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Does Trade Weaken Product Quality Standards?

By

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Abstract

In this paper we investigate the interrelationships between trade and national minimum quality standards. We employ a simple partial equilibrium model in which national regulators set a minimum quality standard for a product whose quality is unobservable to consumers prior to purchase. Both producers and consumers can benefit from a minimum standard, but the former prefer a lower standard to the latter. Because producers are organised and consumers are not, the standards set by national regulators may tend to unduly favour producer interests. We focus on two specific issues: first, how the weight given to producer interests affects the outcomes in autarky and the open economy; and, second, how outcomes differ when the effects of standards on trade are explicitly taken into account or ignored in standard setting in the open economy.

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Keywords: Product standards; political economy; asymmetric information.

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Non-Technical Summary

The interactions between international product trade and national product standards have generated policy debate on two counts. On one side has been concern that governments might be tempted to employ product standards as non-tariff barriers to trade. On the other side are concerns that the growing importance of trade and international competitiveness may induce governments to weaken certain standards, if this confers a competitive advantage on domestic firms relative to their foreign competitors. Both of these concerns are likely to be positively correlated with the degree of private sector involvement in standard setting. We investigate these issues in a simple partial equilibrium model of a product whose quality is unobservable to consumers at the time of purchase. To deal with the resulting "lemons problem", a minimum quality standard is set by a Regulatory Authority. Both consumers and producers can benefit from such a standard, but have different views over its optimal level. We assume that the Authority acts to maximise an objective function in which the welfare of both groups feature, but in which producer interests may be over-represented. Adopting a political economy approach allows us to consider standard setting in a range of contexts, from the "ideal" of aggregate welfare maximisation, through partial regulatory capture by producer interests, to standard setting by industry associations.

We ask four main questions in our analysis. First, does (increased) trade lead to weaker or stronger standards in importing and exporting countries? We find that the standards are always higher in the trading equilibrium than in autarky in the exporting country, but that the standard adopted by the importer could be higher or lower than in autarky. If the weight on aggregate welfare in the decision process is high enough, both standards would be higher in the trading equilibrium. Second, do independent national standards tend to increase or reduce trade, relative to say a harmonised standard? Here the answer is unambiguous. National standards reduce trade relative to a common standard, even when standards are precluded from being used as surrogate commercial policies. The third question concerns the political economy of standard setting. Is trade restricted more when producers are given a higher weight in standard selection? We find that the equilibrium trade share is increasing in the weight given to producer interests. Far from restricting trade, an increase in the producer influence on standard setting was more likely to increase trade. Finally, if regulatory authorities take into account the effects of their decisions on the volume of trade, does this lead to higher or lower standards and to more or less trade than otherwise? Here the outcome depends on the degree of producer influence. Where producer interests dominate, standards tend to be higher in both trading partners, but the trade share is lower. The opposite occurs when the weight on aggregate welfare in standard setting is relatively high. While the effects on the trade share are as one might expect, our results indicate that 'protective' standards may be higher or lower than 'non-protective' standards. Thus the task of determining whether a regulatory authority is employing standards as a 'disguised restriction to international trade' or is setting standards that are 'more trade-restrictive than necessary' to fulfil its objective, behaviour proscribed by the WTO, will be far from straightforward.

1. Introduction

The interactions between international product trade and national product standards have proved both politically contentious and awkward to analyse. The number of product standards worldwide is very large¹, and features relating to both their purpose and their setting complicate their economic analysis and their international control. While all governments are involved in product standard setting to some degree², many product standards are notionally voluntary standards set by the private sector³ that become de facto mandatory⁴. Even where government bodies do directly set standards they are heavily reliant on information provided by the private sector. The analysis of standard setting should therefore allow that this process may be implicitly or explicitly captured by private interests. As for why they are set, WTO (2005) classifies standards into three broad categories based on their motivations. There are *compatibility standards* which are applied to complementary products in order to facilitate the exploitation of network externalities; *environmental standards* aimed at reducing (negative) environmental externalities; and *safety standards* applied in cases of information asymmetry between producers and consumers for experience and particularly for credence goods. In general, producers and consumers have a common interest in establishing compatibility standards, so it makes sense for these to be left to the private sector and for them to be internationally harmonised. Global environmental externalities are best dealt with by internationally harmonised regulations set cooperatively, difficult though this has proved to be. But as WTO (2005) concludes, the case for international harmonization of standards aimed at information asymmetries or local environmental externalities is weak.

¹ For example Perinorm, a database of the standards published by the main national and international standards' authorities, includes over 650,000 standards from 23 countries (Swann, 2010 and WTO, 2005).

² Here we follow common practice in this literature and use the term 'standards' to apply to both *regulations* (which are compulsory requirements) and *standards* (which are voluntary). The distinction is blurred in practice, as we note below.

³ The relative importance of private sector standard setting varies across countries. In North America standards setting is decentralised and market oriented, while such activities have traditionally been much more centralised in Western Europe

⁴ The WTO (2005) notes that "...a large number of organisations produce voluntary standards, some of which become mandatory by being referred to in technical rules and regulations drafted by government agencies." (p75); and "In the US local authorities, which typically lack the technical resources necessary to formulate standards, often adopt privately developed standards." (p90) 'It is interesting to note that voluntary standards sometimes become de facto mandatory. In the United States, for example, wholesalers or retailers sometimes refuse to sell non-standard products because they do not wish to bear the responsibility in cases where products create problems.' (p90).

The interaction between trade and standards has generated policy debate on two counts. On one side has been concern that governments, having tied their hands on the use of formal trade barriers, might be tempted to employ other policies, including product standards, as non-tariff barriers to trade. Baldwin (2001) terms this “regulatory protection”. Even where standards do not have the restriction of trade as their primary objective, they might act to impede trade, and this may be considered a particular risk where standards are set by the private sector. This concern has led to the inclusion of Agreements on Technical Barriers to Trade and the Application of Sanitary and Phytosanitary Measures as part of the WTO. These Agreements apply to all WTO members, prohibit discrimination amongst members and require that standards be set such that the impact on trade is minimised⁵. Governments have also been encouraged to harmonise standards as a means of facilitating trade, although most commentators agree that heterogeneity to accommodate significant differences in, say risk tolerance, incomes or geography are desirable (Sykes, 1999). On the other side are concerns that the growing importance of trade and international competitiveness may induce governments to weaken certain standards, if by so doing they confer a competitive advantage on domestic firms relative to their foreign competitors. These concerns often relate to cross-border externalities and are associated with possible “races to the bottom” in environmental and labour standards etc., although there is little evidence that this is happening (Vogel, 2001 and references). Again these concerns are likely to be positively correlated with the degree of private sector involvement in standard setting. A related concern is that where governments do impose stringent standards, their attempts to extend these to imports will be countered by foreign governments claiming a breach of WTO concessions on behalf of their exporting firms. The growth of the anti-globalisation movement is at least partly a manifestation of these fears.

Fears of a race to the bottom have also led to pressure for standards to be harmonised⁶ and much of the early literature on product standards was concerned with establishing that a race to the bottom was not a necessary, desirable or even a likely outcome of standard setting in integrated markets⁷. Casella (1996) noted that standards can be viewed as local public goods

⁵ The preambles of both the TBT and SPS Agreements state that members should not apply standards in a manner that would constitute a “disguised restriction to international trade”. Art 2.2 of TBT states that ‘...technical regulations should not be more trade-restrictive than necessary to fulfil a legitimate objective...’.

⁶ Leebron (1996) reviews the arguments for harmonisation and the mechanisms through which standards can be harmonised.

⁷ See the chapters by Bhagwati and Srinivasan on environmental standards, and Brown, Deardorff and Stern on labour standards in Bhagwati and Hudec (1996). Races to the bottom or top can occur where distortions are

and that the optimum standard will therefore depend on the characteristics of the relevant community. Trade will affect optimum standards, but there is no reason to expect reductions in standards in both trading partners⁸. The basic characteristics of the outcomes in standard setting games were illustrated by the early contributions. Rauscher (1991), for example, considers the effects of increased integration, in the form of reduced costs of capital mobility, on national environmental policies. Stricter emissions requirements reduce the productivity of capital encouraging capital outflows. In the trading (Nash) equilibrium, each government chooses its emissions standard to maximise national welfare taking as given its trading partner's standard, but taking into account the effects of its choice on international capital flows. Increased integration reduces emission levels in the exporter, but may increase or reduce emissions in the importer, depending on parameter values. Bommer and Schulze (1999) also consider environmental policies, this time affecting a polluting export sector. They consider a two sector model of a small country, where environmental policy is chosen to maximise a political support function in which the welfare of capital owners in the two sectors, labour and environmentalists are equally weighted. They find that increased integration (modelled as an increase in the relative price of the export good) unambiguously raises environmental standards. In this case tighter environmental standards are a means of transferring some of the gains from trade from exporting capital and labour to import-competing capital and environmentalists.

From this discussion it is clear that standards arise in a range of contexts and can affect market behaviour in a variety of ways. This is illustrated in the context of (numerical) general equilibrium modelling by Ganslandt and Markusen (2001), who argue that standards can be viewed: as purely trade cost increasing (i.e. like tariffs); as affecting firms' fixed⁹ or variable

present and optimal interventions are unavailable, however. See the Wilson chapter in the same volume for examples. Krugman (1997) provides an overview of the issues. The claim of a race to the bottom in standards has also been challenged in the political science literature. Vogel and Kagan (2002) provide an overview of contributions in different policy areas dealing specifically with the direction of change in national regulations induced by globalisation.

⁸ Empirical evidence on whether standards converge is mixed. Prakash and Potoski (2006) find evidence that exporting countries adopt importers' environmental standards, while Donovan et. al. (2001) do not. But Frankel (2003) finds little statistical evidence that openness to trade reduces environmental standards. As is the case for other non-tariff barriers, the empirical analysis of the effects of standards on trade is hampered by having to rely on an index of standardisation activities (e.g. the number of standards or technical measures maintained by a country; or the proportion of tariff lines in a given industry to which standards apply) that does not capture the economic function or motivation of the standards. For a review of this evidence see Swann (2010).

⁹ Reyes (2010) uses a heterogeneous firm model to consider the effects of harmonisation of standards on the intensive and extensive margins of trade. Standards are assumed to affect the fixed costs of exporting to a particular market. In an empirical application he finds that EU standards in electronics encourage US exports via the entry of new exporters rather than increased exports by existing exporters.

costs; as changing the degree of complementarity or substitutability between products; or simply as a market segmentation device¹⁰. They investigate the effects of standards in each case, but do not model the choice of standard itself. Fischer and Serra (2000) analyse the choice of standards in a two country segmented markets model, where each country has a national firm. Higher product standards reduce the negative consumption externality associated with this product, but also increase firms' marginal costs. If standards differ in the two markets, then exporting firms incur a fixed cost in adapting their domestic product to the standard of the importing market. They focus on the case where only one firm can export. The choice of standard can induce two possible outcomes – a monopoly by the national firm or a duopoly. Fischer and Serra (2000) define a *non-protectionist standard* as one chosen by a social planner as if all firms were national, and show that the importer's standard will typically be protectionist, because the profits on imports are excluded from the national welfare calculations. Suwa-Eisenmann and Verdier (2001) extend this work by allowing intra-industry trade and consider the political economy of international agreements on standard-setting. Marette and Beghin (2010) amend the Fischer and Serra (2000) model by dropping fixed costs, which allows them to consider competitive industries, but allowing the foreign industry to have a cost advantage in meeting the standard. This creates the possibility of 'anti-protectionist' standard setting, where the importing country standard is below that set if foreign-firms' profits are included in the welfare analysis. The foreign industry's cost advantage must be sufficiently strong for this to occur. None of this analysis covers the information asymmetry that is our focus below, however, because standards have no direct effect on demand, but only affect it indirectly through firm marginal costs and hence prices. It also restricts attention to cases where the standard is set to maximise aggregate welfare.

Given the extensive literature on externalities, our primary interest in this paper is in the effects of (opening up to) trade on national product quality standards, and our focus is on standards as instruments to deal with informational asymmetries, rather than externalities. Since the private sector is heavily involved in setting standards, we examine national standard determination in a political economy context. We ask four main questions. First, does (increased) trade lead to weaker or stronger standards in importing and exporting countries? Do we observe a race to the bottom by the country with the higher standard in autarky, or trading up by that with the lower standard? In answering this question we determine when

¹⁰ Swann (2010, Figure 4) lays out the wide range of channels through which standards could influence trade.

standards will tend to converge (possibly to the point of harmonisation) and when they will tend to diverge, relative to autarky. Second, do independent national standards tend to increase or reduce trade, relative to say a harmonised standard? These are questions that have been considered in the literature, and our contribution is to investigate the sensitivity of the outcomes to the weight given to producer interests (relative to aggregate welfare) in the standard setting process. This allows us to answer our third question – is trade necessarily restricted more when import-competing producers are given a higher weight in standard selection, as it would be for tariffs? The answers to all these questions may depend on whether standards have a surrogate commercial policy role, which leads to our final question. If regulatory authorities take into account the effects of their decisions on the volume of trade, does this lead to higher or lower standards and to more or less trade than otherwise? To investigate this question we conduct our analysis in two stages. To begin with we exclude a trade policy role by assuming that regulatory authorities take import and export market shares as given when setting standards. We then relax this constraint and compare the solutions in the two cases.

In the next section we set up a simple partial equilibrium model of a product whose quality is unobservable to consumers at the time of purchase. To deal with the resulting “lemons problem” (Akerlof, 1970), the government legislates a minimum quality standard whose level is set by a Regulatory Authority (RA)¹¹. Both consumers and producers can benefit from such a standard, but have different views over its optimal level. We assume that the RA acts to maximise an objective function in which the welfare of both groups feature, but in which producer interests may be over-represented. Adopting a political economy approach allows us to consider standard setting in a range of contexts, from the “ideal” of aggregate welfare maximisation, through (partial) regulatory capture by producer interests, to standard setting by private producer interests (industry associations)¹².

¹¹ WTO (2005) notes that about 40% of the notifications under the TBT and SPS Agreements in 2004 were measures to protect human health and safety, and that the prevention of deceptive practices and consumer information and labelling were other reasons frequently given for new measures. “This suggests that many of the technical regulations that have come into being in the past ten years are concerned with solving information asymmetry problems.” (WTO, 2005, p.59).

¹² Producers have clear priorities and are usually better organised than consumers and so typically play the leading role. In some countries governments actively promote the participation of consumers by funding consumer organisations. Casella (1996) discusses the importance of standards as a “club good” and how the number and levels of such standards might be affected by opening to international trade.

The structure of the remainder of this paper is as follows. The next section sets up our model, and derives the autarky outcomes. Section 3 then characterises the trading equilibrium when there is no commercial policy role in standard setting. Section 4 shows how the solutions would change if a commercial policy role is permitted. This is followed by our conclusions.

2. The analytical framework

2.1 The micro-structure of the model

We begin by setting up the model in the closed economy. On the supply side, we assume that each unit of industry specific capital (K) when combined with labour can produce one unit of output¹³. The “quality” of that unit (λ) is positively related to the number of workers employed in its production. If w is the wage, the unit cost function is

$$c(w, \lambda) = \frac{w\lambda^2}{2} \quad (1)$$

which is increasing in the wage and increasing and convex in quality. We assume a perfectly competitive market structure so that the wage and output price are taken as given by individual producers. Beyond some minimum level ($\underline{\lambda}$), quality is an unobservable product characteristic prior to purchase. The market is characterized by many small firms each producing an output indistinguishable from its competitors. Since producing higher quality is costly and higher quality cannot be identified by potential buyers, each firm has an incentive to set its quality at the highest observable level. Given this, we assume that in the absence of regulatory intervention, the market equilibrium involves sales at the minimum quality only.

On the demand side, we assume “representative” price-taking individuals in each country with identical preferences in terms of quantity consumed (X) and quality such that:

$$u(X, \lambda) = \lambda \left[DX - \frac{X^2}{2} \right] \quad (2)$$

where $D > 0$ is a preference parameter¹⁴. This implies a demand function

$$X(p, \lambda) = D - \frac{p}{\lambda} \quad (3)$$

The quantity demanded falls as the quality-adjusted price (p/λ) increases. The total profits of the owners-producers are given by:

$$\Pi(p, \lambda) = K\{p - c(w, \lambda)\} = K \left[p - \frac{w\lambda^2}{2} \right] \quad (4)$$

¹³ This removes any incentive for harmonisation of standards based on economies of scale.

¹⁴ One interpretation of λ is the probability that the product does not fail, with no utility being achieved in the event of failure.

2.2 The regulatory structure

The RA sets a *minimum* quality level that producers must comply with in order to be able to sell in the market. Although it is formally a minimum, there will be no incentive for any individual producer to choose a higher level, so that the RA is in fact setting the quality level in the market. We assume that the level of λ emerges from a political economy game between the RA and special interest groups of the type considered by Grossman and Helpman (1994, 1995). Consumers are not organised because of the strong incentive to free-ride within a large group (Olson, 1965). Producers are assumed to be sufficiently small in number to overcome the collective-action problem (even though large enough to be consistent with the assumption of perfect competition). The RA values contributions from the lobbies, but also aggregate welfare, $W(\lambda)$ defined here as the sum of producers' profit and consumer surplus $S(\lambda) \equiv u(X, \lambda) - pX$. This implies that the optimum (autarky) equilibrium standard, (λ^A) can be derived by maximizing¹⁵

$$G = \Pi(\lambda) + aW(\lambda) = [1 + a]\Pi(\lambda) + aS(\lambda) \quad (5)$$

where $a > 0$ measures the RA's sensitivity to aggregate welfare relative to contributions. This leads to the following first-order condition:

$$[1 + a] \frac{d\Pi}{d\lambda} = -a \frac{dS}{d\lambda} \quad (6)$$

In equilibrium the weighted gain for one social group induced by a marginal change in quality needs to be equal to the weighted loss for the other social group.

2.3 The autarky equilibrium

Equating demand from (3) with supply (K), gives the equilibrium autarky price:

$$p^A = \lambda[D - K] \quad (7)$$

which is increasing in product quality and market size ($D - K$). We then have

$$\Pi(\lambda) = \lambda K \left[D - K - \frac{w\lambda}{2} \right] \quad \text{and} \quad S(\lambda) = \frac{\lambda K^2}{2} \quad (8)$$

This in turn gives us

$$\frac{d\Pi}{d\lambda} = K[D - K - w\lambda] \quad \text{and} \quad \frac{dS}{d\lambda} = \frac{K^2}{2} \quad (9)$$

An increase in quality has two direct effects. On the supply side, it raises production costs (cost effect), while on the demand side utility and quantity demanded increase with quality (consumer confidence effect). Indirect effects are then triggered by the increase in the

¹⁵ For the proof see footnote 7 in Grossman and Helpman (1994).

equilibrium price associated with a quality increase. This price effect will obviously be positive for producers and negative for consumers. From (9) we see that consumer surplus is always increasing in λ , showing that the positive confidence effect always dominates the negative price effect for consumers. Given this, *in equilibrium* we must have producers' profit decreasing in λ (i.e. in equilibrium the negative cost effect dominates the positive price effect for producers). The equilibrium is such that consumers prefer a higher standard, whereas producers would opt for a lower standard (unless $a = 0$).

Substituting in (6) we have

$$[1 + a]K[D - K - w\lambda] = -a \frac{K^2}{2} \quad (10)$$

From which we derive the autarky equilibrium quality standard:

$$\lambda^A = \frac{D-K}{w} + A \frac{K}{2w} \quad (11)$$

where $A \equiv a/1 + a^{16}$. Other things equal, the equilibrium quality standard is increasing in market size, supply and in the relative weight attached to consumers' versus producers' interests. When $D-K$ increases, given K , we know from (9) that the marginal loss for producers in equilibrium becomes smaller (thanks to the increase in the price due to greater demand) and this leads, *ceteris paribus*, to higher optimal quality. As consumers prefer a higher standard in equilibrium, a larger relative weight A assigned to consumers' interests *ceteris paribus* raises the optimal standard. For a given market size, an increase in K has a stronger positive effect on the marginal consumer surplus gain from an increase in quality than it does on the marginal producer loss. Hence the optimum standard increases. Equilibrium quality is decreasing in the cost of quality (w).

This solution can also be used to identify boundary cases. If the RA is only concerned with aggregate welfare maximisation (i.e. $A \rightarrow 1$), we have

$$\lambda_W^A \rightarrow \frac{2D-K}{2w} > \lambda^A \quad (12)$$

Unit profits will be positive in this case as long as $D - K > w\lambda_W^A/2$, i.e. as long as $D > 3K/2$. Alternatively, if the regulator is only concerned with contributions from the lobby group (i.e. $A \rightarrow 0$), then

$$\lambda_L^A \rightarrow \frac{D-K}{w} < \lambda^A \quad (13)$$

¹⁶ At the autarky equilibrium, $\partial\Pi(\lambda)/\partial\lambda = -AK/2 < 0$ and unit profit is $\lambda^A\{[D - (1 + A)K]/2\}$ which will be positive for all feasible A as long as $D > 2K$.

This is the quality standard that maximises profits. We can also interpret this as the standard that would be chosen by a self-regulating Industry Association, backed by government sanctions for producers who infringe on the standard. We assume that $\lambda_L^A > \underline{\lambda}$, so that both producers and consumers support the establishment of a regulator, at least in principle. As a further comparator, the standard that maximises consumer surplus is the highest standard for which unit profits are non-negative. From (5) this is

$$\lambda_S^A = 2 \frac{D-K}{w} = 2\lambda_L^A$$

2.4 Comparing the autarky outcomes

We assume that trade is based on supply side differences, in particular that the capital endowments in the two countries are given by:

$$K_1 = [1 - \theta]K \quad K_2 = [1 + \theta]K \quad \text{with } 0 \leq \theta \leq 1$$

Thus the world supply is $2K$, and parameter θ measures the degree of cross-country (supply) asymmetry. Whenever $\theta \neq 0$, $K_1 < K_2$. This leads to autarky quality standards of¹⁷

$$\lambda_1^A = \frac{D-K}{w} + \frac{\theta K}{w} + \frac{A K}{2w} [1 - \theta] \quad \text{and} \quad \lambda_2^A = \frac{D-K}{w} - \frac{\theta K}{w} + \frac{A K}{2w} [1 + \theta] \quad (14)$$

$$\text{with } \lambda_1^A - \lambda_2^A = \theta \frac{K}{w} [2 - A] \quad \text{and} \quad \frac{\lambda_1^A + \lambda_2^A}{2} = \frac{D-K}{w} + \frac{A K}{2w} \quad (15)$$

Other things equal, a wider dispersion of production (larger θ) leads to a larger difference in autarky equilibrium standards, but no change in their (unweighted) average¹⁸. At the extreme values of θ we have

$$\lambda_1^A|_{\theta=0} = \lambda_2^A|_{\theta=0} = \frac{D-K}{w} + A \frac{K}{2w} \quad \text{and} \quad \lambda_1^A|_{\theta \rightarrow 1} \rightarrow \frac{D}{w} > \lambda_2^A|_{\theta \rightarrow 1} \rightarrow \frac{D}{w} - [2 - A] \frac{K}{w} \quad (16)$$

Before turning to the trading outcomes we note that if the two countries were to have a harmonised standard (λ^U), set by a supranational regulatory authority following the same objective function as above, we would find that

$$\lambda^U = \frac{D-K}{w} + A \frac{K}{2w} = \frac{\lambda_1^A + \lambda_2^A}{2} \quad (17)$$

We summarise these results in:

Proposition 1: In autarky (a) a country's equilibrium standard is increasing in market size, quantity supplied and the relative weight attached to consumer interests; and is

¹⁷ $D > \left[1 + \frac{A}{2}\right][1 + \theta]K$ is required to ensure positive unit profits in the autarky equilibrium in country 2. This will hold for all feasible A and θ if $D > 3K$.

¹⁸ The production weighted average standard is given by $\frac{1}{2}\{\lambda_1^A + \lambda_2^A - \theta[\lambda_1^A - \lambda_2^A]\} \leq \frac{1}{2}\{\lambda_1^A + \lambda_2^A\}$.

decreasing in the cost of quality; and (b) the country with the smaller supply will have the higher standard.

3. Trade

3.1 The equilibrium trade share

The potential for trade is generated by the production asymmetry. Country 2 has a larger production capacity than country 1, which suggests that country 2 will export this product if trade is possible. But the volume and potentially the direction of trade are also influenced by the differing quality standards chosen by the national RAs. These in turn also reflect the difference in production capacities. Our assumption is that sales in a market must meet the minimum quality standard of that market. Thus production for export will meet the standard of the importing market, regardless of whether it is higher or lower than the standard in the exporting country¹⁹.

To establish the direction of trade, it is straightforward to show²⁰ that in autarky unit profits are lower in the country with the larger capacity – country 2. With the opening of trade, firms in country 2 will find exporting to country 1 attractive, given autarky prices and quality standards. Firms in country 1 will prefer to sell in their home market. Given quality standards, a trading equilibrium will be achieved where unit profits are the same in the two markets. But quality standards will also adjust in both markets to reflect the new balances of producer and consumer interests. It is these adjustments in standards, and how they are related to the volume of trade, that are our primary interest here.

Production capacity in country 2 is $[1 + \theta]K$. We suppose αK of this is used for exports. Then world production for market 1 is $[1 - \theta + \alpha]K$, world production for market 2 is $[1 + \theta - \alpha]K$, and the prices in the two markets in the trading equilibrium are given by

$$p_1^T = \lambda_1\{D - K + [\theta - \alpha]K\} \quad \text{and} \quad p_2^T = \lambda_2\{D - K - [\theta - \alpha]K\} \quad (18)$$

¹⁹ Thus imports receive national treatment (NT) in the importing market. A strand of the literature on standards and trade that is broadly linked to our research analyses standard setting under the GATT-WTO principles of NT, Mutual Recognition (MR) and harmonisation. In a recent contribution Costinot (2008) models product quality standard setting under three institutional regimes - independent national regulation, NT and MR. Under NT, the domestic government sets a standard that applies to both domestic and foreign producers selling in the domestic market. Under MR, it is the foreign government that sets the standard for its firms exporting abroad. Dinopoulos et. al. (2010) demonstrate the welfare benefits of Country-Of-Origin Labelling when product risk depends on origin. There are no information asymmetries, and product risks are fixed so that origin provides complete information on risk.

²⁰ See Appendix A.

The difference in quality-adjusted prices is

$$\frac{p_1^T}{\lambda_1} - \frac{p_2^T}{\lambda_2} = 2[\theta - \alpha]K \quad (19)$$

By substituting (18) in the expressions for unit profits we obtain the condition for equal unit profits in the two markets:

$$\pi_1(\lambda_1, \alpha) \equiv \lambda_1 \left\{ D - K + [\theta - \alpha]K - \frac{w\lambda_1}{2} \right\} = \lambda_2 \left\{ D - K - [\theta - \alpha]K - \frac{w\lambda_2}{2} \right\} \equiv \pi_2(\lambda_2, \alpha) \quad (20)$$

From this we derive the equilibrium trade share, α^* , for given quality standards λ_1 and λ_2 as

$$\alpha^* = \theta + \frac{\lambda_1 - \lambda_2}{K} \left\{ \frac{D - K}{\lambda_1 + \lambda_2} - \frac{w}{2} \right\} \quad (21)$$

While α^* is nonlinear in the quality standards, one can see that $\alpha^* = \theta$ when $\lambda_1 = \lambda_2$. Such would be the case for example if a harmonised standard was set by a supranational regulatory authority as in (17) above. Substituting (21) back into (20), we find that the common unit profit in the trading equilibrium for the given standards is

$$\pi^*(\lambda_1, \lambda_2) = \lambda_1 \lambda_2 \left\{ \frac{2[D - K]}{\lambda_1 + \lambda_2} - \frac{w}{2} \right\} \quad (22)$$

3.2 Equilibrium standards in the open economy

To explore how trade impacts on the quality standards chosen by the RAs in the two countries, we first derive the expressions for profits and consumer surplus under trade. Producers in the exporting country are now split into two groups – those that sell on their domestic market (receiving total profits of $\Pi_{22}(\lambda_2)$) and those that export (receiving total profits of $\Pi_{21}(\lambda_1)$). This gives us:²¹

$$\Pi_2(\lambda_1) = [1 - \theta]K\pi_1(\lambda_1, \alpha) \quad (23A)$$

$$\Pi_{22}(\lambda_2) = [1 + \theta - \alpha]K\pi_2(\lambda_2, \alpha) \quad (23B)$$

$$\Pi_{21}(\lambda_1) = \alpha K\pi_1(\lambda_1, \alpha) \quad (23C)$$

$$S_1(\lambda_1) = \lambda_1 \frac{K^2[1 - \theta + \alpha]^2}{2} \quad (23D)$$

$$S_2(\lambda_2) = \lambda_2 \frac{K^2[1 + \theta - \alpha]^2}{2} \quad (23E)$$

²¹ Expressions (23A) and (23B) are derived simply by substituting the equilibrium prices under trade (18), as well as the functional form used for production costs (1), in the general expression for producer profits (8). Expressions (23D) and (23E) are obtained by substituting the equilibrium prices under trade (18) in the general expression for consumer surplus.

The RAs each choose the relevant quality standard to maximise an objective function that reflects general welfare and industry lobbying as before. As noted in the introduction, to begin with we assume that they ignore any effects of their decision on the trade share (and therefore on the standard in the other country). This has two important implications. First, it excludes an explicit commercial policy role for standards. This does not seem unrealistic. Quality standards will respond to changes in the trade share, because the latter affects domestic welfare and profits. Similarly changes in standards will affect the trade share, as shown in (21). But it is not unreasonable to assume that a domestic RA charged with setting a minimum quality standard for the domestic market would not focus on the effects of its decision on the share of imports. Second, it means that the two standards are set independently. Each RA need make no assumption on the behaviour of its foreign counterpart.

The equilibrium outcomes will depend on whether “exporters” can lobby in the importing country, and on whether their profits are included in importing country welfare²². The general case is discussed in Appendix B. Here we restrict attention to the case where exporting firms are excluded from lobbying in the importing country. If we are dealing with trade in goods then foreign-based exporters are likely to be precluded from lobbying and are unlikely to feature in importing country welfare. With these assumptions in place, the RAs’ objective functions can be written from (5) as:

$$G^1(\lambda_1) = [1 + a]\Pi_1(\lambda_1) + aS_1(\lambda_1) \quad (24A)$$

$$G^2(\lambda_2) = [1 + a]\Pi_{22}(\lambda_2) + aS_2(\lambda_2) + a\Pi_{21}(\lambda_1) \quad (24B)$$

Because the profits of exporting firms are unaffected by their home standard, they do not lobby the exporting country RA, and while their profits remain part of the exporting country’s aggregate welfare, the fact that these profits are unaffected by the exporter’s domestic standard (for a given trade share) effectively eliminates them from consideration by this RA.

Using (23)-(24B) we can derive the first order conditions. For the importing country we have:

$$-[1 - \theta]K\{D - K + [\theta - \alpha]K - w\lambda_1\} = A \frac{K^2[1-\theta+\alpha]^2}{2} \geq 0 \quad (25A)$$

and for the exporter:

²² Note that exporters would have to be treated like firms for the standard to be ‘non-protective’ in the sense of Fischer and Serra (2000). The importer’s standards considered below are ‘protective’, according to their definition.

$$-[1 + \theta - \alpha]K\{D - K - [\theta - \alpha]K - w\lambda_2\} = A \frac{K^2[1+\theta-\alpha]^2}{2} \geq 0 \quad (25B)$$

At the optimal standards, the left sides of these two equations must both be nonnegative (zero when $A = 0$), while at the same time unit profits must be positive. Using (22), (25A) and (25B) this requires²³ that

$$2 \frac{D-K}{\lambda_1+\lambda_2} \geq \frac{w}{2} \geq \frac{D-K}{\lambda_1+\lambda_2} \quad (26)$$

From (21), we then have that $\alpha \lesseqgtr \theta$ as $\lambda_2 \lesseqgtr \lambda_1$. Solving the first order conditions yield optimum quality standards of

$$\lambda_1^T = \frac{D-K}{w} + \frac{[\theta-\alpha]K}{w} + \frac{A}{2} \frac{K}{w} \frac{[1-\theta+\alpha]^2}{1-\theta} = \lambda_1^A - \alpha \left\{ \left[1 - \frac{A}{2} \right] - \frac{A}{2} \frac{[1-\theta+\alpha]}{1-\theta} \right\} \frac{K}{w} \quad (27)$$

$$\lambda_2^T = \frac{D-K}{w} - \frac{[\theta-\alpha]K}{w} + \frac{A}{2} \frac{K}{w} [1 + \theta - \alpha] = \lambda_2^A + \alpha \left[1 - \frac{A}{2} \right] \frac{K}{w} \geq \lambda_2^A \quad (28)$$

$$\text{Further, } \lambda_1^T + \lambda_2^T = \lambda_1^A + \lambda_2^A + \alpha \frac{K}{w} \frac{A}{2} \frac{[1-\theta+\alpha]}{1-\theta} \geq \lambda_1^A + \lambda_2^A \quad (29)$$

$$\lambda_1^T - \lambda_2^T = \lambda_1^A - \lambda_2^A - \alpha \left\{ 2 \left[1 - \frac{A}{2} \right] - \frac{A}{2} \frac{[1-\theta+\alpha]}{1-\theta} \right\} \frac{K}{w} \quad (30)$$

There are two points to note here. First, as long as there is trade ($\alpha > 0$), the exporting country's optimal standard will be higher than in autarky ($\lambda_2^T \geq \lambda_2^A$). Given that a subset of producers (the exporters) have ceased from domestic lobbying, this is not unexpected and one might be tempted to attribute it to an increase in the relative importance of consumer surplus in the RA's objective function. But this is not the full story, because the optimal standard will rise even if the RA is concerned only with lobbyists' contributions (i.e. $A = 0$). The optimal standard for domestic producers has also risen as a result of the trade-induced price increase. Second, whether the importing country's optimal standard rises or falls, depends on the volume of trade and model parameters, as

$$\lambda_1^T \geq \lambda_1^A \text{ if } 1 \leq \frac{A}{2} \left[2 + \frac{\alpha}{1-\theta} \right] \text{ that is if } \alpha \geq 2[1 - \theta] \frac{1-A}{A} \equiv \bar{\alpha} \quad (31)$$

We have the possibility that standards are higher in both markets if the trade share is sufficiently high – i.e. $\alpha \geq \bar{\alpha}$. As $\bar{\alpha}$ is decreasing in both θ and A , this outcome is more likely the greater the supply asymmetry and the greater the weight on aggregate welfare, a conclusion we confirm by simulation below.

Equations (27) and (28) are implicit solutions to the equilibrium standards because the trade share depends on both standards as shown in (21). Unfortunately, the nonlinear nature of the

²³ That is $D - K + [\theta - \alpha]K - w\lambda_1 \leq 0$ and $D - K - [\theta - \alpha]K - w\lambda_2 \leq 0$. Summing these gives us $2[D - K - w[\lambda_1 + \lambda_2]] \leq 0$.

relationships between the trade share and the standards precludes an analytic solution for the general case in even this very simple model. But the two benchmark cases of aggregate welfare maximization and contribution maximization on the part of RAs provide some guidance. We begin with the latter, where the solutions are obtained by setting $A=0$ above. From (23A) and (23B) we see that in this case the two RAs are selecting their standards to maximise unit profits in their respective markets. In autarky this leads to

$$\lambda_{1L}^A = \frac{D-K}{w} + \frac{\theta K}{w} \quad \text{and} \quad \lambda_{2L}^A = \frac{D-K}{w} - \frac{\theta K}{w} \quad (32)$$

which imply that $\lambda_{1L}^A - \lambda_{2L}^A = 2\theta K/w$, $\lambda_{1L}^A + \lambda_{2L}^A = 2[D-K]/w$ and the trade share at the autarky standards is $\alpha_L^A = \theta$. From this position, unit profits in country j are simply $\lambda_j \left[D - K - \frac{w\lambda_j}{2} \right]$, implying that when they adjust their standards, both RAs choose the same standard²⁴

$$\lambda_{1L}^A = \lambda_{2L}^A = \frac{D-K}{w} \quad \text{and} \quad \alpha = \theta \quad (33)$$

In this case trade lowers the optimal standard in the importing country (while raising it as usual in the exporting country), and the outcome is harmonisation. An RA that maximizes contributions from lobbies is obviously only considering the fact that trade negatively affects producer profits in the importing country. As a result, its equilibrium standard is lower in the trading equilibrium compared to autarky.

The case with aggregate welfare maximization ($A=I$) is less straightforward, but revealing nonetheless. As $\alpha = 0$ is not an equilibrium outcome in this case, from (31) we have $\alpha \geq \bar{\alpha} = 0$ and we are in the range where trade raises the optimal standard in both countries.

$$\lambda_{1W}^T = \lambda_{1W}^A + \frac{\alpha^2}{1-\theta} \frac{K}{2w} \geq \lambda_{1W}^A \quad \text{and} \quad \lambda_{2W}^T = \lambda_{2W}^A + \alpha \frac{K}{2w} \geq \lambda_{2W}^A \quad (34)$$

When consumers' and producers' interests attract the same weight in policy-setting, the beneficial effect that trade has on consumer surplus in the importing country (through a lower equilibrium price) always dominates the negative impact on producer profits. So trade raises standards. But what do standards do to trade? We note that the difference in standards may actually increase (relative to autarky), since

$$\lambda_{1W}^T - \lambda_{2W}^T = \lambda_{1W}^A - \lambda_{2W}^A + \alpha \left[\frac{\alpha}{1-\theta} - 1 \right] \frac{K}{2w} \quad (35)$$

which may in turn imply a smaller trade share. Again we summarise in:

²⁴ This solution can also be obtained from (27) and (28) as shown in Appendix C.

Proposition 2: In the trading equilibrium (a) the exporting country's standard is higher than in autarky; and (b) the importing country's standard may be higher or lower than in autarky, but is more likely to be higher the greater supply and the greater the weight on aggregate welfare.

Corollary 2.1: Standards set by industry associations will be harmonised and will be lower than autarky in the importer and higher than autarky in the exporter.

Corollary 2.2: Standards set to maximise (national) aggregate welfare will be higher in the trading equilibrium than in autarky in both countries.

3.3 The trading equilibrium

Inspection of (27) and (28) indicates the key parameters that determine the characteristics of the trading equilibrium. Some, specifically K/w and $\delta \equiv D/K$, have largely scale effects. But the relative weight given to aggregate welfare in the RA's objective functions (A) and the degree of cross-country asymmetry (θ) are important for the nature of the equilibrium itself.

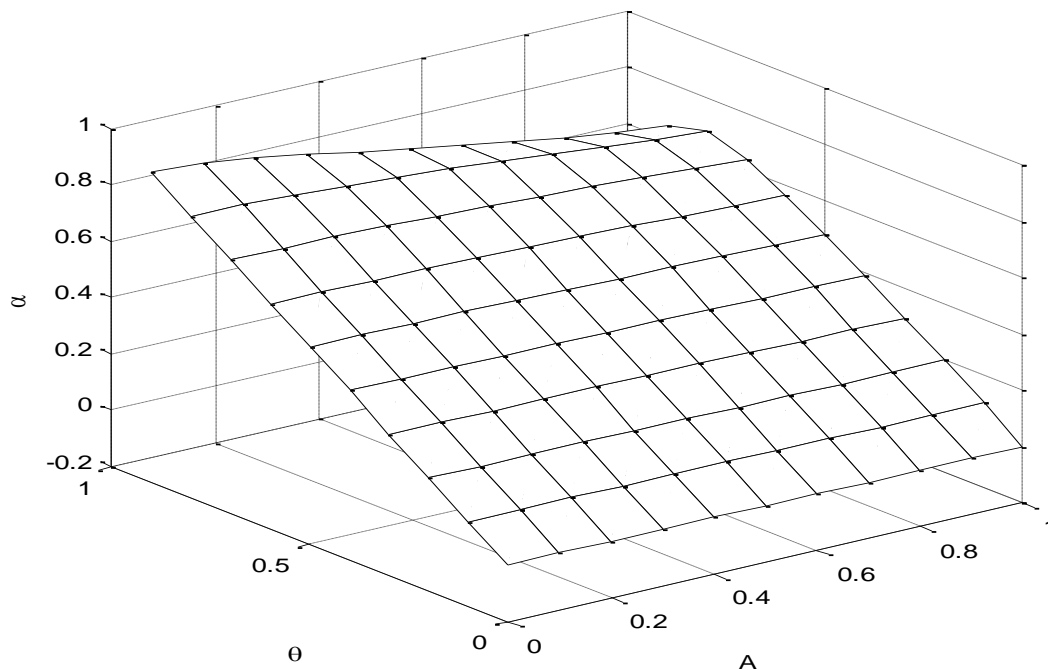


Figure 1: The Equilibrium Export Share ($K/w = 3, \delta = 8$)

Figure 1 plots the equilibrium trade share against both the relative weight on aggregate welfare and the supply side asymmetry. It shows that the equilibrium trade share is decreasing in A for all non zero values of θ , although only when both the supply asymmetry and the relative weight on aggregate welfare are large is the difference in standards such that

α falls noticeably below θ . This has interesting implications. While we may have excluded an explicit commercial policy role for these standards, their chosen values do imply less trade than a harmonised standard. One suspects that the conventional wisdom might be that, in general, the higher the weight attached to producer interests the more restrictive of trade the standards are likely to be. But here the opposite is the case. Indeed, when both the relative weight on welfare and the supply asymmetry are sufficiently large ($A \geq 0.4, \theta \geq 0.8$) the response of national standards to an increase in the supply side asymmetry actually *reduces* the volume of trade²⁵. This represents a crucial difference from a harmonised standard. In each case the trade share adjusts to equate unit profits in the two markets, but with a harmonised standard the two markets also have a common price, and a change in θ is simply reflected in a change in trade share (i.e. $\alpha = \theta$ in equilibrium). Different national standards lead to different national prices and the equilibrium α needed to have identical profits in the two countries will be lower as a consequence. National standards therefore lead to partial fragmentation of the market. When θ and A are large, the gap between optimal standards is so large that a further increase in θ (enlarging this gap) turns out to be trade-reducing (the larger gap in the equilibrium prices due to the increase in θ is more than compensated by the larger gap in the standards). In Figure 1 the trade share falls away for high θ as A increases.

In Figure 2 we examine how the relative weight on aggregate welfare influences the difference in equilibrium standards in trade from autarky, and how this is related to the magnitude of the supply side asymmetry. Several conclusions²⁶ emerge. First, for low values of A the standard set by the importing country in the trading equilibrium is lower than it would be in autarky. Second, the increase in the standard applied by the exporter is declining in A , while the increase in that applied by the importer (which can be negative) is rising in A . Third, trade raises standards (relative to autarky) in both countries over a large subset of the parameter space, and the greater the degree of asymmetry and the higher the relative weight on aggregate welfare, the more likely that trade raises standards in both the importing and the exporting country. Fourth, once the degree of asymmetry is large enough, the absolute increase in the standard in the importing country exceeds that in the exporter, as suggested by (35) above.

²⁵ A larger δ reduces the likelihood of this outcome, since an increase in δ leaves the difference in standards largely unaffected, but raises both their levels.

²⁶ These results are not affected by changes in δ .

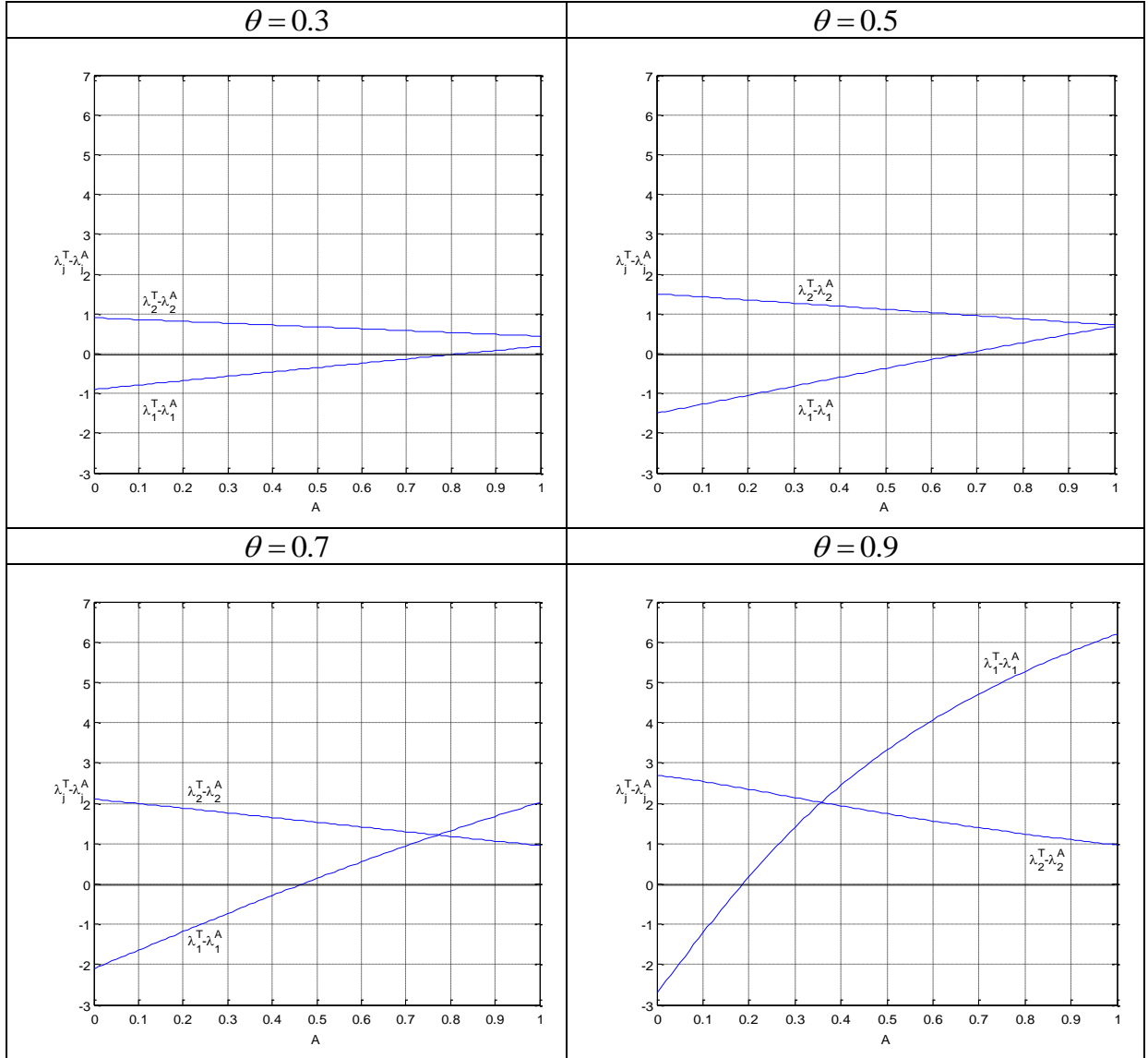


Figure 2: Changes in Standards Relative to Autarky ($K/w = 3$, $\delta = 8$)

The possibility that the difference in standards may actually be larger in the trading equilibrium than in autarky – i.e. a move away from harmonisation - is worthy of further investigation. We begin by exploring the interaction between standards and the trade share. Substituting from (15) into (21) it is straightforward to show that the trade share at the autarky standards is

$$\alpha^* = \theta - \frac{A}{2} \frac{[\lambda_1^A - \lambda_2^A]}{\lambda_1^A + \lambda_2^A} \leq \theta$$

The autarky standards are such as to reduce the trade share from what it would be under a harmonised standard (i.e. θ). How does the opening of trade influence the optimal standards? From (27) and (28) we find

$$\frac{\partial \lambda_1^T}{\partial \alpha} = \frac{K}{w} \frac{A}{[1-\theta]} \left[\alpha - \frac{\bar{\alpha}}{2} \right] \quad \text{and} \quad \frac{\partial \lambda_2^T}{\partial \alpha} = \frac{K}{w} \left[1 - \frac{A}{2} \right] > 0 \quad (36)$$

Other things equal, an increase in the trade share unambiguously raises the optimal standard in the exporting country. A smaller group of domestic producers in country 2 reduces pressure exerted by the lobby on the national RA, which can therefore better accommodate the consumers' wish for a higher standard. But an increase in the trade share has an ambiguous impact on the optimal standard in the importing country. Other things equal, the standard increases (decreases) with α when the trade share is above (below) a threshold ($\bar{\alpha}/2$). This ambiguity reflects the opposing effects of changes in the equilibrium price on consumer surplus and producer profits. The threshold simply represents the point beyond which the trade share makes consumers' interests in the importing country strong enough (relative to producers' interests) to push the optimal standard up in the trading equilibrium. We can see from (31) that this threshold is decreasing in A (with a larger A implying a larger relative weight attached to consumers' interests in policy-setting) and θ (with a larger θ reducing the size of the domestic industry, and corresponding lobby, in country 1). Thus, other things equal, the larger A or θ , the more likely that optimal standard in country 1 is higher in the trading equilibrium relative to autarky, as consumers' interests become relatively stronger. Given that the exporter's standard always increases, these are the circumstances under which the difference in standards can become larger.

How do adjustments in standards reflect back onto the trade share? Using (21), (25A) and (25B) (see Appendix [D]), we find

$$K \frac{\partial \alpha}{\partial \lambda_1} = \frac{2\lambda_2}{[\lambda_1 + \lambda_2]} \frac{[D-K]}{[\lambda_1 + \lambda_2]} - \frac{w}{2} \leq 0 \quad \text{and} \quad K \frac{\partial \alpha}{\partial \lambda_2} = \frac{w}{2} - \frac{2\lambda_1}{[\lambda_1 + \lambda_2]} \frac{[D-K]}{[\lambda_1 + \lambda_2]} \geq 0 \quad (37)$$

From (25A) and (25B), the equalities hold when $A = 0$.

These results are summarized in:

Proposition 3: In the trading equilibrium: (a) the standard is lower than in autarky in the importer when the weight on aggregate welfare is low; (b) a rising weight on aggregate welfare implies a smaller increase in the exporter's standard and a greater increase (which could be negative) in the importer's standard; (c) if the degree of supply side asymmetry is large enough, the absolute increase in the standard of the importer could exceed that of the exporter implying a move away from harmonization; and (d) if the weight on aggregate welfare is high enough or the

supply difference is sufficiently large, trade may lead to higher standards in both countries.

4. Equilibrium with Trade Effects in Standard Setting

We now drop the assumption that the RAs take the trade share as given when setting standards. This has two main implications for the outcomes. First, the exporting firms now have an incentive to lobby their home RA since the latter now takes into account the effects of its choice of standard on exporters' profits through the trade share. Second, rather than being independent (though related) choices, now equilibrium standards are set in a game between the two RAs. We begin by considering how the recognition of trade share effects changes the equilibrium considered in the previous section. Does an explicit recognition that standard choice affects trade result in higher or lower equilibrium standards in the two countries? What happens to the volume of trade?

The most straightforward way to answer these questions is to rewrite the RAs' objective functions taking explicit account of the trade share and the lobbying by the exporters. This gives

$$G^1(\lambda_1, \alpha) = [1 + a]\Pi_1(\lambda_1, \alpha) + aS_1(\lambda_1, \alpha) \quad (38A)$$

$$G^2(\lambda_2, \alpha) = [1 + a]\{\Pi_{22}(\lambda_2, \alpha) + \Pi_{21}(\lambda_1, \alpha)\} + aS_2(\lambda_2, \alpha) \quad (38B)$$

and allows us to write the FOCs as

$$\frac{dG^1}{d\lambda_1} = G_1^1 + G_\alpha^1 \frac{\partial \alpha}{\partial \lambda_1} = 0$$

$$\frac{dG^2}{d\lambda_2} = G_2^2 + G_\alpha^2 \frac{\partial \alpha}{\partial \lambda_2} = 0$$

The first term on each right hand side is the condition used to solve for the standard in the trading equilibrium above. How this equilibrium will change will depend on the signs of the second terms, which we now investigate. From (37) we have that $\partial \alpha / \partial \lambda_1 \leq 0$ and $\partial \alpha / \partial \lambda_2 \geq 0$, and $|\partial \alpha / \partial \lambda_1| \geq |\partial \alpha / \partial \lambda_2|$ since $\lambda_1 \geq \lambda_2$. Interestingly, at the equilibrium in the previous section when $A=0$ both standards are equal and $\partial \alpha / \partial \lambda_1 = \partial \alpha / \partial \lambda_2 = 0$, independent of θ . Thus the equilibrium is unchanged if the RAs consider the effects of their decisions on trade shares. This is the only value of A for which these derivatives are zero.

Considering the effects of a change in the trade share on the RA's objective function, we have

$$G_{\alpha}^1 = \frac{\partial \Pi^1}{\partial \alpha} + A \frac{\partial S^1}{\partial \alpha} = [1 - \theta]K \frac{\partial \pi^1}{\partial \alpha} + A \frac{\partial S^1}{\partial \alpha} = -\lambda_1[1 - \theta]K^2 + \lambda_1 A[1 - \theta + \alpha]K^2$$

The effects here are relatively straightforward. An increase in the trade share reduces profits and increases consumer surplus in the importer. Which effect dominates depends on the relative weight on consumers' interests. Thus if $A = 0$, producer interests dominate and $G_{\alpha}^1 = -\lambda_1[1 - \theta]K^2 < 0$; while if $A = 1$, both interests are equally weighted, but the effect on consumer surplus is larger hence $G_{\alpha}^1 = \lambda_1 \alpha K^2 > 0$. Given any θ , continuity implies there is some value of A (say A_1) for which these two effects balance and $G_{\alpha}^1 = 0$. Simulations show that $A_1 \approx 1 - \theta$, with the actual (implicit) solution

$$A_1 = \frac{1 - \theta}{1 + \alpha - \theta} > 1 - \theta$$

The more important domestic profits the larger the relative weight on consumer surplus required to balance these two effects.

Similarly, for the exporter we have

$$\begin{aligned} G_{\alpha}^2 &= \frac{\partial \Pi^{22}}{\partial \alpha} + \frac{\partial \Pi^{21}}{\partial \alpha} + A \frac{\partial S^2}{\partial \alpha} = -K\pi^2 + [1 + \theta - \alpha]K \frac{\partial \pi^2}{\partial \alpha} + K\pi^1 + \alpha \frac{\partial \pi^1}{\partial \alpha} + A \frac{\partial S^2}{\partial \alpha} \\ &= \lambda_2[1 + \theta - \alpha]K^2 - \lambda_1 \alpha K^2 - \lambda_2 A[1 + \theta - \alpha]K^2 \end{aligned}$$

This time there are three effects; a positive effect on domestic profits and negative effects on exporter profits and consumer surplus. Again, for any given θ we can establish the sign of G_{α}^2 at the extreme values of A . Recall that when $A = 0$ we have $\lambda_1 = \lambda_2 = \tilde{\lambda}$, $\alpha = \theta$ and producer interests dominate, so that $G_{\alpha}^2 = \tilde{\lambda}[1 - \theta]K^2 > 0$. While when $A = 1$, $G_{\alpha}^2 = -\lambda_1 \alpha K^2 < 0$. Again there is some interior value of A (say A_2) for which the three effects cancel and $G_{\alpha}^2 = 0$. Simulations show $A_2 \approx 1 - \theta$, with the actual (implicit) solution

$$1 - A_2 = \theta \frac{\lambda_1 \alpha}{\lambda_2 \theta [1 + \theta - \alpha]} < \theta.$$

The larger is θ , the greater is the deviation of A_2 from $1 - \theta$.²⁷

Thus, for any given θ , the equilibria for values of A near $1 - \theta$ will be very similar to those when RAs ignore the effects of their choices on the trade share. This gives us two ranges to consider. When $0 \leq A \leq 1 - \theta$, profit interests dominate and we have $G_{\alpha}^1 \frac{\partial \alpha}{\partial \lambda_1} > 0$ and $G_{\alpha}^2 \frac{\partial \alpha}{\partial \lambda_2} > 0$. Thus both RAs set higher standards than when the effects on trade shares are ignored. But they do this for opposite reasons – the importer wants a lower trade share and

²⁷ For example if $\delta = 8, K/w = 1$ and $\theta = 0.9$ then $A_2 \approx 0.07 < 0.1$.

the exporter a higher trade share. The equilibrium standards are both higher as a consequence. When $1 - \theta \leq A \leq 1$, consumer interests dominate and we have $G_{\alpha}^1 \frac{\partial \alpha}{\partial \lambda_1} < 0$ and $G_{\alpha}^2 \frac{\partial \alpha}{\partial \lambda_2} < 0$, and both RAs set lower standards than otherwise. Again this is for opposite reasons – the importer wants a larger and the exporter a smaller trade share. The equilibrium standards are both correspondingly lower.

The outcomes for the equilibrium trade share depend on the relative strengths of these effects in the importing and exporting country. These are difficult to evaluate analytically, but are clear near the extreme values of A , where $|\partial \alpha / \partial \lambda_1| \geq |\partial \alpha / \partial \lambda_2|$ and $|G_{\alpha}^1| = |G_{\alpha}^2|$. Thus importer effects tend to dominate at the extremes and simulations show that this is true across the board. The change in the equilibrium standard is larger in the importer than the exporter. Consequently, the trade share moves in the direction desired by the importing RA, and hence falls when $0 \leq A \leq 1 - \theta$ and rises when $1 - \theta \leq A \leq 1$. That is, the trade share is lower when producer interests dominate and higher when consumer interests dominate. The case where $\theta = 0.5$ is illustrated in Figures 3A to 3C.

Figure 3A: Comparison of Trade Effects [$\delta = 8, K/w = 3, \theta = 0.5$]

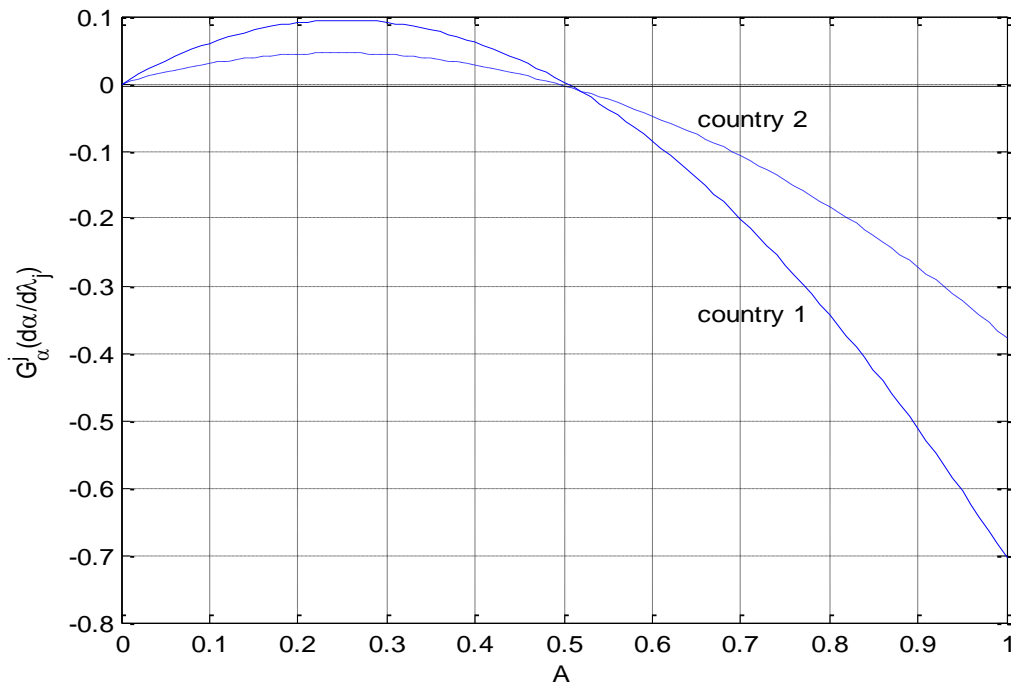


Figure 3B: Comparison of Standards when RAs allow for (TE) and ignore effects on trade share

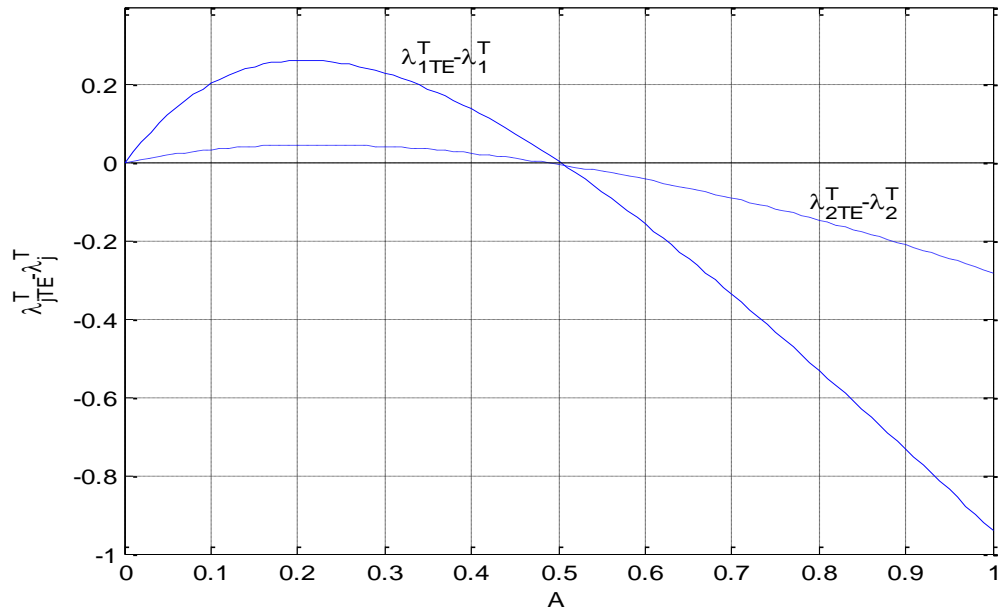
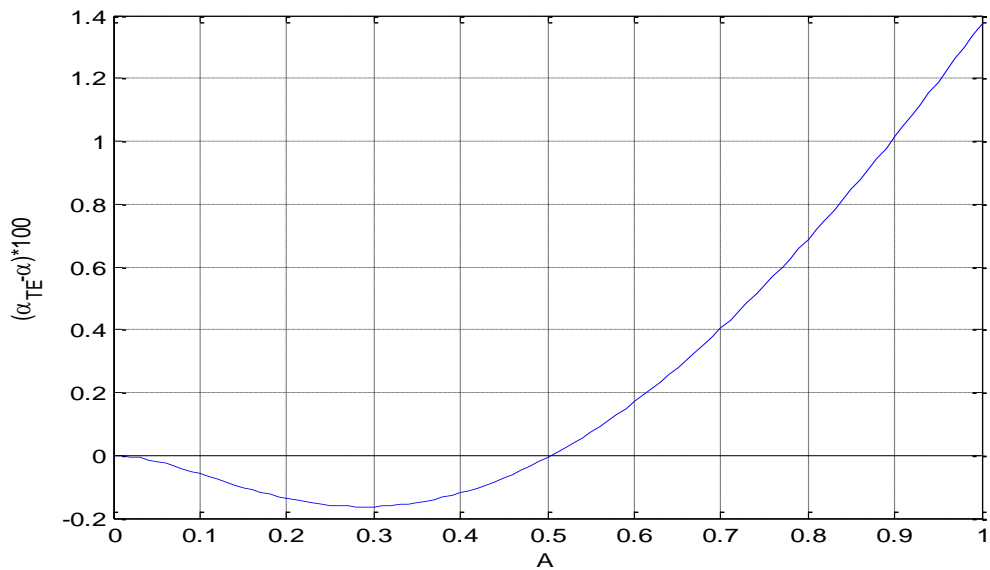


Figure 3C: Difference in equilibrium trade share when RAs allow for (TE) and ignore effects on trade share



We are now in a position to answer the two questions posed above. Does an explicit recognition that standard choice affects trade result in higher or lower equilibrium standards in the two countries? The answer depends on the relative weight on producer and consumer interests. Interestingly both standards move in the same direction, and this is not the direction one might naively expect – i.e. when producer interests dominate standards tend to rise, while when consumer interests dominate they tend to fall. What happens to the volume of trade?

Again this depends on whether producer or consumer interests dominate, but here the movement is in line with a naïve prediction. When producer interests dominate the trade share is lower, when consumer interests dominate it rises.

Again we summarise these results in:

Proposition 4: when the effects on the trade share are taken into account in standard setting, the consequences for the equilibrium standards and the trade share will be: (a) no change if standards are set by an industry association ($A = 0$) or the weight on aggregate welfare takes on an intermediate value (A near $1 - \theta$); (b) both standards will rise and the trade share will fall if producer interests dominate ($0 \leq A \leq 1 - \theta$); and (c) both standards will fall and the trade share will rise when consumer interests dominate ($1 - \theta \leq A \leq 1$).

5. Conclusions

In the introduction we noted that we aimed to answer four main questions in this paper. The first was whether there was any tendency towards harmonisation of standards. Did (increased) trade lead to weaker or stronger standards in importing and exporting countries? We found that the standards were always higher in the trading equilibrium than in autarky in the exporting country – a ‘trading up’ effect. This reflected the reduced importance of producers for the domestic market, and the common interest of both consumers and producers in a higher standard as the price increased in the trading economy. But the standard adopted by the importer could be higher or lower than in autarky. This standard tends to be lower (higher) for low (high) weights on aggregate welfare in the decision process, relative to the degree of supply side asymmetry. The gap between the trading and autarky standards was declining in the weight given to producers, which implied that if the weight on aggregate welfare was high enough, both standards would be higher in the trading equilibrium. The greater the degree of supply side asymmetry the larger the range of aggregate welfare weights for which this holds. Clearly, given the difference in their autarky values, a declining standard in the importer and a rising standard in the exporter implies convergence. But full harmonisation only occurs when national industries set the standards (i.e. the weight on aggregate welfare is zero). Divergence in standards as a result of trade is also possible, if the degree of supply side asymmetry or the weight on aggregate welfare is large enough.

The second question was whether independent national standards tend to increase or reduce trade, relative to a harmonised standard. Here the answer was unambiguous. National standards reduce trade relative to a common standard, even when standards are precluded from being used as surrogate commercial policies. This is consistent with the evidence reported by Swann (2010). When importing countries adopt international standards (i.e. standards are harmonised) imports are higher. When importers use national standards, imports may be higher or lower for ‘standards’ (i.e. set by industry associations) and are definitely lower for ‘regulations’ (i.e. where consumer interests receive a higher weighting).

The third question concerned the political economy of standard setting; specifically whether trade was restricted more when producers were given a higher weight in standard selection. We found that the equilibrium trade share was increasing in the weight given to producer interests for any size of supply side asymmetry, although the effect was only significant when the supply side asymmetry was large and the weight attached to producer interests was small. Far from restricting trade, an increase in the producer influence on standard setting was more likely to increase trade.

Finally, we allowed the effects on the trade share to be taken into account in standard setting and asked if this resulted in higher or lower standards and an increased or reduced share of trade. We found that the outcome depended on the degree of producer influence. Where producer interests dominate, standards tend to be higher in both trading partners, but the trade share was lower. The opposite occurred when the weight on aggregate welfare in standard setting was relatively high.

Clearly some of our results are sensitive to the assumptions that we have made in order to make the analysis as tractable as possible. Complete international harmonisation of standards chosen by industry associations is not a likely outcome if countries differ in their costs of producing quality (our ‘w’), for example. But the effects that we have identified remain present in more general settings and the qualitative outcomes should persist. Most significantly our results confirm those in the externalities literature, that ‘protective’ standards may be higher or lower than ‘non-protective’ standards, so that the task of determining whether a regulatory authority is employing standards as a ‘disguised restriction to international trade’ or is setting standards that are ‘more trade-restrictive than necessary’ to fulfil its objective will be far from straightforward.

Appendix

[A]. To establish the direction of trade, we first compare the unit profits (π) obtained in the two markets in their autarky equilibria. Using (4), (9) and (13) we have

$$\pi_j^A = p_j^A - w \frac{[\lambda_j^A]^2}{2} = \frac{1}{2w} \left\{ D - K_j \left[1 - \frac{A}{2} \right] \right\} \left\{ D - K_j \left[1 + \frac{A}{2} \right] \right\}$$

From which it is straightforward to show that

$$\frac{\partial \pi_j}{\partial K_j} = \frac{1}{w} \left\{ K_j \left[1 - \frac{A}{2} \right] \left[1 + \frac{A}{2} \right] - D \right\} < 0$$

Thus unit profits are lower in the country with the larger capacity – country 2.

[B]. The equilibrium outcomes will depend on whether “exporters” can lobby in the importing country, and on whether their profits are included in importing country welfare. In general, we can think of this in terms of different modes of market access. Suppose, for example, that the product under consideration is a service, produced by human capital (our K) and unskilled labour. Then if skilled workers migrate permanently to the “importing” country, a scenario in which they can lobby along with the other domestic producers and their income is included in importing country welfare is not unreasonable. If this migration is temporary and the migrants’ income is remitted back to their country of origin, however, then their inclusion in importing country welfare is unlikely though they may still be able to lobby. If, instead, we are dealing with trade in goods then foreign-based exporters are likely to be precluded from lobbying and are unlikely to feature in importing country welfare.

With these assumptions in place, the regulatory authorities’ objective functions can be written from (7) as:

$$G_1(\lambda_1) = [1+a]\Pi_1(\lambda_1) + \gamma\Pi_{21}(\lambda_1) + aS_1(\lambda_1) \quad (\text{A1})$$

$$G_2(\lambda_2) = [1+a]\Pi_{22}(\lambda_2) + aS_2(\lambda_2) + a\Pi_{21}(\lambda_1) \quad (\text{A2})$$

Here $\gamma' = 1$ if exporters can lobby, but are not included in importing country welfare; $\gamma' = 1+a$ if exporters both lobby and are included in welfare; and $\gamma' = 0$ otherwise. Because the profits of exporting firms are unaffected by their home standard, they do not lobby the exporting country RA, and while their profits remain part of the exporting country’s aggregate welfare, the fact that these profits are unaffected by the exporter’s domestic standard effectively eliminates them from consideration by this RA.

We can derive the first order conditions. For the importing country we have:

$$\left[(1-\theta) + \gamma\alpha \right] K \left[D - K + (\theta - \alpha)K - w\lambda_1 \right] = -A \frac{K^2(1-\theta+\alpha)^2}{2} \quad (\text{A3})$$

where $\gamma = \gamma' / [1+a]$, and for the exporter:

$$(1+\theta-\alpha)K \left[D - K - (\theta - \alpha)K - w\lambda_2 \right] = -A \frac{K^2(1+\theta-\alpha)^2}{2} \quad (\text{A4})$$

Solving these first order conditions yield optimum quality standards of

$$\begin{aligned}\lambda_1^T &= \frac{D - [1 - \theta + \alpha]K}{w} + \frac{A}{2} \frac{K}{w} \frac{[1 - \theta + \alpha]^2}{[1 - \theta + \alpha\gamma]} \\ &= \lambda_1^A - \alpha \left\{ \left[1 - \frac{A}{2} \right] - [1 - \gamma] \frac{A}{2} \frac{[1 - \theta + \alpha]}{[1 - \theta + \alpha\gamma]} \right\} \frac{K}{w}\end{aligned}\quad (\text{A5})$$

$$\lambda_2^T = \frac{D - [1 + \theta - \alpha]K}{w} + \frac{A}{2} \frac{K}{w} [1 + \theta - \alpha] = \lambda_2^A + \alpha \left[1 - \frac{A}{2} \right] \frac{K}{w} \geq \lambda_2^A \quad (\text{A6})$$

There are two points to note here. First, as long as there is trade ($\alpha > 0$), the exporting country's optimal standard will be higher than in autarky ($\lambda_2^T \geq \lambda_2^A$). Second, whether the importing country's optimal standard rises or falls, depends on the volume of trade and model parameters – including the treatment of the exporters. If exporters effectively “migrate” to the importing country ($\gamma = 1$), then we have the case defined as a ‘non-protective standard’ by Fischer and Serra (2000). The importer's optimal standard falls by the same amount as the exporter's rises,²⁸ and standards are de facto harmonised. If exporters are excluded from both lobbying and the importing RA's objective function ($\gamma = 0$), then we have the case discussed in the text.

[C]. Solution for equilibrium standards in trading equilibrium when $A = 0$. From (32)

$$\begin{aligned}\lambda_{1L}^T &= \frac{D - [1 - \theta + \alpha]K}{w} \quad \text{and} \quad \lambda_{2L}^T = \frac{D - [1 + \theta - \alpha]K}{w} \\ \lambda_{1L}^T + \lambda_{2L}^T &= \lambda_{1L}^A + \lambda_{2L}^A = \frac{2[D - K]}{w}\end{aligned}\quad (\text{A7})$$

$$\lambda_{1L}^T - \lambda_{2L}^T = \lambda_{1L}^A - \lambda_{2L}^A - \alpha \frac{2K}{w} \quad (\text{A8})$$

$$\alpha = \theta + \left[\lambda_{1L}^T - \lambda_{2L}^T \right] \frac{w}{2K} \quad (\text{A9})$$

From which we obtain solutions

$$\lambda_{1L}^T = \lambda_{2L}^T = \frac{D - K}{w} \quad \text{and} \quad \alpha = \theta$$

[D] Effects of changes in standards on the trade share. From (25A) and (25B) we have that

$$D - K + (\theta - \alpha)K - w\lambda_1 \leq 0 \quad \text{and} \quad D - K - (\theta - \alpha)K - w\lambda_2 \leq 0$$

in the trading equilibrium. Substituting for $\theta - \alpha$ from (21) and rearranging, gives

$$\frac{2\lambda_2}{\lambda_1 + \lambda_2} \frac{D - K}{\lambda_1 + \lambda_2} - \frac{w}{2} \leq 0 \quad \text{and} \quad \frac{2\lambda_1}{\lambda_1 + \lambda_2} \frac{D - K}{\lambda_1 + \lambda_2} - \frac{w}{2} \leq 0$$

From (21)

$$\frac{\partial \alpha}{\partial \lambda_1} = \frac{1}{K} \left\{ \frac{2\lambda_2}{[\lambda_1 + \lambda_2][\lambda_1 + \lambda_2]} \left[\frac{D - K}{\lambda_1 + \lambda_2} - \frac{w}{2} \right] \right\} \quad \text{and} \quad \frac{\partial \alpha}{\partial \lambda_2} = -\frac{1}{K} \left\{ \frac{2\lambda_1}{[\lambda_1 + \lambda_2][\lambda_1 + \lambda_2]} \left[\frac{D - K}{\lambda_1 + \lambda_2} - \frac{w}{2} \right] \right\}$$

$$\text{Hence } \frac{\partial \alpha}{\partial \lambda_1} \leq 0 \quad \text{and} \quad \frac{\partial \alpha}{\partial \lambda_2} \geq 0$$

²⁸ Clearly the exporters' profits should no longer be included in exporting country welfare in this case, but their inclusion or omission has no effect on the optimal export-country standard.

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