibrium outcome in a democratic world. In Section V we study transfers within a country. Section VI discusses the issues of democratization and economic integration, and some extensions. The last section concludes.

II. The Basic Model: Assumptions and Interpretation

We focus on a trade-off between the benefits of large countries and the costs of heterogeneity in large populations. Larger political jurisdictions bring about several benefits. First, the per capita cost of any nonrival public good decreases with the number of people who finance it. Also, the per capita costs of several pub-

2. Wei [1992a, 1992b] develops modified versions of the Casella-Feinstein model in order to study secessions.

lic goods is decreasing with the population size.[3] In addition, Easterly and Rebelo [1993] find that larger countries (measured by population size) rely more heavily on more efficient forms of taxation (i.e., income tax) relative to less efficient ones (custom taxes), even after controlling for different levels of income. Their explanation is that income taxes have larger setup bureaucratic costs, relative to, say, customs duties. A second benefit of country size is related to the dimension of markets. In a world of less than perfect free trade, the size of markets is affected by the size of political jurisdictions, and, in the extreme case of autarky, the two coincide. Thus, any model with increasing returns in the size of the economy implies increasing returns in the size of countries. Third, exposures to uninsurable shocks is more costly for smaller countries. A region of a large country hit by an idiosyncratic, region-specific, negative shock is compensated with redistributions from the rest of the country.[4] However, if the same region were an independent country, it would receive no transfers. Last, but not least, security considerations may be a determinant of size. While our model explicitly accounts for the first two features (the second one in Section VI), the last two benefits of size are not in the model.

Beyond a certain point, the benefits of scale may be counterbalanced by congestion and coordination problems, but up to a point, economies of scale prevail. However, taking advantage of the economies of scale in large countries may come at a "political cost." A larger population is likely to be less homogeneous: the average cultural or preference distance between individuals is likely to be positively correlated with the size of the country. In small, relatively homogeneous countries, public choices are closer to the preferences of the average individual than in larger, more heterogeneous countries.[5] Barro [1991] summarizes the trade-off that we emphasize as follows: "We can think of a country's optimal size as emerging from a trade-off: A large country can spread the cost of public goods, . . . over many taxpayers, but a large country is also likely to have a diverse population that is difficult for the central government to satisfy."

3. For a recent review of the empirical evidence on this point, see Sadler and Hartley [1995].
4. Sachs and Sala-i-Martin [1992] document that these types of transfers are rather large across U. S. states.
5. Dahl and Tufte [1973] convincingly illustrate the benefits of cultural homogeneity in small democracies.

In order to keep the model tractable, we consider only one public good, which identifies each nation. We call this nonrival public good the "government," a term with which we identify a bundle of administrative, judicial, economic services, and public policies. The world population has mass 1, and we assume a continuum of individuals with ideal points distributed uniformly on the segment [0,1].[6] Individuals' utility is decreasing with the distance of their government from their ideal point.

Every country needs a single government, and the citizens of each country have to finance and can take advantage of the only government of their country. The world needs at least one government. Thus, $N \geq 1$, where N is the number of countries in the world. Each government costs k, regardless of the size of the country.[7] Every individual has the same, exogenous income y, and pays tax t_i. Thus, the utility of individual i is

$$U_i = g(1 - al_i) + y - t_i, \tag{1}$$

where g and a are two positive parameters and l_i is the preference distance from individual i to his government. Thus, the utility function is linear in consumption. The parameter g measures the maximum utility of the public good, when $l_i = 0$. The parameter a measures the loss in utility that an individual suffers when the type of government is far from his preferred type.[8]

Thus far, we have been silent on the geographical distribution of individuals. Clearly, in our model, individuals who are close to each other in terms of preferences would like to form a country together. If there were no relationship between geographical location and preferences, then there would be no presumption that a country would be geographically connected. From the point of view of realism, this problem can be addressed in two ways. One is to impose additional costs on governments of countries that are not geographically connected. The second way is to

6. In Section VI we briefly illustrate in which direction our results would change with more general distributions. Also, without any qualitative change in our results but with some not trivial changes in notation and presentation, we could model the world as a circle, rather than as a segment.

7. We could model the costs of government as $k = \alpha + \beta s$, where $\alpha > 0$, $\beta > 0$ are parameters, and s is the size of the country. As long as $\alpha > 0$, our results generalize, without qualitative changes.

8. A sufficient condition to ensure that a higher g increases utility for every type of government is $a < 1$. This is not necessary for the results of this paper, but it is a natural assumption if we interpret g as a measure of "government services" and a as reduction in the "marginal utility" of government services when the government is located at a distance l_i from the individual's preferred type.

assume that individuals who are close to each other in preferences are also close to each other geographically. Both assumptions are reasonable, and nonmutually exclusive. Here we adopt the simplest possible one by requiring that the geographical and the preference dimensions coincide. Therefore, l_i in equation (1) captures both the geographical and the preference distance. We assume that individuals are not mobile. Country borders are endogenously determined in our model, but the geographical location of each individual is fixed. In order to analyze geographic mobility, we would need to break the identity between preferences and geographical location, and endogenously determine their relationship in equilibrium; this is a task that we leave for future research.[9]

III. The Social Planner Solution

A world benevolent planner can choose the number and sizes of countries and the type of government within each country. A social planner who maximizes the sum of individual utilities solves this problem:

$$\max \int_0^1 U_i di, \tag{2}$$

$$\int_0^1 t_i di = Nk. \tag{3}$$

The following proposition characterizes the result.

PROPOSITION 1. The social planner (i) locates the government in the middle of each country, and (ii) chooses N^* countries of equal size, such that

$$N^* = \sqrt{ga/4k}, \tag{4}$$

provided that $\sqrt{ga/4k}$ is an integer. Otherwise, the efficient number of countries N^* is given by either the largest integer smaller than $\sqrt{ga/4k}$, or the smallest integer larger than $\sqrt{ga/4k}$.

9. Note that the literature on mobility across localities provides some theoretical underpinnings for our assumption. One of the most common results in this literature is that individuals with different preferences or characteristics (i.e., income) locate in the same community; namely, stratification is achieved in equilibrium. The classic reference is Tiebout [1956]. For a survey see Rubinfeld [1987]. More recent contributions include Epple and Romer [1991], in which sorting is derived in a model with forward-looking voters, and Bénabou [1993], in which the overall distribution of types is determined in equilibrium, together with the composition of local communities.

The formal proof is in the Appendix, but the intuition is simple. Given a certain number of countries, the social planner locates the government in the middle of each one: this choice minimizes average distance from each government. Given the symmetry of the problem and, in particular the uniform distribution of preferences, average utility is maximized by choosing countries of equal size. The number N^* optimizes over the trade-off between average taxes and average distance, and is increasing in the benefits of governments and costs of distance (g and a) and decreasing in the cost of the government (k). Individual utility depends on the distribution of individual taxes t_i.

IV. The Stable Number of Nations

We make the following two assumptions about public policy and taxation.

A.1. Within each country the location of the government is decided by majority rule. The vote on the type of government is taken after the borders of the country are established.

A.2. In each country taxes are proportional to income, with the same tax rate for every citizen.

The first assumption implies that decisions about policy are taken after a country is formed. The second assumption implies that, within each country, every citizen pays the same tax. In Section V we remove this assumption and discuss voting over redistributive schemes. Given A.1 and A.2, an immediate application of the median voter theorem implies that *the government is located in the middle of each country, given country borders.*

In order to study the equilibrium number of countries, we have to define ways of creating a new country or eliminating an existing one. We begin with the first rule (Rule A) for border redrawing. Rule A establishes that nobody can be forced to belong to a country if he prefers a different one. More specifically, if a "region" (regardless of its size) wants to abandon a country and join the neighboring one, neither of the two countries affected by this move can prevent it. This rule can be expressed as follows:

A. Each Individual at the Border between Two Countries Can Choose Which Country to Join.

A configuration of N countries is

1. An A-equilibrium if the borders of the N nations are not subject to change under Rule A;

2. A-stable if it is an A-equilibrium and it is stable under Rule A.

Our notion of "stability" is quite standard. A-stability implies that if an A-equilibrium is subject to a "small" perturbation, the system returns to the original position. A "small" perturbation in this case would be moving a border so that a small set of individuals are moved to a different (neighboring) country.

A direct consequence of Rule A is the following.

PROPOSITION 2. A configuration of countries is A-stable only if all countries have equal size. A configuration of N equally sized countries is A-stable if and only if

$$N < \sqrt{ga/2k}\,. \tag{5}$$

Proof. See the Appendix.

First, Proposition 2 implies that if all the countries are not the same size, the equilibrium is not A-stable. In fact, the individual at the border between two countries of different sizes, in general, will not be indifferent between the two countries.[10] Moreover, only countries that are not "too small" are A-stable. When countries are below a minimum size, any perturbation that increases the size (by "moving in" a set of individuals from a neighboring country) would induce even more people to join the enlarged country. Thus, the initial perturbation would be amplified.

We now introduce a second rule (Rule B) for country formation. Rule B refers to the case of border rearrangements obtained by an international agreement among existing countries, ratified by majority rule votes within each country. That is, borders can be changed if a majority of the citizens of the countries affected by the border change are in favor of it. More specifically:

B. A New Nation Can Be Created, or an Existing Nation Can Be Eliminated, If the Modification is Approved by Majority Rule in Each of the Existing Countries Affected by the Border Redrawing.

We can now define a B-equilibrium. A configuration of N countries is a B-equilibrium:

1. if it is A-stable and no new nation is created or no existing nation is eliminated under A-stable applications of Rule

10. There is only one case of "border indifference" with differently sized countries, but this case is not A-stable. See the Appendix.

B. That is, any A-stable proposed modification to create or eliminate a country is rejected by majority voting in at least one of the affected countries; and

2. B-stable if it is a B-equilibrium and it is stable under Rule B.

Several clarifications are in order. First, the definition of B-equilibrium implies that when groups of countries contemplate redrawing borders according to Rule B, they consider only a new configuration of countries which is stable under Rule A. In other words, proposals of border changes that are not A-stable are not admissible. This assumption is made for tractability, but it also has an intuitive appeal. It would not make much sense for a group of countries to vote on a border rearrangement that, as they know, would not be an equilibrium because individuals and regions would want to change borders. Second, the notion of B-stability is standard: it implies that a B-equilibrium is stable if, after a perturbation in the number of countries the system returns to the B-equilibrium with repeated applications of Rule B.Third, we can show that an alternative Rule B' yields the sameresults: *a country can be created or eliminated if the border redrawing is approved by majority rule in each of the regions that would constitute new countries under the proposed modification.*[11] Finally, note that Rules A and B do not allow the unilateral creation of new countries by groups of individuals, an issue which we address below by showing that a B-stable configuration of countries is also stable with respect to unilateral secessions.

We now proceed to study the consequence of Rule B. Because of Proposition 2 and our definition of B-equilibrium, we can focus on countries of equal size.

PROPOSITION 3. A configuration of equally sized countries is a B-equilibrium if and only if their number $\tilde{N}$ is given by the largest integer smaller than

$$\sqrt{ga/2k}\,. \tag{6}$$

Proof. See the Appendix.

Thus, Proposition 2 implies that any N below $\sqrt{ga/2k}$ is an A-equilibrium. Proposition 3 implies that the largest N below that critical value is the unique B-equilibrium.

The intuition of the proof of Proposition 3 can be summarized

11. Results using B' instead of B are available upon request, and were included in the working paper version.

as follows. We focus on any configuration of N equally sized countries, and we derive the conditions under which, given N, a majority in at least one country objects to changes of borders that lead to the creation of $(N + 1)$ or $(N - 1)$ countries. The move from N to $N + 1$, implies two changes for each individual. First, his tax will increase, since the new country size is smaller. Second, his distance from the government will change. The average distance from the government is lower with smaller countries, and for a majority of individuals, their own distance becomes smaller moving from N to $N + 1$ countries. Thus, a change from N to $N + 1$ countries is approved by majority rule if in every one of the N countries, for a majority of individuals, the benefits (due to a reduced distance) are greater than the costs (due to higher taxes). Note that the critical voter is the person with the median change in distance when moving from N to $N + 1$, since the change in taxes is the same for everyone. Analogous considerations hold for a move in the opposite direction, from N to $N - 1$ countries. The proof consists of checking whether, given a certain number of countries N, there exists at least one country in which a majority would vote against moving to either $N + 1$ or $N - 1$. We show that in each of the existing countries there exists a majority against the creation of a new country if and only if

$$N(N + 1) \geq ga/2k. \tag{7}$$

This condition ensures that in each country the *median* reduction in the distance from the government does not compensate for the higher taxes that each citizen must pay when the number of nations increases. On the other hand, there always exists at least one country that will veto the shift from N to $(N - 1)$ nations if and only if

$$N(N - 1) \leq ga/2k. \tag{8}$$

This condition ensures that in at least one country the reduction in taxation associated with the lower number of countries does not compensate a majority of voters for the increase in distance from the government. From (7) and (8), Proposition 3 easily follows.

Next we show that, when N is a B-equilibrium, if one perturbs that number in any direction, repeated applications of Rule B would lead the number of countries back to N.

PROPOSITION 4. Every configuration of nations that is a B-equilibrium is B-stable.

Proof. See Appendix.

We now consider the possibility of unilateral secessions, by allowing an additional rule (Rule C) for country creation.

C. A New Nation Can Be Created When a Connected Set of Individuals Belonging to an Existing Country Unanimously Decides to Become Its Citizens.

DEFINITION. A country of size s is C-stable if there exist no groups of citizens of size z that would want to break away and form a new country of size z, using Rule C, for any z.

PROPOSITION 5. A country of size s is C-stable if and only if

$$s \leq \left(\sqrt{6} + 2\right)\sqrt{k/ga}\,. \tag{9}$$

Proof. See Appendix.

COROLLARY. A configuration of N countries of equal size is C-stable if and only if

$$N \geq \frac{1}{\sqrt{6} + 2}\sqrt{\frac{ga}{k}}\,. \tag{10}$$

Thus, countries that are too large cannot be C-stable. In fact, beyond a certain size, individuals close to the borders are so distant from the government that they would unilaterally form a new country and be better off, despite the much higher per capita taxes.

Rule C allows for secessions of citizens of the same country. More generally, members of two neighboring countries may want to unilaterally break away and create a new country. More specifically, we can consider a modified notion of C-stability.

DEFINITION. Two neighboring countries of size s each are C'-stable if no connected group of individuals, belonging to either country, would unanimously want to form a new country.

A generalization of the proof of Proposition 5 leads to the result that a configuration of N countries of equal size is C'-stable if and only if

$$N > \frac{1}{\sqrt{2} + 2}\sqrt{\frac{ga}{k}}\,. \tag{11}$$

Thus, both the efficient number of countries (N^*) and, more importantly, the B-stable number, $\tilde{N}$, are both C-stable and C'-stable. Therefore, from now on we will simply refer to $\tilde{N}$ as the "stable" number of countries, implying that this number is A-, B-, and C- (and C'-) stable. We are now ready to state one of the main results of the paper, which implies a comparison of $\tilde{N}$ and N^*:

The stable number of countries is larger than the efficient one. The efficient number of countries is not stable.[12]

Consider the efficient number N^*. This configuration is efficient, A-stable, and C- (and C'-) stable but not B-stable. This result follows from a well-known "imperfection" of majority voting, with a "one person one vote" rule. Without costless compensatory schemes, the majority voting equilibrium is not efficient because individuals far from the government obtain a low level of utility. These individuals are not compensated, since taxes are the same for everyone. Therefore, when they vote, they do not appropriately take into account the aggregate loss of efficiency in moving beyond the optimal number of countries. Thus, it is the vote of those close to the borders that leads to the inefficient equilibrium. Note, in fact, that the stable number of countries $\tilde{N}$ solves the problem of a "Rawlsian" social planner, who maximizes the utility of the least well off individual but cannot use lump-sum transfers. Conversely, the stable number of countries $\tilde{N}$, which is larger than N^*, is inefficient. Thus, with an appropriate scheme of lump-sum redistributions, a social planner could "move" the equilibrium from $\tilde{N}$ to N^* without making anybody worse off. This scheme would reward individuals who are located far from the borders. In the next section we discuss the political feasibility of compensatory schemes.

V. Compensation Schemes

Can individuals who are located far from the government be compensated so that they would not vote in favor of creating a number of countries greater than the efficient one? In other words, can one support an equilibrium with fewer countries than

12. More precisely, $N^* \leq \tilde{N}$ always, and $N^* < \tilde{N}$ for $\tilde{N} > 4$. One can also notice that efficient numbers and stable numbers tend to infinity for k tending to zero.

$\tilde{N}$ using compensation schemes? We consider tax schedules in which individuals far from the government pay less (or may even receive a positive transfer). For tractability we focus on linear compensation schemes of the following type:

$$t_i = \bar{q} - q l_i, \tag{12}$$

where $\bar{q}$ and q are nonnegative parameters. In order to avoid uninteresting knife-edge ties in voting, we assume (realistically) that there exist some costs (W) in the administration of the compensatory schemes. Thus, for a country with borders b and b' with $b' > b$, and size s, the budget constraint is

$$\int_b^{b'} t_i di = k + W. \tag{13}$$

Define $\bar{l}$ as the average distance from the government, and $w = W/s$ as the per capita administrative costs. Also, for concreteness, without loss of generality, we posit a specific functional form for w:[13]

$$w(q) = \gamma q^2 \qquad \gamma > 0. \tag{14}$$

Using (13) and (14), one obtains

$$t_i = k/s + \gamma q^2 + q(\bar{l} - l_i). \tag{15}$$

Before proceeding, two observations are in order:

1. For any positive γ, the social planner would choose N^* countries of equal size, and $q = 0$.

2. If $q = ga$ and the government is in the middle of the country, every individual achieves the same level of utility (compensation is complete). Compensation is incomplete for $0 \leq q < ga$.

We now investigate the majority-rule equilibrium compensation schemes, voted after the country borders are established. Specifically, we assume that after the borders of a country are established, the citizens vote on the location of the government (as above) and then on the compensation scheme, i.e., a scheme with $0 \leq q \leq ga$. Under these assumptions the following proposition holds.

13. An alternative specification leading to qualitatively identical results would be to impose distortionary costs of taxation. All the results of this section can be obtained with a generic function $W(q)$ with $W' > 0$.

PROPOSITION 6. For any positive γ, however small, $q = 0$, and the government is located in the middle of the country.[14]

Proof. See the Appendix.

Proposition 6 implies that what we had *assumed* in Section II, namely no compensation, can in fact be derived as a result from more fundamental hypotheses concerning, in particular, the order of voting. The assumption that transfer schemes are decided *after* borders are defined is critical and highlights a kind of time inconsistency problem. Perhaps, before the decision on country borders, majorities in every existing country would want to commit to transfer schemes with $q > 0$, which would enforce country sizes greater than the one that is stable for $q = 0$. However, the credibility of these compensation schemes is problematic. When a country is created, a majority can always change national tax policy. In other words, the timing of decisions underlying Proposition 6 implies that it is "easier" to change national tax policies than international arrangements on borders. Also, remember that the stable number of countries, $\tilde{N}$, obtained with $q = 0$, is stable to unilateral secessions as well: no compensations are needed to prevent secessions.

One may then ask: which compensation schemes would be approved by majority vote, if they could be voted upon at the same time (or before) country borders are set, with an irrevocable commitment? Can the efficient number of countries N^* be supported by a majority-approved commitment to linear transfer schemes as in (12)? The answer involves studying multi-issue voting on borders (Rule B), transfer schemes (q), and government location, simultaneously. While this problem of multi-issue voting, with nonsingle-peaked preferences, escapes an obvious solution, two simple observations exclude that N^* can be enforced for *every* set of parameter values. First, income per capita may simply not be high enough to support the necessary transfers from the center to the borders. Second, the waste, i.e., the parameter

14. It is worth stressing that we are limiting our analysis to the range of parameter values between no compensation, and full compensation, defined as everyone having the same utility. In principle, one could think of transfer schemes that redistribute so much away from the center to the borders, that individuals at the center are worse off than individuals at the periphery. This would be the case of $q < 0$. These ranges of parameter values give rise to nonsingle peaked preferences over q for given choice of location of the government. We focus here on the case in which preferences are single peaked.

γ, could be high enough so that the necessary transfers would be too costly.

In summary, problems of feasibility, waste in the redistributive process, and, perhaps more interestingly, of commitments, may make it difficult (if not impossible) to implement the compensation schemes that would enforce the efficient number of countries.

VI. Economic Integration, Democratization, and Generalizations

Given the result of Proposition 6, we can now continue with the assumption of no compensatory schemes.

VI.1. Economic Integration

Consider a country that is completely closed to any economic contact with the rest of the world: then the size of the market for this country is identical to the size of the country itself. If, for whatever reason, the productivity or the level of economic activity in this country is positively influenced by the size of the market, then the level of per capita income or of growth would be positively influenced by the size of the country. In the opposite extreme of a complete open economy, the size of the country is irrelevant for economic activity because it does not determine the size of the market. This simple consideration underlies the result of this section, namely that the stable number of countries is increasing in the amount of economic integration and openness.

One among many reasons why there might be increasing returns in the size of an economy is given by the relationship between human capital and productivity, as emphasized by the recent endogenous growth literature.[15]

Define H_{ix} as the aggregate human capital in country x, where i belongs; and H_{-ix} as the aggregate human capital in the rest of the world. Assume that individual income depends linearly on aggregate human capital:

$$y_{ix} = b + b_1 H_{ix} + b_2 H_{-ix};\ b_i > 0 \quad i: 0, 1, 2. \tag{16}$$

15. Human capital externalities on total factor productivity are emphasized, for instance, by Romer [1986], Lucas [1988], and Grossman and Helpman [1991]. For a general treatment of the field, see Barro and Sala-i-Martin [1995]. Equation (16) implies that individual income is given by a constant plus a linear term in aggregate human capital, at home and abroad.

If each individual is endowed with the same amount of human capital (h) so that $H_x = s_x h$ and $H_{-x} = (1 - s_x)h$, and we set $b_2 = (1 - j)\, b_1$, we obtain

$$y_{ix} = b_0 + b_1 s_x h + b_1(1 - j)(1 - s_x)h. \tag{17}$$

If $j = 0$, there is no difference between domestic human capital and foreign human capital. If $j = 1$, the domestic economy is completely insulated from the rest of the world (autarky). Intermediate values of j capture situations of openness that are less than perfect. Repeating all the analysis of the previous two sections (details are available), we obtain the following:

PROPOSITION 7. The efficient number of countries, N^*, is the maximum between 1 and the integer closest to

$$\sqrt{(ga - 4b_1 jh)/4k}. \tag{18a}$$

The stable number of countries $\tilde{N}$ is the maximum between 1 and the largest integer smaller than

$$\sqrt{(ga - 4_1 b_1 jh/2k}. \tag{18b}$$

As before, it follows that $N^* < \tilde{N}$. What is more interesting now is that both N^* and $\tilde{N}$ are decreasing in j, for given b_1. Thus, we have the following corollary.

COROLLARY. The efficient and the stable number of countries are increasing in the amount of international economic integration.

The intuition is that a breakup of nations is more costly if it implies more trade barriers and smaller markets. On the contrary, the benefits of large countries are less important if small countries can freely trade with each other. Concretely, this result suggests that regional political separatism should be associated with increasing economic integration.

For a given strictly positive value of j, both the efficient and stable number of countries decrease with b_1, namely the magnitude of the human capital externality. The intuition is that, if the externality is large, and international integration is low (i.e., j is high), then the size of countries is higher, and their number lower. In fact, the benefits of the human capital externality are mostly within country boundaries. As j goes to zero, the effect of b_1 on $\tilde{N}$ goes to zero as well. For $j = 0$ the human capital externality does not affect country size.

In summary, this section has two empirical implications. First, political separatism should go hand in hand with economic integration. We feel that the current European experience, the idea of a *Europe of regions,* and the separatism of Quebec in the context of NAFTA yield some support for this implication. Furthermore, the incentives for the states of the former Soviet Union, Yugoslavia, and Czechoslovakia to break away would have been much lower if they had expected to be economically isolated instead of integrated with the rest of the world, in particular, with Western Europe. Conversely, countries that are too small may not be viable in a world of trade restrictions. The second implication is that the benefit of country size on economic performance should decrease with the increase of international economic integration and removal of trade barriers.[16]

Finally, the causal relationship between degree of international economic integration and national size can go both ways. Higher economic integration implies smaller countries, and smaller countries will need more economic integration. An extension of our analysis is to study the joint endogenous determination of j and N.[17]

VI.2. Democratization

We now compare the stable number of countries in a democratic world with the number of countries in a world of dictators. We define a dictator as a Leviathan who maximizes rents, i.e., tax revenues net of expenditures.[18] For simplicity, we return to a world with fixed individual income, denoted y. We begin with the simplest case of a single-world Leviathan who has to supply at least one government. In the absence of additional constraints, his problem has an obvious (corner) solution at $t = y$ and $N = 1$. A Leviathan who does not care about individuals' utility would supply only the minimum possible amount of the public service (that is, one), and tax at the maximum feasible level.

More realistically, it is unlikely that even dictatorial governments can be completely insensitive to the welfare of their citizens. Even dictators might have to guarantee some minimal level

16. Alesina, Spolaore, and Wacziarg [1997] provide a more elaborated model of the relationship between trade openness and country size and successfully test its implications using both cross-country regressions and historical evidence on country formation.
17. A first step in this direction is Spolaore [1996].
18. A classical analysis of governments as revenue maximizers is Brennan and Buchanan [1980].

of utility to at least part of the population, to avoid insurrections. We model this constraint by posing that a Leviathan has to guarantee at least a utility level of u_0 to a fraction δ of his citizens.

We analyze a world of Leviathans in which national borders maximize governments' joint net revenues. This is the cooperative solution that would be adopted by a class of Leviathans (a group of individuals who can become country rulers), if they could transact at no cost and use unrestricted side payments, and this is the case analyzed by Friedman [1977]. He argues that in a world of rent-maximizing governments, the size and shape of nations will be such as to maximize their joint potential net revenues, even when they do not explicitly cooperate. We continue to assume that taxes have to be the same for everyone.[19]

PROPOSITION 8. Countries have the same size. The number of countries that insures a minimum utility u_0 to a fraction δ of the population in each country is $\max[1, N_\delta]$, where

$$N_\delta = \sqrt{ag\delta/2k}, \tag{19}$$

provided that max 1, N_δ is an integer.[20] The tax is

$$t_\delta = g(1 - a\delta/2N_\delta) + y - u_0. \tag{20}$$

Proof. See Appendix.

This Proposition implies that

$$\text{if} \quad \delta < \frac{1}{2} \qquad N_\delta < N^* \tag{21a}$$

$$\text{if} \quad \delta = \frac{1}{2} \qquad N_\delta = N^* \tag{21b}$$

$$\text{if} \quad \frac{1}{2} < \delta < 1 \qquad N^* < N_\delta < \tilde{N} \tag{21c}$$

$$\text{if} \quad \delta = 1 \qquad N_\delta = \tilde{N}. \tag{21d}$$

Thus, for any value of δ strictly less than one, there are fewer countries with Leviathans than in a democratic world. For $\delta <$ 1/2, the more realistic range, since by definition a dictator can rule without the consent of a majority, the number of countries with Leviathans is below the efficient number. Thus, the implica-

19. If the Leviathans could discriminate among citizens and charge different taxes, they would. We do not develop this issue here.

20. Otherwise, the solution is given by the integer that is closer to $\sqrt{ag\delta/2k}$.

tion is that there are too few countries in a world of Leviathans. *Hence, democratization leads to the creation of more countries.*[21]

Finally, note that, since with dictators, countries are relatively large, even unilateral secessions may become attractive. In fact, straightforward calculations, available upon request, show that if δ is below a certain threshold, a dictator faces a "secession threat." In this case, either Leviathans use repression by force to avoid unilateral secessions, or they have to become less totalitarian, by increasing δ, i.e., the fraction of the population they care for.

VI.3. Countries of Different Size

The result that, in equilibrium all the countries have equal size (an obviously unrealistic implication), is an artifact of the assumption that individuals are uniformly distributed. This assumption makes the model tractable in closed forms. In what follows, we briefly sketch how one might extend the model to the nonuniform case.

Define the cumulative distribution of the world population as $F(z)$. The population of country x, p_x, is thus given by $p_x = F(\bar{b}_x) - F(\underline{b}_x)$ where $\bar{b}_x$ ($\underline{b}_x$) is the upper (lower) border of country i. As above, the government is located at the median in each country, except that now the median does not coincide with the middle of the country. Define as $\underline{d}_x$ the distance from the median of country x to its lower border, and $\bar{d}_x$ the distance from the median to the upper border. The conditions of indifference at the borders, implied by Rule A, are as follows:

$$\underline{d}_{x+1} - \bar{d}_x = \frac{k}{ag}\frac{p_{x+1} - p_x}{p_x \cdot p_{x+1}} \quad \text{for } x = 1, \ldots, N \tag{22}$$

if N is the number of countries, and the countries are numbered in increasing order from left to right. In addition to the $(N - 1)$ conditions (22), we have that $\sum_{x=1}^{N} p_x = 1$. For the uniform distribution, expression (22) reduces to $s_{x+1} = s_x$ for $x = 1, \ldots, N$.[22] A simple examination of (22) shows that in general countries will have different population sizes and geographical extensions.[23]

As for Rule C the results of Proposition 5 can (conceptually

21. In the working paper version we discuss an analogy of this model of Leviathans with a model of product differentiation in industrial organization.

22. The other solution is $s_i \cdot s_{i+1} = 2k/ag$; this is the unstable solution of Rule A discussed in the Appendix.

23. Details are available.

at least) easily be extended to the nonuniform case. In this case as well, the secession threat is highest for individuals at the borders. Obviously, the "no secession" conditions analogous to equation (9) would depend on the shape of the distribution $F(z)$. Finally, the application of Rule B would certainly be computationally very demanding. As for the uniform case, one would allow voting only on proposals that are A-stable, except that now the condition for A stability does not necessarily imply countries of equal size, but must satisfy the system of conditions in equation (22).

VII. Conclusion

This paper is a step toward applying economic analysis to the study of the number and size of countries. Rather than reviewing our results, in this concluding section we highlight some of the questions that we have left open.[24]

First, the coincidence of the geographical and cultural dimensions precluded the consideration of ethnic or cultural minorities. By removing the coincidence between the two dimensions, one can start with an arbitrary distribution of preference and geographic location and study the adjustment process and the formation of countries. This development requires a study of geographical mobility, and may connect with the literature on migrations. Our model, nevertheless, suggests in which direction the results would change with ethnic minorities and costs of relocation. Countries would not be of equal size, and ethnic minorities should be willing to bear the relatively high costs of forming small countries in exchange for not having to share a government with the ethnic majority.

Second, we have not modeled the role of military threats and of defense spending. The optimal size of a country and the optimal amount of its public good "defense" clearly depends upon the size of other countries, and their aggressive military potential. Empirically, one may argue that the emergence of regionalism in Europe (East and West) is related not only to democratization and economic integration, as this paper suggests, but also to the disappearance of the Soviet military threat. We discuss some of these issues in Alesina and Spolaore [1996].

24. Alesina, Perotti, and Spolaore [1995] and Bolton, Roland, and Spolaore [1996] relate the results of this paper to the literature.

Third, we have greatly simplified the treatment of the "public good," or "government" that identifies a country. In reality, a government provides many functions. Some of them can be decentralized to regional or local governments within the context of a decentralized country. In other words, an answer to the trade-off between economies of scale and heterogeneity can be found in a decentralized structure of government. This line of argument would connect us to the literature on fiscal federalism, an avenue certainly worth exploring. In fact, our model may also have implications on the degree of federalism in dictatorships or democracies. In fact, rather than thinking about the division of the world into different countries, think about the division of a country into autonomous regions. Then, our result implies that dictatorships should be more centralized than democracies. Ades and Glaeser [1995] provide some evidence that is indirectly supportive of this argument. They find that countries with a history of dictatorial regimes have capital cities that are much larger, relative to the size of the nation, than in democratic countries.

Fourth, we have largely ignored the question of the redistributive role of governments, since we have not considered differences in individual income. Differences in income, in addition to differences in preferences, may be crucial determinants of the degree of heterogeneity in the population that determines the equilibrium size and number of countries.

Finally, one could study which supermajority rules for changing borders might enforce the efficient number of countries as a stable equilibrium.

Appendix

Proof of Proposition 1

The social planner maximizes the sum of all individual utilities:

$$\int_0^1 U_i di = \sum_{x=1}^{N} s_x[g(1 - a\bar{l}_{ix}) + y - \bar{t}_{ix}] \tag{A1}$$

subject to

$$\sum_{x=1}^{N} \bar{t}_{ix} = Nk, \tag{A2}$$

where $\bar{l}_{ix}$ and $\bar{t}_{ix}$ are, respectively, the average distance and the average tax in country x and s_x is the size of country x. For given N, $\bar{l}_{ix}$ is minimized if the public good is in the middle of each country. Hence, the average distance in each country is $s_x/4$. Therefore, the social planner's problem can be written as

$$\text{(A3)} \qquad \min \quad \frac{ga}{4}\sum_{x=1}^{N} s_x^2 + Nk$$

subject to

$$\text{(A4)} \qquad \sum_{1}^{N} s_x = 1.$$

The sum of squares of sizes is minimized by choosing countries of equal size $s = 1/N$. Therefore, the solution for N is the positive integer that solves

$$\text{(A5)} \qquad \min \quad ga/4N + kN.$$

The first-order condition with respect to N implies that

$$\text{(A6)} \qquad N^* = \sqrt{ga/4k}.$$

The above expression gives us the solution only if it is an integer. In general, the solution will be characterized as follows. Define $M = \sqrt{ga/4k}$. Define N' as the integer in the interval $(M-1, M)$ and N'' as the integer in the interval $(M, M+1)$. Then the efficient number of nations is N' if and only is $s' = 1/N'$ gives average utility not lower than size $s = 1/N''$; that is, if and only if

$$\text{(A7)} \qquad g\left(1 - \frac{a}{4N}\right) - kN' \geq g\left(1 - \frac{a}{4N''}\right) - kN''$$

or

$$\text{(A8)} \qquad N'N'' \geq ga/4k.$$

Otherwise, N'' is the efficient number. Therefore, the efficient number of nations is equal to M itself if M is a positive integer. Otherwise, it is equal to

a. the integer N' immediately below M if N' $(N' + 1)$ is larger than $ga/4k$;
b. the integer $N'' = N' + 1$ immediately above M if N' $(N' + 1)$ is smaller than $ga/4k$;
c. both integers N' and N'' if $N'N'' = ga/4k$.

As case c has measure zero, the efficient number of nations is generically unique.

Proof of Proposition 2

An individual at the border between two countries of sizes s_1 and s_2 is indifferent if

$$g\left(1 - a\frac{s_1}{2}\right) - \frac{k}{s_1} = g\left(1 - a\frac{s_2}{2}\right) - \frac{k}{s_2}. \tag{A9}$$

The above condition is satisfied if

$$s_1 = s_2 \tag{A10}$$

or

$$s_1 s_2 = 2k/ga. \tag{A11}$$

Start with (A10), and consider N countries of equal size. Perturb the equilibrium so that two bordering countries (call them 1 and 2) now have different sizes, $s - \varepsilon$ and $s + \varepsilon$, respectively, where ε is an arbitrarily small positive number. The original equilibrium is A-stable if and only if the individual at the new border always strictly prefers the smaller country (1) to the larger country (2); that is,

$$g\left(1 - a\frac{s - \varepsilon}{2}\right) - \frac{k}{s - \varepsilon} > g\left(1 - a\frac{s + \varepsilon}{2}\right) - \frac{k}{s + \varepsilon}, \tag{A12}$$

which implies that

$$(s - \varepsilon)(s + \varepsilon) > 2k/ga. \tag{A13}$$

At the limit, for ε tending to zero, the condition becomes

$$s^2 > 2k/ga. \tag{A14}$$

With an analogous procedure one can show that the case of non-equally sized countries (A11) is unstable. Thus, using (A14), one can conclude that the A-stable number of equally sized countries has to satisfy

$$N < \sqrt{ga/2k}. \tag{A15}$$

Proof of Proposition 3

As stated in Proposition 2, only equally sized nations are A-stable. Thus, in what follows, "number of nations" is implicitly defined as meaning "number of nations of equal size." Also, because of our assumptions on voting within a country, i.e., for given borders, we can use the result that, for any N, the government is located in the middle of each country. We begin by introducing definitions and notation.

Let $l_i\{N\}$ denote the distance of individual i's preferred type from the median voter's preferred type when the total number of nations is N. When we move from N to N' nations, denote the new distance by $l_i\{N'\}$. Let $d_i\{N,N'\}$ denote the change in the distance experienced by individual i. Simple algebraic manipulations show that individual i will prefer N to N' as long as

$$agd_i\{N,N'\} + k(N' - N) \geq 0. \tag{A16}$$

Let $d_m^x\{N,N'\}$ denote the median distance change in nation x (where $x = 1, 2, \ldots, N$).[25] As an immediate implication of the above definitions, nation x will have a majority that prefers N to N' if and only if

$$agd_m^x\{N,N'\} + k(N' - N) \geq 0. \tag{A17}$$

We define Rules $B1$ and $B2$ as follows.

B1. A new country can be *created* when the change is approved by majority rule in each existing country whose territory will be affected by the border redrawing.

B2. An existing country can be *eliminated* when the change is approved by majority rule in each existing country whose territory will be affected by the border redrawing.

A configuration of N nations is

- A $B1$-equilibrium if no nation is created under applications of Rule $B1$. That is, any proposed modification to increase the number of countries by one is rejected by majority voting in at least one of the affected countries.
- A $B2$-equilibrium if no nation is eliminated under applications of Rule $B2$. That is, any proposed modification to decrease the number of countries by one is rejected by majority voting in at least one of the affected countries.

We will then derive the B-equilibrium configuration, i.e., the configuration that is a $B1$-equilibrium and a $B2$-equilibrium when only *A-stable* modifications can be proposed. First, we state and prove the following four lemmas:

25. That is, if N' nations were to be formed, half of the citizens of nation x would experience distance changes larger than $d_m^x\{N,N'\}$, and the other half would experience distance changes smaller than $d_m^x\{N,N'\}$, where $x = 1, 2, \ldots, N$.

LEMMA 1. The median distance change $d_m^x\{N,N+1\}$ is the same for all x ($x = 1, 2, \ldots, N$) and is given by

(A18) $$d_m^x\{N,N+1\} = (s' - s)/2,$$

where

(A19) $$s \equiv 1/N \text{ and } s' \equiv 1/(N+1).$$

Proof. Consider a nation x of size $s = 1/N$, which extends from point A to point B, as in the following figure:

Let $s = |AB|$ denote the distance between A and B. Call M the midpoint. When $N + 1$ nations are formed, the citizens of nation x are divided in two new nations of size $s' = 1/(N + 1)$. Call them x' and x''; M' (M'') denotes the point in the middle of nation x' (x''). Call C the point located halfway between M' and M, and D the point located halfway between M and M''. As $|M'M''| = s'$, we also have, by construction,

(A20) $$|CD| = s'/2.$$

Note that all individuals between C and D belong to country x. In fact, the maximum distance between M and either M' or M'' is $m = 3s'/2 - s/2$ ($|MM''| = m$ for $x + 1$ and $|MM'| = m$ for $x = N$). Therefore, C and D are located at a distance from M that cannot exceed $3s'/4 - s/4$, which is strictly smaller than $s/2$. It follows that

(A21) $$\begin{aligned} &d_i\{N,N+1\} = 0 \text{ for } i = C \text{ and } i = D;\\ &d_i\{N,N+1\} > 0 \text{ for } i \in (C,D);\\ &d_i\{N,N+1\} < 0 \text{ for } i \in (A,C) \text{ and } i \in (D,B). \end{aligned}$$

In particular, for every point H' between M' and C which belongs to nation x, the distance change is given as follows:

(A22) $$\begin{aligned} d_{H'}\{N,N+1\} &= |M'H'| - |M'H'| \\ &= (|M'C| - |H'C|) - (|CM| + |H'C|) = -2|H'C|. \end{aligned}$$

Analogously, for every point H'' between D and M'' which belongs to nation x, we have a distance change equal to $-2|DH''|$. Call E the point between M' and C, and F the point between D and M'', chosen in order to satisfy the following two conditions:

(A23) $$|EC| = |DF|$$

(A24) $$|EF| = s/2.$$

From (A.22) and (A.23) we have

(A25) $$d_E\{N,N+1\} = d_F\{N,N+1\} = -2|EC|.$$

Therefore, we get

$$\begin{aligned} EF &= |EC| + |CD| + |DF| \\ &= 2|EC| + |CD| = 2|EC| + s'/2 = s/2, \end{aligned}$$

which implies that

(A26) $$|EC| = (s - s')/4.$$

As the maximum distance between M and M' is $3s'/2 - s/2$ (which holds for $x = N$), then max $|EM| = (3s'/2 - s/2)/2 + (s - s')/4 = s'/2 < s/2$. Therefore, E belongs to country x. Analogous argument shows that F belongs to x. By substituting (A26) in (A25), we obtain

(A27) $$d_E\{N,N+1\} = d_F\{N,N+1\} = (s' - s)/2.$$

Because of (A21), all individuals between E and F experience a distance change higher than the distance change experienced by the individuals located in point E and in point F, and all individuals between A and E and between F and B experience a smaller distance change experienced by the individuals at E and F. As the individuals between E and F are half the citizens of country x by (A26), the individuals at E and F experience the median distance change. Hence,

(A28) $$d_m^x\{N,N+1\} = (s' - s)/2.$$

LEMMA 2. The maximum $d_m^x\{N,N-1\}$ change is given by

(A29) $$\max d_m^x\{N,N-1\} = (s'' - s)/2,$$

where $s \equiv 1/N$ and $s'' \equiv 1/(N-1)$.

Proof. N odd. The maximum median distance occurs in the middle nation $x = (N+1)/2$, where the median voter $M = 1/2$ is located in the middle of the internal [0,1]. When $N - 1$ nations are formed, M becomes the border voter; i.e., $|M'M| = MM''| = s''/2$. Call A and B the points at the borders of nation $x =$

$(N + 1)/2$, as in the following figure:

```
M'    A  E  M  F  B   M
|....|__|__|___|__|...|.
```

The median distance change is experienced by the individuals E and F who are located at a distance $|EM| = |MF| = s/4$ from the former median voter; clearly, $|EF| = s/2$. Their distance change is given by

$$\text{(A30)} \quad d^x_m\{N, N-1\} = |M'E| - |EM| = (|M'M| - |EM|) - |EM| = \left(\frac{s''}{2} - \frac{s}{4}\right) - \frac{s}{4} = \frac{s'' - s}{2}.$$

N even. The maximum median distance occurs in the middle nations $x = N/2$ and $x + 1 = N/2 + 1$. Consider nation $x = N/2$. Call A and B the points at its borders, as in the following figure:

```
  M'        A  E  A'  M  F  B
..|.......|__|___|___|___|__|.
```

When $N - 1$ nations are formed, B becomes the median voter of nation $x' = (N - 1)/2$. Call A' the point at the left border of nation x'.[26] As B is the median voter of nation x', we have $|A'B| = s''/2$. The distance between A' and M is

$$\text{(A31)} \quad |A'M| = |A'B| - |MB| = s''/2 - s/2.$$

The distance change is increasing between A and A', constant at the maximum value of $s/2$ between A' and M, and decreasing between M and B. In particular, every individual H' located between A and A' at the distance $|H'A'|$ from A' experiences a distance change equal to

$$\text{(A32)} \quad |M'H'| - |H'M| = (|M'A'| - |H'A'|) - (|H'A'| + |A'M|) = \frac{s''}{2} - \left(\frac{s''}{2} - \frac{s}{2}\right) - 2|H'A'| = \frac{s}{2} - |H'A'|.$$

Analogously, every individual H'' located between M and B at a distance $|MH''|$ from M experiences a distance change equal to

$$\text{(A33)} \quad s/2 - 2|MH''|.$$

26. We will derive the median distance change for nation x. As the median voter of nation x' is located at the border between x and $x + 1$, the distance changes in the two nations are perfectly symmetric, and the median distance change is the same.

Call E the individual allocated between A and A', and F the individual located between M and B, such that

(A34) $$|EA'| = |MF|$$

(A35) $$|EF| = s/2.$$

By construction,

(A36) $$|EF| = |EA'| + |A'M| + |MF|.$$

Substituting (A31), (A34), and (A35) in (A36), we obtain

(A37) $$|EA'| = s/2 - s''/4.$$

Hence, for $H' = E$ we can substitute (A37) in (A32), and derive the median distance change:

(A38) $$d_m^x\{N,N-1\} = \frac{s}{2} - 2|EA'| = \frac{s}{2} - s + \frac{s''}{2} = \frac{s''-s}{2}.$$

LEMMA 3. A number of nations N is a B1-equilibrium if and only if the following condition holds:

(A39) $$N(N+1) \geq ga/2k.$$

for every $x = 1, 2, \ldots, N$.

Proof. Consider (A17) when $N' = N + 1$. Then, every nation has a majority against the shift from N to $N + 1$ if and only if

(A40) $$agd_m^x\{N,N+1\} + k \geq 0.$$

Using Lemma 1, (A39) follows.

QED

LEMMA 4. A number of nations N is a B2-equilibrium if and only if the following condition holds:

(A41) $$(N-1)N \leq ga/2k.$$

Proof. Analogous to Lemma 3, using Lemma 2.

Because of Proposition 2 and Lemmas 3 and 4, a configuration of N countries is a B-equilibrium if and only if

(i) all N countries have equal size;
(ii) $N < \sqrt{ga/2k}$;
(iii) $N(N+1) \geq ga/2k$ (Lemma 3) for $N + 1 < \sqrt{ga/2k}$;
(iv) $N(N-1) \leq ga/2k$ *(Lemma 4) for* $N - 1 < \sqrt{ga/2k}$.

Clearly, (ii) implies (iv). One and only one integer simultaneously satisfies (ii) and (iii). Denote with $\tilde{N}$ the largest integer smaller than $\sqrt{ga/2k}$. $\tilde{N}$ satisfies (ii) and (iii). On the other hand, any other integer larger than $\tilde{N}$ does not satisfy (ii), and any other integer smaller than $\tilde{N}$ does not satisfy (iii). Therefore, the unique B-equilibrium configuration of countries is given by the configuration of $\tilde{N}$ countries of equal size.

QED

Proof of Proposition 4

Consider an A-stable configuration of N' nations, with $N' < \tilde{N}$. Clearly, this configuration does not satisfy the above condition (iii). Consequently, there exists a majority within each country in favor of shifting to the new A-stable configuration of $N' + 1$ equally sized countries (Lemma 3). By repeated application of Rule B, the system will converge to $\tilde{N}$, which is therefore B-stable.

QED

Proof of Proposition 5

First, note that we must have $z < s/2$. If not, the individual with $l_i = 0$ in the original country would have to join the new one. He cannot be better off in the new country because per capita taxes cannot be lower. A secession of size z would occur if and only if

$$ga\frac{z}{2} + \frac{k}{z} \leq ga\left(\frac{s}{2} - z\right) + \frac{k}{s}. \tag{A42}$$

This condition implies that the least well-off individual in the secession, that is, the individual with $l_i = (s - z)/2$ in the original country, is not worse off by joining the new breakaway nation. Thus, a country of size s is stable if and only if

$$ga\frac{s}{2} + \frac{k}{s} \leq \min_{z}\left[\frac{3}{2}gaz + \frac{k}{z}\right]. \tag{A43}$$

Solving (A43), one obtains (9).

Proof of Proposition 6

By assumption, given national borders, the voters first vote on the type of government and then on q for $0 \leq q \leq ga$. We use backward induction, calculating q for any given government type. Consider a country of size $s = b' - b$ with government of type $c = b + e$. The utility of an individual at a distance l_i from the chosen type of government is

(A43) $$U_i = g(1 - al_i) + y - k/s - \gamma q^2 - q(l_m - l_i).$$

Denote by q_i the parameter that maximizes (A43) for given c and s:

(A44) $$q_i = 2/\gamma(l_i - \bar{l}).$$

In the voting equilibrium, q will be chosen by the individual at the median distance l_m. That is, the equilibrium q will be

(A45) $$\tilde{q} = \max\{0, 2/\gamma(l_m - \bar{l})\}.$$

By definition, the average distance is given by the following:

(A46) $$\bar{l} = \frac{1}{s}\int_b^{b'} |x - b - e| dx = \frac{e^2}{s} - e + \frac{s}{2}.$$

The set of individuals whose distance is smaller or equal to the average distance has size larger or equal to $s/2$.[27] Hence, the average distance is always larger or equal to the median distance: $l_m \leq l$. Therefore, from (A45), we have

(A47) $$\tilde{q} = 0.$$

QED

Proof of Proposition 8

The first part of the proposition is immediate. N_δ solves

(A48) $$\max_{t,N} \quad t - Nk$$

subject to

$$g(1 - a(\delta/2N)) + y - t = u_0.$$

We used the fact that the utility constraint is binding for the two individuals at a distance $l_\delta = \delta/2N = \delta s/2$ from the government. This will ensure that the s_δ individuals at a distance smaller than l_δ have utility higher than u_0. Finally, note that, for feasibility, we need $t_\delta \leq y$. Thus, we need $u_0 \geq g(1 - a\delta/2N_\delta)$.

QED

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27. Define $Z = \{i \mid l_i \leq \bar{l}\}$. Consider $e \leq s/2$. We have $Z = 2l$ for $\bar{l} \leq e$ and $Z = \bar{l} + e$ for $\bar{l} \geq e$. By substituting from (A45), we find that $Z = s/2$ for $e = 0$ and $e = s/2$, and $Z > s/2$ otherwise.

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