BOND UNIVERSITY

GLOBALISATION & DEVELOPMENT CENTRE

Katia Berti and Rod Falvey[♦]

DOES TRADE WEAKEN PRODUCT QUALITY STANDARDS?

No. 29, April 2009

[♦] Rod Falvey, Professor of Economics, School of Economics, University of Nottingham and External Associate, Globalisation and Development Centre, Bond University. E-mail: rod.falvey@nottingham.ac.uk

DOES TRADE WEAKEN PRODUCT QUALITY STANDARDS?

Katia Berti

Rod Falvey

School of Economics
University of Nottingham
University Park
Nottingham NG7 2RD

Abstract

In this paper we investigate the effects of trade on the national minimum quality standards applied by two trading partners. 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 will tend to unduly favour producer interests. As always, trade changes the balance of consumer and producer interests in the two countries relative to autarky. It also creates a category of exporters, who have an interest in the standard set in the foreign market but do not figure in that country's welfare calculations and may not have lobbying access to its regulatory authority. As a result trade raises the minimum standard in the exporting country and may raise or lower the standard in the importing country, depending on parameter values.

Falvey acknowledges financial support from The Leverhulme Trust under Programme Grant F114/BF.

1. Introduction

The linkages between product trade and product standards have generated interest and 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 trade 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. This concern has lead to the inclusion of Agreements on Technical Barriers to Trade and the Application of Sanitary and Phytosanitary Measures as part of the World Trade Organisation. These Agreements prohibit discrimination amongst members and require that standards be set such the impact on trade is minimised. 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 (see 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 (see Vogel, 2001 and references). 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.

While a significant literature has developed around both these concerns, our primary interest in this paper is not with the potential use of standards as commercial policy instruments or as instruments to deal with cross-border externalities. In fact our analysis assumes an absence of externalities and explicitly eliminates commercial policy as motive for standard setting. Instead we investigate the effects of opening up to trade where national product quality standards are determined in a political economy context, and ask three main questions. First, does (increased) trade lead to weaker or stronger standards in importing and exporting countries? In answering this question we determine when 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? It is clear that trade would likely be reduced if standards were surrogate commercial policies, but is trade reduced even when they are not? In each case we 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 producers are given a higher weight in standard selection?

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. Both consumers and producers can benefit from such a standard, but have different views over its optimal level. We assume that the Regulatory 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 private producer interests (industry associations)[1]. We exclude the intentional use of standards as a non-tariff barrier by assuming that the Regulatory Authorities take the trade share as given when selecting the standard. The volume of trade will still affect the standard that is chosen, and the standard in turn will affect the volume of trade; but the standards themselves will not be selected with one eye on their implications for the volume of trade.

Fears of a race to the bottom lead to pressure for standards to be harmonised[2] 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 markets[3]. Casella (1996) noted that standards can be viewed as local public goods 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 both trading partners[4]. 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 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 the 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.

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 trade and section 4 sets out the properties of the trading equilibrium. This is followed by our conclusions.

---

[1] As Casella (2001) notes: "Often, however, technical standards, including the specific measures that satisfy the objectives of the government regulations, are left to private organisations and publicized as voluntary standards." (p 258). 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.

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

[3] 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 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.

[4] See Vogel and Kagan (2002) for a broad assessment of the literature on regulatory convergence or divergence and races to the bottom/top. 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.

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 output. 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

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

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:

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

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

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

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

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

2.2 The regulatory structure

The regulatory authority (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 (GH) (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). Producers offer policy-contingent contributions, $C(\lambda)$, to the RA so as to maximise their net return:[5]

$$\Pi(\lambda) - C(\lambda) \tag{5}$$

The RA values contributions from the lobbies, but also aggregate welfare, W, including both organised and unorganised segments of society. Its objective function is:

$$C(\lambda) + aW(\lambda) \tag{6}$$

where a>0 measures the RA's sensitivity to aggregate welfare relative to contributions. Aggregate welfare $W(\lambda)$ is defined here as the sum of producers' profit $\Pi(\lambda)$ and consumer surplus $S(\lambda) \equiv u(X,\lambda) - pX$.

We adopt the same equilibrium concept used by GH that applies the theoretical framework developed by Bernheim and Whinston (BW) (1986) for first-price menu auctions.[6] For simplicity we restrict attention to truthful contribution schedules, i.e. schedules that reflect the lobby's true preferences away from the equilibrium[7], and focus on truthful Nash Equilibria (NE) among all possible NE. This implies that the optimum (autarky) equilibrium standard, (λ^A) can be derived by maximizing[8]

$$G = \Pi(\lambda) + aW(\lambda) = (1+a)\Pi(\lambda) + aS(\lambda) \tag{7}$$

which leads to the following first-order condition:

$$(1+a)\frac{d\Pi}{d\lambda} = -a\frac{dS}{d\lambda} \tag{8}$$

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:

$$p^A = \lambda(D - K) \tag{9}$$

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

$$\Pi(\lambda) = \lambda K\left[D - K - \frac{w\lambda}{2}\right] \quad \text{and} \quad S(\lambda) = \frac{\lambda K^2}{2} \tag{10}$$

This in turn gives us

$$\frac{d\Pi}{d\lambda} = K(D - K - w\lambda) \quad \text{and} \quad \frac{dS}{d\lambda} = \frac{K^2}{2} \tag{11}$$

On the supply side, an increase in quality raises production costs (cost effect), while on the demand side utility and demand increase with quality (consumer confidence effect). These two can be seen as the direct effects of an increase in quality. Indirect effects are then triggered by the increase in the equilibrium price associated with a quality increase. This price effect will obviously be positive for

---

[5] We assume, as in GH (1995), that producers capture a negligible fraction of consumer surplus (which can therefore be excluded from producers' objective function (5)).

[6] The structure of a first-price menu auction is applicable to this framework. Special interest groups represent the bidders that name a vector ('menu') of contributions, where each specific contribution level refers to a possible policy outcome chosen by the RA (the auctioneer). Lobbying groups then stick to their announced contributions ('first price') when paying the bid to the RA after the policy-setting stage.

[7] As GH (1994) observe, the lobby's contribution schedule is locally truthful around λ^A.

[8] For the proof see footnote 7 in GH (1994).

producers and negative for consumers. From (11) 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.

Substituting in (8) we have

$$(1+a)K\left[D-K-w\lambda\right]=-a\frac{K^2}{2} \tag{12}$$

From which we derive the equilibrium quality standard:

$$\lambda^A=\frac{D-K}{w}+A\frac{K}{2w} \tag{13}$$

where $A\equiv a/1+a$ [9]. 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 (11) 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. $A\to 1$), we have

$$\lambda_W^A\to\frac{2D-K}{2w}>\lambda^A \tag{14}$$

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. $A\to 0$). Then

$$\lambda_L^A\to\frac{D-K}{w}<\lambda^A \tag{15}$$

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 (7) this is

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

We can write the welfare maximising standard as a weighted average of the consumer surplus and profit maximising standards as

---

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

$$\lambda_W^A = \frac{K}{2[D-K]}\lambda_S^A + \frac{2D-3K}{2[D-K]}\lambda_L^A .$$

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:

$$K_1 = (1-\theta)K \qquad K_2 = (1+\theta)K \qquad \text{with } 0 \le \theta \le 1$$

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 of[10]

$$\lambda_1^A = \frac{D-[1-\theta]K}{w} + \frac{A}{2}\frac{K}{w}[1-\theta] \text{ and } \lambda_2^A = \frac{D-[1+\theta]K}{w} + \frac{A}{2}\frac{K}{w}[1+\theta] \qquad (16)$$

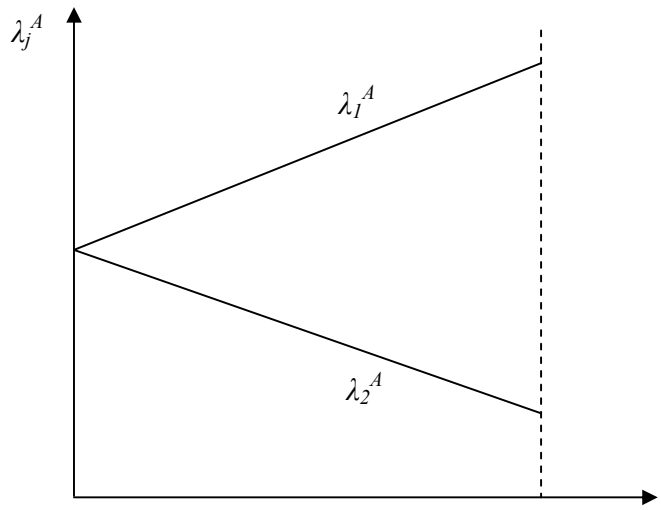
$$\text{with } \lambda_1^A - \lambda_2^A = \theta\frac{K}{w}[2-A] \ge 0 \quad \text{and } \frac{\lambda_1^A + \lambda_2^A}{2} = \frac{D-K}{w} + \frac{A}{2}\frac{K}{w} \qquad (17)$$

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) average[11]. At the extreme values of θ we have

$$\lambda_1^A\Big|_{\theta=0} = \lambda_2^A\Big|_{\theta=0} = \frac{D-K}{w} + A\frac{K}{2w} \text{ and } \lambda_1^A\Big|_{\theta=1} = \frac{D}{w} > \frac{D}{w} - [2-A]\frac{K}{w} = \lambda_2^A\Big|_{\theta=1} \qquad (18)$$

This allows us to represent the two autarky standards as functions of θ (Figure 1), and (16) shows that the two functions are simply straight lines with identical slopes (in absolute value).

Figure 1 – Autarky standards as functions of *θ*



[10] $D > [1+A][1+\theta]K$ is required to ensure positive unit profits in the autarky equilibrium in country 2. This will hold for all feasible A and θ if $D > 4K$.

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

0 1 θ

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

$$\lambda^U = \frac{D-K}{w} + A\frac{K}{2w} = \frac{\lambda_1^A + \lambda_2^A}{2}. \qquad (19)$$

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 regulatory authorities. 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 country.

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

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

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. 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

$$p_1^T = \lambda_1\left[D - K + (\theta-\alpha)K\right] \quad \text{and} \quad p_2^T = \lambda_2\left[D - K - (\theta-\alpha)K\right] \qquad (20)$$

By substituting (20) in the expressions for unit profits we obtain the condition for equal unit profits in the two markets:

$$\lambda_1\left[D-K+(\theta-\alpha)K-\frac{w\lambda_1}{2}\right]=\lambda_2\left[D-K-(\theta-\alpha)K-\frac{w\lambda_2}{2}\right] \tag{21}$$

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

$$\alpha^*=\theta+\frac{[\lambda_1-\lambda_2]}{K}\left\{\frac{[D-K]}{\lambda_1+\lambda_2}-\frac{w}{2}\right\} \tag{22}$$

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 (19) above. Substituting (22) back into (21), we find that the common unit profit in the trading equilibrium for the given standards is

$$\lambda_1\lambda_2\left\{\frac{2[D-K]}{\lambda_1+\lambda_2}-\frac{w}{2}\right\} \tag{23}$$

3.2 Equilibrium standards in the open economy

To explore how trade impacts on the quality standards chosen by the regulatory authorities 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:[12]

$$\Pi_1(\lambda_1)=\lambda_1(1-\theta)K\left[D-K+(\theta-\alpha)K-\frac{w\lambda_1}{2}\right] \tag{24}$$

$$\Pi_{22}(\lambda_2)=\lambda_2(1+\theta-\alpha)K\left[D-K-(\theta-\alpha)K-\frac{w\lambda_2}{2}\right] \tag{25}$$

$$\Pi_{21}(\lambda_1)=\lambda_1\alpha K\left[D-K+(\theta-\alpha)K-\frac{w\lambda_1}{2}\right] \tag{26}$$

$$S_1(\lambda_1)=\frac{\lambda_1K^2(1-\theta+\alpha)^2}{2} \tag{27}$$

$$S_2(\lambda_2)=\frac{\lambda_2K^2(1+\theta-\alpha)^2}{2} \tag{28}$$

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, we assume that they ignore any effects of their decision on the trade share (and therefore on the standard in the other country). This is to exclude an explicit commercial policy role for standards. It 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 (22). 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 level of imports.

[12] Expressions (24) and (25) are derived simply by substituting the equilibrium prices under trade (20), as well as the functional form used for production costs, (1), in the general expression for producer profits, (10). Expressions (27) and (28) are obtained by substituting the equilibrium prices under trade (20) in the general expression for consumer surplus.

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:

$$G_1(\lambda_1) = [1+a]\Pi_1(\lambda_1) + \gamma'\Pi_{21}(\lambda_1) + aS_1(\lambda_1) \qquad \text{(29A)}$$

$$G_2(\lambda_2) = [1+a]\Pi_{22}(\lambda_2) + aS_2(\lambda_2) + a\Pi_{21}(\lambda_1) \qquad \text{(29B)}$$

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.

Using (24)-(29B) we can derive the first order conditions. For the importing country we have:

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

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

$$(1+\theta-\alpha)K\left[D-K-(\theta-\alpha)K-w\lambda_2\right] = -A\frac{K^2(1+\theta-\alpha)^2}{2} \qquad (31)$$

At the optimal standards, the left sides of these two equations must both be negative, while at the same time unit profits must be positive. Using (23), (30) and (31) this requires[13] that

$$2\frac{D-K}{\lambda_1+\lambda_2} > \frac{w}{2} > \frac{D-K}{\lambda_1+\lambda_2} \qquad (32)$$

From (22), we then have that $\alpha < (>)\ \theta$ as $\lambda_2 < (>)\ \lambda_1$. Solving the first order conditions yield optimum quality standards of

$$\begin{aligned}\lambda_1^T &= \frac{D-[1-\theta+\alpha]K}{w} + \frac{A}{2}\frac{K}{w}\frac{[1-\theta+\alpha]^2}{[1-\theta+\alpha\gamma]} \\ &= \lambda_1^A - \alpha\left\{\left[1-\frac{A}{2}\right]-[1-\gamma]\frac{A}{2}\frac{[1-\theta+\alpha]}{[1-\theta+\alpha\gamma]}\right\}\frac{K}{w}\end{aligned} \qquad (33)$$

[13] That is $D-K+(\theta-\alpha)K-w\lambda_1 < 0$ and $D-K-(\theta-\alpha)K-w\lambda_2 < 0$. Summing these gives us $2[D-K]-w[\lambda_1+\lambda_2] < 0$.

$$\lambda_2^T = \frac{D-[1+\theta-\alpha]K}{w} + \frac{A}{2}\frac{K}{w}[1+\theta-\alpha] = \lambda_2^A + \alpha\left[1-\frac{A}{2}\right]\frac{K}{w} \geq \lambda_2^A \tag{34}$$

Further, $\lambda_1^T + \lambda_2^T = \lambda_1^A + \lambda_2^A + \alpha\left\{[1-\gamma]\frac{A}{2}\frac{[1-\theta+\alpha]}{[1-\theta+\alpha\gamma]}\right\}\frac{K}{w} \geq \lambda_1^A + \lambda_2^A$ (35)

$$\lambda_1^T - \lambda_2^T = \lambda_1^A - \lambda_2^A - \alpha\left\{2\left[1-\frac{A}{2}\right] - [1-\gamma]\frac{A}{2}\frac{[1-\theta+\alpha]}{[1-\theta+\alpha\gamma]}\right\}\frac{K}{w} \tag{36}$$

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 would rise even if the RA was 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 – including the treatment of the exporters. If exporters effectively "migrate" to the importing country ($\gamma = 1$), then the importer's optimal standard falls by the same amount as the exporter's rises,[14] and standards are de facto harmonised. If exporters are excluded from both lobbying and the importing RA's objective function ($\gamma = 0$), then

$$\lambda_1^T \geq \lambda_1^A \text{ if } 1 \leq \frac{A}{2}\left[2+\frac{\alpha}{1-\theta}\right] \qquad \text{or if} \quad \alpha \geq 2[1-\theta]\frac{1-A}{A} \equiv \bar{\alpha} \tag{37}$$

We have the possibility that standards are higher in both markets if the trade share is sufficiently high – i.e. $\alpha \geq \bar{\alpha}$. It is straightforward to see that $\bar{\alpha}$ is decreasing in both θ and A, suggesting that this outcome is more likely the greater the supply asymmetry and the greater the weight on aggregate welfare, an conclusion we confirm by simulation below. Henceforth we restrict attention to the case where exporting firms are excluding from lobbying in the importing country ($\gamma = 0$).

Equations (33) and (34) are implicit solutions to the equilibrium standards because the trade share depends on both standards as shown in (22). Unfortunately, the nonlinear nature of the 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, obtaining

$$\lambda_{1L}^T = \frac{D-[1-\theta+\alpha]K}{w} \qquad \text{and} \quad \lambda_{2L}^T = \frac{D-[1+\theta-\alpha]K}{w} \tag{38}$$

$$\lambda_{1L}^T + \lambda_{2L}^T = \lambda_{1L}^A + \lambda_{2L}^A = \frac{2[D-K]}{w} \tag{39}$$

[14] 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.

$$\lambda_{1L}^{T} - \lambda_{2L}^{T} = \lambda_{1L}^{A} - \lambda_{2L}^{A} - \alpha \frac{2K}{w} \qquad (40)$$

$$\alpha = \theta + \left[\lambda_{1L}^{T} - \lambda_{2L}^{T} \right] \frac{w}{2K} \qquad (41)$$

Using (38)-(41) we obtain solutions

$$\lambda_{1L}^{T} = \lambda_{2L}^{T} = \frac{D-K}{w} \quad \text{and } \alpha = \theta \qquad (42)$$

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=1*) is less straightforward, but revealing nonetheless. As $\alpha = 0$ is not an equilibrium outcome in this case, we have $\alpha \geq \overline{\alpha} = 0$ and are in the range where trade raises the optimal standard in both countries.

$$\lambda_{1W}^{T} = \lambda_{1W}^{A} + \frac{\alpha^2}{[1-\theta]} \frac{K}{2w} \geq \lambda_{1W}^{A} \quad \text{and} \quad \lambda_{2W}^{T} = \lambda_{2W}^{A} + \alpha \frac{K}{2w} \geq \lambda_{2W}^{A} \qquad (43)$$

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

$$\lambda_{1W}^{T} - \lambda_{2W}^{T} = \lambda_{1W}^{A} - \lambda_{2W}^{A} + \left[\frac{\alpha}{[1-\theta]} - 1 \right] \frac{\alpha K}{2w} \qquad (44)$$

which may in turn imply a smaller trade share.

4. The Trading Equilibrium

Inspection of (33) and (34) 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 2 illustrates how the equilibrium export share (α) varies for different values of A and θ.

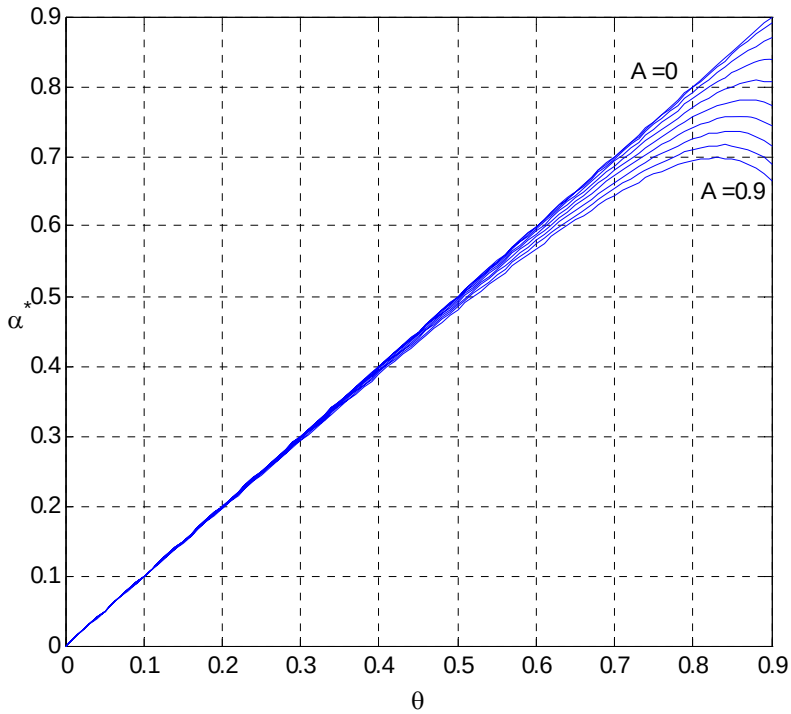


Figure 2: Equilibrium export share ($K/w = 3$, $\delta = 8$)

This figure 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 trade[15]. 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). These outcomes are further illustrated in Figure 3 which plots the equilibrium trade share against both the relative weight on aggregate welfare and the supply side asymmetry. The trade share falls away for high θ as A increases.

[15] 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.

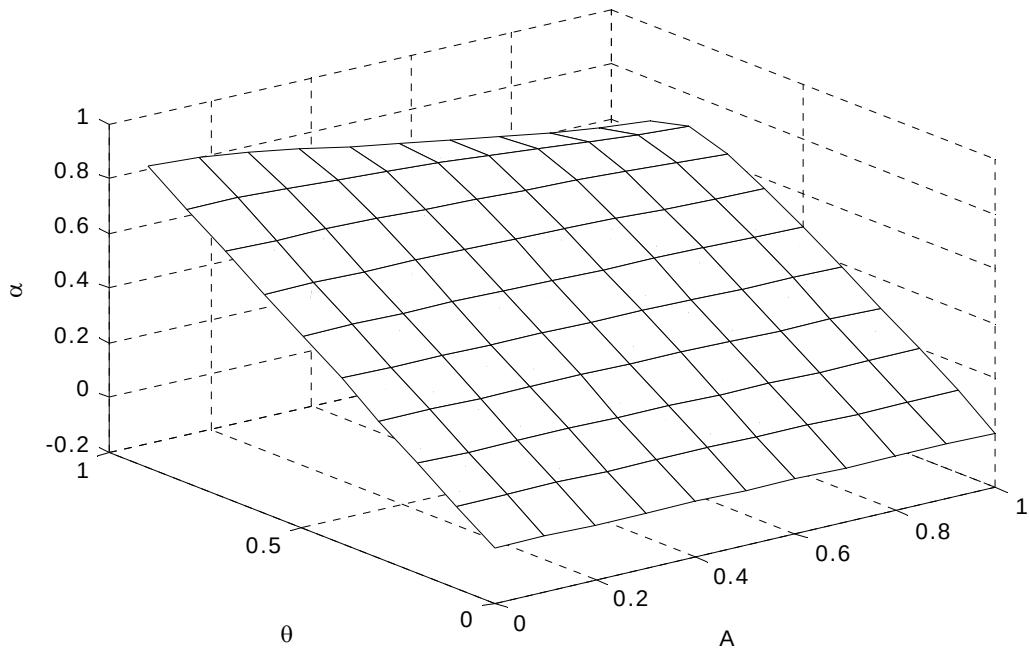
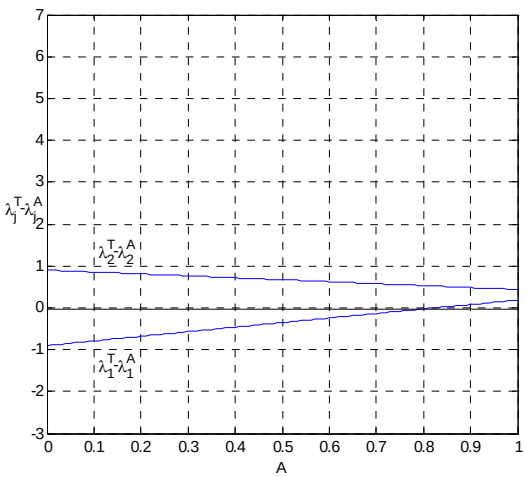
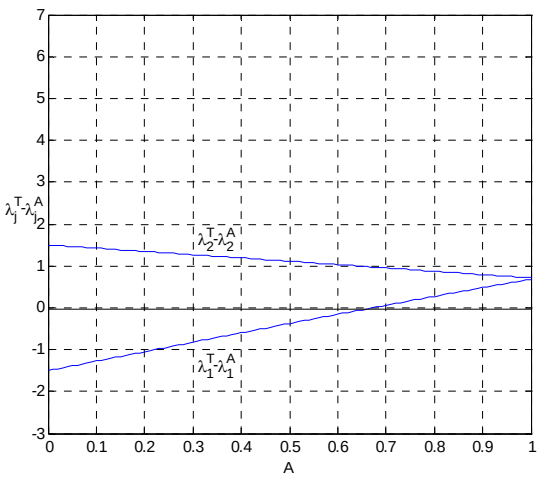


Figure 3: The Equilibrium Export Share

In Figure 4 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.

$\theta = 0.3$	$\theta = 0.5$
	
$\theta = 0.7$	$\theta = 0.9$

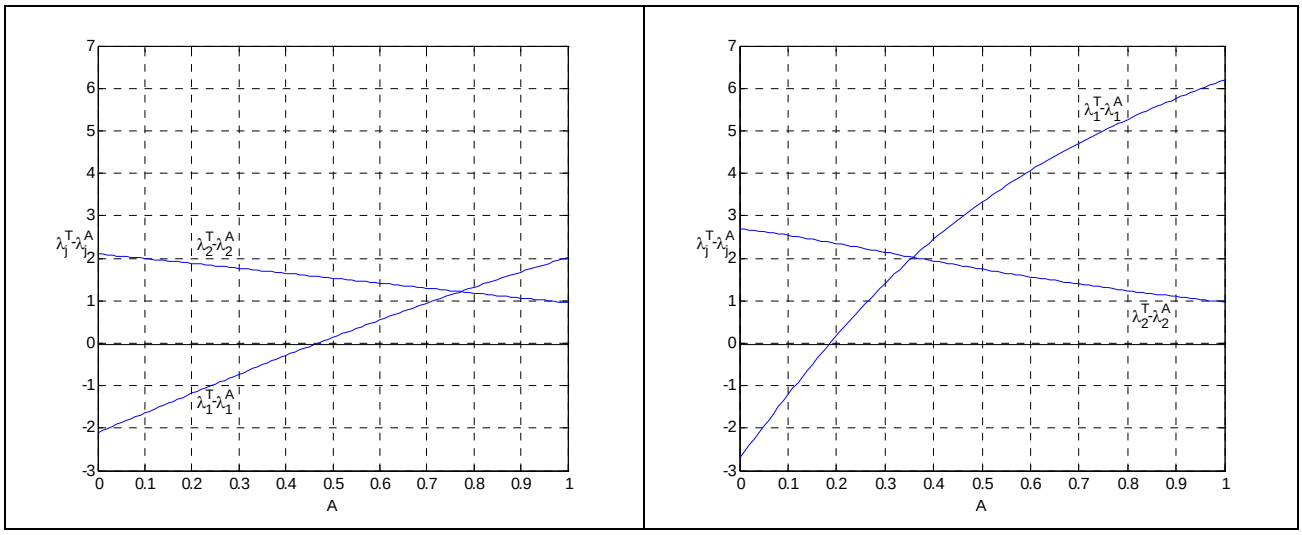


Figure 4: Changes in Standards Relative to Autarky (K/w = 3, δ = 8)

Several conclusions[16] emerge from Figure 4. 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 (44) above.

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 (17) into (22) it is straightforward to show that the trade share at the autarky standards is

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

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 (33) and (34) we find

$$\frac{\partial \lambda_1^T}{\partial \alpha} = \frac{K}{w}\frac{A}{[1-\theta]}\left[\alpha - \frac{\bar{\alpha}}{2}\right] \qquad \text{and} \quad \frac{\partial \lambda_2^T}{\partial \alpha} = \frac{K}{w}\left[1 - \frac{A}{2}\right] > 0 \qquad (45)$$

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 with α when the trade share is above a

[16] These results are not affected by changes in δ.

threshold ($\bar{\alpha}/2$), and decreases with α when the trade share is below the threshold. This ambiguity reflects the opposing effects of changes in the equilibrium price on consumer surplus and producer profits. The threshold in (45) 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 [37] that the 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 exporters 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? From (33), (34) and using $\lambda_1 \geq \lambda_2$ and (32), we find

$$K\frac{\partial\alpha}{\partial\lambda_1} = \frac{2\lambda_2}{[\lambda_1+\lambda_2]}\frac{[D-K]}{[\lambda_1+\lambda_2]} - \frac{w}{2} < 0 \text{ and } K\frac{\partial\alpha}{\partial\lambda_2} = \frac{w}{2} - \frac{2\lambda_1}{[\lambda_1+\lambda_2]}\frac{[D-K]}{[\lambda_1+\lambda_2]} \quad (46)$$

Given that condition (32) implies a negative coefficient on $\lambda_1 - \lambda_2$ in (22), one would expect an increase in the standard in the importing country to reduce trade, other things equal, and an increase in the exporter's standard to increase trade. The first part of this expectation is correct. The second will also be correct, but only as long as the standards are not too different.

In Figure 5 we illustrate the combinations of the relative weighting on aggregate welfare, the supply asymmetry and relative market size for which the difference between standards in the trading equilibrium is the same as in autarky[17].

[17] The relevant equations are given in the Appendix.

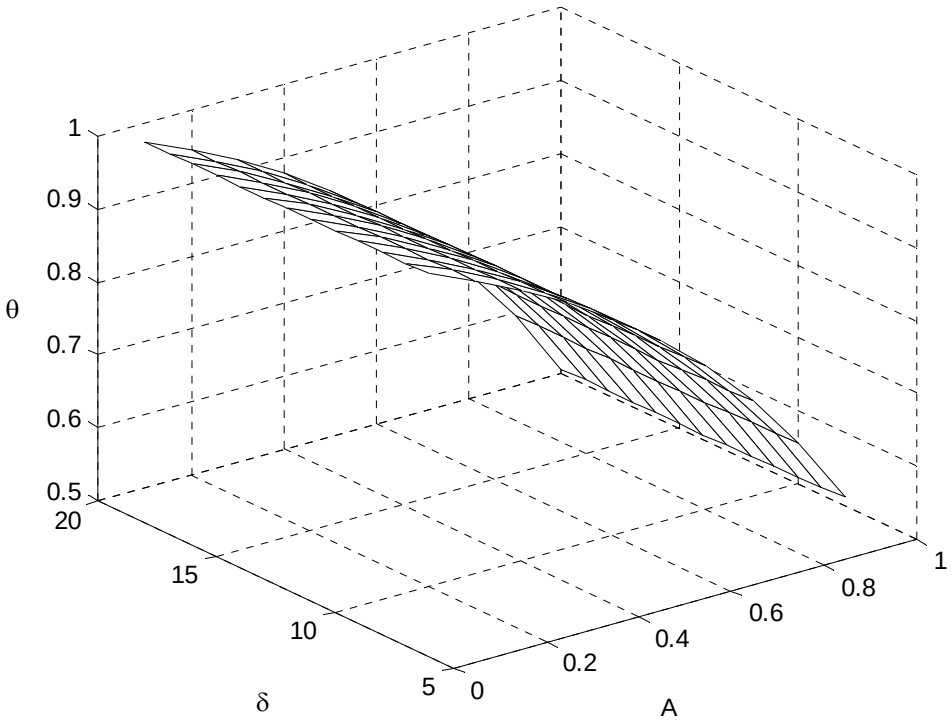


Figure 5: Combinations which give an unchanged gap in standards.

As expected we find the relative weighting on aggregate welfare and the index of supply side asymmetry are substitutes on this "iso-gap" locus. The locus itself does not appear to be sensitive to market size. As the final panel of Figure 4 shows, parameter combinations above (below) the locus correspond to cases where the trading equilibrium has larger (smaller) gap between standards than in autarky.

5. Conclusions

In the introduction we noted that we aimed to answer three 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. This reflected the reduced importance of producers for the domestic market, and the common interest of both consumers and producers in a higher standard 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. This 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. This despite our assumption that precluded standards from being used as surrogate commercial policies.

The third question was 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.

Appendix

For what combinations of A, θ and δ is the gap between standards the same in the trading equilibrium as in autarky?

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

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

So for $\lambda_1^T - \lambda_2^T = \lambda_1^A - \lambda_2^A$ we need $2\left[1-\frac{A}{2}\right] = \frac{A}{2}\frac{[1-\theta+\alpha]}{[1-\theta]}$ (or $\alpha = \frac{1-\theta}{A}[4-3A]$)

In which case

$$\lambda_1^T + \lambda_2^T = \lambda_1^A + \lambda_2^A + 2\alpha \left\{ 1-\frac{A}{2} \right\} \frac{K}{w} = \lambda_1^A + \lambda_2^A + 2\left\{ 1-\frac{A}{2} \right\} \frac{K}{w} \frac{1-\theta}{A} [4-3A]$$

Now

$$\frac{\lambda_1^A + \lambda_2^A}{2} = \frac{D-K}{w} + \frac{A}{2}\frac{K}{w}$$

So that $\lambda_1^T + \lambda_2^T = 2\left\{ \frac{D-K}{w} + \frac{A}{2}\frac{K}{w} \right\} + 2\left\{ 1-\frac{A}{2} \right\} \frac{K}{w} \frac{1-\theta}{A} [4-3A]$

Also

$$\lambda_1^A - \lambda_2^A = \theta \frac{K}{w} [2-A]$$

Using

$$\alpha^* = \theta + \frac{\left[\lambda_1^T - \lambda_2^T\right]}{K} \left\{ \frac{[D-K]}{\lambda_1^T + \lambda_2^T} - \frac{w}{2} \right\}$$

And substituting for trade share and standards we get

$$\frac{1-\theta}{A}[4-3A] = \theta + \frac{\theta[2-A]}{w} \left\{ \frac{[D-K]}{\left\langle 2\left\{ \frac{D-K}{w} + \frac{A}{2}\frac{K}{w} \right\} + 2\left\{ 1-\frac{A}{2} \right\} \frac{K}{w} \frac{1-\theta}{A} [4-3A] \right\rangle} - \frac{w}{2} \right\}$$

i.e.

$$\frac{1-\theta}{A}[4-3A] = \theta + \frac{\theta[2-A]}{2} \left\{ \frac{\delta - 1}{\left\langle \left\{ \delta - 1 + \frac{A}{2} \right\} + \left\{ 1-\frac{A}{2} \right\} \frac{1-\theta}{A} [4-3A] \right\rangle} - 1 \right\}$$

From which we can solve for the relevant combinations of A and θ. The solutions may also depend on δ.

References

Akerlof, G. (1970) "The market for 'Lemons'" *Quarterly Journal of Economics*, 84, 488-500.

Baldwin R.E. (2001) "Regulatory Protectionism, Developing Nations and a Two-Tier World Trade System" *Brookings Trade Review*, 3, 237-80.

Bernheim, B. D. and M. D. Whinston (1986) "Menu auctions, Resource Allocation, and Economic Influence" *Quarterly Journal of Economics* 101(1), 1-31.

Bhagwati J. and R.E. Hudec (1996) *Fair Trade and Harmonization: Prerequisites for Free Trade? Volume 1.* MIT Press, Cambridge MA and London.

Bureau, J-C., S. Marette and A. Schiavina (1998) "Non-tariff trade barriers and consumers' information: The case of the EU-US trade dispute over beef", *European Review of Agricultural Economics*, 25, 437-462.

Casella, A. (1996) "Free Trade and Evolving Standards" Chapter 3 in J. Bhagwati and R. E. Hudec (eds.) *Fair Trade and Harmonization: Prerequisites for Free Trade? Volume 1.* MIT Press, Cambridge MA and London.

Casella, A. (2001) "Product Standards and international Trade; Harmonization through Private Coalitions?", Kyklos, 54(2/3), 243-64.

Donovan, J. A., J. A. Caswell and E. Salay (2001) "The effects of stricter foreign regulations on food safety levels in developing countries: a study of Brazil" *Review of Agricultural Economics* 23(1), 163-75.

Grossman G. and E. Helpman (1994) "Protection for Sale" *American Economic Review* 84(4) 833-850.

Grossman G. and E. Helpman (1995) "The Politics of Free Trade Agreements" *American Economic Review* 85(4) 667-690.

Krugman, P. (1997) "What should trade negotiators negotiate about?" *Journal of Economic Literature* XXXV(1), 113-120.

Leebron D. W. (1996) "Lying down with Procrustes: An analysis of harmonization claims" Chapter 2 in J. Bhagwati and R. E. Hudec (eds.) *Fair Trade and Harmonization: Prerequisites for Free Trade? Volume 1.* MIT Press, Cambridge MA and London.

Olson, M. (1965) *The Logic of Collective Action*. Harvard University Press

Prakash A. and M. Potoski (2006) "Racing to the bottom? Trade, environmental governance and ISO 14001" *American Journal of Political Science* 50(2), 350-64.

Rauscher, M. (1991) "National environmental policies and the effects of economic integration" *European Journal of Political Economy* 7, 313-329.

Sykes, A. O., (1999) "The (Limited) Role of Regulatory Harmonization in International Goods and Services Markets", *Journal of International Economic Law*, 2(1), 49-70.

Vogel, D. (2001) "Is there a Race to the Bottom? The Impact of Globalization on National Regulatory Policies", *Tocqueville Review/La Revue Tocqueville*, XXII(1), 1-11.

Vogel, D. And R. A. Kagan (2002) "National regulations in a global economy" in D. Vogel and R. A. Kagan (eds) *Dynamics of Regulatory Change: How Globalisation Affects National Regulatory Policies*, University of California Press.