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STANDARDIZATION POLICY AND INTERNATIONAL TRADE: ISRAEL'S STANDARDIZATION INSTITUTIONS & OPTIMAL STANDARDIZATION POLICIES

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Abstract

We provide a general equilibrium welfare analysis of the consequences of recognizing and not recognizing foreign standards of imported products. We then define the concepts of Standardization Unions and Open Standard Areas and investigate whether countries can gain by committing to these agreements which entail mutually standard recognition among member countries. Our results depend on whether standard conversion costs are transfers among countries or whether they constitute a real loss to the world economy. We then show how the model can be used to make recommendations regarding Israel's standardization policy.

Keywords: International Standards, International Trade, Standardization Policy, Trade Policy

JEL Classification Numbers: F13, L5

1 Introduction

The trade literature has focused primarily on the strategic effects and welfare consequences of 'traditional' trade barriers such as tariffs, quotas, VER, custom unions, and other preferential trading arrangements.[1] The success of GATT in reducing these trade restrictions has been accompanied by an increase in less visible trade restrictions in which standardization is used as a key instrument. Even the Uruguay Round GATT (1993) left countries with the option of restricting trade on safety and health grounds.[2]

Our goal is to examine the strategic aspects of governmental standardization policy. In the paper, we develop a three-country, three-variety world economy model and analyze (1) governments' incentives to unilaterally recognize foreign standards and (2) incentives to form unions for the purpose of mutual standard recognition. We conduct the analysis under two alternative settings: (i) standard conversion costs are captured as rents and hence are transfers among countries and (ii) standard conversion costs require real resources and therefore constitute a real loss to the world economy.

1.1 International standardization

At the international level, membership in international standards organizations is open to all countries of the world. The main task is to elaborate and publish standards and to harmonize standards of their members. The International Electrotechnical Commission (IEC) was founded in 1906 and the International Organization for Standardization (ISO) was founded in 1946; see Thiard and Pfau (1992) for details. The bulk of work carried out by the ISO and IEC leads to international standards. However, ISO/IEC members are not obliged to implement international standards as national standards. Every member can freely decide whether it wishes to recognize the international standard directly, i.e., to accept it as a

[1] See Corden (1984) for a summary of this research.

[2] See *Business America*, Vol 115: 22-23, January 1994.

national standard, or to develop its own national standard.[3]

1.2 Harmonization of technical standards within the EC

Since our analysis analyzes the incentives for mutual standard recognition, we briefly review the European Community's (EC's) mutual standardization policy. The 1957 Treaty of Rome was intended to create a single market across the European countries. Article 30 prohibited not only quantitative restrictions on imports but also *all* measures having an *equivalent* effects. Although a customs union was established very quickly and significant progress made with respect to the free movement of goods, physical and technical barriers continued to exist which prevented the creation of a genuine single market. Indeed, Article 36 of the Treaty permits prohibition or restrictions on the movement of goods based on health and safety concerns.

Up until 1985, the Community (using the so called 'old approach') removed technical barriers by harmonizing technical product specifications.[4] This approach became more difficult to employ since it fixed technical specifications without taking account of the diversity of production methods and consumers' preferences for variety.

In 1985, the Commission adopted a *new approach* to technical harmonization and standards.[5] Under the new policy the manufacturer may freely choose how to meet the essential (EC policy) requirements. To assist in the process, the Commission issued mandates to European Standardization bodies (CEN, CENELEC, and ETSI) to develop voluntary standards which meet the essential requirements. The EC has also taken up a number of initiatives in order to reduce technical barriers to trade outside the legislative framework, by supporting close co-operation between the European standard setting bodies and International Standards bodies

[3] A recent EC document, for example, expresses concern that while the European Community is committed to ISO/IEC standards, the United States relies heavily on domestic standards. A U.S. Congressional Research Service (1989) document notes that of the approximately 89,000 standards recognized in the U.S., only 17 were adopted directly from the ISO and none were adopted from the IEC.

[4] "A New Community Standards Policy," *Commission of the European Communities*, 4, January 1993.

[5] Council Resolution of 7 May 1985, *Official Journal of the European Communities*, No. C 136/1.

like the ISO/IEC.

1.3 Organization of the Paper

The paper is organized as follows: Section 2 develops the basic three-country, three-firm general equilibrium product differentiation model and defines governmental standardization policies. Section 3 solves for governments' standardization policies under two alternative assumptions concerning the source of standard conversion costs. Section 4 defines Standardization Unions, and Open Standards Areas, and analyzes countries' incentives to form such organizations. these commitments. Section 5 briefly investigates how different population sizes affect countries' incentives to form standardization unions. In section 6, we use the model to make recommendations regarding Israel's standardization policy.

2 A Three-Country Model

In this section, we develop a three-country, three-variety world economy model. We denote the three countries by α, β, and γ and the three varieties by 1, 2, and 3, where brand 1 is produced in country α, brand 2 in country β, and brand 3 by country γ. We index countries by $\kappa = \alpha, \beta, \gamma$, and brands by $i, j, k \in \{1, 2, 3\}$.

In the following subsections we describe the market in one *representative* country where all three firms are selling.

2.1 Consumers

In each country κ, $\kappa = \alpha, \beta, \gamma$, there is a continuum of consumers uniformly distributed uniformly on a circle; we normalize the population (circumference) to three (3). The circle is illustrated in Figure 1.

We further assume that each consumer has an inelastic demand for the product and buys one unit from one of the firms located on the circle. Let $d_1(x)$, $d_2(x)$, and $d_3(x)$ denote the

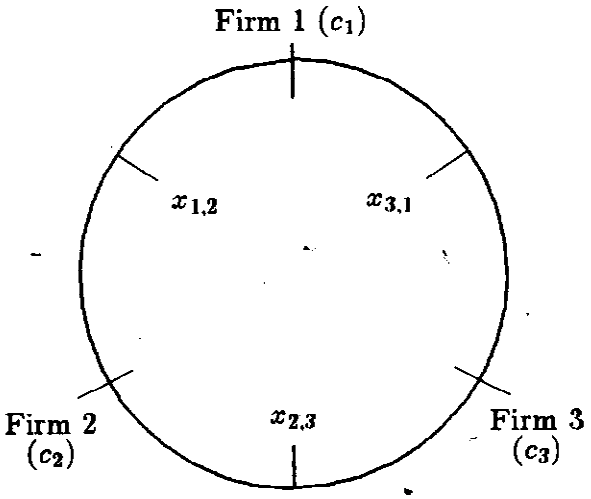

Figure 1: Salop's circular country

shortest arc distance between an arbitrary consumer x and firms 1, 2, and 3, respectively, and let p_1, p_2, and p_3 be the price charged by each firm respectively. We assume that the loss function of an arbitrary consumer x is given by

$$L_x \equiv \begin{cases} \tau d_1(x) + p_1 & \text{if he buys brand 1} \\ \tau d_2(x) + p_2 & \text{if he buys brand 2} \\ \tau d_3(x) + p_3 & \text{if he buys brand 3} \end{cases} \tag{1}$$

where τ measures the per unit transportation cost associated with buying a brand which is located distance $d_i(x)$ from the consumer's 'ideal' brand. Hence the utility function of an arbitrary consumer x is[6]

$$U_x = \theta - L_x \tag{2}$$

2.2 Firms and technology

In each country there is a single firm *producing* a single brand. Brand 1 is produced in country α, brand 2 in country β, and brand 3 in country γ. Consumer preferences are such

[6]Our assumption that each consumer makes a purchase means that θ is relatively large.

that the firms are assumed to be equally spaced on each country's $3 - unit$ circle, so the distance between any two firms equals exactly one unit of distance.

We assume that with the exception of "standard conversion costs," production costs are identical for all brands and without loss of generality, we normalize these costs to zero. The specifications (standards) of each product are different, that is, all products have different standards. Thus, for example, if country β decides to recognize the standard employed by the domestic producer only, foreign producers will have to incur standard (unit) conversion costs in order to adhere to the local specification and be permitted to sell in country β. On the other hand, if the government of a particular country recognizes all standards, foreign producers need not incur the conversion cost in order to sell in the local market. We denote this unit conversion cost for brand i by c_i, $i = 1, 2, 3$, where

$$c_i \equiv \begin{cases} c & \text{if standard } i \text{ is not recognized in country } \kappa \\ 0 & \text{if standard } i \text{ is recognized in country } \kappa \end{cases} \tag{3}$$

We assume that each country has an established standard and that the domestic product meets this standard. Thus, the firm located in country α produces brand 1 to operate on α's standard. Similarly, the firm located in country β produces good 2 to operate on β's standard, and so on.

We further assume that standard conversion costs are such that $c \leq 5\tau/2$. This assumption ensures that all firms always have strictly positive market shares in each country.

In the case in which foreign standards are not recognized, standards may be protected by patents belonging to the domestic agents. More precisely, for example, if β's standard is not recognized in country α, firm 2 has to pay a licensing fee of ρc per unit sold in country α to the government of country α. Assuming $0 \leq \rho \leq 1$, this licensing fee is equal to a fraction of the per unit conversion cost that makes the product meets the domestic standard, while $(1 - \rho)c$ reflects the real resource cost associated with physically converting a product to operate on a different standard. We will consider the extreme cases defined below.

DEFINITION 1 *If $\rho = 1$, we say that standard conversion cost is solely a* **patent licensing fee**. *If $\rho = 0$, we say that standard conversion cost is* **real**.

When $\rho = 1$, the standard conversion cost is a pure transfer between nations. Examples include all products in which regulations require importers to obtain certification from the domestic standard institute or equivalent.[7] In contrast, when $\rho = 0$ conversion requires changes in the physical characteristics of the product and therefore constitute pure social waste. For example, cars imported from one country to another need to adhere to local specifications, e.g., replacing headlights, which constitute a social loss to the world economy.

Finally, we assume that national markets are fully segmented so that no arbitrage takes place. This assumption implies that firms can set different prices in different countries.

2.3 Standardization policies

In the basic model, each government κ is restricted to choosing an action $a^\kappa \in \{R, NR\}$, where R means recognizing *all* foreign standards, and NR means not recognizing foreign standards. We assume that the objective of each government κ is to maximize welfare, which is defined to be the sum of domestic firm profits, licensing fees, and consumer surplus. We define a world standardization outcome as the strategy triplet $(a^\alpha, a^\beta, a^\gamma)$.

[7] An equivalent alternative interpretation of the model in this case is that consumers have preferences for standards that are recognized domestically, either by the country's official Standards Institute or by a regulatory body that has the authority to recognize or certify standards.

For example, Tadiran, the only Israeli domestic producer of refrigerators recently advertised that its standard was recognized by the Israeli Standards Institute and no foreign manufacturers had received such recognition. Another example, cited by Muren (1994), is that the (U.S.) Lighting Protection Institute (LPI) will not certify products of non-members, even if they meet LPI standards.

Consider the case in which there are no standardization costs, but consumers have preferences for standards that are recognized domestically so that the consumer loss function is:

$$L_x \equiv \begin{cases} \tau d_1(x) + p_1 + c_1 & \text{if he buys brand 1} \\ \tau d_2(x) + p_2 + c_2 & \text{if he buys brand 2} \\ \tau d_3(x) + p_3 + c_3, & \text{if he buys brand 3} \end{cases} \tag{4}$$

where c_i is from (3).

It can easily be shown that the results using this alternative model are identical to the case when $\rho = 1$.

3 Equilibrium Standardization Policies

3.1 Timing of the game

In the first stage, each country decides whether to recognize all foreign standards or not recognize any foreign standard.[8] In the second stage, each firm sets profit maximizing prices in each country and consumers make purchases. We solve the game by backwards induction beginning with the second stage.

3.2 Second stage: equilibrium prices and market shares

In this stage, government standardization policies are given (therefore the firms' unit costs in each country are given). Under our assumption that $c \leq 5\tau/2$, all firms will have positive market shares in each country in equilibrium, implying that we can solve for the equilibrium prices in a representative country. Denote by x_i the market share of firm i, and by $x_{i,j}$ the location of a consumer who is indifferent between buying brands i and j, as measured from the location of firm i, see Figure 1. Each firm takes the prices of its rivals (and government standardization policy as given) and sets its price to maximize its profit in that country. We can state the following proposition, which is proved in Appendix A.

Proposition 1 *Equilibrium prices (p_i), market shares (x_i), and profits (π_i) of firm i in a representative country are:*

$$p_i = \tau + \frac{c_j + c_k}{5} + \frac{3c_i}{5}, \qquad i,j,k \in \{1,2,3\}, \;\; i \neq j \neq k \tag{5}$$

$$x_{i,j} = \frac{1}{2} + \frac{c_j - c_i}{5\tau} \quad \textit{and} \quad x_i = 1 - x_{k,i} + x_{i,j} = 1 + \frac{c_j + c_k - 2c_i}{5\tau} \tag{6}$$

[8] The results are unaffected by allowing a country the option of recognizing one foreign standard, but not recognizing another foreign standard.

$$\pi_i = \frac{(5\tau + c_j + c_k - 2c_i)^2}{25\tau}, \quad i,j,k \in \{1,2,3\}, \quad i \neq j \neq k. \tag{7}$$

3.3 Total surplus under all possible standardization policies

Let Π_i denote firm i's aggregate world-wide profit from selling brand i in the three countries. That is, $\Pi_i = \pi_i^\alpha + \pi_i^\beta + \pi_i^\gamma$, where π_i^κ is the profit earned by firm i from selling in country κ which is given in (7).

Assuming that firm k is located in country κ (hence, $c_k = 0$), the licensing fees earned by country κ are

$$LF^\kappa = \rho c_i x_i + \rho c_j x_j = c_i \left[1 + \frac{c_j - 2c_i}{5\tau}\right] + c_j \left[1 + \frac{c_i - 2c_j}{5\tau}\right], \tag{8}$$

Hence,

$$LF^\kappa = \begin{cases} 2\rho c \left(\frac{5\tau - c}{5\tau}\right) & \text{if } a^\kappa = NR \\ 0 & \text{if } a^\kappa = R \end{cases} \tag{9}$$

In a given country, denote by E_i the total consumer expenditure on brand i, $i = 1,2,3$. Then, by (5) and (6) we have that

$$E_i \equiv p_i x_i = \left[\tau + \frac{c_j + c_k + 3c_i}{5}\right]\left[1 + \frac{c_j + c_k - 2c_i}{5\tau}\right] \tag{10}$$

Finally, we wish to calculate the aggregate consumer transportation costs for each brand producing firm for this representative country. Figure 1 shows that to the left of firm 1 the average distance traveled to firm 1 is $x_{1,2}/2$, while the average distance traveled by the consumers located to the right of firm 1 is $(1 - x_{3,1})/2$. Hence, using (6), the aggregate transportation cost for brand 1 is given by

$$T_1 \equiv \frac{\tau(x_{1,2})^2}{2} + \frac{\tau(1 - x_{3,1})^2}{2} = \frac{\tau}{2}\left[\frac{1}{2} + \frac{c_2 - c_1}{5\tau}\right]^2 + \frac{\tau}{2}\left[\frac{1}{2} + \frac{c_3 - c_1}{5\tau}\right]^2$$

More generally, for each brand i, $i = 1, 2, 3$, the aggregate consumer transportation cost for brand i is given by

$$T_i = \frac{\tau}{2}\left[\frac{1}{2} + \frac{c_j - c_i}{5\tau}\right]^2 + \frac{\tau}{2}\left[\frac{1}{2} + \frac{c_k - c_i}{5\tau}\right]^2, \quad i, j, k \in \{1, 2, 3\}, \quad i \neq j \neq k \tag{11}$$

From (1) and (2), country κ's aggregate consumer surplus is given by total gross utility (3θ) less the sum of aggregate consumer expenditure on all brands and the aggregate economy's transportation cost. Formally, country κ's consumer surplus is

$$CS^\kappa \equiv 3\theta - (E_1^\kappa + E_2^\kappa + E_3^\kappa + T_1^\kappa + T_2^\kappa + T_3^\kappa), \quad \kappa = \alpha, \beta, \gamma \tag{12}$$

where E_i^κ is defined in (10) and T_i^κ in (11). Hence total surplus in country κ, with domestic firm k is

$$TS^\alpha \equiv CS^\kappa + \Pi_k + LF^\kappa. \tag{13}$$

3.4 First stage: Equilibrium standardization policies

The government of country κ chooses its action to maximize (13). Table 1 provides the total surplus of country α under all possible standardization policies outcomes.

Recalling our assumption that $c \leq 5\tau/2$, Table 1 implies the following proposition:

Proposition 2 *When government's action set is restricted to fully recognizing all foreign standards, or not recognizing any foreign standard, then*

1. *if the standard conversion cost is comprised of a patent licensing fee (Definition 1), then choosing not to recognize foreign standards is a dominant strategy for each country. Formally, if $\rho = 1$, then $a^\kappa = NR$ is a dominant strategy for every country $\kappa = \alpha, \beta, \gamma$;*

2. *if standard conversion cost is real, then choosing to recognize all foreign standards is a dominant strategy for each country. Formally, if $\rho = 0$, then $a^\kappa = R$ is a dominant strategy for every country $\kappa = \alpha, \beta, \gamma$.*

$(a^\alpha, a^\beta, a^\gamma)$	α's Welfare (TS^α)
(R, R, R)	$3\phi - \frac{3\tau}{4}$
(NR, R, R)	$3\phi - \frac{3\tau}{4} + \frac{6c^2}{25\tau} - \frac{6c}{5} - \frac{2c^2\rho}{5\tau} + 2c\rho$
(R, NR, NR)	$3\phi - \frac{3\tau}{4} + \frac{6c^2}{25\tau} - \frac{6c}{5} - \frac{2c^2\rho}{5\tau} + 2c\rho$
(NR, NR, NR)	$3\phi - \frac{3\tau}{4} + \frac{8c^2}{25\tau} - 2c - \frac{2c^2\rho}{5\tau} + 2c\rho$
(R, R, NR)	$3\phi - \frac{3\tau}{4} + \frac{c^2}{25\tau} - \frac{2c}{5}$
(NR, NR, R)	$3\phi - \frac{3\tau}{4} + \frac{7c^2}{25\tau} - \frac{8c}{5} - \frac{2c^2\rho}{5\tau} + 2c\rho$

Table 1: Country α's total surplus under all possible standardization policy outcomes

When the standard conversion cost is purely a tax on foreign producers, choosing not to recognize foreign standards has several opposing effects on total surplus. On one hand, non-recognition means that foreign firms pay standard licensing fees to the non-recognizing country. On the other hand, the higher costs for the foreign firms reduces price competition in the recognizing country, thereby increasing prices of all brands. The higher costs for foreign producers also result in increased price dispersion, which means higher transportation costs for consumers. Total surplus is higher under non-recognition because the licensing effect dominates the consumer surplus effect.[9] In contrast, when a country does not collect licensing fees from foreign producers, a country can only lose from not recognizing foreign standards, since recognition leads to lower prices and less price dispersion.

We close this section by stating the following corollary, which is implied by Table 1.

Corollary 1 *Regardless of the type of standardization cost, "mutual" policy recognition of standards by all countries yields higher total surplus to each country than mutual non-recognition. Formally, for every* $0 \leq \rho \leq 1$, *the outcome* (R, R, R) *yields a higher total*

[9]This result is similar in spirit to Gross (1987), who using a Chamberlinian monopolistic competition trade model in a Dixit-Stiglitz-Krugman environment, that the optimal tariff is strictly positive.

surplus to each country compared with the outcome (NR, NR, NR).

Corollary 1 follows from the fact that even if standard conversion cost are net transfers between firms to (foreign) governments, mutual recognition welfare dominates non-recognition due to the increased price dispersion associated with non-recognition. Thus, the case in which $\rho =$ '1 results in a Prisoners' Dilemma outcome; countries do not recognize foreign standards, yet mutual recognition would increase the total surplus of all countries.

4 Common Markets and Standardization Policies

The previous section showed that if coordination concerning standardization policies is not possible, then each country will choose not to recognize foreign standards if standard conversion cost consists mainly of patent licensing fees, and to recognize all foreign standards if standard conversion costs constitute a real resource loss. In this section we examine whether a policy of 'mutual standard recognition' can emerge as an equilibrium.

Similar to the concepts of Custom Union and Free Trade Area, we introduce the following terminology:

DEFINITION 2 *1. An* **Open Standards Area** *(OSA) exists if all member countries mutually recognize all standards of the goods produced in other member countries; in an OSA, each member country is free to set its own standardization policy with respect to non-member countries.*

2. A Standardization Union (SU) exists if countries enter into an OSA and, in addition, agree to set a common standardization policy towards non-member countries.

Thus, in this section we enlarge the strategy set of each government to include the possibility of recognizing the standard of one foreign country but not recognizing the standard of another foreign country. We denote by $a^{\kappa} = R^{\kappa', \neg\kappa''}$ an action where the government of country κ recognizes the standard of country κ' but *does not* recognizes the standard of country κ''.

Thus, the strategy set of each country κ is now enlarged to the set $\{R, NR, R^{\kappa',\neg\kappa''}, R^{\kappa'',\neg\kappa'}\}$, $\kappa \neq \kappa' \neq \kappa''$ and $\kappa, \kappa', \kappa'' = \alpha, \beta, \gamma$.

4.1 Standardization Union (SU)

In the first stage, any two countries can agree to "mutual recognition" of standards, and set a common standardization policy with respect to the non-member countries. In such a case, the standards of the respective domestic firms are recognized in both countries. In the second stage, firms set prices in each market and consumers make purchases. We again solve the game by backwards induction.

Without loss of generality, we assume that if a mutual recognition policy is agreed upon, it is between countries α and β. The total surplus for country α when countries α and β form a SU and neither recognizes country γ is shown in Table 2. The table also shows the surplus received by country' γ.

$(a^\alpha, a^\beta, a^\gamma)$	α's Welfare (TS^α)	γ's Welfare (TS^γ)
$(R^{\beta,\neg\gamma}, R^{\alpha,\neg\gamma}, NR)$	$3\phi - \frac{3\tau}{4} + \frac{c^2}{5\tau} - \frac{3c}{5} - \frac{2c^2\rho}{5\tau} + c\rho$	$3\phi - \frac{3\tau}{4} + \frac{14c^2}{25\tau} - \frac{14c}{5} - \frac{2c^2\rho}{5\tau} + 2c\rho$
$(R^{\beta,\neg\gamma}, R^{\alpha,\neg\gamma}, R)$	$3\phi - \frac{3\tau}{4} + \frac{4c^2}{25\tau} - \frac{c}{5} - \frac{2c^2\rho}{5\tau} + c\rho$	$3\phi - \frac{3\tau}{4} + \frac{8c^2}{25\tau} - \frac{8c}{5}$

Table 2: Total surplus for SU member Country α, and non-member country γ

Proposition 3 *1. When standard conversion cost consists only of licensing fees ($\rho = 1$, the unique subgame perfect equilibrium is for two countries to agree on a SU and mutually agree not to recognize the standard prevailing in the excluded country.*

2. When standard conversion costs constitute a real loss ($\rho = 0$), the above statement holds if and only if $c \geq 5\tau/4$.

3. *The non-member (excluded) country does not recognize any foreign standard if* $\rho = 1$ *and will recognize all standards if* $\rho = 0$.

Proof. Clearly, by Proposition 2, we can restrict our welfare comparison to the mutual non-recognition outcome (NR, NR, NR). When $\rho = 1$, Tables 1 and 2 imply that

$$TS^{\alpha}(R^{\beta,\neg\gamma}, R^{\alpha,\neg\gamma}, NR) > TS^{\alpha}(NR, NR, NR)$$

When $\rho = 0$, Tables 1 and 2 imply that

$$TS^{\alpha}(R^{\beta,\neg\gamma}, R^{\alpha,\neg\gamma}, R) > TS^{\alpha}(R, R, R) \quad \text{if and only if} \quad c > \frac{5\tau}{4}$$

The last part follows from the third column in Table 2. ∎

Clearly, a standardization union is established for the purpose of increasing the market shares of member countries' firms (at member countries' markets) at the expense of firms in non-member countries. Proposition 3 demonstrates that union formation is always preferred (by member countries) over non-recognition when standardization costs are merely transfers among countries. However, when there are no licensing fees (conversion costs are a pure loss), a union will be formed only if conversion cost is not too small. This result stems from the fact that when conversion cost is not 'too small,' union formation significantly increases the market shares of the firms in member countries' markets, and this profit increasing effect dominates consumer loss associated with price dispersion.[10]

4.2 Open Standards Area (OSA)

There is now an additional stage to the game. In the first stage, any two countries can agree to "mutual recognition" of standards. In such a case, the standards of the respective

[10]We use the term price distortion to indicate two inefficiencies associated with price dispersion: (a) Given our symmetric model, efficient pricing means that all brands are sold for the same price. (b) Transportation costs are higher with unequal market shares than they are with equal market shares.

domestic firms are recognized in both countries. In the second stage, each "member" country (independently) decides whether to recognize the other standard, and the non-member country decides whether or not to recognize foreign standards.

Corresponding to Table 2, the total surplus for a union member country α when it also recognizes the non-member's standard (while the other member country β does not recognize the non-member's standard), is given by

$$TS^{\alpha}(R^{\beta,\gamma}, R^{\alpha,\neg\gamma}, NR) = 3\phi - \frac{3\tau}{4} + \frac{2c^2}{25\tau} \tag{14}$$

Similarly,

$$TS^{\alpha}(R^{\beta,\gamma}, R^{\alpha,\neg\gamma}, R) = 3\phi - \frac{3\tau}{4} + \frac{c^2}{25\tau} + \frac{2c}{5} \tag{15}$$

Proposition 4 *1. When $\rho = 1$ and $c > 10\tau/7$, an OSA is formed and no member country recognizes the non-member's standard. Otherwise, an OSA and SU do not form and the unique equilibrium is (NR, NR, NR).*

2. When $\rho = 0$, an OSA is formed whenever an SU would be formed (Proposition 3); no member country recognizes the standard of the non-member country γ.

Proof. The first part follows from Comparing TS^{α} in (14) with Table 2 when $a^{\gamma} = NR$. The second part follows from Comparing TS^{α} in (15) with Table 2 when $a^{\gamma} = R$. In this case, no member recognizes the non-member if $c > 5t/3$ which is implied by the condition in Proposition 3. ■

5 Countries' Size and Standardization Unions

In the previous section we investigated the incentives for two countries to mutually recognize each other's standards. We showed that in the setting in which all countries are the same size, any two countries will have an incentive to reach an agreement to mutually recognize standards. The obvious follow-up question is how country size affects the incentives of

countries to form standardization unions. We examine this question for the case in which $\rho = 1$.

Let the population size of country κ be denoted by $3z^{\kappa} > 0$, $\kappa = \alpha, \beta, \gamma$. We'll continue to assume that consumer tastes are uniformly distributed on the 3-unit circle; hence a change consumer density (z^{κ}) does not affect the location of the "indifferent" consumers, nor equilibrium prices in each economy, which are given by (5). Hence, per-capita consumer welfare in each country, defined in (12), is not affected by changing a country's consumer density.

However, changes in population size in each country will affect the profit of firms and the licensing fees. It can be shown that the total surplus of a representative country α under the setting in which only the domestic standard is recognized in each country is

$$TS^{\alpha}(NR, NR, NR) = 3\theta + (z^{\beta} + z^{\gamma} - 2z^{\alpha})\frac{(5\tau - c)^2}{25\tau} - z^{\alpha}\left(\frac{3\tau}{4} + \frac{2c^2}{25\tau}\right). \qquad (16)$$

Further it can be shown, similar to the case in which all of the countries are all the same size, that when a country is restricted to either recognize foreign standards or not recognize them (that is mutual recognition is not possible), the unique subgame perfect equilibrium is not to recognize foreign standards.

Now suppose that countries α and β reach a mutual recognition agreement, that these two countries do not recognize the standard of the third country and that the third country does not recognize foreign standards. Then the total surplus in country α is

$$TS^{\alpha}(R^{\beta,\neg\gamma}, R^{\alpha,\neg\gamma}, NR) = 3\theta + (z^{\beta} - z^{\alpha})\frac{(5\tau + c)^2}{25\tau} + z^{\gamma}\frac{(5\tau - c)^2}{25\tau} - z^{\alpha}\frac{(5\tau - 2c)^2}{25\tau} - z^{\alpha}(\frac{3\tau}{4} + \frac{2c^2}{25\tau}). \qquad (17)$$

The increase in total surplus for country α from the formation of the mutual recognition pact with country β is (17) - (16) or

$$\Delta TS \equiv (z^{\beta})\frac{(5\tau + c)^2}{25\tau} - z^{\alpha}\frac{(10\tau c + 3c^2)}{25\tau}. \tag{18}$$

From the above equation, we see that the incentive to form a standardization union is increasing in the population of the "partner" country and decreasing in the population of domestic country. Equation (18) is not necessarily positive for all country pairs, although it clearly is positive for the smaller country in the partnership. If (18) is positive for all country pairs, the largest two countries will form the standardization union. On the other hand, if one country is much larger than the other two countries, a standardization union may form between the two smaller countries. Finally, if the population of the countries diverge greatly, no standardization union will form.

6 Israel's Standardization Policy

We now use the above models and the results to analyze Israel's standardization policies.

6.1 Background

Until the early 1990s, all importers had to obtain separate import licenses from the Ministry of Trade and Industry (MTI) for each good that they imported. Recent reforms mean that importers now can obtain a general license allowing them to commercially import groups of products. However, there has been no reform of the MTI policy requiring that importers receive certification that their products meet Israeli standards; domestic testing is required, even if the products have been certified by foreign standardization institutions.

With the exception of communications equipment, the standards are set by the Israel Standards Institute (ISI) in conjunction with the MTI; the ISI also conducts the certification tests. In the case of communications equipment, standardization policy is determined by the Ministry of Communications (MOC) and this Ministry also conducts certification tests.

Our discussion of Israel's standardization policy is divided into three parts: In section 6.2

we discuss how MTI/ISI policy affects import competition. In section **6.3** we examine the effects of the Ministry of Communications' standardization policy. Section **6.4** concludes with policy recommendations.

6.2 The Israel Standards Institute

With the exception of telecommunications equipment, the Israel Standard Institute (ISI) is the (sole) authority for standard certification in the State of Israel. The ISI has 800 workers and 99 percent of its income comes fees collected by laboratory tests it performs.[11]

The stated goals of the ISI are:

1. Determine and publish standards for products sold in Israel.
2. To perform lab test for products sold in Israel, as directed by the Ministry of Trade and Industry.
3. To test and certify all products (mainly locally produced) that the manufacturer wishes to be certified.

The ISI can essentially set any standard it wishes, and the standards need not be related to safety, health, or pollution of the products. In practice, the ISI's standardization policy affects nearly every product sold in Israel. ISI standardization policy often rules out imported products simply because they are *different* from the locally produced specifications (e.g., dimensions, shapes, language etc.)

Importers of products into Israel are required by the Ministry of Trade and Industry to submit samples to the ISI for testing adherence to local standards. Nearly all products are tested even if they have been previously approved by well known standard setting institutions.

[11]Background information on the ISI and on ISI standardization policy come from ISI publications and the HA-ARETZ, Weekend Supplement, March 10, 1995.

6.3 Communication equipment

Israel's telephone services are primarily provided by Bezeq, the governmental company which owns the telecommunications infrastructure. *All* imported equipment that is to be connected to the telecommunications network must be tested and certified by the MOC laboratories; the MOC charges hefty fees for testing and certification.[12]

In order to have its product tested by the MOC labs, the importer must:

1. Submit three (3) units of each product.
2. Submit a certification from the ISI for each electrical product, asserting that the product is safe.
3. Submit a variety of documents including:
   (a) Detailed technical charts.
   (b) Copies of the importer's registration certificate and cards, names of CEOs and all those who are eligible to sign on behalf of the company.
   (c) Original brochures and operating manuals must be translated into either Hebrew or English. (This must be done before testing begins).
   (d) Foreign test results and registration approval for the product.
   (e) A list of stores and licensees that will sell the product locally.[13]

Of course, the MOC laboratories charge (separate) fees for the application, lab reports, custom release documents, etc. Importers are also required to deposit money in an MOC bank account during the testing process. For example, the total fee for testing a simple telephone is $ 400, but the applicant must secure around $ 3,300 as a deposit. If the MOC approves the product, the importer is granted a "special permit" to import the product for *three* years.

[12]Background information on MOC certification policy comes from MOC publications.
[13]The applicant is required to continuously update of this list.

6.4 Recommended policy changes for Israel

Despite a cumbersome and expensive certification process, many foreign manufacturers find it profitable to change specifications in order to sell in the Israeli market. Our theoretical model discussed two cases:

1. If rents can be collected from the foreign manufacturers, a country can benefit from non-recognition of foreign standards.

2. If rents cannot be collected from foreign manufacturers, unilateral recognition of foreign standards is the optimal policy.

In our theoretical model, we assumed that the rents collected from testing and certification benefit society as a whole. That is, we made the typical assumption that rents are always equally distributed among consumers. However, most of the rents collected by the ISI from its lab tests do not benefit society as a whole. Further, despite the fact that the rents from testing communications equipment are collected by a government agency, most of these rents do not benefit society as a whole. Hence, if we discount the rents, the Israeli setting is closer to case 2.

Hence, the main effect of the certification process in Israel is to raise domestic prices and reduce the variety of products available.[14] We have the following recommendations:

6.4.1 Separation of standard regulating and standard testing bodies

In any regulating process, it is desirable to separate the regulating agency from the enforcement agency in order to prevent excess regulations. We therefore suggest that the standards regulating agencies (ISI, MOC) should not be allowed to operate the laboratories to test the products.

[14]The reduction in variety indirectly contributes to higher prices by increasing the monopoly position of brands that are sold in the country.

6.4.2 Recognizing foreign labs

The ISI does not recognize EC standards because EC does not recognize ISI standards. Since case 2. (above) likely applies for Israel, we suggest that the ISI recognize EC and US standards despite the fact that there is no mutual recognition.

6.4.3 Scope of Regulation

While we think that the government plays a key role in defining the rules of the game (by legislating antitrust, product liability and other consumer protection laws), we believe that with the exception of health and safety standards, the Israeli market should be open and not managed by the ISI. This suggestion is in line with European Community policy which allows local standardization policies only in cases in which there are health and safety concerns.

6.4.4 Communication equipment

We cannot find any justification for the MOC' import certification policy for communication equipment. We believe that the current policy should be replaced by the policy adopted by the U.S. Federal Communications Commission (FCC) where the standard for terminal equipment is limited to "no harm to the network." The current Israeli policy results in visible damages to consumers in the form of (a) high prices, and (b) the import of old outdated equipment due to the fact that the certification process is quite lengthy.

Appendix

A Deriving a circular country model with asymmetric cost structure

A.1 The n-brand case

Consider an economy with population size z and n firms located on an n-circumference circle, where each firm produces a single brand. Then, the firms are located one unit of distance from each other and population density is given by z/n, which also equals the number of consumers located between any two firms. Figure 1 illustrates such an economy where $n = 3$. Given prices for the three brands, the consumer who is indifferent between purchasing brand 1 and brand 2 must satisfy

$$p_1 + \tau x_{1,2} = p_2 + \tau(1 - x_{1,2})$$

implying that

$$x_{1,2} = \frac{1}{2} + \frac{p_2 - p_1}{2\tau} \tag{19}$$

Firm 1 takes all prices charged by other firms as given and chooses p_1 that solves

$$\max_{p_1} \pi_1 = (p_1 - c_1)\frac{z}{n}(x_{1,2} + 1 - x_{1,3}) = (p_1 - c_1)\left(1 + \frac{p_2 - p_1}{2\tau} + \frac{p_3 - p_1}{2\tau}\right)$$

yielding first order condition given by

$$0 = \frac{\partial \pi_1}{\partial p_1} = \frac{z}{n}\left(1 + \frac{p_2 + p_3}{2\tau} - \frac{2p_1}{\tau} + \frac{c_1}{\tau}\right) \tag{20}$$

We can now generalize (20) to any firm j, assuming that firm j is located between firms i and k. Thus, for any firm j, $i < j < k$; $i, j, k \in \{1, 2, \ldots, n\}$

$$p_j = \frac{\tau}{2} + \frac{p_i + p_k}{4} + \frac{c_j}{2} \tag{21}$$

A.2 The 3-brand case

Suppose now that $n = 3$ and $z = 1$. In this case, (21) is given by

$$\begin{aligned} 4p_1 &= 2\tau + p_2 + p_3 + 2c_1 \\ 4p_2 &= 2\tau + p_1 + p_3 + 2c_2 \\ 4p_3 &= 2\tau + p_1 + p_2 + 2c_3 \end{aligned} \tag{22}$$

Solving (22) yields the equilibrium prices given in (5). Substituting (5) into (19) and generalizing for all brands yields (6).

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