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National Standards and International Trade

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Abstract

Standards and technical regulations which govern the admissibility of imported goods into an economy raise costs of exporters entering new markets, and may have a particularly high impact on firms seeking to export from developing countries. Yet standards may also have a positive side, such as certifying product quality and safety for the consumer. This paper analyzes potential conflicts of interest between consumers and firms in a developed and a developing country under different assumptions about the costs and benefits of standards imposed on tradable products by one or both of the countries.

Keywords: Technical standards, product standards, non-tariff barriers

JEL classification: F12, F13, F15

1. Introduction

Standards and technical regulations have assumed increased importance in the trade-policy agenda. Possibly, this is because they have become quantitatively more important and burdensome, or possibly they are simply relatively more important as traditional trade barriers such as tariffs and quotas decline in importance (Baldwin, 2000). In either event, there seems to be a case for closer examination and more formal modeling of standards as they impact on trade and national welfare (Maskus and Wilson, 2000).

Standards and technical regulations are often portrayed as barriers to trade that restrict competition in the local economy by raising costs to foreign suppliers. For instance, the WTO Agreement on Technical Barriers to Trade (GATT, 1994) seeks to “ensure that technical regulations and standards, including packaging, marking and labelling requirements, and procedures for assessment of conformity with technical regulations and standards do not create unnecessary obstacles to international trade.”

The idea that standards can constitute an anti-competitive and protectionist device seems obvious. Yet it is clear that they may also have benefits, not just to domestic consumers but also to foreign suppliers. If a standard certifies a product as safe, healthy, compatible with complementary inputs such as the power supply, etc., such certification can raise consumer demand for the imports (cf. Akerlof, 1970). This effect can possibly result in increased profits to foreign firms in spite of higher costs (see Jones and Hudson, 1996).¹

The purpose of this paper is to study the specific economic impact of differing technical

¹This idea seems to be supported by empirical evidence to some extent. In a detailed empirical study, Moenius (1999) finds that country-specific standards reduce imports for non-manufactured goods, while they promote trade in the manufacturing sector.

regulations and standards across national boundaries.² The analysis focuses on the welfare effects of different cost structures induced by national standards. Several questions - related to the WTO Agreement on Technical Barriers to Trade - are particularly interesting in this context. Generally, what are the effects of different standards and related regulations on consumer welfare as well as firms' profits in developed and developing countries? More specifically, what are the effects in developing countries of costly procedures for assessment of conformity with standards in developed countries?

We suggest two approaches to formally modeling national standards in international markets. First, national standards are modeled as a real trade cost, which can be either variable or fixed. For instance, testing procedures and border controls fall into this category. Second, national standards are modeled as a market-segmenting instrument, possibly represented as an arbitrage cost. Formal restrictions on parallel trade is an example in this category.

The discussion and conclusions in this paper build on the analysis presented in Ganslandt and Markusen (2000), where we solve all of the models discussed here. Sections 2 and 4 use a two-good, two-factor, two-country, general-equilibrium model in which countries have identical relative productivities across sectors and relative factors endowments.³ In general we assume that one country is considerably larger than the other, either because of endowment size or (sector neutral) technical superiority, trying to capture one notion of rich/big versus poor/small countries. Each country has a fixed number of imperfectly competitive firms in the X sector. In section 3 and 5 we restrict our attention to a partial equilibrium analysis of an international

²There appears to be several motivations for more detailed studies of the sources of market fragmentation (see for instance Head and Mayer, 2000).

³By identical "relative" technologies or productivities across sectors we mean that there is no Ricardian comparative advantage. One country could be uniformly more advanced in all sectors.

monopoly. This simplified version of the model is used to study the relationship between national standards and firm behavior.

In the first three models, section 2-4, the standards in the two countries are simply different, neither is better nor worse. The standards raise the cost of trade in the imperfectly competitive sector, but the quality of the goods remains unaffected by the different standards. This assumption in the last model, presented in section 5, in which the difference in national standards is enhancing the provision of local public goods.

In section 2, we show how to model a purely cost-increasing standard; that is, there is no beneficial effect from the standard. Not surprisingly, a standard imposed by one country tends to benefit producer interests at the expense of consumer interests.⁴ An important result, but possibly also not surprising, is that the small country cannot win a “standards’ war” in which both countries impose cost-increasing standards on imports, analogous to a tariff war in traditional trade theory. Both producers and consumers may lose in the small country. Thus an international code that restricts the use of purely “harassment” standards (e.g., multiple inspection requirements) aids the small/poor country and may even win support from small-country import-competing producers.

In section 3, we consider the idea that standards may act as a market-segmentation device, which prevents arbitrage and parallel trade in imperfectly competitive markets. In the automobile industry, for example, country-specific emission and safety standards prevent non-auto firms and

⁴Several papers have stressed that a single country may have an incentive for a “strategic” use of standards. For instance, Wallner (1998) shows that a standard can be used as a strategic tool to raise domestic welfare by raising the cost of foreign producers relative to the cost of local firms in a Cournot triopoly. In yet another partial-equilibrium analysis, Gandal and Shy (2000) show that large countries can raise their welfare by exclusive MRAs (mutual recognition agreements) at the expense of smaller trading partners. Other examples include Jensen and Thursby (1996) and Barrett and Yang (1996).

consumers from arbitraging products from one market to another. In many situations this might not be an issue for developing countries. But there are instances in which a poor country could be helped by restrictions on arbitrage. More specifically, a poor country could benefit from diverging national standards, if optimal pricing by a imperfectly competitive company dictates a lower price in the small/poor country compared to an integrated world market.

In section 4, we assume that the standard creates a fixed cost for the small country's firms.⁵ For example, a new design might be required, but once this is created the marginal cost of production is unchanged. The interesting thing about this case is that, when there are multiple firms, there may be multiple equilibria. With a coordination problem (or free-rider problem) among firms, there may be one equilibrium in which no firm exports, and one in which there are substantial exports. Thus standards of this type create a role for the government in the non-standard-imposing country to oppose the standard or to coordinate compliance and compliance costs.⁶

In section 5, we analyze the interaction between market-segmenting standards and the provision of public goods.⁷ This is particularly relevant if the variation in preferences or income is large across markets. A monopolist may find it profitable to provide a public good jointly with a private good as long as the supply of the private good does not spill-over from the small/poor country to the large/rich country. Under such conditions different national standards can be used

⁵Fischer and Serra (2000) analyze a model in which each country set a country-specific standard and foreign firm must incur a fixed cost to export to the other market.

⁶This result is highly relevant for developing countries. For instance, Finger and Schuler (1999) note that the costs of implementation of requirements under the WTO Sanitary and Phytosanitary Standards Agreement are extremely high relative to budgets in many of the least developed countries.

⁷It is also possible to think of the standard itself as a public good, which generates joint consumption benefits. Casella (1997) argues that "Inherent in the meaning of the word *standard* is thus the concept of joint consumption by a group. The standard is a public good."

to prevent arbitrage and facilitate private provision of public goods in both developed and developing countries to the benefit of consumers in both countries.⁸

Finally, section 6 ends by drawing some policy conclusions. In particular, we discuss the potential conflicts between large/rich countries and small/poor countries.

2. Standards as Real Trade Costs

In this section, we assume that standards imply real trade costs for exporting firms in the imperfectly competitive sector.⁹ The standards of the two countries are simply different, neither is better nor worse than the other. Any exports to a country must meet the importing country's standard to be permitted to enter. An example that might come close is 110 volt versus 220 volt systems for small electrical appliances.

The model assumes two goods, X and Y , two factors, labor and capital (L and K), and two countries home and foreign (h and f). Throughout the paper, we will think of country h as a large/rich developed country, and f as a smaller/poorer developing country. In the following analysis it is also assumed that country h has a much larger share of world income than country f . The Y sector produces a homogeneous good with constant returns to scale and perfect competition, while the X sector produces differentiated goods with imperfectly competitive firms, which compete in quantities. The number of X firms is fixed in each country.

Let X_{ji} be the supply by a single firm in country j to the market in country i . Welfare in

⁸A related argument is presented in Casella (1995). Because standards respond to local demand for public goods, there is no *a priori* reason why standards should be equal in different countries.

⁹Baldwin (2000) refers to these standards as “TBTs based on horizontal norm differences” or “horizontal TBTs”.

country i is given by

$$(1) \quad U_i = Y_i^{1/2} UX_i^{1/2} \quad UX_i = A \left[n_h X_{hi}^{\beta_i} + n_f X_{fi}^{\beta_i} \right]^{1/\beta_i} \quad \sigma_i = \frac{1}{1 - \beta_i}$$

where n_h and n_f are the number of firms (varieties) in countries h and f respectively. σ_i is the elasticity of substitution between any two X goods in country i . In this section, it is assumed that the elasticity of substitution is the same in both countries, that is, $\sigma_i = \sigma$. The production function for Y in country i is given by

$$(2) \quad Y_i = L_{iy}^\gamma K_{iy}^{1-\gamma}$$

Production functions for X are identical across firms and countries. The production by a representative firm in country i is given by

$$(3) \quad X_i = L_{ix}^\delta K_{ix}^{1-\delta}$$

L and K are in inelastic supply, so factor-market clearing requires that factor demands add up to total factor supplies in country i .

$$(4) \quad L_i^* = L_{iy} + n_i L_{ix} \quad K_i^* = K_{iy} + n_i K_{ix}$$

Firms in the X sector are imperfectly competitive. Let p_{ij} denote the price for X of a firm producing in market i selling in market j . The firms' markups m_{ij} are

$$(5) \quad p_{ii}(1 - m_{ii}) = mc_i(w_i, r_i) \quad p_{ij}(1 - m_{ij}) = (1 + s_j) mc_i(w_i, r_i)$$

where mc_i is the marginal cost of producing a variety X_i and w and r are the prices of labor (L) and capital (K). $s_j mc_i$ is the cost of meeting country j 's standard when exporting from country i . The Cournot markup formula for the markup of an individual firm located in market i and selling in market j is given by (Lopez-de-Silanes, Markusen, and Rutherford, 1996):

$$(6) \quad m_{ij} = \frac{1}{\sigma} + \left[1 - \frac{1}{\sigma} \right] \frac{n_i X_{ij}}{n_i X_{ij} + n_j X_{ji}} \frac{1}{n_i}.$$

In the case of homogeneous goods where the elasticity of substitution is infinite, this reduces to the well-known equation that a firm's markup is its market share.

Next, we proceed to analyze the effects of cost-raising standards. We are particularly interested in three cases: (i) a unilaterally imposed standard in the large country, (ii) a unilaterally imposed standard in the small country and, finally, (iii) two national standards which symmetrically raise the real trade cost in both directions between the two countries.

First, consider the effects of a standard imposed by the large country. Profits increase substantially for firms in the large country and fall for the small-country firms. The intuition for this result is that the standard in the large country raises the marginal cost for small-country firms and, consequently, they reduce their output. The strategic response by the large-country firms is to expand their output and gain market shares. Total output from large-country and small-country firms is lower than in the no-standard case and the price level is higher. The result is, therefore, higher profits for large-country firms. The anti-competitive effect hurts consumers in both countries. Large-country consumers are worse off due to a higher price level. Small-country consumers are hurt by lower factor income as the imperfectly competitive sector in the small country shrinks. Thus, the standard serves the interest of the large-country firms at the expense of everyone else.

Second, consider the effects of a standard imposed by the small country. The small country cannot hurt the large country very much. The large-country firms earn most of their revenues in the large market and, consequently, the standard imposed by the small country has a small effect on their profit. The effect of a small-country standard on the small-country firms

is more interesting. The small-country standard actually hurts its own firms for low and intermediate trade costs. This is a general-equilibrium effect, in that the small-country restriction on imports from the large country causes the latter's firms to supply more to their own market, "crowding out" imports from the small country. A lower output from large-country firms intended for the small market results in a fall of factor prices for the X industry in country *h*. Thus marginal revenue (initially unchanged) exceeds marginal cost for sales to the *h* firms own market, and supply will increase. As a result the optimal supply from small-country firms in the large market is reduced and revenues from this market falls. For low levels of the restriction, this effect reduces profits of the small-country firms in the large market by more than it increases their profits from protection at home. In this case it is in the political interest of all groups - consumers and firms - to remove the cost-raising standard in the small country.

Finally, consider the case when both countries impose the same ad valorem restrictive standard. In this case consumers in both countries are hurt, but they are hurt far more in the small country *f* than in the large country *h*. Profits increase for firms in the large country even though they face an import barriers into country *f*. Profits for firms in the small country *f* fall up until an intermediate level of the barrier and then begin to rise, but only to recover their free-trade level at a very high trade cost. In other words, the small/poor country cannot win a "standards war". Conversely, an agreement to limit purely cost-increasing standards helps the small country most (although it helps large-country consumers as well).

3. Standards as a variable or fixed arbitrage cost

In some cases it is realistic to think that standards not only affect real trade costs for manufacturing firms but also changes the scope and prospects for international arbitrage. Generally, standards can either facilitate or hinder arbitrage and market integration, depending

on their exact design and content. In this section we will model national standards as a market-segmenting device.

More specifically, we model different national standards as a combination of variable and fixed costs of arbitrage. The cost can apply to all trade with the commodity or only to arbitrage activities. The exact cost structure is determined by a number of factors, including border controls, test procedures and the need to adapt foreign varieties to the local market.

The interaction between the costs of different national standards and arbitrage can be studied in a partial analysis of the model in the previous section. We are primarily interested in the relationship between different standards and firm behavior and the model can, therefore, be simplified in several respects. The imperfectly competitive X sector in the large country is assumed to be a monopoly. The price is p_{hh} in country h and p_{hf} in country f . The price of the X variety from the small country, on the other hand, is held constant and normalized to 1. The two countries differ with respect to the elasticity of substitution between products rather than market size. The elasticity of substitution between the two X varieties is strictly lower in the large/rich country than in the small/poor country, i.e. $\sigma_h < \sigma_f$. The monopolist's X variety has a different standard in country h and f and importing X goods from country f to country h is associated with a variable arbitrage cost t and a fixed arbitrage cost T .

The arbitrage condition for the large/rich country can be stated in the following way: the utility of buying the local standard of the large-country variety of X at local prices must be at least as high as the utility of buying the foreign standard of the same variety at foreign prices, including all arbitrage costs associated with the different standard. More formally, the individual arbitrage condition for X in the large country is

$$(7) \quad v(p_{hh}, I) \geq v(p_{hf} + t, I - T)$$

where $v(p,I)$ is the indirect utility function for the representative consumer in market h .

Maximizing utility with respect to income gives the indirect utility function

$$(8) \quad v(p,I) = I \left[\frac{(1+p^{\sigma-1})^{\frac{1}{\sigma-1}}}{p} \right],$$

which can be used to evaluate the individual arbitrage condition with the appropriate parameters and prices.

Next, we can proceed to study the effects of fixed and variable costs associated with different national standards. Evaluating (7) at the variable cost t it implies that the conventional arbitrage condition $p_h \leq p_f + t$ must hold.

The individual arbitrage condition can be used to study the welfare effects of a consumption distortion caused by different national standards in an international monopoly. If arbitrage is permitted, it imposes a restriction on the international price differential but no arbitrage will actually occur in equilibrium. The monopolist maximizes its profit

$$(9) \quad \pi_h = \sum_{i=h,f} X_{hi}(p_{hi})(p_{hi} - mc_i)$$

$$\text{s.t. } v(p_{hh}, I) \geq v(p_{hf} + t, I - T),$$

where mc_i is the marginal cost of production (possibly including a real trade cost for the manufacturing firm to export the goods to market i) and X_{hi} is the supply by the monopolist to the market in country i .

The main difference between variable and fixed arbitrage costs follows immediately from the arbitrage condition. The price differential increases linearly in the variable arbitrage cost to a relatively high variable cost, where arbitrage is unprofitable at segmented prices. A fixed arbitrage cost, on the other hand, makes arbitrage unprofitable at rather low levels and could,

therefore, support the assumption of segmented international markets.

Total welfare including profits and consumer surplus in both countries is higher without the standard. The main reason for the increase in total welfare is that equalized prices in the large and small country result in a reduction of the international consumption distortion caused by different local prices in the segmented equilibrium. Arbitrage serves to re-allocate goods from consumers with low valuation in small/poor countries to consumers with higher valuation in large/rich countries without reducing the total output.¹⁰ It can be argued, however, that total welfare is not particularly interesting in the international political context.

More interesting is the distribution of surplus between consumers and firms in different countries when a cost-raising standard is imposed by the large/rich country. Consumers in the large/rich country are hurt by the standard as the standard allows the monopolist to charge a higher price in the large/rich country. Consumers in the small/poor country, on the other hand, benefit from the standard in the large/rich country as the market segmentation enables the monopolist to offer its goods to the small/poor country at a rebated price without having to consider parallel imports back to the large/rich country.

So far we have discussed a pure market-segmenting standard. The welfare effect in the small country is, however, quite different when the cost of the standard applies not only to the arbitrage activity but also to trade by the original manufacturing firm. In this case, there is an important difference between a fixed and variable trade cost of different national standards, as the latter (but not the former) changes the marginal incentives of the manufacturing firm, which in turn affects total output and, ultimately, the welfare of consumers and firms in the two

¹⁰A monopolist charging different prices in two segmented markets, as in the case with cost-raising standards, is engaging in third-degree price discrimination. Varian (1985) shows that a necessary condition for total welfare to increase under third degree price discrimination is that total output increases.

countries.

Consider a national standard which affects the variable cost of arbitrage as well as the manufacturing firm's trade with the product. For instance, think of a national standard which require each unit of the good to be controlled at the national border.¹¹ The manufacturing firm produces the final good in one location; (i) production is located in the small/poor country and the product is exported to the large country or (ii) production is located in the large/rich country and the final good is exported to the small/poor country.

First, consider production in the small/poor country and exports to the large/rich country. A standard imposed by the large country raises the variable trade cost on imports to the large country. The higher marginal cost in the large market results in a higher optimal price in this market. The higher price in the large market results in a higher (not lower) price in the small market. The reason is that prices in both markets have to satisfy the arbitrage condition. For low trade costs the arbitrage condition implies that the price differential between the two markets has to be narrow and, consequently, the higher price in the large market spills-over to the small market. This arbitrage-effect dominates for low trade costs, but is moderated at high trade costs. The revenues in the large market is a small share of the total profit for high trade costs and the arbitrage condition has less impact on the price in the small/poor country. Eventually, for very high trade costs the price in the small market is falling. Welfare in the small/poor country, therefore, has a u-shaped form. Consumers in the small/poor country as well as consumers in the large/rich country are hurt by a standard in the large country, which results in a moderate trade cost. In this case, consumers in both countries prefer to remove the national standard in the large/rich country.

¹¹Border controls to verify that food or animals are uncontaminated could possibly be included in this category.

Next, consider production in the large country, with exports to the small country. Different national standards in the large and small country results in a symmetric bilateral trade cost between the two markets. Now, a higher variable trade cost in the small country results in a higher optimal price in this market, which tends to relax the arbitrage condition. For low variable costs the arbitrage condition binds, but the effect on the price in large country is less strong. For high variable costs, on the other hand, the arbitrage condition is not binding. It immediately follows that prices in both countries are lower in the absence of national standards and, consumers in both countries prefer the situation with no standard to a situation with national standard imposed by the large and small countries.

The results in this section reinforces the results from the previous section. Consumers in the small/poor country and consumers in the large/rich country are hurt by national standards which raises the real trade cost. One exception is that small-country consumers benefit from purely market-segmenting standards as long as the result is a rebated price from an international monopolist compared to the integrated equilibrium.

4. Standards as a fixed cost of entry: multiplicity of equilibria

A national standard may require exporting firms to develop a new design for the standard-imposing country. This new design may result in a fixed cost, after which the good can be produced and traded at the old marginal cost. The new design created by this fixed cost can in turn be purely private, or it may be a non-excludable public good. An example in the latter category is health and safety standards. In some cases, “scientific evidence” has to be presented to show that a particular production method is “safe” before a product can be exported to the standard-

imposing country.¹² The cost of producing the scientific evidence is mainly fixed and the result is a public good for all exporting firms.

The case of a non-excludable public good is particularly interesting and leads to different theoretical, modeling, and policy issues. One of these is the possibility of multiple equilibria, which will be the focus of this section. At a given fixed cost needed to meet the large-country standard, there may be two equilibria, one with zero exports from the small country and one with positive exports.

The model from section 2 can be slightly modified to study this issue. We assume that the firms in the small country has to incur a joint fixed cost F to export to the large country and consider a case with private, non-cooperative contributions F_f by each firm. The profit in the export market of a representative firm in country f is

$$(10a) \quad \pi_{fh} = X_{fh}(p_{fh})(p_{fh} - mc_f) - F_f \text{ if } \sum_{n_f} F_f \geq F \text{ or}$$

$$(10b) \quad \pi_{fh} = -F_f \text{ if } \sum_{n_f} F_f < F,$$

where F_f is the private contribution to the joint fixed cost by the firm and n_f is the number of exporting firms in the small/poor country.

Restricting our attention to symmetric cases we see that there are two equilibria, one with positive exports and one with no exports. In the export equilibrium, each firm will contribute with one n :th of the total fixed cost F as long as it expect all other exporting firms to contribute. In the no-export equilibrium, each firm will refrain from contributing as long as it expects no other firm

¹²This issue is particularly important in a number of WTO trade disputes, including the European ban on the use of hormones in meat and meat products (see WTO Dispute Settlement Panel Report WT/DS165/R).

to contribute.

In the export equilibrium, firms in country f are worse off.¹³ The cost of the standard reduces the profit of small-country firms in equilibrium without any offsetting positive effects. As long as the fixed cost is sufficiently small to induce entry by all exporting firms in the small country it would not serve to protect the interests of the large-country firms either. In this case, the standard uses real resources without offsetting positive effects and welfare is negatively affected for all interest groups.

In the no-export equilibrium, on the other hand, large-country firms get a large profit boost, while large-country consumers, small-country consumers, and small-country firms are all worse off. Deterrence of imports in the large country has two negative effects on large-country consumers. It has an anti-competitive effect, which raises the prices on domestic varieties. It also has a direct effect on utility since consumers have fewer varieties to choose from. Small-country consumers are mainly hurt by falling factor prices when the X sector shrinks, which has a negative effect on consumer welfare. Finally, small-country firms get reduced revenues from the export market and, consequently, lower profits. Note also that aggregate welfare is lower in both countries.

In conclusion, the findings in this section show that a fixed cost may deter exports from the small country. The government in the small/poor country can play an important role in helping export firms to coordinate in the export equilibrium in the interest of both consumers and firms in the small/poor country. Firms in the large country are the main winners in the deterrence

¹³With a different division of the joint fixed cost - proportional to the sales of each firm - the results are slightly different (see Ganslandt and Markusen, 2000). In particular, the export volume from the small country falls when the fixed cost increases. Consequently, consumers in country f are worse off as the factor income in country f falls. Moreover, higher prices in the large/rich country hurt consumers in country h .

equilibrium.

5. Standards which affect the provision of public goods

Another positive effect of standards is to guarantee the provision of public goods. This is particularly relevant if the variation in preferences or income is large across markets (cf. Casella, 1995 and 1997). A monopolist may find it profitable to provide a public good jointly with a private good as long as the supply of the private good does not spill-over from the small/poor country to the large/rich country.¹⁴ In this situation, national standards can be used to segment markets and facilitate private provision of public goods in both large and small countries. One example of a pure market-segmenting standard is the “regional code” incorporated in the new video standard, DVD (digital versatile discs), which allows consumers with players from one region to play discs from the same region, but not from other regions of the world.

The interaction between standards and private provision of a public good can be studied as a continuous choice problem, e.g. investment in informative advertising or a more environment-friendly production process. The question is whether a market-segmenting standard supports a socially desirable level of public goods provision in the small and large country relative to the integrated equilibrium with no standard. This issue can be analyzed in a reduced version of the monopoly-model presented in section 3. The monopolist incurs a cost $c(\theta_j)$ to provide a public good θ_j jointly with the private good X to consumers in market j , where $c'(\theta_j) > 0, c''(\theta_j) < 0$.

The cost to provide the public good is independent of the

¹⁴Examples of privately provided public goods include informative advertising about the existence and characteristics of new products as well as pre-sale services offered by the manufacturing firm or its agents.

quantity of the private good. Demand for product the private good X is assumed to be

$$(9) \quad D_i(\theta_i, p_i) = \theta_i X_i(p_i)$$

and the monopolist maximizes its profit

$$(10) \quad \pi_h = \sum_{i=h,f} D_i(p_{hi})(p_{hi} - mc) - c(\theta_i),$$

where mc is the marginal cost. Our attention is restricted to a partial analysis in which the marginal cost is fixed and unaffected by the factor market.

In the segmented equilibrium, prices are independent of the level of the public good in market h and f . The first order conditions with respect to θ_j is

$$(11) \quad X_j(p_j^*)(p_j^* - mc) - c'(\theta_j) = 0$$

where segmented prices maximizes $X_j(p_j^*)(p_j^* - mc)$ and (11) implies that the provision of the public good is maximized at these prices.

A removal of the market-segmenting standard, i.e. an elimination of the price differential between the two countries, reduces the provision of the public good not only in the large country but also in the small country. First, less of the public good is provided in the large country as a direct consequence of free-riding. A fraction of large-country consumers buys the private good in the small country where the price is lower, but still benefit from the public good in the large country. Accordingly, the profitability to provide the public good in the large country is lower and in equilibrium less of the public good is provided. Second, less of the public good is provided in the small/poor country for strategic reasons. A lower level of the public good in the small country reduces the size of this market. The monopolist incentive to consider this market in its pricing

decision is, therefore, reduced and a higher price in the more profitable large country can be maintained.

In conclusion, the consumers in the small country as well as consumers in the large country can benefit from a market-segmenting standard. The main reason is that a purely market-segmenting standard may enhance the private provision of public goods in all markets, which is in the interest of consumers in both countries.

6. Summary

The purpose of this paper is to consider potential conflicts of interest with respect to standards and technical regulations governing international trade.

Our analyses show that large-country firms are the main winners in almost all situations with diverging (vertical or horizontal) national standards. This result provides a plausible explanation of the widely observed phenomena of lobbying by large-country firms to introduce and maintain standards in developed countries.

Consumers in both developed and developing countries tend to be hurt by cost-raising national standards, if there are no offsetting positive effects. Small developing countries are hurt more by diverging standards than large countries. Moreover, the analysis shows that small countries cannot win “standard wars”. Conversely, an agreement to limit purely cost-increasing standards helps the small country most (although it helps large-country consumers as well).

One exception from this result is that a pure market-segmenting standard may benefit consumers in small developing countries. If a firm in the developed country can offer its product at a rebated price in the developing country without having to consider the risk of arbitrage trade back to the developed country, then the consumers in the developing country are better off with the standard than without. This suggests that an agreement such as the TRIPS (Trade-related aspects of intellectual property rights) in the WTO, which largely protects the developed countries’ intellectual property, may be more beneficial to developing countries if it is combined with an agreement preventing international arbitrage. This issue can be of significant importance for products such as pharmaceuticals.

Standards which require firms from a small developing country to incur a joint fixed cost in order to export their products to a large developed country may give rise to multiple equilibria. In particular, there can be an equilibrium in which exports are completely deterred and one in

which the export volume is close to free trade. Consumers and firms in the small developing country strictly prefer the export equilibrium. Achieving the export equilibrium, therefore, calls for government action in the developing country to avoid getting stuck in the deterrence equilibrium.

Finally, market-segmenting standards can have additional effects, which affects welfare positively. In particular, standards that enhance the provision of public goods benefit consumers and firms by expanding the market for private goods in both the developed and developing countries.

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