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**PUBLIC GOODS IN TRADE:  
ON THE FORMATION OF MARKETS AND JURISDICTIONS\***

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Must the integration of markets be accompanied by the harmonization of societies' institutions? We study a model of heterogenous individuals where a public good directly affects returns from trade. Trade takes place in the market, whereas the public good is provided by the jurisdiction, and individuals choose which market and which jurisdiction to join. Although trade between different jurisdictions entails transaction costs, only at intermediate market sizes must trading partners belong to a single jurisdiction. When markets are small, multiple jurisdictions can exist, although a single one is preferable; when markets are large, multiple jurisdictions are both possible and desirable.

1. INTRODUCTION

The large increase in trade flows of the recent decades has generated a passionate debate on the harmonization across countries of those institutions that facilitate and regulate market exchanges. One common view is that integrated markets will work more efficiently if the laws, the standards, the currencies that support private transactions become more similar. The most remarkable example of this approach is the adoption of a common currency by the members of the European Monetary Union, independent countries of comparable economic and political weight voluntarily renouncing their monetary sovereignty in favor of joint decision making. The official rationale for monetary unification was unambiguous: A single money was required to gain full advantage from the establishment of a single market for goods and factors. Appropriately, the original study by the European Commission making the case for the Euro bore the title *One Market, One Money* (Commission of the European Communities, 1990).

The opposite position is that harmonization is not necessarily desirable but may be the inevitable consequence of opening national markets. Thus, for example, environmental and labor groups fear that international competition will force laws

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and regulations to converge to their minimum level, and they oppose further free-trade negotiations.<sup>2</sup>

A priori it is not clear that market integration should bring with it more similarity in public goods, either as a normative prescription or as a positive statement. Intuitively, larger markets should make economic agents more diverse by allowing them to specialize and by increasing the range of products and transactions. But if economic roles become more varied as markets become wider, why should individuals' policy preferences become more similar? And if policy preferences do not become more similar, why should individuals not organize themselves in multiple and different jurisdictions? An instructive example is provided by the problems posed by conflicts of laws in enforcing international contracts. While large trade flows demand certainty in contract enforcement, the solution has not been found in harmonizing national laws or even in guaranteeing the recognition of foreign courts' awards through official treaties. What has happened instead is that private international traders have been encouraged to settle their disputes through specialized arbitration, deemed more responsive and more informed about the usages and customs of their specific transactions. In other words, international traders have been allowed to opt out of the jurisdiction of the courts, a new international jurisdiction has emerged, and the whole spectrum of norms applied in judgments has become more, not less, rich.<sup>3</sup>

Thus what intuition suggests, and the example of arbitration supports, is that the integration of markets will affect the provision of public goods not only directly, but also through its influence on the formation of jurisdictions. When studying the effect of larger markets on the provision of public goods, it is important to let the borders of the jurisdictions change endogenously. This is the approach followed in this article and the main methodological point we want to raise.<sup>4</sup> Although logically straightforward, to our knowledge this is the first article that attempts to derive rigorously the contemporaneous formation of both markets and jurisdictions.

We define "jurisdictions" as groups of agents who decide together, share, and finance a common public good, and "markets" as groups of agents who exchange private endowments. Both markets and jurisdictions form endogenously, and each individual decides his membership into two different groups—a market and a jurisdiction—among all markets and jurisdictions that form in equilibrium. The link between the two comes from the influence of the public good on the functioning of the private markets.

The public goods we try to capture in our model are necessary prerequisites for the conclusion of private transactions. They can be given a physical representation—roads, airports, infrastructure—or, as in the examples discussed so far, they can be more abstract—laws and legal enforcement, rules and conventions, standards and

<sup>2</sup> For an overview of economists and law scholars' analyses of these concerns, see Bhagwati and Hudec (1996).

<sup>3</sup> In European countries in particular, a large number of laws were passed in the 1980s, extending the scope of private arbitration, especially in international disputes. For a summary discussion of the recent evolution of international private arbitration and its link to trade, see Casella (1996).

<sup>4</sup> The observation, now relatively common, was discussed at greater length in the original working paper (Casella and Feinstein, 1990).

regulations, currency, and language. An important feature of the examples we have in mind is that preferences over the specific realization of the public good are not homogeneous among all market participants but depend on each individual's position within the market. Again, in the case of roads and infrastructure we can give a spatial meaning to the extension of the market and interpret each trader's position literally. In the case of laws and regulations, on the other hand, what matters is the specific activity and economic role that characterize each individual. For example, agents engaged in different trades have different opinions about the importance of swift judgment versus careful protection of the weaker party or about safety requirements versus ease of innovation.<sup>5</sup> But even if preferences differ, the range of public goods existing within a market must be limited: Trading partners face transaction costs whenever they must learn about each other's public good. Thus, the size and the composition of each jurisdiction, and its interaction with the market, are determined by the opposing forces of heterogeneous preferences and transaction costs in a world of increasing trade.

Public goods are said to be harmonized in this economy when all traders belonging to the same market choose to unite in a single jurisdiction. Our main result is that market integration *per se* is neither necessary nor sufficient for harmonization of public goods. We find that it is only at intermediate market sizes that all individuals in a single market must belong to the same jurisdiction: When the market is either smaller or larger, trading partners may well choose different jurisdictions and different public goods. Thus, an increase in market size may be accompanied by a shift from an equilibrium with two jurisdictions to an equilibrium with a single one, but, depending on the initial market size, the opposite is also possible. In addition, when the market is small, the choice between jurisdictions is dominated by the effort to save on taxes and on transaction costs; it is only when the market is large that traders' ability to self-select between jurisdictions and obtain more specialized public goods becomes important. Thus, harmonization of public goods is optimal at small market sizes, and diversification when the market is large. In other words, multiple institutions play a useful role even when—indeed, especially when—markets are perfectly integrated.

Our work is related to several distinct literatures. The importance of studying together the development of markets and institutions has been forcefully argued by North (e.g., North, 1981). However, most formal analyses tend to focus on either endogenous markets or endogenous jurisdictions. Among the former, we were influenced by the literature on "economic geography" (e.g., Krugman, 1991) and by the very elegant model of market formation designed by Economides and Sjow (1988). Both lines of work, however, ignore public goods.<sup>6</sup>

<sup>5</sup> As mentioned earlier, the possibility of specialized judgments is considered the primary motivation for choosing arbitration, especially in the case of international arbitration, whose costs have been rising. The assumption of preferences heterogeneity is also appropriate if we interpret the public good as money (the ideal monetary policy differs across industries and wealth groups), but in this case it is more difficult to think of jurisdictions as voluntary coalitions of private individuals, a point to which we return in the conclusions to the article.

<sup>6</sup> Clarida and Findlay (1991a, b) share our objective to include public goods within the traditional scope of international trade, but they take the composition of the jurisdictions as given.

From the theory of public finance, we borrow the notion of freely forming groups that choose the provision of a public good (Tiebout, 1956; Buchanan, 1965). Tying this provision directly to trade, however, is unusual. A recent article by Perroni and Scharf (2001) is closest to our approach. Perroni and Scharf study the effect of capital tax competition, triggered by an increase in capital mobility, on the formation of jurisdictions. As in our case, they concentrate on the change in jurisdictional borders accompanying a change in private markets. Their model, however, is quite different, reflecting their specific interest in capital taxation, and their focus is on symmetrical jurisdictions, as opposed to the asymmetrical jurisdictions that are of interest to us. Two works by Wilson (1987a, b) analyze the endogenous distribution of individuals among regions providing potentially different public goods in response to the opening of trade. Wilson defines a region as a political unit providing a public good, a labor market employing all resident workers, and a piece of land whose owners control the political power. In our analysis, on the other hand, a jurisdiction is only a coalition for the provision of a public good; it is not a market and it need not be a geographical area. In addition, in our model, markets are formed endogenously.

Our definition of jurisdiction is similar to that of a club—a group of individuals consuming the same public good and whose optimal size may be less than the total population, as in the original definition of a club in Buchanan (1965) (see also Pauly, 1970; Wooders, 1978; Scotchmer and Wooders, 1986; Scotchmer, 1993).<sup>7</sup> Our methodology and our aims, however, are different from those usually found in club theory. Most analyses of clubs aim at characterizing a price mechanism through which allocations in the core of the club economy can be decentralized. We do not study such a mechanism, but we ask how the composition and the size of the clubs are affected by changes in markets. Among articles in this literature, Wooders (1988, 1989, 1997) and Gilles and Scotchmer (1997) explicitly study the interaction between gains from private trade and club formation. In these models, participation into clubs affects the marginal rate of substitution between private goods; as a result agents with identical preferences and endowments should be optimally sorted into different clubs and engage in trade. In our model, the club good affects trade directly by facilitating transactions; agents are heterogenous and trade remains advantageous when all agents belong to a single jurisdiction. In addition, we do not require that the equilibrium partition into jurisdictions be robust to deviations by subcoalitions (as opposed to individual deviations), and thus we can make no claim that our equilibria lie in the core.<sup>8</sup>

Finally, our work is related to recent articles in political economy that study the equilibrium formation of jurisdictions in the presence of different constitutional rules (Jéhiel and Scotchmer, 2001), the related question of secession in a political jurisdiction (Alesina and Spolaore, 1997; Bolton and Roland, 1997), and the

<sup>7</sup> These articles introduced models of clubs in the literature. They all have a single private good and do not study the interaction between clubs and private trade.

<sup>8</sup> Concern with the appropriate optimality condition in club economies began with Ng's (1973) critique of Buchanan's original paper. Buchanan and Faith (1987) use the term "internal exit" to describe the threat of deviation to a new club by an exploited subcoalition and study the constraints that such a threat imposes on the ruling elite. For a recent review and discussion of the literature on clubs, see Wooders (1999).

possibility of overlapping jurisdictions in worlds with multiple public goods (Casella and Frey, 1992; Frey and Eichenberger, 1995). However, these articles once again do not make the connection between endogenous market partition and jurisdiction formation that is at the heart of our work.

In the next section of the article, we describe the model; Section 3 studies the market equilibrium in the case of a single club; Section 4 extends the analysis to two clubs; Section 5 discusses the results; and Section 6 concludes.

## 2. THE BASIC MODEL

As markets expand, economic agents modify their demands for public goods. And because individuals' relative positions in the market shift as markets are transformed, individuals' preferences over the public good do not change homogeneously. Thus, the *distribution* of demands for the public good changes with economic integration, leading agents to form new coalitions. This is the central idea of the article. A tractable model capturing this point is bound to be rather special: In a world of heterogeneous agents, it must allow for the endogenous formation of both markets and jurisdictions. We present a simple framework that satisfies these minimal requirements.

To build intuition for the complete model, we begin with the simpler case where all agents belong to a single jurisdiction, and we concentrate on the formation of markets. In the core of the article, we will allow traders to sort themselves among different jurisdictions and study the relationship between size and composition of markets and size and composition of jurisdictions.

The economy consists of a continuum of individuals, each endowed with one unit of a specific variety of a differentiated good. Individuals, and varieties, are distributed uniformly along a line segment extending from  $-1$  to  $1$ . Each individual's endowment is not productive in itself but must be matched with the endowment of a partner. The return from the joint venture depends on the two endowments—the specific resources the two individuals bring to the venture—and on a public good that allows the partners to trade. A joint venture between individuals  $i$  and  $j$  yields pretax return  $y_{ij}$  to each partner, and we specify

$$(1) \quad y_{ij} = z_{ij}(g - z_{ij})$$

where  $z_{ij}$  is the Euclidian distance between  $i$  and  $j$ , and  $g$  is the public good. The return from the match is a function of the difference between the two partners' endowments, captured schematically by their distance on the line and representing traditional gains from trade; however, the function is not increasing everywhere: There are limits to how different the partners can be and still cooperate productively, and the limits are determined by the public good.<sup>9</sup> As shown by Figure 1(a), for a

<sup>9</sup> Think, for example, of two coauthors collaborating on a joint paper. The two individuals should have different talents, to insure that their joint work is superior to what each of the two can do alone, but their fields of competence cannot be too far apart, or communication becomes impossible. The public good in this case is general education, or the extent of shared knowledge that allows them to communicate. The larger this knowledge is, the more distant their fields of specialization can be.

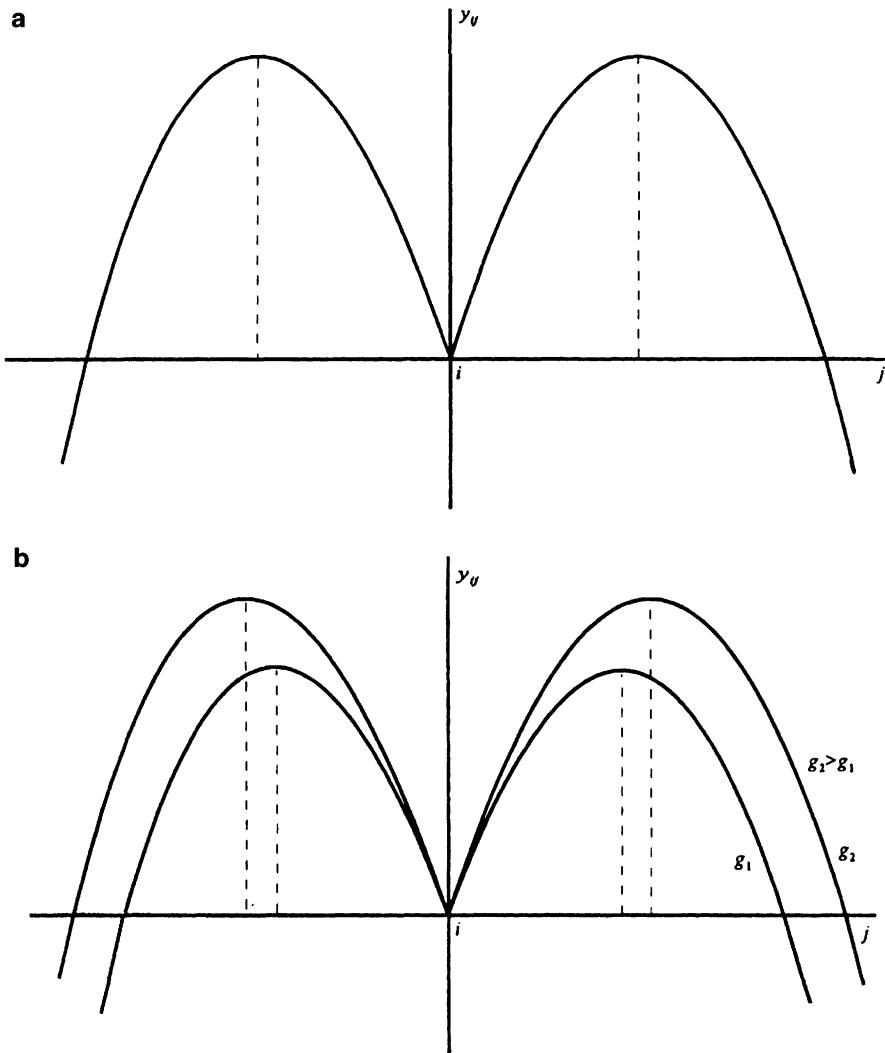


FIGURE 1

THE PRODUCTION TECHNOLOGY: (a) OUTPUT AS A FUNCTION OF  $i$ 'S PARTNER; (b) COMPARISON OF OUTPUT FUNCTIONS FOR DIFFERENT  $g$

given value of  $g$ , an individual of variety  $i$  has a pair of ideal trading partners, each at distance  $g/2$  from him. Thus, if  $i$  is matched to a partner whose variety is very close to his own, the output from the match is close to zero, reflecting the small gains from trade; but output again falls when  $i$  matches with a partner who is too distant, because the partners are then too dissimilar to cooperate successfully. An increase in the public good  $g$  causes an increase not only in the return from all partnerships, but also in the optimal distance between two partners (Figure 1(b)). Thus, Equation (1) is very similar to the "ideal variety" specification of utility used in analyses of

monopolistically competitive markets (Lancaster, 1979), with the difference that for each individual the identity of the ideal partner is not fixed but depends on the public good.<sup>10</sup>

The public good is chosen by majority vote of all jurisdiction members—at this stage all individuals in the economy—and the cost is shared equally by all. The relationship between individual lump-sum taxes  $t$  and the public good  $g$  is given

$$(2) \quad g = t^\alpha \quad \alpha < 1$$

This specification implies that the public good is rival: An increase in the population would require a corresponding increase in total resources devoted to the public good, if the level available to each individual is to remain unchanged. Whether or not the assumption is appropriate depends on the type of public good; we make it for simplicity only and have verified that our qualitative results are not sensitive to it.

Traders can sort themselves into multiple markets. A market  $M$  is a set of potential matching partners: a finite union of intervals in  $[-1, 1]$ . Each individual  $i$  belongs to one and only one market; thus, a partition of the economy into markets  $\mathcal{M}$  is a collection  $\{M_m\}$  such that  $\bigcup_{m=1}^n M_m = [-1, 1]$  and  $M_m \cap M_s = \emptyset$ . We set no constraint on the total number of markets  $n$  (beside requiring that it be finite) or on the markets' composition. Traders choose which market to join; there is free entry into all markets.

Although the partition  $\mathcal{M}$  and the distribution of types are common knowledge, a trader can verify the identity of his specific match partner only after the match is established. Thus, individuals know whether “on average” a market is good for them, but they are unable to select precisely *ex ante* the identity of their partner. The assumption captures an information problem that appears pervasive in forming joint ventures, or more generally in transactions with unfamiliar partners,<sup>11</sup> and, as we shall see, has the important advantage of generating heterogeneity over public good preferences in a particularly simple manner.

Each individual  $i$  chooses which market to attend so as to maximize his expected after-tax return  $Ey_i$ . Define  $|M_m|$  as the mass of traders in market  $m$ . Then

$$(3) \quad Ey_i \mid i \in M_m = \frac{1}{|M_m|} \int_{j \in M_m} z_{ij}(g - z_{ij}) dj - t = gEz_i \mid i, j \in M_m - E(z_i^2 \mid i, j \in M_m) - t$$

where the symbol  $E$  represents expected values and  $Ez_i$  is  $i$ 's expected distance from a random type belonging to the same market as  $i$ . With expected return a function of expected distance, each individual's preference over the public good depends on his relative position within the market. With individuals distributed on a line, for any arbitrary formation of markets no more than two traders within the same market can ever be in the same position relative to the other market members. Thus, individuals' tastes over the public goods are heterogeneous, derive from their position in the

<sup>10</sup> Output is zero at a distance  $g$  from  $i$  (twice the ideal point) and becomes negative for even more distant matches. The negative output may be taken to refer to the presence of sunk costs in establishing the relationship (or learning one's partner's type), which are present in all matches but are normally outweighed by the match benefits.

<sup>11</sup> See, for example, the discussion in Casella and Rauch (2002).

market, and change as the structure of markets changes. The model captures our initial intuition.<sup>12</sup>

We define an equilibrium of this model as a partition into markets  $\mathcal{M}^*$  and a public good  $g^*$  such that given  $\mathcal{M}^*$ ,  $g^*$  is preferred by a majority of voters to any alternative  $g$ , and given  $g^*$ , each agent attends his preferred market. Call  $P$  the set  $\{i \mid EY_i(g^*, M_m) > EY_i(g, M_m) \forall g \neq g^*, \forall M_m \in \mathcal{M}^*\}$  and  $|P|$  its measure. With a single jurisdiction, the total mass of voters equals the total mass of individuals in the economy (i.e., equals 2). Hence, we require (i)  $|P| \geq 1$  and (ii)  $EY_i(g^*, M_m) \geq EY_i(g^*, M_s) \forall i \in M_m; \forall M_m, M_s \in \mathcal{M}^*$ , where this latter condition states that, given  $g^*$ , no individual can obtain higher utility from switching market.

### 3. EQUILIBRIA WITH ONE JURISDICTION

**3.1. One Market.** We begin with the simplest example, when all traders belong to a single market, because it illustrates several features of the model that will remain present in the more complex cases.

When there is only one market, no single agent can deviate from it,<sup>13</sup> and the only decision to be made is the choice of the public good expressed by voting. Each agent knows the composition of the market and can directly calculate the distribution of potential partners he faces. The expected after-tax income of agent  $i$  is given by (3), where  $M_m = [-1, 1]$ . Substituting  $t$  from Equation (2) and maximizing with respect to  $g$ , we find the level of public good desired by agent  $i$ , which we denote  $g_i^d$ :

$$(4) \quad g_i^d = (\alpha E z_i \mid j \in [-1, 1])^{\alpha/(1-\alpha)}$$

Given

$$(5) \quad Ez_i \mid j \in [-1, 1] = \frac{1}{2} \left[ \int_{-1}^i (i - j) dj + \int_i^1 (j - i) dj \right] = \frac{1+i^2}{2}$$

(where the term  $1/2$  is the density, or the inverse of the total size of the market), we obtain

$$(6) \quad g_i^d = \left[ \frac{\alpha}{2} (1+i^2) \right]^{\alpha/(1-\alpha)}$$

Notice that the expected distance is increasing (and convex) in  $|i|$ : Agents at the two extremes of the line have the highest potential productivity and the greatest need for the public good.

For each  $i$  the demand for the public good is well behaved and single-peaked around the optimal level in Equation (6). Hence, we can apply standard median

<sup>12</sup> Notice that if individuals' types were distributed around a circle, in the presence of a single market all points would be equivalent and preferences over the public good would collapse to unanimity. Our choice of modeling assumptions reflects our belief that heterogeneity does not disappear in response to market integration.

<sup>13</sup> Because we are not interested in possible autarky outcomes, we rule them out by assumption: Our production function (1) always requires that an agent be matched with a partner. (Equivalently, we can normalize the utility of an agent not trading to a large negative number.)

voter results: Since preferences over  $g$  are monotonic in  $|i|$ , the median voters are individuals at positions  $i = \pm 1/2$ . Thus  $g^*$ , the choice of public good that cannot be defeated by a majority of voters against any other, equals

$$(7) \quad g^* = \left(\frac{5\alpha}{8}\right)^{\alpha/(1-\alpha)}$$

In equilibrium, and substituting (5) in (3), expected return for agent  $i$  is then

$$(8) \quad EY_i = \frac{g^*}{2} (1 + i^2) - i^2 - \frac{1}{3} - t^*$$

where  $t^*$  and  $g^*$  are obtained from Equations (2) and (7). In general, expected return can be concave or convex in the agents' type  $i$ , depending on the public good. With a single market, (8) shows that expected return is concave in  $i$  if  $g^*$  is smaller than 2, a condition that we know is satisfied from Equation (7). We can then verify that  $EY_i$  reaches a maximum at  $i=0$ , the type located in the middle of the market and facing the smallest expected distance from a random partner. As we shall see, neither the concavity of returns nor the desirability of the central position need to be true in the presence of multiple markets.

Finally, integrating expected individual returns over the whole support, we obtain expected per capita income:

$$(9) \quad Ey = \frac{2}{3}(g^* - 1) - t^*$$

where again  $g^*$  and  $t^*$  are given by (2) and (7).<sup>14</sup>

**3.2. Multiple Markets.** The major difficulty in characterizing the equilibrium with multiple markets lies in determining their composition. It might seem that almost any configuration could be an equilibrium, with traders belonging to the same market coming from anywhere in the variety space. However, this is not so, as the following proposition makes clear:

**PROPOSITION 1.** *If there is only one jurisdiction, a partition into  $n$  markets  $\mathcal{M}^*$  and a public good level  $g^*$  are an equilibrium if and only if (i) each market  $M_m$  is an interval; (ii)  $|M_m| = 2/n \forall M_m \in \mathcal{M}^*$ ; (iii)  $n \leq (2^{1+2\alpha}/(5\alpha)^\alpha)^{1/(1-2\alpha)}$  if  $\alpha < 1/2$ ; and (iv)  $g^* = (5\alpha/8n)^{\alpha/(1-\alpha)}$ .*

Proposition 1 establishes four points. First, it is not possible to sustain an equilibrium where agents belonging to disconnected segments all participate in the same market. Intuitively, if the public good is large enough to support trade between disconnected segments, the agents in between these segments will always want to enter that market. Second, in equilibrium all markets must be identical. Third, if  $\alpha$  is

<sup>14</sup> Because of the curvature in Equation (3), the median voter's choice of  $g$  does not maximize expected per capita output. The optimal level of the public good (according to this welfare criterion) is  $g^{**} = (2/3\alpha)^{\alpha/(1-\alpha)}$ , which corresponds to the preferences of individuals positioned at  $\pm\sqrt{1/3}$ , lying to the outside of  $\pm 1/2$ .

smaller than 1/2, there is a limit to the largest possible number of markets. (Notice that this is not true with  $\alpha \in [1/2, 1]$ .) Finally, given  $n$ , there is a unique equilibrium level of the public good. In what follows we prove conditions (ii)–(iv), given (i). Condition (i) is proved in the Appendix.

In any equilibrium partition into multiple markets, no trader can gain by changing market. Given the continuous distribution of individuals, the temptation to deviate to a neighboring market must be exactly zero for traders at the border between two markets and negative for all others. Because access to the public good is not affected by participation in a specific market, a border trader can be indifferent between the two markets on his two sides only if his expected distance from a partner is the same in both. If each market is an interval, then all intervals must have the same length. This is condition (ii) in Proposition 1.

Notice then that all markets are equivalent: Each is an interval of identical size, and all traders have access to the common public good. Thus, we can focus on only one market, whose extremes we label, for convenience,  $(-1/n, 1/n]$ . Expected income for agent  $i$  belonging to this market is

$$(3') EY_i | i, j \in (-1/n, 1/n] = gEz_i | i, j \in (-1/n, 1/n] - E(z_i^2 | i, j \in (-1/n, 1/n]) - t$$

or

$$(10) \quad EY_i = g \left[ \frac{1 + (ni)^2}{2n} \right] - i^2 - \frac{1}{3n^2} - t$$

Given  $n$ , a trader's preferences over  $g$  depend only on his relative position in the market he attends. It is easy to verify from (10) that the desired public good is minimum for the trader in the middle of a market and increases monotonically and symmetrically for types closer to the edges. Hence, as in the case of a single market, the median voters are located at one-fourth and three-fourths of the total length of each market segment and have identical preferences in all markets. Substituting  $i = \pm 1/(2n)$  in (10), we obtain

$$(11) \quad g^* = \left[ \frac{5\alpha}{8n} \right]^{\alpha/(1-\alpha)}$$

the equilibrium level of the public good in Proposition 1. Comparing (11) with (7), the public good choice in a single market, we see how the smaller width of each market leads to a proportionally smaller  $g^*$ .

If a border trader is indifferent between the two markets on his two sides, traders inside the borders must strictly prefer their own market, because their position is not symmetrical to the position they would occupy in any other market. Consider type  $i$  belonging to market  $(-3/n, -1/n]$  and evaluating a possible jump to the neighboring market  $(-1/n, 1/n]$ . It is easy to verify that the temptation to deviate  $T_i$  (the difference in expected returns) is given by

$$(12) \quad T_i \equiv EY_i | j \in (-1/n, 1/n] - EY_i | j \in (-3/n, -1/n] = \frac{4(1 + ni)}{n^2} - g^* \left( \frac{(ni)^2 + 6ni + 5}{2n} \right)$$

This expression equals zero for  $i$  corresponding to the border trader ( $i = -1/n$ ) and in equilibrium must be strictly negative for all other  $i \in (-3/n, -1/n)$ . Since it is everywhere concave in  $i$ , (12) has a maximum at  $i = -1/n$  if and only if  $\partial T_i / \partial i \geq 0$  at  $i = -1/n$ , or

$$(13) \quad g^* \leq \frac{2}{n}$$

Thus, a partition into multiple markets can be an equilibrium only if this condition is satisfied.<sup>15</sup>

The conclusion is not surprising. Equation (10) shows that if (13) is violated and  $g^* > 2/n$ , expected return within each market is convex in  $i$ . In this case, all traders strictly inside the market have lower expected returns than the border trader, because they have lower expected distance from a partner. From their point of view the market is too small. At least some individuals close to the border must find it profitable to join the next market.

Substituting (11) in (13), we can easily verify that (13) is satisfied for all  $n$  if  $\alpha \geq 1/2$  but requires

$$n \leq \left( \frac{2^{1+2\alpha}}{(5\alpha)^\alpha} \right)^{1/(1-2\alpha)} \quad \text{if } \alpha < 1/2$$

This is condition (iii) in Proposition 1.<sup>16</sup>

Summarizing, in all equilibria with a single jurisdiction a market must be an interval, and if multiple markets exist, they must be all of identical length. Thus, the equilibrium *structure* of markets in our model is determined uniquely, and it is this result that makes the analysis possible at all. However, the equilibrium *number* of markets is not unique: For all values of  $\alpha$  multiple equilibria exist. The number of possible equilibria declines as  $\alpha$  declines, but even as  $\alpha$  approaches zero, both  $n=1$  and  $n=2$  satisfy the condition in Proposition 1. Nevertheless, we will show in the rest of the article that the unique structure of markets is sufficient to derive strong results on the formation of jurisdictions.

#### 4. ENDOGENOUS JURISDICTION FORMATION

**4.1. The Model.** A jurisdiction (or club)  $C$  is a coalition of individuals choosing and financing a public good; thus, like a market, it is simply a subset of individuals in our variety space: a finite union of intervals in  $[-1, 1]$ . To keep the analysis tractable,

<sup>15</sup> The temptation to enter a neighboring market becomes more positive at lower levels of  $g$  than the temptation to enter a market farther away.

<sup>16</sup> In previous versions of this article, we had parametrized the marginal productivity of the public good by assuming  $\partial y_{ij}/\partial g = \beta z_{ij}$  and had interpreted  $\beta$  as an index of development. When  $\alpha$  is smaller than  $1/2$ , market size must increase with increases in  $\beta$ . At low  $\beta$ , traders can remain in “neighborhood” markets, where the distance from an expected partner is small, and the reliance on the public good limited. At higher  $\beta$ , the public good is both more productive and more abundant, and for many traders the ideal partner lies beyond the borders of the narrow local market. Only larger markets can form, and the economy moves eventually to a single market.

we will concentrate on equilibria with two jurisdictions: Each individual  $i$  belongs to either  $C_1$  or  $C_2$ . We denote by  $\mathcal{C}$  the partition of the economy into  $\{C_1, C_2\}$  such that  $C_1 \cup C_2 = [-1, 1]$  and  $C_1 \cap C_2 = \emptyset$ . There is no constraint on the composition of the two jurisdictions and there is free entry in both. The important point is that  $\mathcal{C}$  need not coincide with  $\mathcal{M}$ —each individual belongs to two different subsets of our line segment: a market subset, composed of his trading partners, and a jurisdiction subset, composed of his partners in the choice of the public good. There is no compelling reason why the two should be the same. Our goal is to study under which conditions the two partitions will or will not coincide.

To address this question, we must specify how traders from different jurisdictions combine the two public goods they have access to when they are matched in the same market. We assume that they are free to choose the public good they want to use, but each individual pays transaction costs  $c$ , representing the effort or the resources that must be devoted to learning about the partner's public good. Formally, the return to trader  $i$  from a match with  $j$  is

$$(1') \quad \begin{aligned} y_{ij} &= z_{ij}(g_a - z_{ij}) - t_a && \text{if } i, j \in C_a, a = 1, 2 \\ y_{ij} &= z_{ij}[\max(g_a, g_b) - z_{ij}] - t_a - c && \text{if } i \in C_a, j \in C_b, b \neq a \end{aligned}$$

Notice that each agent pays taxes in the jurisdiction he belongs to.

The assumption that each partnership can use the best of the two public goods at its disposal implies that some individuals in the economy will be able to free ride: They will save on the cost of the public good, knowing that in all “interjurisdictional” matches they will have access to the better public good available to their partner. Free riding plays a role in many real-world examples but is not critical in our model; although we find specification (1') more intuitive, most of our qualitative results would not be modified if, for example, traders were always required to use their own public good.<sup>17</sup>

An equilibrium of our complete model is then a partition into markets  $\mathcal{M}^*$ , a partition into jurisdictions  $\mathcal{C}^*$ , and a pair of public goods  $\{g_1^*, g_2^*\}$  such that given  $\mathcal{M}^*, \mathcal{C}^*$ , and  $\{g_1^*, g_2^*\}$ , each agent belongs to his preferred market and his preferred jurisdiction, and given  $\mathcal{M}^*, \mathcal{C}^*$ , and  $g_2^*$ ,  $g_1^*$  is preferred by a majority of voters in  $C_1$  to any alternative  $g$  (and similarly for  $g_2^*$ ). Formally, call  $P_a$  the set  $\{i \mid Ey_i(g_a^*, g_b^*, M_m, C_a) \geq Ey_i(g_a, g_b^*, M_m, C_a) \forall g_a \neq g_a^*, \forall M_m \in \mathcal{M}^*, \{C_a, C_b\} = \mathcal{C}^*\}$ , where  $a \in \{1, 2\}$ ,  $b \in \{1, 2\}$ ,  $a \neq b$ . Then, we have the following equilibrium conditions: (i)  $|P_a| \geq |C_a|/2$  (each public good is preferred by a majority of voters in the corresponding jurisdiction); (ii)  $Ey_i(g_a^*, g_b^*, M_m, C_a) \geq Ey_i(g_a^*, g_b^*, M_s, C_a)$

<sup>17</sup> We have studied an alternative specification where the trader providing the larger public good is rewarded with a larger share of output, so that the scope for free riding can be parametrized, but the generalization did not lead to new insights. Two additional observations: (1) Specification (1') guarantees that a subset of the traders internalize the need for the public good in the market, so that their jurisdiction will not underprovide it in equilibrium. This avoids a complication that is not related to the focus of the article. (2) The possibility of using the partner's public good, together with the assumed absence of economies of scale in public goods provision, creates fiscal imbalances in the two clubs. The problem would disappear if we assumed that the public goods were nonrival. As mentioned earlier, we have verified that this modification would not alter our results, and to avoid complicating the analysis we have decided to ignore the imbalance.

$\forall i \in M_m \cap C_a, \forall M_m, M_s \in \mathcal{M}^*, C_a \in \mathcal{C}^*$  (no individual can gain from switching market); (iii)  $Ey_i(g_a^*, g_b^*, M_m, C_a) \geq Ey_i(g_a^*, g_b^*, M_m, C_b) \forall i \in M_m \cap C_a, \forall M_m \in \mathcal{M}^*, \{C_a, C_b\} = \mathcal{C}^*$  (no individual can gain from switching jurisdiction); (iv)  $Ey_i(g_a^*, g_b^*, M_m, C_a) \geq Ey_i(g_a^*, g_b^*, M_s, C_b) \forall i \in M_m \cap C_a, \forall M_m, M_s \in \mathcal{M}^*, \{C_a, C_b\} = \mathcal{C}^*$  (no individual can gain from switching both market and jurisdiction).

4.2. *Solution.* We want to study the existence and welfare properties of equilibria with “interjurisdictional” trade, that is, equilibria where members of both jurisdictions belong to the same market. Without setting any prior constraint on the partition of each market into members of the two jurisdictions, we concentrate on symmetrical equilibria where such a partition, whatever it may be, is identical in all markets. Thus, we use the term “symmetrical” to indicate that all markets are replicas of one another, but it is not the case that the two jurisdictions are identical and provide equal public goods. Indeed, in all equilibria with symmetrical markets and trade across jurisdictions, the opposite must be true:

**LEMMA 1.** *If  $C_1 \cap M_m \neq \emptyset$  and  $C_2 \cap M_m \neq \emptyset \forall m$ , then (i)  $g_1^* \neq g_2^*$ ; (ii)  $M_m$  is an interval and  $|M_m| = 2/n \forall m$ .*

**LEMMA 2.** *If  $M_m$  is an interval and  $g_1^* < g_2^*$ , then  $C_1 \cap M_m$  must be an interval.*

Both lemmas are proved in the Appendix. Lemma 1 makes two points. First, if members of the two jurisdictions share the same market, then the two public goods must differ. Intuitively, the possibility of choosing the partner’s public good when matched with someone from the other jurisdiction creates a discontinuity in expected income at the point where the two public goods are equal. We call  $C_1$  the jurisdiction that in equilibrium provides the lower public good, and  $C_2$  the jurisdiction that supplies the larger. Second, given the difference in public goods, if there are members of both jurisdictions in each market, then each market must be an interval and all markets must have the same size. This result is a straightforward extension of Proposition 1 and greatly simplifies the analysis.

Lemma 2 builds on Lemma 1 to show that the set of  $C_1$  members in an individual market must then be an interval. We know that the individuals desiring a higher public good are located at the edge of the market. Thus, it is plausible to expect that traders in the interior of each market would join  $C_1$ , and traders at the edges  $C_2$ . Lemma 2 confirms that the intuition is correct but stresses that there is no requirement that the members of  $C_1$  be centered exactly around the middle of each market. Figure 2 illustrates one possible configuration.

Although the partition of each market’s participants into members of the two jurisdictions is not unique, the two lemmas take us a long way toward characterizing the equilibrium. Indeed we can state the following proposition:

**PROPOSITION 2.** *An equilibrium with two jurisdictions and  $n$  symmetrical “interjurisdictional” markets exists if and only if*

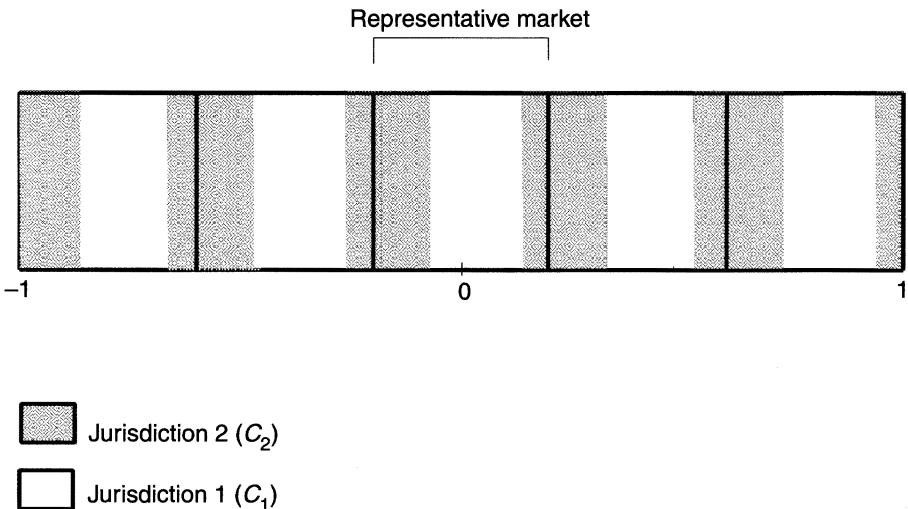


FIGURE 2

n-MARKETS, TWO-CLUB EQUILIBRIUM

(i)  $\exists \theta \in (0, 2)$  such that

$$\theta^2/(4n)(g_2^* - g_1^*) - [(g_2^*)^{1/\alpha} - (g_1^*)^{1/\alpha}] - c(\theta - 1) = 0$$

(ii)  $g_2^* \leq 2/n$  if  $n > 1$ (iii)  $|P_{1A}| \geq \theta/2$ ;  $|P_{2A}| \geq (2 - \theta)/2$ 

where

$$g_1^* = \left( \frac{5\theta^2\alpha}{32n} \right)^{\alpha/(1-\alpha)}$$

$$g_2^* = \left[ \frac{\alpha[4 + (x + \theta)^2]}{8n} \right]^{\alpha/(1-\alpha)} \quad x \in \left[ \max\left(0, \frac{2 - 3\theta}{2}\right), \frac{2 - \theta}{2} \right]$$

$$P_{1A} = \{i | EY_i(g_1^*, g_2^*, M_m, C_1) > EY_i(g_1, g_2^*, M_m, C_1) \forall g_1 > g_2^*, \forall M_m \in \mathcal{M}^*, \{C_1, C_2\} = \mathcal{C}^*\}.$$

$$P_{2A} = \{i | EY_i(g_1^*, g_2^*, M_m, C_2) > EY_i(g_1^*, g_2, M_m, C_2) \forall g_2 < g_1^*, \forall M_m \in \mathcal{M}^*, \{C_1, C_2\} = \mathcal{C}^*\}.$$

As we shall see, condition (i) implies that no individual would prefer to change jurisdiction; condition (ii) implies that no individual would prefer to change market; and condition (iii) ensures that the public good choices specified in the proposition cannot be beaten by any other alternative. The following arguments prove the proposition:

Consider trader  $s$  belonging to a representative market  $M_m$  and located at a border between the two jurisdictions. In equilibrium, trader  $s$  must be indifferent between belonging to either  $C_1$  or  $C_2$ . If he belonged to  $C_1$ , he would pay lower taxes and

would be able to use  $g_2^*$  when matched with traders from  $C_2$ , but he would have to use  $g_1^*$  when matched with traders from  $C_1$ ; in addition, his expected transaction costs would be different in the two jurisdictions if  $C_1$  and  $C_2$  have different sizes. In equilibrium, the following condition must hold:

$$(14) \quad (g_2^* - g_1^*)(Ez_s | j \in C_1) - (t_2^* - t_1^*) - c[\text{Prob}(j \in C_1) - \text{Prob}(j \in C_2)] = 0$$

where  $j \in M_m$ . Call  $\theta$  the total size of jurisdiction 1:  $\theta \equiv |C_1|$  (hence  $\theta/n$  is the mass of traders in market  $M_m$  belonging to  $C_1$ :  $\theta/n \equiv |C_1 \cap M_m| \forall m$ ). For ease of notation, define  $C_{1m} \equiv C_1 \cap M_m$ . Because the distribution of types is uniform and  $C_{1m}$  is an interval,  $|s - Ej|$ , conditional on  $j \in C_1$ , equals  $\theta/(2n)$ , and  $\text{Prob}(j \in C_1) = (\theta/n)/(2n) = \theta/2$ . Thus

$$(15) \quad \theta^2/(4n)(g_2^* - g_1^*) - (t_2^* - t_1^*) - c(\theta - 1) = 0$$

In addition, again because  $C_{1m}$  is an interval, within each market  $Ez_s | j \in C_1 < Ez_i | j \in C_1 \forall i \in C_2$  and  $Ez_s | j \in C_1 > Ez_i | j \in C_1 \forall i \in C_1$ . Thus, if Equation (15) holds, the incentive to belong to  $C_1$  rather than  $C_2$  is zero for the border trader, strictly negative for the other members of  $C_2$ , and strictly positive for the other members of  $C_1$ : Equation (15) is necessary and sufficient to guarantee that each individual belongs to the jurisdiction of his choice. Notice that, given  $g_1^*$  and  $g_2^*$ , (15) does not depend on the specific location of the border between the jurisdictions. Expressing equilibrium taxes in terms of public goods supplies, from Equation (2), we obtain condition (i) in the proposition.

Members of  $C_1$  vote on the public good, taking as given the level of  $g_2$ . In an equilibrium with  $g_1^* < g_2^*$ , they anticipate that their own public good will be used only in transactions with other members of their own jurisdiction. The desired level of  $g_1$  is given by

$$(16) \quad g_{i1}^d = [\alpha(Ez_i | j \in C_1)]^{\alpha/(1-\alpha)}$$

where  $i, j \in M_m$ . The term  $Ez_i | j \in C_1$  depends only on the size of  $C_{1m}$  and on the relative position of agent  $i$  within that interval. In particular, the median voters must be located at one-fourth and three-fourths of the length of  $C_{1m}$ , in all markets  $M_m$ . The majority choice of  $g_1$  is

$$(17) \quad g_1^* = \left( \frac{5\theta^2\alpha}{32n} \right)^{\alpha/(1-\alpha)}$$

Consider now the voters in jurisdiction 2. In an equilibrium with  $g_1^* < g_2^*$ , they expect that  $g_2$  will be used in all transactions, and each individual's preferred level depends on his expected distance from a partner anywhere in the market, whether belonging to  $C_1$  or  $C_2$ . The preferred level of  $g_2$  is given by the generalization to  $n$  markets of Equation (6):

$$(6') \quad g_{i2}^d = \left[ \frac{\alpha}{2n} (1 + (ni)^2) \right]^{\alpha/(1-\alpha)}$$

Equation (6') is monotonic in  $|i|$ . However, the identification of the median voter in  $C_2$  is not immediate, because it now requires specifying the exact position of  $C_{1m}$

within the market (and thus of its complement  $C_2 \cap M_m \equiv C_{2m}$ ). We need to distinguish several cases, and these are discussed in detail in the Appendix. Taking into account the different possible compositions of  $C_{2m}$ , and hence the possible identities of the median voter, we obtain the general equation:

$$(18) \quad g_2^* = \left[ \frac{\alpha[4 + (x + \theta)^2]}{8n} \right]^{\alpha/(1-\alpha)} \quad x \in \left[ \max\left(0, \frac{2 - 3\theta}{2}\right), \frac{2 - \theta}{2} \right]$$

where  $x$  can take any value in the specified interval.

With multiple markets, we must verify that in equilibrium no trader wants to deviate to a different market, taking as given the partition into jurisdictions and the public goods levels. Consider a member of  $C_2$  at the border between two markets. Because the markets have the same size and the same composition in terms of  $C_1$  and  $C_2$  members, and because he is in the same relative position with respect to the two markets and would use  $g_2^*$  in both, he is indifferent between them. For every other trader the temptation to deviate must be negative. But from the point of view of members of  $C_2$ , who use  $g_2^*$  in all transactions, the situation is identical to the case of a single jurisdiction, studied in Section 3. An equilibrium with  $n$  markets requires

$$(14') \quad g_2^* \leq \frac{2}{n}$$

This condition is necessary and sufficient to prevent deviation to a different market by members of  $C_2$ ; since  $g_2^* > g_1^*$ , it is also sufficient to prevent deviation by members of  $C_1$ . Finally, in conjunction with (15) it is sufficient to guarantee that no individual can gain by changing both market and jurisdiction.

This concludes the characterization of the equilibrium with  $g_1^* < g_2^*$ . To guarantee that an equilibrium exists, however, we must also verify that, given  $g_2^*$ , a majority of members of  $C_1$  prefers  $g_1^* < g_2^*$  to any other choice of public good *larger* than  $g_2^*$  (and similarly, that given  $g_1^*$ , a majority of members of  $C_2$  prefers  $g_2^* > g_1^*$  to any other choice of  $g_2$  *smaller* than  $g_1^*$ ). This is condition (iii) above and in general may or may not be satisfied, depending on the configuration of  $C_2$  (as captured by  $x$ ) and on  $\alpha$ .<sup>18</sup> Proposition 2 is established.

## 5. RESULTS

Does an equilibrium with two jurisdictions always exist? In particular, how does the existence of multiple jurisdictions correlate with the size and number of markets? What are the welfare properties of these equilibria? Do these properties depend on the size of markets? These are the questions we analyze in this section.

Although the results of the model are difficult to characterize analytically, we can prove formally the answers to these questions in the special case  $\alpha = 1/2$ . For any possible composition of  $C_{2m}$  within each market interval, the following proposition must hold:

<sup>18</sup> It is possible to show that condition (iii) is always satisfied for some partitions (e.g., when  $C_1$  members are located at the center of each market) but may be violated for others (e.g., when  $C_{2m}$  is an interval).

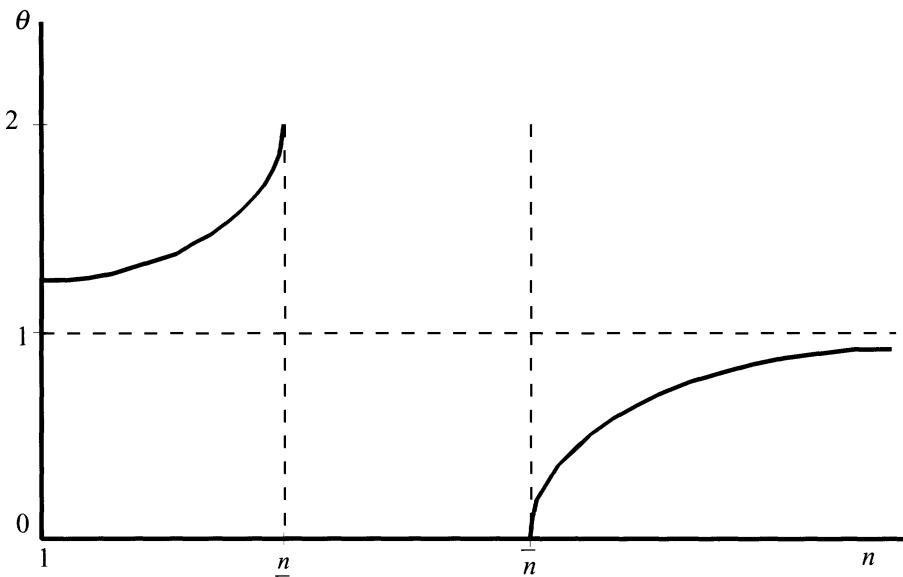


FIGURE 3

## EQUILIBRIUM SIZE OF JURISDICTION 1

**PROPOSITION 3.** Suppose  $\alpha=1/2$ . Then an equilibrium with two jurisdictions and  $n$  symmetrical “interjurisdictional” markets exists if and only if  $n < \underline{n}$ , or  $n > \bar{n}$ , where  $\underline{n}=3/(16\sqrt{c})$  and  $\bar{n}=5/(16\sqrt{c})$ .

The proof is provided in the Appendix.

The proposition states that there are some market sizes for which multiple jurisdictions cannot be present simultaneously in the same market. Precisely, which market sizes require a single jurisdiction depends on the specific value of the transaction costs  $c$ ; however, if  $c$  is not too large, the surprising conclusion is that a single jurisdiction must obtain for intermediate market sizes: Two jurisdictions may exist either when  $n$  is very small, and hence the market is large, or when  $n$  is large, and hence the market is small (Figure 3, based on the proof of Proposition 3 in the Appendix, illustrates this result).<sup>19</sup> We have run a series of numerical exercises to investigate the robustness of the conclusion to different values of  $\alpha$ . In all cases, we have obtained the same result, and it seems safe to conjecture that the proposition reflects a general property of the model.<sup>20</sup>

Intuitively, the result arises from the complementarity between market size and public good. When the market is small, the productivity of the public good is

<sup>19</sup> The number of markets  $n$  must be a positive integer. Thus, there is a market size for which an equilibrium with two jurisdictions fails to exist if and only if there exists at least one positive integer  $n$  such that  $\sqrt{c} \in [3/(16n), 5/(16n)]$ .

<sup>20</sup> Recall that with  $\alpha < 1/2$ , Equation (12') imposes an additional constraint on  $n$ .

small and the advantage of having a public good that is closer to one's preferences is negligible. Transaction costs and taxes dominate the consideration of which jurisdiction to join: There is an equilibrium with two jurisdictions where a minority of the market participants belongs to  $C_1$ , their lower taxes offset by the higher expected transaction costs. The smaller the market, the more important the relative weight of the transaction costs and the smaller the difference between the two jurisdictions; as  $n$  goes to infinity and market size goes to zero, the two jurisdictions approach equal size. When the market is large, on the other hand, the benefit from having an appropriate public good is also large, while the fixed transaction costs matter much less. For a minority of market participants, guaranteed access to the larger public good  $g_2^*$  can compensate for both higher taxes and higher expected transaction costs. It is in this case that the possibility of self-selecting into different jurisdictions really bears fruit. As the market size continues to increase, the membership in the two jurisdictions approaches what it would be if transaction costs were zero: Both the size of  $C_2$  and the difference between the two public goods increase. At intermediate market sizes, however, neither is the public good sufficiently productive nor the transaction costs sufficiently onerous to justify a jurisdiction charging higher taxes, whatever its size.

The immediate implication is that the link between the unification of markets and the unification of jurisdictions often postulated in policy debates is broken. Consider a status quo where each market is formed exclusively by members of one jurisdiction; then, the unification of two neighboring markets might result in the formation of a common jurisdiction, but it need not.<sup>21</sup> A move to larger markets per se is neither necessary nor sufficient for the unification of jurisdictions: There is no logical link between the two.

The important question of course is when such a unification of jurisdictions is desirable. The discussion above anticipates the welfare properties of the equilibria. Call  $Ey^*(\mathcal{M}^*, \mathcal{C}^*)$  expected per capita income in the economy in an equilibrium with a partition into symmetrical markets  $\mathcal{M}^*$  and jurisdictions  $\mathcal{C}^*$ , where  $\mathcal{C}(2)^*$  is an equilibrium partition into two jurisdictions, and  $\mathcal{C}(1)^*$  denotes the existence of a unique jurisdiction. When two jurisdictions are present, we focus on equilibria with "interjurisdictional" trade. Then we can establish the following proposition:

**PROPOSITION 4.** *Suppose  $\alpha=1/2$ . Then  $Ey^*(\mathcal{M}^*, \mathcal{C}(2)^*) > Ey^*(\mathcal{M}^*, \mathcal{C}(1)^*)$  if and only if  $n < \underline{n}$ , where  $\underline{n}=3/(16\sqrt{c})$ .*

The proof is provided in the Appendix.

Taking expected per capita income as the welfare metric, the results are unambiguous. Although two jurisdictions can coexist in the same market either when the market is small or when the market is large, they are welfare inferior to a single jurisdiction in the first case, but welfare superior in the second. The result is formally established for the case  $\alpha=1/2$ , but we have found it to hold in all numerical

<sup>21</sup> In this model, a symmetrical equilibrium with no trade across jurisdictions exists where all markets have the same size and the two jurisdictions provide the same public good.

exercises we have run, for different parameter values. As mentioned above, because market size and public good are complementary, it is only when the market is sufficiently large and diverse that the possibility of choosing a public good better tailored to one's specific needs is valuable enough to compensate for the higher taxes and the transaction costs.

Expected per capita income in the economy as a whole is a plausible welfare measure because it implies that losers can be compensated, but losers of course may well exist and be numerous. An alternative measure that seems natural in the present context is a majority vote on the choice between the one-jurisdiction and the two-jurisdiction regime, whenever both can be sustained in equilibrium. For different values of  $\alpha$  and various possible compositions of  $C_2$ , we have verified that an economy-wide vote would parallel the result of Proposition 4: The one-jurisdiction regime would win when  $n > \bar{n}$ , while the two-jurisdiction regime would win when  $n < \underline{n}$ .<sup>22</sup>

## 6. CONCLUSIONS

This article has studied the contemporaneous formation of markets and jurisdictions in a general equilibrium model where a public good is needed to facilitate trade. We have found that equilibria with “interjurisdictional” trade can exist either when the markets are small or when the markets are large, but not for an intermediate range of market sizes. Thus, a movement toward larger markets could be matched by the integration of institutions, but this integration may disappear once markets have become still larger. Indeed, according to our welfare measures, the contemporaneous presence of multiple jurisdictions in a single market is desirable if the size of the market is sufficiently big.

We began our analysis motivated in part by the debate about the effect of a single market on European institutions. Although it would be tempting to forecast, on the basis of our results, that the European Monetary Union will not last, in truth the formation of a monetary union is a much more centralized, top-down process than the voluntary, decentralized formation of coalitions we study. The role of single individuals switching between currencies in forcing changes in monetary regimes is probably very minor, barring a major crisis (e.g., a hyperinflation). Outside the monetary sphere we believe that our model does help us understand current developments in Europe. In particular, we think of the claims for increased regional independence that in many European countries have accompanied the creation of the single market. In the presence of smaller national markets, institutions should be homogeneous, because the needs of the market participants are relatively similar and transaction costs would otherwise be excessive. But when the market becomes large, and regions in each country increasingly compete and trade with the rest of Europe, individuals may well realize that their preferences in policy and institutions are more similar to those of their foreign partners than to the needs of other economically

<sup>22</sup> If we study the two jurisdictions separately, the results are weaker. Considering either expected per capita income or majority voting *within each jurisdiction*, our numerical exercises suggest that when  $n$  is larger than  $\bar{n}$  but sufficiently close to it, members of  $C_1$  prefer two jurisdictions; while for  $n$  smaller than  $\underline{n}$  but sufficiently close to it, members of  $C_2$  prefer a single jurisdiction (for all locations of  $C_2$  we have tried). All other results are unchanged.

different regions from their own country. Market integration is accompanied by fragmentation into multiple jurisdictions.

Our results are driven by the complementarity we assume between market size and public good, and although we find this assumption realistic in most cases, our model is clearly special. But our goal is not to claim general conclusions; rather, it is to stress that much more thought is needed to improve the current debate on economic integration. The integration of markets and the integration of institutions devoted to public good provision are interdependent but different processes; they need not proceed together and policy discussions should distinguish between them. Our model has provided a simple but rigorous example of their complex interaction.

#### APPENDIX

**PROOF OF PROPOSITION 1.** We prove here part (i). Parts (ii)–(iv) are proved in the text.

(a) First, we show that there cannot be an equilibrium where one market is an interval but is surrounded on both sides by traders participating in a second market. Consider a scenario where  $M_1 = (-\mu + \delta, \mu + \delta)$ , and  $M_2 = [-1, -\mu + \delta] \cup [\mu + \delta, 1]$ , where  $\mu < 1$  and  $\mu - 1 < \delta < 1 - \mu$ . From (3), expected return for individual  $i \in [\mu + \delta, 1]$  trading in  $M_1$  is given by

$$Ey_i | i \in M_1 = \frac{1}{2\mu} \left( g^* \int_{-\mu+\delta}^{\mu+\delta} (i-j) dj - \int_{-\mu+\delta}^{\mu+\delta} (i-j)^2 dj \right) - t^*$$

while  $i$ 's expected return from trading in  $M_2$  is

$$\begin{aligned} Ey_i | i \in M_2 = \frac{1}{2(1-\mu)} & \left\{ g^* \left[ \int_{-1}^{-\mu+\delta} (i-j) dj + \int_{\mu+\delta}^i (i-j) dj + \int_i^1 (j-i) dj \right] \right. \\ & \left. - \int_{-1}^{-\mu+\delta} (i-j)^2 dj - \int_{\mu+\delta}^1 (i-j)^2 dj \right\} - t^* \end{aligned}$$

Solving the integrals and comparing the two expected returns, we see that  $i$  will stay in  $M_2$  if and only if

$$(A.1) \quad (3/2)g^*(i-1)^2 + 3\delta g^* - (1-\mu^2) + 3\delta(\delta-2i) \geq 0$$

If  $\delta \geq 0$ , the left-hand side of Equation (A.1) is decreasing in  $i$ . Since in equilibrium the condition must hold with equality at  $i = \mu + \delta$ , it must be violated for all  $i \in (\mu + \delta, 1]$ , implying that all traders in this interval will want to join  $M_1$ . If  $\delta < 0$ , exactly the same argument holds for all  $i \in [-1, -\mu + \delta]$ . The conclusion would not be altered if  $M_2$  were to include other nonadjacent segments of traders.

(b) We then prove that there cannot be an equilibrium where two markets are composed of alternating segments of traders. Consider a scenario where

$M_1 = [-1, -\delta] \cup [0, \delta]$ , and  $M_2 = (-\delta, 0) \cup (\delta, 1]$ , where  $\delta < 1$ . Following the usual procedure for comparing expected returns, we can establish that trader  $i \in [0, \delta]$  will not deviate if and only if

$$(A.2) \quad g^*[l^2 + 2i(1 - 2\delta)] - 2i(1 - 2\delta^2) \geq 0$$

This condition must hold with equality at the two borders  $i=0$  and  $i=\delta$ . But since the left-hand side of equation (A.2) is convex over the entire interval, the condition must be violated for all  $i \in (0, \delta)$ , implying that all traders in this interval want to join  $M_2$ . The symmetry imposed in the example simplifies the notation but is irrelevant to the proof. Again, the conclusion would not be altered by allowing more than two disjoint segments of traders in each market and/or a larger number of markets. ■

PROOF OF LEMMA 1. (i) Suppose  $g_1^* = g_2^*$ . There are three possible scenarios.

(a) Imagine a scenario where members of both jurisdictions expect their public good to be used in all transactions, and  $g_1^* = g_2^* = g^*$ . Then the expected distance from a market partner must be equal for the median voters of both jurisdictions (call them  $t^*$ ), and  $g^*$  must satisfy  $Ez_{t^*} = \partial t / \partial g|_{g^*}$ .

Consider the median voter in  $C_1$ . By reducing  $g_1$  slightly, his expected income would change by  $-(Ez_{t^*}|_{j \in C_1}) + \partial t / \partial g|_{g^*} > 0$ . Thus,  $g^*$  cannot be his preferred level of the public good, and this scenario cannot be an equilibrium.

(b) Imagine a scenario where members of both jurisdictions expect their public good to be used only within the jurisdiction, and  $g_1^* = g_2^* = g'$ .

Then,  $(Ez_{t^*}|_{j \in C_1}) = (Ez_{t^*}|_{j \in C_2}) = \partial t / \partial g|_{g'}$ . Consider the median voter in  $C_1$ . By increasing  $g_1$  slightly, his expected income would change by  $(Ez_{t^*}|_{j \in C_1}) + (Ez_{t^*}|_{j \in C_2}) - \partial t / \partial g|_{g'} > 0$ .

Thus,  $g'$  cannot be his preferred level of the public good, and this cannot be an equilibrium.

(c) Finally, imagine a scenario where the members of  $C_1$  expect to use  $g_1$  in all transactions, while the members of  $C_2$  expect to use  $g_2$  only within  $C_2$ , and  $g_1^* = g_2^* = g''$ . Then,  $Ez_{t^*} = (Ez_{t^*}|_{j \in C_2}) = \partial t / \partial g|_{g''}$ . Consider the median voter in  $C_1$ . By decreasing  $g_1$  slightly, his expected income would change by  $-(Ez_{t^*}|_{j \in C_1}) + \partial t / \partial g|_{g''} > 0$ . Thus,  $g''$  cannot be his preferred level of the public good, and this scenario cannot be an equilibrium. ■

(ii) With  $g_1^* < g_2^*$ , members of  $C_2$  expect to use  $g_2^*$  in all their transactions. In a symmetrical equilibrium, expected transaction costs are equal in all markets, and from the point of view of  $C_2$  members, the choice among markets is identical to the problem studied by Proposition 1. ■

PROOF OF LEMMA 2. Consider trader  $s$  at the border between the two jurisdictions, for any arbitrary configuration of the two jurisdictions with  $g_1^* < g_2^*$ . Trader  $s$  must be indifferent between belonging to either  $C_1$  or  $C_2$ :

$$(14) \quad (g_2^* - g_1^*)(Ez_s|_{j \in C_1}) - (t_2^* - t_1^*) - c[\text{Prob}(j \in C_1) - \text{Prob}(j \in C_2)] = 0$$

Equation (14) must hold for all individuals at the border between the two jurisdictions. But this can be true only if the term  $(Ez_s|_{j \in C_1})$  is the same for all  $s$ 's located at the border. When the market is an interval, this requirement implies that

there can be at most two border points. With a maximum of two border points, either  $C_{1m} \equiv C_1 \cap M_m$  must be an interval, or  $C_{2m} \equiv C_2 \cap M_m$  must be an interval (or both). Suppose that  $C_{2m}$  were an interval, with  $C_{1m}$  divided into two segments at the two edges of  $C_{2m}$ . Then, it is easy to show that the temptation to deviate to  $C_{2m}$  for a member of  $C_{1m}$  (the left-hand side of (14)) reaches its minimum for the two traders at the border between the two jurisdictions. Therefore, if the two border traders are indifferent between the two jurisdictions, everyone else in  $C_{1m}$  prefers to belong to  $C_{2m}$ . Thus, if an equilibrium with two jurisdictions exists,  $C_{1m}$  must be an interval. ■

*Identity of the median voter in jurisdiction 2.* Call  $\theta$  the size of  $C_1$ , and  $\delta$  a parameter measuring the asymmetry between the two segments belonging to  $C_2$ . Then  $C_{2m} = [-1/n, 1/n - \delta - \theta/n] \cup (1/n - \delta, 1/n]$ , and  $C_{1m} = [1/n - \delta - \theta/n, 1/n - \delta]$ , where  $\delta \in [0, (2 - \theta)/(2n)]$ . When  $\delta = (2 - \theta)/(2n)$ ,  $C_{2m}$  is symmetric around  $C_{1m}$  and extends between  $-1/n$  and  $-\theta/(2n)$  and between  $\theta/(2n)$  and  $1/n$ ; when  $\delta = 0$ , both  $C_{2m}$  and  $C_{1m}$  are intervals; for all other values of  $\delta$ ,  $C_{2m}$  is divided in two asymmetric segments at the two edges of  $C_{1m}$ . Call  $i_2^*$  the location of the median voter in club 2. Then,

$$\begin{aligned} \text{if } \delta \in [(2 - \theta)/(4n), (2 - \theta)/(2n)] & \quad i_2^* = \pm(2 + \theta)/(4n) \\ \text{if } \delta \in [\max(0, (2 - 3\theta)/(4n)), (2 - \theta)/(4n)] & \quad i_2^* = -(\delta + \theta)/(2n) \\ \text{if } \delta \in [0, \max(0, (2 - 3\theta)/(4n))] & \quad i_2^* = \pm(2 - \theta)/(4n) \end{aligned}$$

If  $C_1$  is relatively large ( $\theta \geq 2/3$ ), only the first two scenarios are relevant; otherwise, all three scenarios are a possibility. As  $\delta$  decreases, the location of  $C_{2m}$  around  $C_{1m}$  becomes progressively more asymmetric, and for given  $\theta$ , the more asymmetric location always corresponds to a median voter closer to the center of the market, and therefore to a lower  $g_2^*$ .

To see intuitively how the identity of the median voter is determined, consider the following simple examples: Suppose that both  $C_{2m}$  and  $C_{1m}$  are intervals, with  $C_{2m} = [-1/n, 1/n - \theta n]$ , and  $C_{1m} = [1/n - \theta n, 1/n]$ . Then, we know that unless  $\theta$  is too small, the median voter in  $C_2$  is located in the middle of  $C_{2m}$ , at position  $-\theta/(2n)$ , with all individuals to his left preferring a higher public good, and all individuals to his right preferring a lower one. This is correct if his ideal public good is not smaller than the public good desired by the border trader  $i = (1/n - \theta n)$ , a condition that, given (7), corresponds to  $\theta \geq 2/3$ . Otherwise, the median voter will be located symmetrically around 0, at positions  $\pm(2 - \theta)/(4n)$ . On the other hand, suppose that  $C_{2m}$  is formed by two symmetrical segments at the two edges of the market, that is,  $C_{2m} = [-1/n, -\theta/(2n)] \cup [\theta/(2n), 1/n]$ . Then, regardless of the size of  $C_1$ , the median voter in  $C_2$  must be at positions  $\pm(2 + \theta)/(4n)$ . The same logic can be applied to the other possible cases.

**PROOF OF PROPOSITION 3.** An equilibrium with two jurisdictions exists if and only if it satisfies the three conditions of Proposition 2. We consider them in turns.

- (i) Given  $\alpha = 1/2$ , there must exist a value of  $\theta \in (0, 2)$  that solves

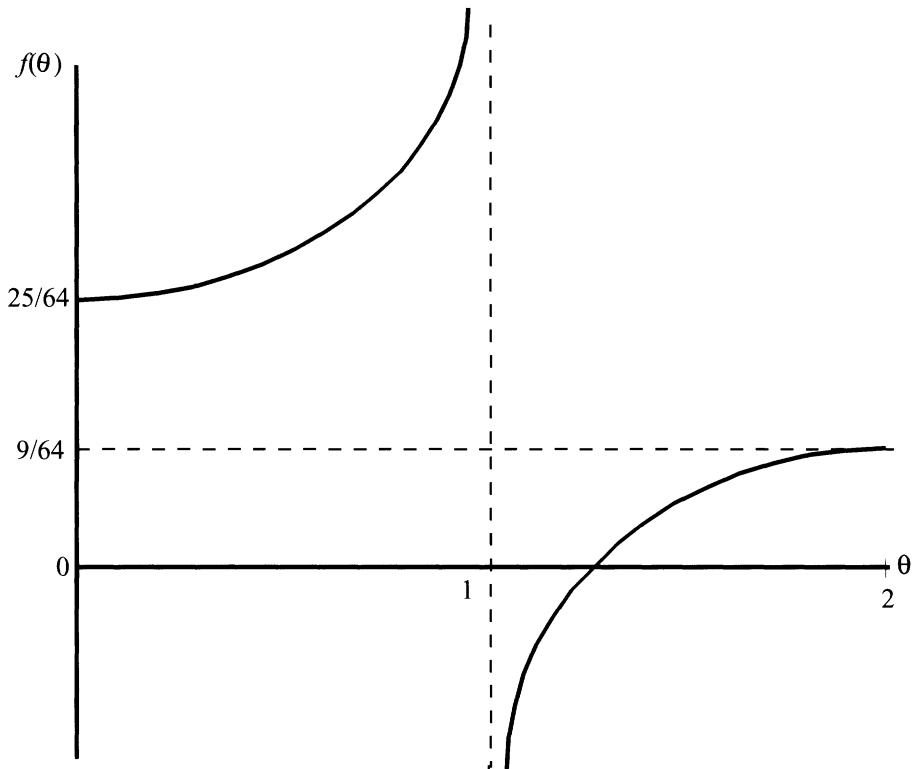


FIGURE A.1

FAILURE OF EXISTENCE OF THE EQUILIBRIUM WITH TWO JURISDICTIONS

$$(A.3) \quad f(\theta) = \frac{(\sigma - (5\theta^2/16))((11\theta^2/16) - \sigma)}{4(\theta - 1)} = 4cn^2$$

where

$$\sigma = 1 + \frac{(x + \theta)^2}{4} \quad x \in \left[ \max\left(0, \frac{2 - 3\theta}{2}\right), \frac{2 - \theta}{2} \right]$$

We begin by observing

$$\lim_{\theta \rightarrow 0} f(\theta) = 25/64; \quad \lim_{\theta \rightarrow 1^-} f(\theta) = \infty; \quad \lim_{\theta \rightarrow 1^+} f(\theta) = -\infty; \quad \lim_{\theta \rightarrow 2} f(\theta) = 9/64$$

(Notice that the limits do not depend on  $x$ , i.e., on the location of  $C_2$ .) The function  $f(\theta)$  is continuous in  $\theta$ , for all  $\theta \in [0, 1) \cup (1, 2]$ . It follows from these limits that if  $\partial f(\theta)/\partial \theta > 0 \forall \theta \in (0, 1) \cup (1, 2)$ , then there can be no  $\theta \in (0, 2)$  that solves (A.3) for  $4cn^2 \in [9/64, 25/64]$ , or equivalently for  $n \in [3/(16\sqrt{c}), 5/(16\sqrt{c})]$ . In addition, if this condition is satisfied, for any value of  $x$  (i.e., for any given location of  $C_2$ ), there is one and only one value of  $\theta \in (0, 2)$  that solves (A.3) for  $n < 3/(16\sqrt{c})$  or  $n > 5/(16\sqrt{c})$ .

Straightforward calculations show

$$\begin{aligned}\text{sign } \partial f(\theta)/\partial\theta = \text{sign} \{ & -21\theta^4 + 4\theta^3(7 + 32x) + 64\theta(x^2 - 4) + 16(2+x)^2(4+x^2) \\ & - 32\theta^2(x^2 + 6x - 4) \}\end{aligned}$$

This expression is everywhere increasing in  $x$ . We know  $x \geq 0$ ; hence, our conclusion will be proved if the expression above is positive when evaluated at  $x=0 \forall \theta \in (0, 1) \cup (1, 2)$ . It is not difficult to verify that this is indeed the case. (For  $x=0$  and  $\theta < 1$ , the conclusion is immediate; for  $x=0$  and  $\theta > 1$ , we need to verify that the expression is positive at the value of  $\theta$  that minimizes it, a result that can be easily established.) Thus, for any admissible value of  $x$ ,  $f(\theta)$  has the shape depicted in Figure A.1.

(ii) With  $\alpha=1/2$ , any  $n$  satisfies  $g_2^* \leq 2/n$ —hence there is no additional constraint on the possible number of markets.

(iii) For  $x=(2-\theta)/2$ , condition (iii) in Proposition 2 is always satisfied. But the limits above do not depend on  $x$ ; thus, for all  $n \in [3/(16\sqrt{c}), 5/(16\sqrt{c})]$ , there is no equilibrium (as shown above), while for all  $n < 3/(16\sqrt{c})$  or  $n > 5/(16\sqrt{c})$ , at least the equilibrium corresponding to  $x=(2-\theta)/2$  always exists. This concludes the proof of the proposition. ■

**PROOF OF PROPOSITION 4.** For any  $n$ , call  $\Delta EY_1$  the difference in expected aggregate income for members of  $C_1$  in market  $m$  in an equilibrium with two jurisdictions relative to the equilibrium with one jurisdiction:

$$\begin{aligned}(A.4) \quad \Delta EY_1 \equiv g_1^* \int_{C_{1m}} (Ez_i | j \in C_{1m}) di + g_2^* \int_{C_{1m}} (Ez_i | j \in C_{2m}) di \\ - g^* \int_{C_{1m}} (Ez_i | j \in [-1/n, 1/n]) di - \frac{\theta}{n}(t_1^* - t^*) - \frac{c\theta(2-\theta)}{2n}\end{aligned}$$

and similarly for members of  $C_2$ :

$$(A.5) \quad \Delta EY_2 \equiv (g_2^* - g^*) \int_{C_{2m}} (Ez_i | j \in [-1/n, 1/n]) di - \frac{(2-\theta)}{n}(t_2^* - t^*) - \frac{c\theta(2-\theta)}{2n}$$

In all equilibria with two jurisdictions, (A.3) must hold: We can substitute (A.3) in (A.4) and (A.5) and eliminate  $c$ . In addition, we know from the proof of Proposition 3 that in all equilibria with two jurisdictions,  $\theta > 1$  if and only if  $n < \underline{n}$ . Thus, all we need to show is  $\frac{1}{2}(\Delta EY_1 + \Delta EY_2) > 0$  if and only if  $\theta > 1$ . The proof is not difficult, but it is tedious because it requires solving the integrals explicitly and analyzing separately the different possible locations of  $C_2$  that correspond to different possible identities of its median voter. To avoid computational errors, we have checked our calculations with *Mathematica*. The details are available upon request, but the logic is the following:

- (1) If  $\delta \in [(2 - \theta)/(4n), (2 - \theta)/(2n)]$ ,  $x = (2 - \theta)/2$  and  $\frac{1}{2}(\Delta EY_1 + \Delta EY_2) \equiv A(\theta, n)B(\theta, \delta n)$ , where  $A(\theta, n)$  is defined only for  $\theta \neq 1$ , and  $A(\theta, n) > 0 \Leftrightarrow \theta > 1$ . Thus, the conclusion follows if and only if  $B(\theta, \delta n) > 0 \forall \theta \in (0, 1) \cup (1, 2)$ . It can be shown that  $\partial B(\theta, \delta n)/\partial(\delta n) > 0$  if  $\theta < 1$ , and  $\partial B(\theta, \delta n)/\partial(\delta n) < 0$  if  $\theta > 1$ . Hence, within this regime  $B(\theta, \delta n)$  reaches a minimum when evaluated at  $\delta n = (2 - \theta)/4$  if  $\theta < 1$ , and at  $\delta n = (2 - \theta)/2$  if  $\theta > 1$ . It is then not difficult to verify that  $\min(B(\theta, \delta n)) > 0 \forall \theta \in (0, 1) \cup (1, 2)$ .
- (2) If  $\delta \in [0, (2 - 3\theta)/(4n)]$  ( $\theta < 2/3$ ),  $x = (2 - 3\theta)/2$ , and  $\frac{1}{2}(\Delta EY_1 + \Delta EY_2) \equiv D(\theta, n)F(\theta, \delta n)$ , where  $D(\theta, n) < 0 \forall \theta < 2/3$ . Hence, we need to show  $F(\theta, \delta n) > 0 \forall \theta < 2/3$ . It is not difficult to verify that over this range of  $\theta$  values,  $F(\theta, \delta n)$  reaches a minimum at  $\delta n = 0$ , and that  $F(\theta, 0) > 0 \forall \theta < 2/3$ , establishing the result.
- (3) If  $\delta \in [\max(0, (2 - 3\theta)/(4n)), (2 - \theta)/(4n)]$ ,  $x = 2n\delta$  and  $\frac{1}{2}(\Delta EY_1 + \Delta EY_2) \equiv G(\theta, n)H(\theta, \delta n)$ , where  $G(\theta, n)$  is defined only for  $\theta \neq 1$ , and  $G(\theta, n) > 0 \Leftrightarrow \theta < 1$ . Thus, the conclusion follows if and only if  $H(\theta, \delta n) < 0 \forall \theta \in (0, 1) \cup (1, 2)$ . For all  $\theta \in [2/3, 1) \cup (1, 2)$ ,  $H(\theta, \delta n)$  reaches a maximum at  $\delta n = 0$  and  $H(\theta, 0) < 0$ ; for  $\theta \in (0, 2/3)$ , we can establish  $H(\theta, \delta n) < 0$  by observing  $\lim_{\theta \rightarrow 0^+} H(\theta, \delta n) = 0^-$ ,  $\partial H(\theta, \delta n)/\partial\theta < 0 \forall \theta < \bar{\theta} < 2/3$ , and  $H(\theta, \delta n) < 0 \forall \theta \in [\bar{\theta}, 2/3]$ .

This completes the proof of the proposition. ■

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