PRODUCT STANDARDS COALITIONS IN A MARKET WITHOUT BORDERS

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ABSTRACT

Traditional analyses of standards in international trade identify standards as government

regulations and investigate the potential for distortion of trade flows. In reality, however, private

industry groups exercise critical influence on the determination of technical standards. The

composition of these groups is affected by technology and market conditions, and in an integrated

market the alliances of private firms are likely to cross national boundaries, generating

harmonization "from the bottom." If standards are public goods whose ideal value differs across

economic activities and across countries, economic integration should bring increased harmonization

across countries and finer differentiation across products. Empirical evidence from the United States

and the European Union, although mostly anecdotical, supports this prediction.

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I. INTRODUCTION

With the progressive elimination of tariff barriers, the debate on international trade policies has shifted to national differences in standards and regulations. Do national governments exploit their free hand in setting regulations to hamper free trade and concede hidden advantages to domestic firms? Is it then appropriate to demand harmonization of standards as precondition for opening borders to foreign producers? As was made clear in North America by the public discussion of NAFTA, the issue is controversial and deeply felt. And although it typically sets more developed countries - with more stringent health, safety, environmental and labor standards - against less developed ones, the role of standards in trade is equally important among similar countries. In the European Union, the move towards mutual standards recognition is considered one of the truly significant steps of the Single Market initiative of 1992.[1]

In this perspective, standards and regulations are seen unequivocally as government policies: they are chosen by a central national authority and they apply within the perimeter of the national state. But is this the correct picture of standard setting in most economies? Consider in particular the case of product standards - the flammability of certain materials, the safety requirement of a valve, the labelling requirement on foodstuff. As described in more detail in the last section of the paper, three different actors interact in the development of a standard. Often the central government establishes general guidelines.[2] Private coalitions of firms then develop exact specifications and a certification mechanism that becomes the reference point for the industry. International standard organizations, manned by representatives of national industry organizations, provide non-binding recommendations, at times functioning as focal points in the international coordination problem. Thus, although

governments are present in the process, the specific standards and the certification process are demanded to coalitions of private firms, and private firms are very influential in the functioning of the international organizations. This observation is the point of departure of this paper.

The next question then comes naturally: if these coalitions are voluntary alliances among firms, is it so obvious that in an open integrated market they will be strictly national? Even if the hidden purpose of the coalition were to stifle competition, the natural composition of the dominant group would be more likely to follow firm and market characteristics than the perimeter of national borders. But if this is true, harmonization is not the most relevant policy problem: it will occur "from the bottom", through the coordinated actions of private firms operating across borders, more quickly than through international treaties and bureaucrats' interventions. Even where national governments must give the final approval, business groups will lobby their respective national authorities to support the privately developed international standards.

This view is supported by the experience of the United States: although in many instances the setting of standards is deferred to states and local authorities, these often lack the necessary technical resources and choose to adopt the voluntary standards developed by industry groups. But because these groups are organized nationally, the result is harmonization across localities, not through explicit policy intervention, but through the common reference to the same set of private standards. For example, Hemenway (1975) cites the National Electrical Code, responsible for 95 per cent of all U.S. regulations concerning electrical safety; or the Boiler and Pressure Vessel Code, developed by the American Society of Mechanical Engineers and transformed into law in most states.

Approaching standards as privately developed by firms is typical of the industrial organization literature (see for example, Dybvig and Spatt, 1983, Farrell and Saloner, 1985, and

Katz and Shapiro, 1985). The main goal of this paper is to suggest that the same perspective should be adopted in the discussion of standards in international markets. When standards are developed privately, the extent to which firms will share them or will agree to provide compatibility is an important question, and the recent literature on industrial organization has begun to address it (see for example, Economides and Flyer, 1995, and the discussions in Besen and Farrell, 1994 or Katz and Shapiro, 1994). Similarly, this paper argues that more attention should be devoted to the formation of international coalitions of private firms in an open market.

Consider first a closed country functioning in isolation; its national industries will develop the required standards. Because the cost of standardization is, by definition, the decline in variety and because different firms may well prefer different standards, it is not a priori obvious that the optimal number of standards is a single one (see, for example, Farrell and Saloner, 1986). The trade-off between economies of scale, a proxy for the advantage of standardization, and desired variety will determine the size of the national standard-sharing coalitions. Now let the market open. Barring complete specialization, domestic firms will come into contact with foreign firms engaged in similar activities, and coalitions will be modified. The new groupings will combine firms from different countries, and at the same time will be more specialized in terms of economic activity. This is the conjecture presented in this paper, made more precise by the formal model developed below.

The European single market provides a natural experiment where the theory can be tested. Although the evidence is mostly anectodical, there are indications that the trend is indeed identified correctly. For example, Sun and Pelkmans (1995) describe instances where European organizations work directly with private firms in the development of Europe-wide standards, sidestepping national governments. Genschel and Werle (1993) and Genschel (1995) describe the shift in European standards organizations in telecommunications from

national public monopolies to an increasing number of fragmented and specialized international coalitions of firms, in response to the accelerated market integration of the last decade. These examples and other relevant empirical evidence are described in more detail later in the paper.

The paper is organized as follows. The next section discusses the interpretation of standards as club goods that will be utilized in the model. Section III presents the model, which is then solved in sections IV and V in the two cases of closed and open markets. Section VI discusses the empirical evidence and section VII concludes the paper by summarizing its main arguments.

II. STANDARDS AS CLUB GOODS

The analysis begins with a tentative definition of the main purpose fulfilled by standards: standards are public goods improving the functioning of the market. At the expense of many interesting features of specific standards, this definition aims at identifying the common characteristic that standards must share. Any individual acting alone can establish a reputation for quality and reliability, any firm can become well-known for the excellent working conditions of its employees. But neither sets a standard until a group of individuals or firms engages in the same behavior. Inherent in the meaning of the word *standard* is thus the concept of joint consumption by a group. The standard is a public good.

Joint consumption per se does not imply however that rents from the standards are impossible to appropriate. This may be true in some cases (weights and measures for example), and not so in others (computer systems, wines DOC). Kindleberger (1983) describes how the establishment of standards has happened sometimes through government action, but often through the cooperation of groups of merchants or the action of a single firm.

The interest of private agents in developing standards speaks to the possibility of reaping benefits from the establishment of the standard, and suggest that the standard may be excludable. As in the model described in the next section, the standard may be a club good (Buchanan, 1965).

The specific functions that standards fulfill are very diverse. Two of the most important are providing compatibility and information. It is through the sharing of a common standard that anonymous partners in a market can communicate at all, can have common expectations on the performance of each other's product, and can trust the compatibility of their joint production. Thus standards are necessary for the smooth functioning of these anonymous exchanges, they are necessary for the efficient functioning of the market.

Although standardization is necessary, it does not follow that all variety is undesirable. Standards reflect the needs of the groups that expressed them, and as long as groups differ, their optimal standards will reflect their differences.[3] The identity of the group can vary because its members can be united according to different dimensions: nationality of course, but also a common interest in a specific industry, or in a specific economic role (consumer versus producer, for example). Thus at any point in time the composition of the group that shares a common standard reflects the state of the economy: the openness of the market, the technology, the distribution of preferences, the variety of products and of economic activities.

Therefore a change in the structure of the economy will affect not only the optimal standard that should be chosen, but also the optimal group that should share it. And because many characteristics of an economic agent play a role in determining the group he should be associated with, it is unlikely that all reorganization will occur in only one dimension.[4]

III. THE BASIC MODEL

In this section I describe a general equilibrium model of trade where the question can be phrased more precisely. The model is very special, and its goal is simply to provide a clear formal representation of the arguments underlying this discussion. The analysis is shaped by three main assumptions. First, in line with the previous discussion, the standard is modeled explicitly as a club good. This modelling choice differs from most of the literature, where the standard is not described explicitly and its presence is captured by the assumption that production costs or consumers' willingness to pay for a product are correlated with the size of the standard-sharing group (see for example, Economides and Flyer, 1995). Identifying standards as club goods is faithful to their purpose and leads to a simple formalization of the trade-off between economies of scale and variety.

Second, and again following the discussion in the previous section, diversity over ideal standards emerges because different individuals engage in different economic activities, and efficient standards are different for these different activities. The appropriate computer language depends on the application; the appropriate environmental regulation depends on the technological characteristics of the industry; the appropriate regulation of torts depends on the product; the appropriate safety standard depends on the composition of the consumer group.

Third, the model studies the central planner's solution to the question of coalitions formation, and thus neglects the strategic considerations often at the center of economists' interest in standards. Its main insight - coalitions are modified by the opening of markets and become less differentiated by country and more by economic activity - would be unchanged in the decentralized equilibrium, but the solution of the model would be much more complex.

I begin by describing an economy formed by a single country. The basic framework is developed in Casella (1996a), and I summarize it in what follows, with some minor modifications. The model will later be extended to represent an integrated international market.

The economy is represented by a circle of unit radius. A continuum of individuals is distributed uniformly along the circle, and each individual owns one unit of the single differentiated good that is traded and consumed in the economy. Each agent's location represents the specific variety of the good he is endowed with. We can think of the unit radius as a measure of the size of the economy, while the angle between two different varieties is a graphic representation of how different the two varieties are.

All individuals have the same preferences summarized in the utility function:

$$U = \left(\int_\Omega c(i)^\theta \, di \right)^{1/\theta} \qquad \theta \in (0,1) \tag{1}$$

where c(i) is individual consumption of variety i and Ω is the measure of the set of available varieties (equal to the length of the circle) (Dixit and Stiglitz, 1977).

All trade takes place in the market located at the center of the circle. To arrive at the market, consumers need roads. Roads are the public goods necessary for the smooth functioning of the market, and here they represent the standards and the regulations that facilitate exchanges. Building roads is costly, and for simplicity I assume that the cost of a road of length r is proportional to its length. Setting the factor of proportionality to 1, in the unit circle the cost of a road to the center of the circle is given by:

$$C(r) = r = 1 \tag{2}$$

Any number of traders can share a road without incurring in additional costs (a simple way to capture economies of scale) and since roads are expensive, consumers lower their costs by uniting in coalitions. Each member of a coalition is taxed a share t of his endowment towards the expense of the road, and only members are given access to it.[5]

To reach the market, traders must first travel from their initial location to the entry of the road, and as they do so their endowment depreciates: an individual at distance σ from his

coalition's road will arrive at the market holding

$$(1-t)e^{-\delta} \tag{3}$$

units of endowment, where t is the tax rate and δ is the depreciation rate. The economic heterogeneity among individuals causes disagreement over optimal standards and imposes costs on those agents who have to make do with less than ideal policies. In this geometrical model, this cost is represented by the cost of travelling to the road's entry: only one member of each coalition will obtain exactly the standard that maximizes his endowment at the market.

Each coalition then is composed by a class of varieties of the homogenous good that share a standard; standards differ across coalitions and within each group there is some disagreement about the optimal standard. So for example, safety standards differ for passenger elevators, relative to freight or mixed use elevators; standards of service differ among different classes in air travel, or among hotels in different categories. And within each class or group, individual firms differ in their choice of the ideal standard.

The number and composition of the coalitions and the location of the road within each coalition are decided by a central planner, assumed to maximize the sum of individual utilities (or equivalently, total real income in the economy):

$$W = \int_0 U(j)\, dj \tag{4}$$

The timing of the model is the following: First coalitions are formed, then members are taxed, roads are built, endowments are brought to the market and trade and consumption take place. An equilibrium for this model is a set of prices and consumption levels for all goods and traders, a partition of all consumers into coalitions and a specified location of roads such that markets clear, the roads' number and location maximize aggregate welfare, and no individual

can be made better off by an alternative consumption plan.

IV. SOLUTION OF THE SINGLE COUNTRY CASE

Consider the problem faced by consumer s, belonging to coalition S and located at distance $\sigma(s)$ from the road provided by his club. Coalition S is of size Ω_s and charges its members taxes t_s, given by:

$$t_s = 1/\Omega_s \tag{5}$$

(In equilibrium, taxes will always be smaller than 1). Consumer s maximizes utility function (1) subject to the budget constraint:

$$\int_\Omega p(j) \, c_s(j) \, dj = E(s) \tag{6}$$

where $p(j)$ is the price of variety j and $E(s)$ is the value of the endowment individual s brings to the market:

$$E(s) = p(s) \, (1-t_s) e^{-\delta \sigma(s)} \tag{7}$$

His demand for variety j equals:

$$c_s(j) = \frac{p(j)^{-1/(1-\theta)}}{\int_\Omega p(i)^{-\theta/(1-\theta)} \, di} \, E(s) \tag{8}$$

Equilibrium prices must be such that for each variety total demand by all consumers equals supply, or:

$$\int_{0}^{r} c_s(j) \, ds = (1-t_j)e^{-\delta \sigma(j)} \tag{9}$$

where variety j belongs to coalition J and is at distance $\sigma(j)$ from its road. Given (7) and (8), the equilibrium price p(j) is given by:

$$p(j) = (1-t_j)^{\theta-1} e^{\delta(1-\theta)\sigma(j)} \tag{10}$$

Given utility function (1), indirect utility function of consumer s can be written as:

$$U(s) = \frac{E(s)}{P} \Omega^{(1-\theta)/\theta} \tag{11}$$

where the price deflator, corresponding to the minimum expenditure yielding one unit of utility, is:

$$P = [\Omega^{-1}\int_{0}^{r} p(j)^{-\theta/(1-\theta)} \, dj]^{-(1-\theta)/\theta} \tag{12}$$

From equation (10), the price deflator becomes:

$$P = [\Omega^{-1}\sum_{i=1}^{n} (1-t_i)^{-\theta} \int_{\Omega_i} e^{-\delta\theta\sigma(j)} \, dj]^{-(1-\theta)/\theta} \tag{13}$$

where Ω_i is the set of traders (and varieties) belonging to coalition i and n is the total number of coalitions in the economy. Substituting (7), (10) and (13) in (11), we obtain indirect utility of consumer s as function of taxes, of the existing number and size of coalitions and of the location of roads:

$$U(s) = (1-t_s)^{\theta} e^{-\delta\theta\sigma(s)} [\sum_{i=1}^{n} (1-t_i)^{\theta} \int_{\Omega_i} e^{-\delta\theta\sigma(j)} \, dj]^{(1-\theta)/\theta} \tag{14}$$

The first two terms in equation (14) capture the effect of taxation and distance from the road on the value of the endowment that consumer s brings to the market. The term in square brackets is the inverse of the price deflator and gives the distribution of consumer s's endowment over purchases of all varieties.

The central planner chooses the number and location of roads so as to maximize aggregate welfare. Given (14) aggregate welfare is simply:

$$W = [\sum_{i=1}^{n} (1-t_i)^\theta \int_{\Omega_i} e^{-\delta \theta \sigma(j)} dj]^{1/\theta} \tag{15}$$

The Uniform distribution of types, together with the exponential depreciation guarantee that each coalition must be formed by a connected segment of consumers and that the optimal location of the road is the center of each segment. It follows then that welfare must be concave in Ω_i; together with the Uniform distribution this implies that the optimal structure of coalitions must be symmetrical: all coalition will be identical. Aggregate welfare becomes:

$$W = (1-t) [2n \int_0^{\pi/n} e^{-\delta \theta \sigma} d\sigma]^{1/\theta} \tag{16}$$

or

$$W = (1 - \frac{n}{2\pi}) [\frac{2n}{\theta\delta} (1-e^{-\theta\delta\pi/n})]^{1/\theta} \tag{17}$$

The function W is globally concave in n: for any value of the parameters, there is a unique number of coalitions that maximizes aggregate welfare. An increase in the number of coalitions increases per capita taxes, but at the same time reduces the average distance between each consumer and the standard his own variety is subject to. Because the cost of this distance is captured by the parameter δ, the optimal number of coalitions must be higher

the higher is δ. As for the parameter θ, a higher θ means a lower premium on diversification in consumption, a higher elasticity of demand and a lower effect on the price deflator of reduced supply. It can be shown that the reduced sensitivity to the cost of less finely tailored standards leads to a reduction in the optimal number of clubs.

Notice that although the optimal number of coalitions and their structure (their identical size and the central location of the road) are univocally determined, their exact location is not. From the point of view of aggregate welfare, in this symmetrical model any rotation is equivalent.

Although each economy exists in isolation, the world is composed of N different countries. In general, economic types will be different in each country, but the structure of the economy, the measure of types, consumers'preferences and the technology of roads are identical to those described above. Thus equation (17) describes welfare in each country. World welfare in autarky is then equal to:

$$W_w^A = N \left(1 - \frac{n}{2\pi}\right) \left[\frac{2n}{\theta\delta} (1 - e^{-\theta \delta \pi/n})\right]^{1/\theta} \tag{18}$$

The optimal number of coalitions that in each country maximizes national welfare remains optimal from the point of view of world welfare.

V. MARKET INTEGRATION

Suppose now that all N countries participate in a single integrated international market. As a natural generalization of the basic model, we want a representation where economic types are different across countries and all are equidistant from the unique market: imagine the world as a sphere, with each country being a longitudinal great circle. Thus all varieties in the world

differ, with the exception of two varieties (of measure zero) that are common to all countries and corresponds to the two poles. To maintain the symmetry of the model, assume that all countries are equally spaced, i.e. the angle between any two contiguous longitudinal circles is constant and at the equator equals $2\pi/N$ (Figure 1).

In this representation, the radius of the sphere (which continues to equal one) and the number of countries N are measures of market size[*]; as in the previous section, the angle between two varieties in each country is a measure of the heterogeneity across varieties, given national characteristics; the angle between two countries is a measure of the heterogeneity across countries, for given economic activity -- and thus of different preferences, cultures, habits. As each country is represented by a longitudinal great circle, each variety corresponds to a latitudinal circle, and is indexed by decreasing differentiation across countries as we move from the equator to the two poles.

The important advantage of the sphere is that it allows us to incorporate two different sources of heterogeneity - across countries and across economic varieties - in a simple symmetrical set-up.

The model is otherwise unchanged. Each individual has preferences given by equation (1); trade takes place at the center of the sphere, and a road is required to reach the common market. The cost of the road is given by equation (2), and coalitions can be formed to share the expense. The road continues to represent the standard, and as before, there is a cost from having a standard that is less than ideal, captured by the depreciation δ per unit distance that each consumer must bear when carrying his endowment to the entry of the road (equation 3). Finally, the number and location of the roads are decided by a central planner who is assumed to maximize aggregate world welfare.

The question we want to ask is to what extent the integration of the markets alters the optimal coalitions sharing the standards. When markets integrate, we expect that countries will

One Country
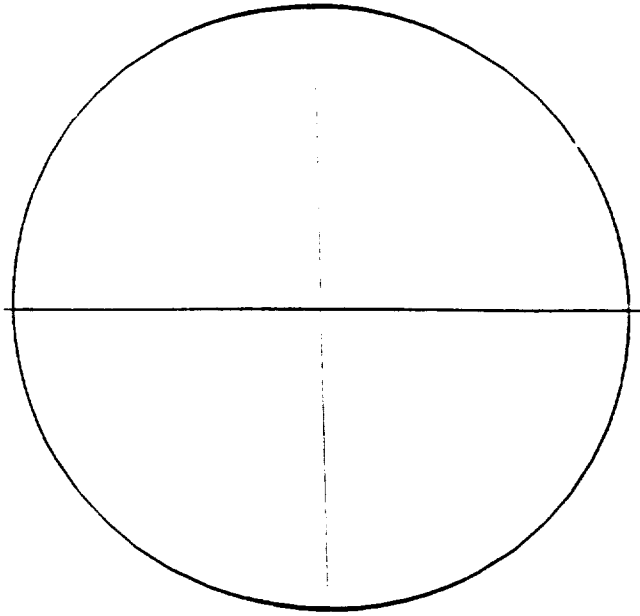
The World
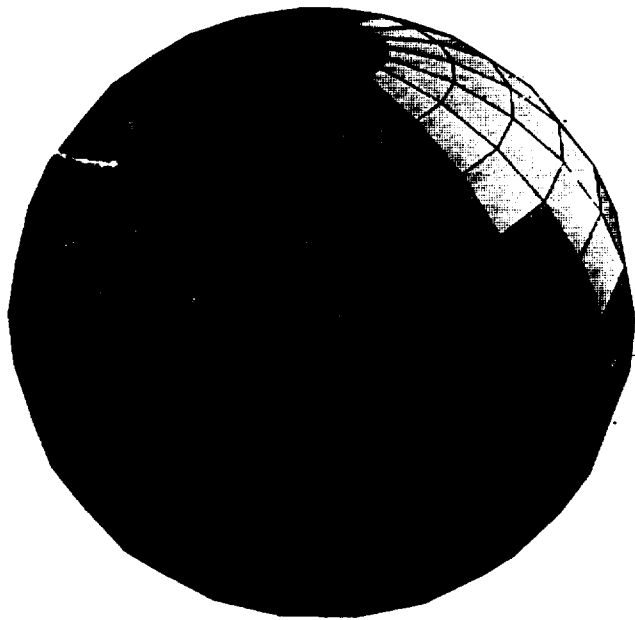
at least partly harmonize their standards, realizing the economies of scale that are possible in their provision. At the same time, however, some of the cost savings realized through the larger scale could be profitably used in providing standards that are more precisely tailored to individuals' economic activities. The result should be international harmonization and economic differentiation. In the national market the optimal coalition is represented by a contiguous segment of the circle; in the integrated market it will be given by all economic types belonging to a specific area of the sphere: in general, the optimal coalition will be international and will represent a smaller spectrum of economic varieties.

To keep our story as simple as possible, suppose that the value of the parameters is such that in autarky the optimal number of coalitions in each country is 1 (δ=0.1 and θ=0.5 are an example of parameter values that lead to this outcome). In what follows I study three alternative scenarios: in the first case each country maintains its national standard, but trade is integrated; in the second case, national standards are harmonized into a single world standard; in the third case, world consumers are partitioned into two coalitions, and two standards are developed.

Suppose first that market integration were to occur without any change in coalitions. In this model, where variety in consumption commands a premium, each consumer would experience higher utility through the increase in the available number of varieties. It is easy to verify that world welfare would increase by a factor of $N^{(1-\theta)/\theta}$. With a single coalition in each country, and thus N coalitions in the world, world welfare would then be given by:

$$W_w(N) = N^{1/\theta} (1 - \frac{1}{2\pi}) [\frac{2n}{\theta\delta} (1-e^{-\theta\delta\eta})]^{1/\theta} \tag{19}$$

Because the location of the road within each country is indeterminate. national welfare is unchanged if in all countries the road is located at the variety that corresponds, for example, to

the Northern pole of the sphere. But then it becomes clear that the creation of a single world standard must be welfare superior: building one single road at the pole would allow countries to save on the costs of building the road without increasing distance for any consumer. Indeed, if a single world coalition is formed, financing and sharing a single road located at the pole, world welfare becomes:

$$W_w(1) = N^{1/\alpha} (1 - \frac{1}{N2\pi}) [\frac{2}{\theta\delta} (1-e^{-\theta\delta\pi})]^{1/\alpha} \tag{20}$$

Comparing (19) and (20), it is clear that the difference in welfare is due to the tax savings. The tax savings refer strictly to the cost of providing the standard, but can be interpreted more widely to include costs of verification and certification, thus capturing the efficiency gain present in international harmonization when standards do not differ in their substance.

In this simple example, there is no issue of distribution across countries, and sharing a single standard increases welfare everywhere. However the model *per se* does not rule out distributional problems, and I will discuss the possibility of differential effects from harmonization at the end of this section.

In the third scenario, the world is divided into two coalitions. Once again, given our functional forms the Uniform distribution implies that the optimal partition must yield two identical coalitions, and within each of them consumers must be disposed symmetrically around the road: the two roads will be at the two poles, and each coalition will be one hemisphere.[7] Thus all countries are present in both coalitions, but the range of varieties represented in each will be limited. World welfare equals:

$$W_w(2) = N^{1/\alpha} (1 - \frac{1}{N\pi}) [\frac{4}{\theta\delta} (1-e^{-\theta\delta\pi/2})]^{1/\alpha} \tag{21}$$

Parameter values affect relative welfare with one or two coalitions in the direction expected. An increase in the parameter δ, the cost of a non-ideal standard, raises the scope for multiple coalitions: the ratio $W_w(2)/W_w(1)$ increases. An increase in the parameter θ, implying an increase in the elasticity of demand, reduces the effects on the aggregate price level of reductions in supply. But the comparison between one and two coalitions depends on the trade-off between taxes and resources lost to inappropriate standards, both of which result in reductions in supply. Thus it is not clear a priori whether higher θ should favor one or two coalitions. Numerical simulations indicate that the smaller impact of inappropriate standards dominates the tax effects: the higher is θ, the lower, ceteris paribus, is the ratio $W_w(2)/W_w(1)$.

Comparing (19), (20) and (21), we can address the question that motivated this exercise: does integration trigger a reorganization of coalitions? The following Proposition provides the answer:

Proposition 1. *Call Δ the set of values of the parameter vector (δ,θ) such that in autarky the optimal n equals 1. Then $\forall\ (\delta,\theta) \in \Delta$, $W_w(1) > W_w(N)$, and there exists a finite number $N'(\Delta)$ such that $\forall\ N > N'(\Delta)$ $W_w(2) > W_w(1)$.*

Proof. The first part of the proposition is immediate and has been discussed above. The second part follows from the following results:

$$\lim_{N \to 1} \frac{W_w(2)}{W_w(1)} = \frac{W_w^{\wedge}(2)}{W_w^{\wedge}(1)} \tag{22}$$

$$\lim_{N \to \infty} \frac{W_w(2)}{W_w(1)} = \left(\frac{2}{1 + e^{-\delta 5 n/2}}\right)^{1/\theta} > 1 \tag{23}$$

$$\frac{d\ (W_w(2)/W_w(1))}{d\ N} > 0 \tag{24}$$

Suppose for example $\theta=0.5$, $\delta=0.1$ and $N=10$. Then in autarky the two values for world

welfare with one and two coalitions in each country are 284.3 and 248.9 respectively; in the integrated market with national coalitions the two values are 2843 and 2489; in the integrated market with a single world coalition welfare is 3327, with two it is 3535. Thus the central planner will choose one coalition in each country in autarky, but two international coalitions, differentiated by economic activity, in the world market. (With $\theta=0.5$ and $\delta=0.1$, the conclusion holds for all $N \geq 3$).

Proposition 1 states that indeed the opening of markets causes a reorganization in the optimal structure of coalitions. One aspect of this reorganization is more harmonization, as wasteful replication of equivalent national standards is avoided. But at the same time, the international coalitions become more diversified in terms of economic activity, because gains from economies of scale can be optimally exploited to provide more appropriately tailored regulations and standards. If the approach taken in this paper is correct, then we should expect industry groups and regulatory agencies to become more international in their composition, and at the same time more specialized in terms of the economic activity they supervise. Stating once again the main insight of the model, the tension is not simply between harmonization and national diversity, but between two different types of heterogeneity: among economic actors even within a single country, and among countries even within the same industry. If the first type of heterogeneity is given its appropriate weight, we may see increased international harmonization but more detailed and more diversified standards.

In the simple examples discussed in this section conflicts among countries on the specific choices of the standards do not arise. This is an artifact of the special cases I have chosen: with either one or two coalitions, it is always optimal to center the coalitions at the poles, guaranteeing that all countries are equally affected by the reorganization triggered by the single market. When the number of coalitions is larger than two, on the other hand, countries will disagree on the exact choice of the standards, and distributional issues will arise. Notice

however that the logic of the model will be unchanged: the geometry of the sphere guarantees that optimal partitions will still be symmetrical areas on the surface of the sphere, i.e. that optimal coalitions will still be international and more compact than national ones in terms of economic types. Of course, in the absence of compensating transfers, individual countries will fare differently, exactly as individual consumers fare differently in all central planner equilibria. Because the focus of this paper is not on distributional factors and because they do not alter the main message of the analysis, I have chosen to ignore them and selected the simplest examples that clarify the functioning of the model.

VI. DISCUSSION

The innovation of this paper is to think of groups sharing standards as flexible coalitions that can be reshaped as markets change. Although the approach is not incompatible with a leading role assigned to national governments or to international treaties, the emphasis on the endogeneity of these coalitions fits best a world where the groups are voluntarily formed "from the bottom", instead than engineered from the top. This does not imply that voluntary groups will act optimally, but suggests the potential for higher flexibility in the formation of coalitions. In this section, I briefly review some evidence on the role of private groups in developing standards.[8]

The organization of the process of standardization varies widely across countries. In general, regulations concerning safety, health and the environment are issued by the government. Often however technical standards, including the specific measures that satisfy the objectives of the government regulations, are left to private organizations and publicized as voluntary standards. At times the deferral to privately developed standards happens implicitly, as these are directly adopted by governments. As mentioned in the Introduction, in the U.S.

this is particularly common in the case of local authorities which typically lack the technical resources necessary to formulate the standards; and because voluntary organizations are typically national, local referral to private standards leads to harmonization across localities.

The United States is remarkable for the high decentralization of its system of standards. In 1984, a census of organizations involved in the development of standards counted 750 different organizations, of which 420 non governmental (Global Engineering Documents, 1984). In 1991, the number of voluntary organizations had risen to 600 (UNIDO, 1991). The pattern has been true since the inception of the U.S. system of standards: "Although the government provided at the turn of the century the first impetus for national standards, it gradually relinquished much of this responsibility to private standards setting organizations." (U.S. Congress, 1992).

Although the extent of decentralization of the United States system is unique, the trend towards voluntary standards is not: "Recent trends in all [OECD] countries seem to converge towards a greater emphasis on self-regulation and non-mandatory standards....[This] introduces an element of flexibility into national safety systems which may become more open to international harmonization' (OECD, 1991, p.55). In Germany, for example, the Deutsches Institut für Normung (DIN) - a private group whose experts are often "on loan" from firms - coordinates all standards activity and represents Germany in international standards institutions. Its activity has been steadily increasing in recent years: DIN standards-in-progress have risen from 12,000 in 1984 to 17,000 in 1988 to more than 20,000 in 1993, and they have been mostly concentrated in new technologies, food and safety rules, exactly the fields where standards have traditionally been considered the realm of government policy (UNIDO, 1991 and DIN, 1994).

Similarly, increased cooperation between government bodies and private organizations is particularly striking in the United States, but is becoming the dominant model through which

regulation is developed in other parts of the world as well. In Germany, France and the United Kingdom, the government has concluded an agreement with the main private organizations and refers to the privately developed standards in regulations (OECD, 1991). This line is also followed in the "New Approach" described by the 1985 EC Council resolution on "Technical Harmonization of Standards": products with potential health, safety or environmental implications are to be regulated by the Council. The Council states the "essential requirements" that products must satisfy, while the European standardization bodies (CEN, CENELEC and ETSI) develop the detailed technical standards. Although the technical standards are not mandatory, national authorities are obliged to recognize products developed according to these standards as satisfying national requirements.[9]

Notice that while the agreement is still between national states - it is an EC Council resolution - the new standards are developed by international technical committees organized by industry. Coupled with the principle of "mutual recognition" for products not regulated by the Commission, the "New Approach" creates the conditions that could lead to the development of standards through voluntary international coalitions following industry lines. Indeed the European approach has been suggested as a possible blueprint for standard setting in the world at large. Mutual recognition would eliminate protectionist motivations in national standards for large classes of products; for more delicate goods, reference standards would be developed by the international standards institutions; finally the pressures of an integrated market would lead firms to cooperate in the development of the international standards (Sykes, 1995).

In Europe, progressive market integration coupled with the new regulatory framework continues to increase firms' incentives to be involved in international standard setting. In Germany, for example, in 1991, only 30 per cent of DIN resources were spent on the development of national standards (compared to 60 per cent in 1984 and 40 per cent in 1988);

35 per cent of resources were spent on work within CEN and CENELEC (compared to 10 per cent in 1984 and 25 per cent in 1988), and 30 per cent on international non-European standards (compared to 25 per cent in 1984 and 30 per cent in 1988) (UNIDO, 1991). In 1993, only 25 per cent of standards in progress were national standards (DIN, 1994). Germany has a leading role in the development of European standards, but a similar trend towards internationalization can be seen in the other major European countries.

Outside of Europe, the two main international organizations for standard setting are the International Organization for Standardization (ISO) and its affiliate, the International Electrotechnical Commission (IEC). They are private, voluntary, non-governmental organizations whose members are the national standards institutes of different countries, and whose support comes from contributions by private industry and national standards organizations. The two organizations issue recommendations, but no member country is obliged to enforce them. These formal organizations are very similar to the international coalitions that the model finds optimal.

The increased richness of standards in response to a more diversified world is reflected in the organization of the standards institutions. These institutions are typically organized in Technical Committees, devoted to specific areas, and their number has been increasing over time: the ISO, for example, had 122 Technical Committees in 1967, 135 in 1973 and 164 in 1989 (ISO, 1991). The history of the individual Committees reflects the evolution of the individual industries: TC97, for example, the Technical Committee created in 1960 and responsible for standardization of computers and computer system, has given origin to a number of subcommittees that have eventually become independent.[10]

In addition to the multiplication of standards and technical committees within international organizations, the fragmentation of coalitions predicted by the model appears to be captured by the fragmentation of the organizations themselves into a multiplicity of specialized units.

Genschel and Werle (1993) and Genschel (1995) describe the multiplication of standards setting organizations in international telecommunications. Until the 1970s, a single organization, the International Telegraph and Telephone Committee (CCITT) enjoyed an effective monopoly and was itself an expression of national monopolies, either public, as in Europe, or private, as in the United States. Over time, however, overlap with the activities of the ISO and the IEC increased, and eventually, during the 1980s, a number of new standards setting bodies was established, mostly with regional focus and set up by private business consortia, up to the point where telecommunications experts now worry about the excessively high number of independent organizations. According to Genschel, the evolution was triggered by changes in technology and in the size of the market: "Networks grew to transnational dimensions, and the technology, which had been marked by strong national peculiarities, became more alike across countries. At the same time, however, it became more diverse across functions. The variety of telecommunication services exploded." (Genschel, 1995, p.5)

Besides creating new standards bodies, international coalitions of producers have cooperated in lobbying for new international standards legislation. In Europe, for example, this has meant advocating the enactment of EC directives to solve contentious cases. A representative instance is reported by Sun and Pelkmans (1995). In 1988, having enacted provisions establishing fire resistance requirements for upholstered furniture, the U.K. and Ireland blocked imports that did not satisfy these requirements; the other EC countries initially brought the case to the European Court of Justice, but were later persuaded to collaborate in the elaboration of a directive establishing acceptable European standards. At this point, business interests organized themselves: the European Flame Retardants Association was formed in 1990 (a subgroup representing a specific technology split up shortly afterwards) and together with the European Chemical Industry Council began lobbying the Commission

directly. Sun and Pelkmans note, with some surprise, that industry organized in EC-wide coalitions and not in national groups, and that there is little evidence that firms tried to exercise their influence through their national governments.[11]

The increased role played by private organizations does not imply that government involvement is undesirable. In the theoretical model discussed in this paper, we could let coalitions form voluntarily, allowing communication and joint deviation by groups of agents. In the simpler autarky case, it can be shown that the decentralized equilibrium leads to the correct structure of coalitions, but not necessarily to the right number: even with complete communication there can be either too few or too many coalitions.[12] Although the change in dimensionality makes the generalization to the integrated market case much more complex, there appears to be no reason why the final result would be modified: the structure of coalitions will again be correct, but the number may well not be. The possible suboptimality of voluntary industry standards is a recurring theme in the literature (see, for example, Dybvig and Spatt (1983), Farrell and Saloner (1985), Katz and Shapiro (1985)) and does not disappear in the approach suggested by this paper.

In the real world, the large role played by private standards developers has predictably raised concerns of anti-trust violations. In 1983, in the United States the Federal Trade Commission noted that private firms provide the bulk of the funds necessary for the development of private standards (FTC, 1983). These funds are not negligible: in 1977, for example, it was estimated that they amounted to roughly half a billion dollar annually (US Department of Commerce, 1977). The FTC discussed the potential to use standards and certification procedures to control the market and expressed its concerns in view of the likelihood that "the use of private standards as a substitute for federal government regulation [will] become even more extensive in the future" (FTC, 1983, p.35). The report describes various examples of standards decisions deemed illegal by the courts. The problem is not

exclusive to the United States. In Germany it has been estimated that private firms sustain 90 per cent of total costs related to the development of standards, a contribution that in 1993 would amount to approximately one and a half billion marks.[13]

In the absence of a regulatory framework, the concern for abuse by private standard organization seems well founded. Thus we conclude this paper with a conjecture: in a world where markets know no national borders, product standards indeed raise a problem for policy. However, contrary to the common view, this problem is not how to orchestrate harmonization through government treaties; it is how to create the appropriate regulatory structure to prevent and if necessary discipline anti-trust violations in international markets.

VII. CONCLUSIONS

This paper has argued that in an open market, product standards will be shaped by the activities of international coalitions of firms. Thus harmonization across countries is likely to take place "from the bottom", because of the international nature of the business interests touched directly by the standards and thus willing to take upon themselves the costs of standards development and certification. The widespread concern with harmonization stems from the identification of standards as government policy. But this is only partially correct: the empirical evidence suggests that private industry groups are typically responsible for defining the specific technical requirements that satisfy the generic guidelines issued by public agencies. The composition of these groups reflects the markets in which they operate: in an open international market, both theoretical arguments and an increasing body of empirical evidence suggest that the industry coalitions will be international. The relevant policy question may then not be harmonization but the creation of a regulatory framework to address international anti-trust violations.

The wider composition of the groups, in term of national affiliation, will allow a more narrow focus on specialized products. The resulting standards will then probably be more similar across countries, but more detailed and differentiated across products.

FOOTNOTES

* A preliminary version of this paper circulated under the title "Setting Standards in a Europe without Borders". I thank Jagdish Bhagwati for first stimulating my interest in problems of standards and trade, and seminar participants at Columbia, Geneva, NBER, the University of Pennsylvania, Princeton, and the CEPS 1995 Tutzing meeting on standards for comments and suggestions. I thank in particular Marcel Thum and Kate Stevenson for numerous and detailed discussions that have substantially improved the paper.

1. For an extensive review of the question of harmonization from both the economic and the legal perspective, see the two volumes edited by Bhagwati and Hudec (1996).

2. In the case of the European Union, this role may be fulfilled by European institutions.

3. For a discussion of optimal differences in standards across countries, see Bhagwati (1994).

4. Discussions of standards harmonization as possible precondition for free trade typically consider the standards as fixed. This neglects the likely change in standards brought about by the very act of liberalizing trade. But even when the endogeneity of the standards is recognized, we should also be aware that the composition of the group expressing and sharing the standard should be modified by the change in regime. This is the point made by this paper.

5. All endowments can be costlessly transformed into resources appropriate for road construction.

6. The total measure of varieties in the world equals $2\pi r^*N$, or $2\pi N$, with a unit radius.

7. Note that the disposition of the countries as longitudinal great circles implies that the only two optimal hemespheres must be symmetrical around the two poles. All other possible hemispheres are suboptimal.

8. A more extensive review is in Casella (1996b). An early and influential discussion of voluntary standard setting is Hemenway (1975).

9. An escape clause allows member states to appeal to the European Court of Justice, on grounds of public morality, or defense of human or animal health, or property. In practice the escape clause has been invoked very rarely (Sykes, 1995). For institutional details on European standards organizations, see Nicolas (1988).

10. In 1987, TC97 itself merged with two IEC committees to become Joint Technical Committee 1 (JTC1).

11. In 1993, as the Commission was ready to discuss the draft of a directive, Delors withdrew the proposal, invoking the principle of subsidiarity.

12. See Casella (1996a).

13. The 90 per cent figure is taken from Berger and Clement (1990); in 1993 DIN's budget, covering then the remaining 10 per cent of standards development costs, was DM 160 m., leading to the one and a half billion figure for firms' costs cited in the text. I thank Marcel Thum for pointing out these numbers to me.

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