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Trade and strategic regulatory bias in monopolistic industries

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Abstract

Regulatory standards, such as on health and safety, may be subject to strategic bias when a country engages in trade. Where regulation is to correct an undersupply of quality by a monopolistic industry, if regulators do not cooperate and firms can vary standards, there will be a tendency to strategic overregulation, which leads to excessive, rather than inadequate trade. When there is a mixture of horizontal and vertical quality regulations, the profit-shifting motive for protection is less than the previous literature suggests. In this case, contrary to previous findings, mutual recognition agreements lead to underregulation.

KEYWORDS: Trade, Oligopoly, Regulation, Standards, Harmonisation. JEL Classification: F13, L13, L51

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1 Introduction

This paper examines the implications of quality regulations (e.g. on safety, reliability or public health and environmental grounds) in an open economy. The existence of trade can result in strategic distortions to regulatory policy. Much of the existing literature makes a presumption not just that there will be a tendency in an open economy to excessive regulation, but that this will be of a protectionist, trade-reducing kind. By contrast, I find that while there may well be over-regulation in importing countries in monopolistic industries, the effects may actually be trade-increasing.

It is worth bearing in mind that much of the existing literature on regulatory protection assumes a profit-shifting motive to benefit local producers. This suggests an oligopolistic trade structure - yet at the same time, there is little discussion of the legitimate grounds for quality regulation which occur when an industry is monopolistic. I show that, on reasonable assumptions, monopolistic producers will tend to produce goods at suboptimal quality. It is perhaps worth noting that this suboptimal quality may take many forms, such as inadequate health, safety and environmental testing, or lack of labeling. Much of this can be corrected by regulation. However, the regulation benefits consumers at the expense of producers: where the producers are foreign, there will be a bias to over-regulation, and this strategic bias continues in the case where countries are symmetrical and product quality can differ between markets. The higher regulatory standards actually increase trade volumes, at the expense of profits. By contrast, mutual recognition agreements - previously considered to be unambiguously welfare improving - may produce underregulation, since exporting countries will have a desire to reduce producers’ costs at the expense of foreign consumers.

This is an important finding, since it casts doubt upon the currently popular prescription of mutual recognition as a response to presumed regulatory bias. In many areas
of current dispute, such as genetically modified foodstuffs, removal of ‘protectionist’ national or regional regulations may be contrary to the interests of consumers, and, contrary to widespread assumptions, may result in falling consumer demand and reduced trade.

Section 2 reviews the background and existing literature on quality regulations and trade. While policymakers and economists accept regulations as potentially legitimate, the literature stresses they will often be greatly distorted for protectionist reasons: a conclusion which this paper challenges when an industry is monopolistic.

In the subsequent sections I concentrate on the underprovision of quality by a classical cross-hauling duopoly. Section 3 examines pure vertical standards: the approach is first to develop a model for a simple monopoly and then to extend it to a cross-hauling duopoly with one identical firm in each of two identical countries, where consumer preferences are identical and the good concerned is a substitute for other consumer goods. In these circumstances, a vertical minimum quality standard is potentially welfare-improving. However, countries will tend to set standards higher than optimal, and cross-country harmonisation benefits welfare. A mutual recognition regime by contrast results in standards below the global optimum.

Section 4 considers pure horizontal quality standards, imposing a resource cost on foreign producers only. These may be imposed for protectionist pro.t-shifting, though only when tariffs are ruled out. However, when there is also vertical regulation, monopolistic pro.t, and hence the pro.t-shifting motive is greatly reduced. Where countries differ in quality of production, the higher-quality country may sometimes choose to raise minimum standards, but again the circumstances and scope for this are less than the previous literature has suggested.

In section 5, I consider the effects of constraining producers to supply at the same qual-
ity to both markets - in particular concentrating on the case where only one country is a producer. A mutual recognition regime under imperfect competition will again result in underregulation (and reduced trade). Where there is no such recognition, the importing country will set the higher standards, but there will be a bilateral game between the two regulators in standard setting. Compared to non-cooperation, mutual recognition will unambiguously worsen welfare in the importing country.

Section 6 concludes.

2 Background and existing literature

As formal trade barriers have been reduced worldwide, there has been increasing recognition of the importance of Technical Barriers to Trade (TBTs) - barriers resulting from a whole raft of national regulations and standards on labelling, product safety, labour standards, environmental quality and so on. The EU Single Market initiative has largely been aimed at removing such barriers,\(^1\) and subsequent mutual recognition agreements (MRAs) have been agreed between the EU and several other countries, as well as within the Asia Pacific Economic Community (see Maskus and Wilson (1), 2001). A similar awareness underlies the articles on TBTs and Sanitary and Phytosanitary Standards (SPS) in the GATT Uruguay Round, and the GATS. For example the WTO Agreement Annex on Technical Barriers to Trade Article 2 states that:

‘Members shall ensure that technical regulations are not prepared, adopted or applied with a view to or with the effect of creating unnecessary obstacles to international trade. For this purpose, technical regulations shall not be more

\(^1\)One EU report in 1996 estimated that 76% of trade between member states was subject to standards, and sectors affected by regulatory trade barriers accounted for 21% of trade and 29% of gross value added (reported in OECD, 1999).
trade-restrictive than necessary to ful...l a legitimate objective....'

Nevertheless, there has been considerable concern that existing agreements do not go far enough, particularly from the viewpoint of developing countries.

TBTs are much more complicated to analyse than tariffs or quotas. Deciding to what extent barriers are in practice legitimate or constitute ‘regulatory protection’ (the term used by Baldwin, 2001) is not simple. First the issue of definition: some authors have used very wide definitions of what constitutes protectionism,\(^2\) exceeding those in the WTO Agreements.

Turning to specific cases, a few conclusions can be drawn from the literature. Even regulations which apply equally to production at home and to imports may discriminate against firms which trade. The literature often discusses pure cost-increasing protectionist regulation (eg Wallner, 1998): however, it seems unlikely substantial use would be made of a policy which imposes high resource costs on consumers unless tariffs, which impose a much smaller deadweight loss, were ruled out.

Regulatory differences between countries can in principle be broadly defined as either horizontal or vertical. The former impose different technologies or incompatible means of achieving a given set of results, such as plug sizes. By contrast, vertical standards are where a regulator clearly insists that goods achieve at least a certain minimum standard of safety or performance. In practice many regulations may have both horizontal and vertical aspects, such as insisting that cars achieve less than certain emissions levels, and specifying use of catalytic converters.

The most widely-recognised motive for horizontal regulation is network externalities

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\(^2\)Fischer and Serra (2000) define a standard in a cross-hauling duopoly model as ‘non-protectionist when it corresponds to the standard the local social planner would use if both firms were domestic’.
(see, eg Gandal, 2001). This is the situation where there is a substantial potential gain if all consumers use a compatible technology (see e.g. Gandal, 2001). The scope for distorting such a system for protectionist purposes is also clear: if technologies are not easily compatible, the government can favour home producers.

In the case of vertical quality, the literature to date recognises three main legitimate reasons for minimum quality controls. First, unreliable or dangerous goods may impose externalities - the most extreme case being disease control (which underlies Sanitary and Phytosanitary Standards). Secondly, purchasers of goods may not easily be able to distinguish the quality. In this case (see e.g. Akerlof, 1970) adverse selection may mean that bad goods drive out the good, unless there is either effective central labelling or some minimum quality standard. The third motivation is where tastes are diverse and supply is oligopolistic. In this model (see Lutz, 1996(1); Das and Donnenfeld (1989) ) mutual recognition benefits both countries, particularly the lower-quality producer.

However, the above papers assume a fixed number of consumers buying at most one good each. This means they tend to ignore a key feature of the classical monopoly/oligopoly model: that producers can raise profits by restricting output. Where quality differences substitute with diminishing returns for quantity of consumption, there may be scope for producers to increase profits at consumers' expense by reducing quality as well as crude quantity. This provides another legitimate reason for minimum quality standards: to correct the underprovision of quality by monopolistic firms.

A lack of competition may reduce quality - on a broad definition - in a number of ways. These could include lack of testing and labelling or use of technological incompatibilities to tie in users to one firm's products. For example, all of these criticisms are seen in the lobbying against genetic modification of foodstuffs. The response of governments to these will, however, depend upon the geographical structure of the industry: in the case of GM
technology, US rms dominate. The analysis of this paper suggests it should be no surprise that European legislators have taken a stricter line than those in North America, leading to a major trade dispute, notably over the separate labelling of GM foodstuffs - however, I would suggest it is likely, if higher labelling standards prevail, that trade will be higher than if they do not, and that this would benefit consumer welfare.\(^3\)

More common, however, may well be industries where trade is in both directions, such as motor vehicles, food products, clothing, petroleum products, pharmaceuticals or mobile telephones. In all of these industries, national standards are seen as extremely important, and yet the symmetries between countries are much greater than with GM crops. I argue there is likely to be a bias towards over-regulation in most countries in these circumstances. For example, there have long been complaints in the USA about supposed overregulation of pharmaceuticals by the Food and Drugs Administration (see Friedman (1980) or more recent work by the right-wing Cato Institute), while similar complaints can be heard from European motor vehicle manufacturers.\(^4\) However, in this paper, I argue that these regulations may actually increase trade volumes (at least when adjusted for quality), though at a cost to manufacturers.\(^5\)

The asymmetric interests cases (such as GM technology) tend to be those which crop up most in WTO disputes, while where interests are symmetric there may be fewer disagreements. However, this disguises important similarities - in both cases, importing countries have a strategic tendency to over-regulate (though it is only in the asymmetric case that

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\(^3\)Nielsen and Anderson (2001) look at one scenario where some of the EU consumer demand is sensitive, but they do not link this to utility, which may explain their rather negative assessment of EU policy.

\(^4\)e.g. the European Automobile Manufacturers' Association http://www.acea.be/AHEAD/20040218PressRelease.pdf

\(^5\)In the case of pharmaceuticals, it may be more accurate to say that higher imposed testing standards would reduce the risk of consumer scares.
this appears as protection - and then only when export and home market technologies cannot be separated cheaply). While one may be tempted to talk of cases such as the GM technology as representing regulatory protectionism, this is also too simple, since it ignores the potential bias in the exporting country towards under-regulation. It is by no means clear that mutual recognition would be welfare-improving in either case - contrary to the drift of much of today’s trade literature.

3  A model of vertical quality regulation

I examine quality regulations as a response to underprovision of quality by a monopolistic industry. Strictly speaking, ‘regulations’ are applied by governments, while ‘standards’ are voluntarily agreed by industries (Sykes, 1995). I concentrate primarily on the former.

The method is to set up a series of theoretical models of a cross-hauling duopoly. The optimal degree of regulation is established, as are the conditions under which actual regulation differs from this, when there is total non-cooperation over regulation setting, or when there is mutual recognition.

Consideration is also given to whether these regulations are in fact protectionist: for this I prefer a relatively narrow definition of protection.

**DEFINITION:** A regulation is non-protectionist if it (i) does not reduce traded volumes; and (ii) does not favour local profits at the expense of foreign producers.

This definition leaves a category of trade-related strategic distortions, notably the case where regulation causes local consumers to benefit from increased sales (at lower cost and reduced profits) by both domestic and foreign producers. In this case, there are much

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6In general, a voluntary industry standard is more likely to be operated to maximise profits of domestic firms than a government regulation. However, under the former, importers may be able to enter the market without complying.
stronger parallels with the issue of international tax competition, rather than with tariff or quota policies.

There is actually a fair amount of evidence to suggest that standards and regulations are generally not protectionist - notably Swann et al’s (1996) British study, finding that increasing numbers of quantitative standards tend to be correlated with increasing volumes of both imports and exports. Moenius (1999) had broadly similar findings. Also note Greenaway and Milner’s (1986) theoretical arguments that standards are trade-promoting, though based on rather different grounds to this paper.

In this paper I am interested in regulations which improve the minimum vertical quality experienced by consumers. In the absence of regulation, monopoly generally reduces the quality of goods on offer, but in the presence of trade there may be strategic distortions if national regulators do not collaborate.

I start with the simplest case of a monopolist. It is assumed that consumers are identical. I consider initially a single country using a partial equilibrium approach, concentrating on just one good. Firms produce output with two features, quality, $Q$, and quantity, $Y$. I assume initially that the total cost of production, $C$, is a linear function of $Q$ and $Y$, with $a$ and $b$ denoting the linear scalars

$$C = aY + bQ: \tag{1}$$

I assume homothetic demand for quality and output, so that we can convert quality and output to a measure of ‘quality-adjusted output’, $X$. For simplicity I assume $X$ is a Cobb-Douglas aggregate of $Y$ and $Q$

$$X = Y^{\bar{\alpha}} Q^{\bar{\beta}}; \tag{2}$$
where \( \bar{\gamma} \) is a scalar which lies between zero and unity.

We can also convert the price per unit of output \( P \) into a price per unit of quality adjusted output, \( P_X \).

Consumer utility depends upon consumption both of quality-adjusted output, \( X \), and of a residual aggregate of other goods, \( G = \bar{M} i \ P_X X \) (where \( \bar{M} \) is an exogenously given endowment) in a quasilinear fashion—thus eliminating income effects. For simplicity the utility from consuming the good in question is assumed to have an elasticity \( \gamma \) with respect to consumption—implying a constant elasticity of demand, \( i^2 = i \ 1 = 1 \):  

\[
U = \bar{M} i \ P_X X + \circ X \gamma :
\]

(3)

#### 3.1 Monopoly equilibrium under quality regulation

I begin with a quality regulated monopolist, whose profit mark-up is a decreasing function of demand elasticity \( \bar{\gamma} \). I assume \( \bar{\gamma} \) exceeds unity, which implies \( 0 < \gamma < 1 \).

I start by considering the behaviour of an unregulated monopoly, denoted superscript \( U \). For a given level of \( X = X^U \), we can obtain the cost-minimising value of \( Q(= Q^U) \). This equals

\[
Q^U = ((a=\bar{\gamma})(1 \ i \ \bar{\gamma})) \ 1 \ 1 \ X^U ;
\]

(4)

and hence yields a constant marginal cost of raising \( X \),

\[
MC^U = (a=\bar{\gamma})((a=\bar{\gamma})(1 \ i \ \bar{\gamma})) \ 1 \ 1 ;
\]

(5)
Now introduce a regulation \( xing Q^R \) (where the superscript \( R \) denotes a regulatory minimum quality). In practice, if \( Q^R > Q^U \) then the \( \text{rm} \) will choose \( Q = Q^R \). It is also assumed that the regulator only sets a minimum quality standard: there is no regulation of volume supplied or price (this may be a more realistic assumption for the oligopoly case considered later).

By contrast with the unregulated case, marginal cost is now a function of \( Q \) and \( X \),

\[
MC^R = (a^\bar{A}^R)(1 - \bar{A}^R)\bar{A}^R; \tag{6}
\]

where \( \bar{A} \) denotes the output/quality ratio \( X = Q \). Differentiating this with respect to \( Q^R \) shows that \( MC^R \) is negative: hence, as \( Q \) is increased by regulation, the marginal cost of quality-adjusted output \( X \) will fall, given a downward-sloping demand curve. This leads to our first result.

**Proposition 1** If a monopolist is constrained to produce to a higher standard than he would otherwise choose, the marginal cost of increasing quality-adjusted output is less than when the choice of quality is unconstrained.

This can be shown in figure 1 (Appendix 1), which deals with the \( \text{rm} \)'s choice of crude output \( Y \). Given free choice, the \( \text{rm} \) will choose \( (Q^U; Y^U) \) on the ray \( Q^U = Y^U = k \). However, regulation prevents \( Q < Q^R \). It follows that for quantities of quality-adjusted output up to \( X^F \), the \( \text{rm} \) is forced to incur higher cost \( C \) than it would freely choose for a given level of quality-adjusted level of output \( X \). However, as output increases the total cost line approaches the ray \( Q^U = Y^U = k \). This suggests that imposing a quality standard of \( Q^R > Q^U \). 

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means the marginal cost of \( X \) is less than it would be if the \( \text{rm} \) freely chose \( Q \) and \( Y \), up to the point where \( X = X^F \). The reason total cost is higher is because the minimum standard effectively imposes a \( \text{xed} \) cost on the \( \text{rm} \).

Assuming a constant demand elasticity, the monopolist will set a \( \text{xed} \) proportional markup over marginal cost. Hence the introduction of \( Q^R \) will lead to lower prices (at least when quality-adjusted), and higher sales, at least as long as the standard is not set so high that the monopolist chooses to exit the market. This leads to our next result:

**Proposition 2** A quality constrained monopolist will sell more quality-adjusted output at a lower quality-adjusted price than an unregulated monopolist, and this output rises monotonically with the quality standard as long as the \( \text{rm} \) continues to produce.

\( X \) is related to \( Q^R \) by setting marginal cost equal to marginal revenue and solving:

\[
X^R = (-\bar{\sigma} \cdot \bar{\alpha})^{-\bar{\sigma}(1-\bar{\sigma})} (Q^R)^{(1-\bar{\sigma})} \cdot (1-\bar{\sigma})^{-\bar{\sigma}} : (7)
\]

This confirms that for positive \( \bar{\sigma} \), \( \bar{\alpha} \) and \( \bar{\sigma} \) and \( 1 > -\bar{\sigma} > 0 \), \( X^R \) is increasing monotonically with respect to \( Q^R \).

This is illustrated in figure 2. For \( X < X^F \) the new marginal cost curve, \( MC^R(X) \), lies below the old one, \( MC^U(X) \). Consequently the monopolist will now increase quality-adjusted output to equal \( X^R \) rather than \( X^U \) as before. It can also be seen fairly easily that consumer surplus is increased. By differentiating (3) we can see that since \( \bar{\sigma} \) lies between 0 and 1, consumer surplus increases monotonically with \( X \), and since Proposition 2 shows \( X \) increases monotonically with \( Q^R \) we derive
Proposition 3  Consumer surplus rises monotonically with the minimum quality.

If the monopolist is foreign, an interesting result follows from Proposition 3:

Proposition 4  If the monopolist is foreign, a regulator maximising domestic welfare will set the highest quality standard at which the firm does not exit the market.

Normally we would assume this to be the firm’s reservation level of $Q^R$ corresponding to $\frac{1}{Q^R} = 0$. The optimal standard when the monopolist is foreign is

$$Q^{RF} = \left(\left(\frac{a}{b}\right) \left(1 \times -\right)\right) \left(\left(\frac{1}{1 \times -}\right) \left(\frac{-o \rightarrow a}{1\rightarrow 1} \right)\right); \tag{8}$$

If the monopolist is domestic, the situation is rather different. Using the superscript $D$ to denote this case, $W^D = U^D + \frac{1}{Q^R}$. We have set up the model such that changes in regulatory quality, $Q^R$, only affect $U^D$ via changes in quality-adjusted sales, $X^D$. Hence we can write

$$dW^D = dQ^R \quad d\frac{1}{Q^R} = dQ^R \quad (dU^D = dX^D)(dX^D = dQ^R); \tag{9}$$

We know that for $0 < \zeta < 1$; these two right hand terms are positive - hence the marginal gain in social welfare from raising $Q^R$ is always greater than the marginal gain in private profit to the firm. We also know that $\frac{1}{Q^R}$ decreases with $Q^R$. We can conclude that at the unregulated monopoly quality, the marginal social gain to raising $Q^R$ will be positive.
By double differentiating (7) with respect to $Q^R$ we know that the rate of increase in output with respect to the regulation quality will decelerate. Likewise by differentiating (3), the increase in consumer utility with respect to output also decelerates when $0 < \gamma < 1$ Hence the difference between marginal social and private net gains will decline as $Q^R$ rises. It seems reasonable to expect that at some point the marginal loss in profits from raising $Q^R$ will exceed the marginal gain to consumers, unless profits have already fallen to below their reservation level at this point.

In this case there will be a social optimum for setting $Q^R$ when the monopolist is domestic, and this level $Q^{RD} > Q^U$ the unregulated monopoly level. If at this level $Q^{RD}$, the profits of the rm are still greater than their reservation level, then the regulator will not impose as high standards as if the rm were foreign. This is important, since, once we allow that some consumption is foreign-produced, there will often be an incentive on the regulator to raise quality standards beyond what is globally optimal, imposing extra costs on the foreign producer(s), but benefiting local consumers. Whether $Q^{RD} > Q^{RF}$ is an empirical matter depending on parameter values.

This can be summed up:

**Proposition 5** The quality standard chosen by a domestic welfare maximising regulator when the producer is foreign exceeds that chosen when the monopolist is domestic, unless parameter values are such that the latter produces zero profits.

Propositions 1-5 have shown that a single unregulated monopolist will undersupply both quality and crude quantity, but that when quality regulation is introduced there can be a bias to excessive regulation where the monopolist is foreign.
3.1.1 More complicated cost structures

The above analysis has relied upon a very simple, linear cost structure, as shown in equation (1). It is worth noting that this result carries through to more general cost structures \( C = C(Y; Q) \), so long as raising quality lowers the marginal cost of producing quality-adjusted output, i.e.

\[
d = dQ(dC = dx) < 0:
\] (10)

For example, where \( X \) is a Cobb-Douglas aggregate, but raising quality has effects on both fixed and variable costs, i.e.

\[
C = aY + bQ + dQY;
\] (11)

where \( a, b \) and \( d \) are non-negative, it is relatively straightforward to show that the conditions in equation (10) hold so long as

\[
a(\bar{\gamma} - 1) + d(2\bar{\gamma} - 1)Q < 0:
\] (12)

Clearly, for \( 0 < \gamma < 1 \) and \( d = 0 \) (the case in the previous section) this holds. Also when \( \gamma < 1 = 2 \) it will hold. For \( \gamma > 1 = 2 \) and \( d > 0 \); (12) will be satisfied if the unregulated monopolist’s output,

\[
Q^U < (a = d)(\bar{\gamma} - 1)(2\bar{\gamma} - 1)):
\] (13)
It is possible, though not trivial, to show that an unregulated monopolist will always choose less than this level of quality - hence quality regulation, at least at the margin, will cause the monopolist to increase output.\(^7\) It may be noted, however, that while the regulator will only increase \(Q\); this will not exceed the point where (12) is satisfied: whether this will affect the interaction with trade depends on parameter values.

For the rest of this paper, I will retain the simpler formulation, for expositional reasons.

3.2 Quality regulation in a cross-hauling Cournot duopoly

I now assume that, instead of a monopolist, the industry contains two identical \(\text{f}_{1}\) and \(\text{f}_{2}\), set in countries \(c = c_{1}\) and \(c_{2}\) respectively. All consumers in both countries have identical tastes, and the two \(\text{f}_{\text{rms}}\) produce goods which are perfect substitutes, with identical production functions.

As before, consumers’ utility in \(c_{1}\) depends on total consumption, which I now denote \(Z_{1}\), where \(Z_{1} = X_{1;1} + X_{2;1}\), the aggregate of the quality-adjusted sales \(X_{f;c}\) of the two \(\text{f}\)\(\text{rms}\) to country 1.

Utility is given by

\[
U_{1} = U + \frac{\circ Z_{1} \cdot P_{X_{1}Z_{1}}}{P_{X_{1}}Z_{1}} \quad (14)
\]

where \(P_{X_{1}}\) is the price of the quality-adjusted output in country \(c_{1}\), which is the same for both suppliers given their outputs are perfect substitutes.

As before, \(X_{1;1}\) and \(X_{2;1}\) are Cobb-Douglas aggregates of quality \(Q_{f;c}\) and crude quantity

\(^7\)For proof, \(dC = dQ = \frac{(dQ(dC = dX))}{b}\). Hence if \(b\) is positive and \(dC = dQ\) is negative, then \(d = dQ(dC = dX)\) is negative.
Y_{f,c}, and cost C_{f,c} is a linear function of Y_{f,c} and Q_{f,c}.^8

We are crucially assuming that rm f chooses its quality to supply to each market separately, and that quality chosen to supply to c₁ has no effect on the costs of quality in c₂.

Since the cost side of the model is unchanged from that of the monopoly above, we can proceed by analogy. When a rm is unregulated the marginal cost of increasing quality-adjusted output \( X_{f,c} \) is constant, as given by (5) above. Likewise, when country c₁ sets a higher quality standard than the unregulated duopoly would choose, marginal costs fall as \( (Q^{R}_{f,1}\div X_{f,1}) \) rises, as indicated by equation (6).

The demand side is somewhat more complicated. For maximum utility, consumption is to the point where marginal utility of \( X_{f,c} \) equals quality-adjusted price.

For maximum profit, rm f will set marginal revenue in market 1 equal to marginal cost. We make the Cournot-Nash assumption that each rm f assumes its rival g will keep quality-adjusted output \( X_{g,c} \) constant in response to changes in f’s output.\(^9\) Calculating marginal revenue for a given level of output, and assuming the two rms are identical we can easily establish combined output for an unregulated duopoly is set at a level somewhat greater than in a monopoly. Setting marginal revenue for each rm equal to price, and assuming the rms are identical,

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8 Strictly speaking, if the values of scale parameters a and b in equation (1) were invariant with the number of rms, the smaller rms in a duopoly case would be producing a lower quality than the monopolist in the rst case. However, a slightly modified formulation (eg where costs are a function of output and quality per plant, and the number of plants) would return the model to the classical features where a monopoly results in lower quality and quantity. Since in this paper I am only interested in cases where the number of rms is fixed, I have retained the linear formulation in (1) for simplicity, but it is worth bearing in mind that a and b are not invariant with the number of rms.

9 The alternative Bertrand-Nash duopoly, where goods are identical, produces the uninteresting result that prices are bid down to marginal cost.
\[ MR_{t,1} = ((1 + \gamma') = \bar{Z}^{\gamma'} Z_i^{1}; \]  

(15)

Hence

\[ Z_{U1} = (\bar{Z}^{\gamma'} (\gamma' + 1) = \bar{Z})^{1} (\bar{MC})^{1}; \]  

(16)

where \( \bar{MC} \) is the constant value of marginal cost as in equation (5).

For a regulated industry, the effects of moving from a monopoly to a regulated duopoly are somewhat more complicated:

\[ Z_{R1} = ((\gamma = a)(\gamma' + 1) = \bar{Z})^{1} (2Q_{R1}^{\gamma'} (1) = (1) = (1)^{1}); \]  

(17)

Importantly, equation (17) implies that the combined duopoly sales, \( Z_{R1} \), rise with respect to \( Q_{R1} \). Therefore, as in the monopoly case, consumer utility \( U_{R1} \) will rise monotonically with \( Q_{R1} \). Hence, the same basic results hold as in the monopoly case:

**Proposition 6** If a Cournot duopoly of identical firms is regulated to produce to a higher standard than they would otherwise choose, the marginal cost of increasing quality-adjusted output is less than when the choice of quality is unconstrained.

**Proposition 7** A regulated duopoly as in Proposition 6 will sell more quality-adjusted output at a lower quality-adjusted price than an unregulated duopoly, and this output rises monotonically with the quality standard as long as the firms continue to supply the market.

**Proposition 8** Consumer surplus with a quality regulated Cournot duopoly rises monotonically with the minimum quality standard.
For optimal choice of quality standards, the analysis can proceed along similar lines to
where there is a monopoly. Total welfare in country \( c_1 \) is

\[
W_1 = U_1 + \frac{1}{4};_1 + \frac{1}{4};_2;
\]

(18)

where \( \frac{1}{4};_1 \) is the profit made by \( f_1 \) in \( c_1 \), and \( \frac{1}{4};_2 \) is the profit \( f_1 \) makes on sales to \( c_2 \).

The implication here is that, only the domestic \( ..rm's \) pro..ts (ie half total pro..ts) will
be taken into account by the regulator. Hence quality standards will be set too high, if the
regulators do not cooperate.

More formally, welfare in \( c_1 \) is assumed to depend only on consumer surplus and \( f_1 \)'s
domestic pro..ts:

\[
dW_{R1} = dQ_{R1} = (dU_{R1} = dZ_{R1})(dZ_{R1} = dQ_{R1}) + d\frac{1}{4};_{R1} = Q_{R1} > d\frac{1}{4};_{R1} = Q_{R1}
\]

(19)

It follows by analogy with the monopoly case that, that if ..r ms are forced to produce
above their unregulated choice of quality, pro..ts will fall. This should lead a non-cooperative
regulator to choose either that standard at which the marginal cost to \( f_1 \) alone equals the
marginal loss of consumer surplus, or else the point at which ..rms exit the market.

Compare this to a globally optimal solution. In this case, global welfare, \( W_G \) is the
sum of \( W_1 \) and \( W_2 \). Digeneratorizing this with respect to \( Q_{R1} \):

\[
dW_{G1} = dQ_{R1} = (dU_{R1} = dZ_{R1})(dZ_{R1} = dQ_{R1}) + 2d\frac{1}{4};_{R1} = Q_{R1}^R;
\]

(20)

assuming (by symmetry) that \( d\frac{1}{4};_{R1} = dQ_{R1} = d\frac{1}{4};_{R1} = dQ_{R1} \).

Once more it will be worth increasing \( Q_{R1}^R \) beyond \( Q_{U1}^U \), the quality which maximises
private profits. However, this time we take into account the decline in both rms’ profits: consequently global welfare peaks with respect to $Q_{R1}$ rather faster than country $c_1$’s welfare, and the regulator will set a more modest standard, unless again the global welfare-maximising standard is still high enough to cause rms to exit.

Proposition 9  The quality standards chosen in an identical cross-hauling Cournot duopoly when the regulators do not cooperate exceed the global optimum, unless parameter values are such that the latter produces zero profits. This overregulation benefits consumers at the expense of both rms.

The point at which the rms exit the market can be deduced by analogy to (8). Again, whether or not this sets a practical ceiling to the level at which the regulators set standards is an empirical matter.

3.3 Mutual recognition

I now examine a mutual recognition agreement, under which each country will set its own quality standard for production, but will accept any goods produced by the other country’s producer which are acceptable to its regulator. With mutual recognition, we assume the regulator in $c_1$ assumes $f_1$ will sell goods at quality $Q_{R1}$ in both markets, but at the same time, $f_2$’s product standards will not change in either market. This means that the regulator is assumed to calculate that only $f_1$ will raise its sales in country 1 in response to rising $Q_{R1}$. Consequently, the marginal increase in combined sales in country 1, $Z_{R1}$, is only half as big as in the case where there is no mutual recognition. However, changes in welfare will include the change in profits of $f_1$’s exports to $c_2$. Raising regulatory standards lowers those profits, while the benefit to foreign consumers is not taken account of by the domestic regulator in $c_1$. More formally, we can say (by symmetry) $dY_{12} = dQ_{R1} = dY_{41} = dQ_{R1}$. Consequently, the
marginal welfare effect to country 1 of changing $Q_1^R$ is

$$dW_{1M}^R=dQ_1^R = dW_G = dQ_1^R \quad (1=2) (dU_{1M}^R = dZ_{1M}^R) (dZ_{1M}^R = dQ_1^R); \quad (21)$$

By contrast, the increase in global welfare from raising $Q_1^R$ will include the gains to consumer utility in $c_2$ from higher quality of exports from $c_1$. Since we can again write (by symmetry) $dU_{2M}^R = dZ_{2M}^R = dU_{1M}^R = dZ_{1M}^R$ and $dZ_{2M}^R = dQ_2^R = dZ_{2M}^R = dQ_2^R$; it follows that the marginal welfare gain to $c_1$ from raising standards is less than the global gain, and that as a result standards under mutual recognition will be set lower than optimal.

Proposition 10 The quality standards chosen by the country regulators in an identical cross-hauling Cournot duopoly where there is mutual recognition will be lower than socially optimal.

As a final point on these models of pure horizontal regulation it is worth noting the following, which follows from Propositions 6-10:

Proposition 11 Non-cooperative setting of pure vertical standards in a cross-hauling Cournot duopoly where consumers and rms are identical does not alter market shares, and increases trade volumes compared to the global optimum. Consequently on definition 1 it should be considered strategic overregulation rather than regulatory protection. Mutual recognition leads to strategic underregulation.

The broad conclusion is that, when identical rms possess monopoly power and are spread across various countries, if regulators do not cooperate they will choose excessive standards. Contrary to the received wisdom these are trade-increasing. However, if the
regulators agree mutual recognition, they will then be tempted to undercut each other's standards, leading to a decline in both quality and trade to below the optimum.

4 Vertical and horizontal quality regulation

The discussion above has concentrated on vertical regulations, which raise some measure of quality experienced by consumers for all goods within an industry. By contrast, much of the literature on TBTs focuses on pure horizontal regulations, which discriminate between suppliers in one country against another, or between those using one technique rather than another, and which do not directly affect consumer utility.

A horizontal TBT involves imposing a resource cost on imports. Any changes in import share could equally be achieved by an equivalent tariff, which would by contrast raise revenue for the importing country. It follows that pure horizontal TBTs are only likely to appeal where tariffs are ruled out (eg by trade agreements), or where TBTs are regarded as less visible, and hence less likely to provoke retaliation. Again, it is worth bearing in mind that in a perfectly competitive model, horizontal TBTs just lower national welfare, since they impose a resource cost which worsens both the importing and the exporting countries' terms of trade.

Horizontal TBTs may, however, appeal to regulators in four circumstances, where the alternative of tariffs is ruled out: (i) given monopolistic profit, there may be a profit-shifting incentive to raise domestic suppliers' market share, to raise their profits, even when this involves imposing a cost on consumers. (ii) Agglomeration economies may mean that a country which raises output by imposing TBTs can either lower production costs or raise local factor rents. (iii) There may be agency capture so that the regulator represents local producers rather than the importing country as a whole. (iv) Horizontal legislation may to some extent be inevitable where there are network externalities.
In this paper I consider the rest of these motives only.

4.1 Pure horizontal technical barriers to trade

Consider rest a pure horizontal TBT in the non-cooperative Cournot duopoly model where there is no vertical regulation. I assume the horizontal TBT adds a cost of $T$ per quality-adjusted unit of the good imported into country $c_1$, while having no effect on the vertical quality experienced by consumers. By contrast, it does not affect the costs to domestic suppliers. It is assumed that tariffs are ruled out by agreement.

From (4), where there is no vertical regulation, marginal costs of producing $X$ are constant at $MC^U$. However, since we have introduced the horizontal TBT, marginal costs for $f_2$ selling to $c_1$ are now

$$MC^H_{2,1} = MC^U + T$$

where the superscript $^H$ denotes the case with horizontal barriers.

If we assume rest $f$'s market share is $\mu^H_{1,2}$, we can show that the rest's marginal revenue declines with its market share. We can also show that the quality-adjusted price facing consumers in $c_1$ rises with the market share for the domestic producer $f_1$. To be precise, if we define $T_{f,1} = 0$ for $..rm 1$ and $T$ for $..rm 2$, then for each supplier, this relationship is given by

$$MR_{f,1}^H = o(z^H)_{1} (1 + (\mu^H_{f,1} + T_{f,1})_{1})$$

It follows that, for the effects of the introduction of a pure horizontal TBT of $T$ per quality-adjusted unit output $X$ on imports from $f_2$ to $c_1$, $f_2$'s marginal costs will be raised,
and consequently, its market share will fall (which raises its marginal revenue, according to equation (23)). Correspondingly $f_1$'s market share will rise, so its marginal revenue will fall somewhat. But, since marginal costs are constant, $f_1$ too will restrain production. The resulting equilibrium will give lower total sales (and hence a higher $P_x$) but a higher market share to $f_1$ than initially.

For the welfare implications, consider total welfare in country 1, which consists of consumer surplus plus $f_1$'s profits at home and abroad. We assume $\frac{1}{4}:2$, the profit made by the domestic firm on its exports, is unaffected by any TBTs introduced by $c_1$. Consequently, this term disappears when we differentiate $W_1$ with respect to $T_1$. This leaves:

$$dW^H = d\Gamma^H_1 = \gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$$  \hspace{1cm} (24)

where

$$\gamma_1 = (MU^H_1 \cdot P_x^H_1) dZ^H_1 = d\Gamma^H_1$$  \hspace{1cm} (25)

$$\gamma_2 = +\mu^H_{1,1}(P_x^H \cdot M C^U) dZ^H_1 = d\Gamma^H_1$$  \hspace{1cm} (26)

$$\gamma_3 = i (1 \cdot \mu^H_{1,1}) Z^H_1 dP x^H_1 = d\Gamma^H_1$$  \hspace{1cm} (27)

$$\gamma_4 = +Z^H_1 (P_x^H \cdot M C^U) d\mu^H_{1,1} = d\Gamma^H_1$$  \hspace{1cm} (28)

$\gamma_1$ is the difference between consumer price and supplier price times the change in consumption. Since we are assuming there are no indirect taxes, this should equal zero. $\gamma_2$ is the home firm's share in the total change in home sales times its profit margin (this will be zero or negative as sales fall when $T_1$ is introduced). $\gamma_3$ is the cost of the increased price to consumers of the initial volume of imports from $f_2$. This also yields negative welfare, since the price of imports rises. $\gamma_4$ represents the profit shift, since $\mu^H_{1,1}$, the home firm's
share, will rise with \( T^H_1 \), and this will yield extra profits, if the profit markup \( ^H_1 \) is positive. This profit-shifting gain is the only potential welfare gain from introducing the horizontal TBT in our model, and yet it will only lead to protection when there is a profit markup which is positive and large enough to outweigh the two terms \( \gamma_2 + \gamma_3 \):

**Proposition 12** Where basic production costs of the two rms are the same, a regulator will only introduce a pure horizontal barrier where pre-barrier profits are positive and the profit shift outweighs the loss of consumer surplus and the effect on domestic profits of a shrinking total home market.

Since the introduction of vertical quality standards in the absence of cooperation or mutual recognition has already been shown (Proposition 9) to either reduce or totally eliminate profits, we deduce:

**Proposition 13** Where basic production costs of both rms are the same, if the regulator also introduces vertical regulations, the incentive to introduce horizontal TBTs is either reduced or completely eliminated.

### 4.2 Cost differences between countries

Even 'pure' vertical standards may of course have a protectionist element if production costs differ. In this case, the country with the lower marginal costs of raising quality may have incentives to raise its vertical quality standards above the socially optimal level for what we are defining as protectionist, rather than simply strategic reasons: higher minimum standards may raise the market share of the domestic producer at the importer's expense.

To see how this can happen, consider the case where the two rms are initially unregulated and produce quality-adjusted output \( X \) at the same price. However, \( \text{rm} 2 \) has higher marginal costs of raising quality and lower marginal costs of raising crude output \( Y \) than
its rival. Formally, \( b_2 = \bar{a}_2 \), in which case raising quality is more expensive for ..rm 2 than ..rm 1 if \( \bar{a} > 1 \). If unregulated marginal costs are the same, it is easy to show that

\[
a_2 = \bar{a}(\bar{a}_1)^{-1} a_1:
\]

(29)

In this case, in the absence of regulation (denoted with superscript \( D \)) the less quality-suited ..rm 2 will set a lower quality than ..rm 1:

\[
Q^D_1 = Q^D_2 = \bar{a}^{1-\bar{a}}
\]

(30)

To analyse what happens in this case, ..rst, consider a situation where the globally optimal regulatory standard \( Q^R_1 \) in country 1 lies between \( Q^D_2 \) and \( Q^D_1 \). In this situation, raising \( Q^R_1 \) at the margin will raise the costs of the importing ..rm \( f_2 \), lowering its market share and pro..ts, but not aect the costs of \( f_1 \). Since in this situation demand will shift towards \( f_1 \), its pro..ts will actually improve as \( Q^R_1 \) is raised (up to the point where \( Q^R_1 = Q^D_1 \)). In the absence of international cooperation, the regulator will only take account of the (rising) consumer welfare and \( f_1 \)'s rising pro..ts, and hence will keep raising \( Q^R \) at least to \( Q^D_1 \), even if this is above the globally optimal level. In this case, \( Q^R_1 > Q^R_1 \) and we clearly have not just strategic distortion but (on our narrow de..nition) protectionism as well, since the higher standard reduces trade and bene..ts local pro..ts at the expense of foreigners.

What about the case, though, where \( Q^R_1 > Q^D_1 \)? It is fairly easy to show that, once \( Q^R_1 \) is raised above \( Q^D_1 \); market shares of the two ..rms cease to change any more. The ratio
of marginal costs of the ..rms beyond this point is given by

\[ MC_1 = MC_2 = (a_1 - a_2)(\mu_{1,1} - (1 - \mu_{1,1}))^{(1 - \mu)} \]  

(31)

which is constant, and since prices depend only on marginal costs and profit markup, the shares of the two ..rms and \( \cdot \), once \( Q^R \) rises above \( Q^D \), further rises in \( Q^R \) will not affect ..rms’ market shares, with marginal costs and prices rising at proportionally the same rate for both ..rms, so there is no profit-shifting motive. Hence the next proposition:

Proposition 14 Where ..rms’ marginal costs of raising quality differ, there may be a profit-shifting motive for the regulator in the country with the lower marginal cost of raising quality to raise vertical standards above the global optimum. However, this motive only exists if the global quality optimum lies below what the domestic ..rm in that country would choose if unregulated.

It follows from the above discussion that, while a profit-shifting motive for introducing cost-increasing pure horizontal TBTs is conceivable, the circumstances in which this is likely to occur, and the degree to which it is likely to apply are greatly reduced compared to the implications of previous studies (eg Baldwin, 2001, Wallner, 1998).

5 Prohibitive costs of providing different standards to different markets

We have so far assumed producers are able to supply at different qualities to different markets. Generally speaking this is the case (for example, the same producers can provide left- and right-hand drive cars, or TV sets for sale in the UK and USA), though usually at a cost. It is worth considering the effects of the extreme alternative case, where the cost of
supplying different qualities to different markets is prohibitive. In this case, if a firm is to supply both markets, it must produce at the same quality for both. This does produce somewhat more complicated solutions: I shall concentrate on the case where there are two countries but just one producing firm, in the exporting country.

Under autarky, the optimal quality standard in the exporting country would be given by

\[ d\frac{\partial Q}{\partial d} + d\frac{\partial U}{\partial d} = 0; \]  (32)

where \( d \) refers to the exporting country's domestic market. The first term is negative, the second positive.

I shall assume consumers' tastes are identical and that the cost structure is such that this is also the global optimum standard \( Q_{d}^* \).

Now consider a mutual recognition agreement. The analysis proceeds much as above: the exporting country regulator sets quality standards for both countries, and since he will take account of the (negative) effect of regulations on the exporting firm's profits, but not of the (positive) effect on foreign consumers' utility, he will seek to set

\[ d\frac{\partial Q}{\partial Q} + d\frac{\partial U}{\partial Q} + d\frac{\partial Q}{\partial Q} = 0; \]  (33)

Given \( d\frac{\partial Q}{\partial Q} = dQ_{d} < 0 \) and \( d\frac{\partial Q}{\partial Q} = dQ_{d}^2 < 0 \) it is fairly trivial to show that this will result in a standard \( Q_{d} \) lower than the socially optimal \( Q_{d}^* \). In general, we would expect the larger the

---

10 An example being the claim by US soya producers that separately labelling GM and non-GM soya for sale abroad would be prohibitively expensive.
export markets relative to the domestic market, the greater the incentive to the regulator to set suboptimal standards.

Now consider what happens where there is no mutual recognition, but non-cooperation between the regulators. Assume the exporting country regulator has initially set $Q_d$. When the regulator in the importing country raises its quality standards $Q_f$, it does not care that the foreign rm has to raise quality in both countries (and so makes less profits than with a lower standard). Hence the regulator will choose to raise quality, up to the point $Q_f = Q_d + r Q_d g$, at which the rm would exit the market. $r$ is given by solving the equation

$$\frac{1}{2}a f Q_d g = \frac{1}{2} a f Q_d + r g + \frac{1}{2} f Q_d + r g; \quad (34)$$

In this case, the point at which the rm exits the export market will depend upon $Q_d$, and upon the relative size of the two markets - a rm will much more readily abandon a small market, implying that, ceteris paribus, $r$ will be less the smaller the export market. This produces a bargaining game between the two countries' regulators, the outcome of which will involve a degree of uncertainty. If the importing country regulator sets its standard above $Q_f = Q_d + r Q_d g$, the rm will not be prepared to export. The exporting country's regulator, in turn, will not set $Q_d$ higher than the level $Q_d^H$ where

$$U_d f Q_d^H + r f Q_d^H g) + \frac{1}{2} a f Q_d^H + r f Q_d^H g + \frac{1}{2} f Q_d^H + r f Q_d^H g = U_d f Q_d^H g + \frac{1}{2} a f Q_d^H g; \quad (35)$$

in other words it will only go above $Q_d^H$ so long as it makes enough profits from sales abroad to compensate it for the loss of profits at home. For this reason $Q_d^H$ is likely to be higher the larger the foreign country. Standards in the importing country will exceed $Q_d^H$ by $r f Q_d^H g$. 29
At the other extreme, the minimum level the exporting country's regulator would ever set is $Q_d^L$, which satisfies

$$d^{\frac{1}{2}} f Q_d^L + ' f Q_d^L gg dQ_d + dU_d f Q_d^L + ' f Q_d^L gg dQ_d + d^{\frac{1}{2}} f Q_d^L + ' f Q_d^L gg dQ_d = 0;$$

(36)

where the only difference from the mutual recognition level $\theta_d$ is given by the fact that the foreign regulator will maintain somewhat higher quality (and hence lower profits) abroad.

Between these two extremes, the outcome quality levels will be determined by bilateral bargaining, reflecting the bidding process and the sizes and institutions of the countries. It is not possible to come to a firm conclusion as to whether the outcome will exceed or fall short of the globally optimal regulation level.

The firm conclusions we can come to from this section are

Proposition 15 Where only one country produces the good, mutual recognition will produce quality below the global optimum, and the importing country will be unambiguously worse off than under non-cooperation.

Proposition 16 When goods cannot be produced at different qualities for different markets and there is no cooperation, goods will be produced to the standard set in the importing country, which will exceed that in the exporting country. The latter however will set a ceiling on how high the importing country can set standards. There will be a bargaining game to determine the two standards.

Looking at the current stand-off between the EU and the USA over separate labelling of GM foodstuffs, the block to trade looks like a disequilibrium phenomenon while negotiation proceeds. The EU, as the expected importer of GM soya, would clearly be better setting
testing and labelling standards independently. The USA by contrast would like a mutual recognition agreement, under which it could export GM soya with suboptimal safeguards. The current standoff will presumably continue until there is a clear understanding of whether mutual recognition will be enforced.

5.1 Quality standards with income differences

A further implication of the basic model investigated above is that, in a country where incomes are relatively lower, consumers will tend to prefer not just lower quantities but also a lower quality of output, whereas in wealthier countries there will be a preference for higher-quality goods. This raises important issues especially when countries of different income levels choose to trade with one another (as, for example, with Mexico trading with the USA and Canada, or with the new Central and European accession states trading with existing EU members).

If there is no cost at producing goods of different quality for different markets, then suppliers will tend to produce lower-quality goods for the poorer countries and higher-quality goods for the richer ones. Perhaps the more interesting case is where firms are unable to vary their quality between countries. In this case, a producer in the poorer country (denoted \( C_P \)) will have to choose whether to supply goods to the richer country (\( C_R \)) at a higher standard than it would wish to supply at home. The minimum standard in the richer country will partly reflect consumer preferences there for higher quality, but also potentially a strategic desire to force oligopolistic producers abroad to raise production standards. If we assume \( C_R \) is a far larger market than \( C_P \), and that geographical distance and formal trade barriers are low (as is the case in NAFTA or was the case in the pre-enlargement Europe Agreements with the Central and Eastern European Countries), then the export market to \( C_R \) will loom large in the business plans of the producer in \( C_P \), so
that it will be prepared to forego substantial profits at home in order to continue to export to \( \mathbb{C}_R \).\textsuperscript{11} In these circumstances, manipulation of quality standards by the regulators in the richer countries may well raise trade volumes (by forcing the poorer country producers to produce goods more to the tastes of rich country consumers) but at the possible cost of reducing utility in the poorer country, where cheap, low-quality goods cease to be available. Low income members of \( \mathbb{C}_P \) would particularly be hit by the quality-upgrading to enter richer country markets.

In these circumstances, entry of poorer countries into a single market with the richer country/countries could have interesting repercussions, with considerable relevance to current debates in the EU. Firstly, where the single market imposes central harmonisation of standards it is likely the richer country would be keen to ensure voting rules ensure its ability to maintain high quality standards is not compromised by admitting new members.\textsuperscript{12} Secondly, there may be even greater reluctance on the part of existing richer members to admit poorer members where mutual recognition is involved, unless the poorer members agree in advance to impose certain minimum standards to avoid quality downgrading.

6 Conclusion

The WTO Agreements recognise the danger of regulatory protection when setting national standards, but also acknowledge legitimate reasons for such standards. The idea that regulations are trade reducing seems to result from counterfactual studies which implicitly assume standards are simply cost-increasing. The conclusions of this literature are contradicted by

\textsuperscript{11} By contrast, where trade costs and/or the income differentials between the two countries are much larger, as between, say some LDCs and the richer countries, firms in the poorer country may simply not export at all.

\textsuperscript{12} The EU Single Market employs a combination of harmonisation and mutual recognition - see Brenton et al, 2001.
the (largely ignored) empirical studies such as Swann et al (1996) which show increasing use of standards tends to go with increased trade. At the other end of the literature is a small amount of theoretical work, mainly based on the Shaked/Sutton differentiated consumers with oligopoly model, which indicates that strategic policy distortions are likely in the presence of trade, and suggests that mutual recognition will increase welfare.

Unlike previous studies, this paper looks at more classical monopolistic distortions. Unregulated monopoly power leads to suboptimal quality as well as quantity of goods supplied. Regulation increases both quantity and quality available, and there is therefore a valid economic reason for quality regulation of a form which actually increases trade.

It is further shown that where some suppliers are foreign, there is an incentive for the domestic regulator to set an excessive minimum standard, reducing pro....s but bene....ing consumers. This strategic distortion, however, does not conform to traditional ideas of protectionism. In many cases it will actually lead to excessive trade volumes, and does not necessarily involve bias against foreign producers. This conclusion holds even when producers can only produce a single quality for both markets.

While mutual recognition removes this strategic distortion (and so, paradoxically, can actually reduce trade), unlike previous approaches this study shows that there is an incentive for regulators to allow lower than optimal domestic standards, to boost exporters' pro....s at the expense of foreign consumers. Hence mutual recognition is not necessarily welfare-improving.

The paper also ..nds an incentive to impose pure cost-increasing standards on foreign .....ms, as Wallner, 1998 and Baldwin, 2001 have indicated, but only where tari....s are ruled out. Also, the gains to an importing country from this kind of horizontal barrier are greatly reduced when vertical regulations are also taken account. In many circumstances, there may be little, if any foreign pro.... for a protected domestic .....m to capture, and, very
likely, not enough for the pro...t-shift to outweigh the losses to local consumers. Even mixed horizontal/vertical barriers may only prove attractive in limited circumstances.

As for assessing current regulations: actually disentangling how far these regulations really comprise regulatory protection may not be an easy task. This paper casts a somewhat sceptical light on the tendency to assume that regulations are trade-impeding and should be tackled under the auspices of the WTO or other trade bodies. Assessment of the welfare effects of harmonisation or mutual recognition should not be carried out on the assumption that regulations are purely cost-increasing, since the above analysis indicates that if regulators are seeking to maximise national welfare it is unlikely they will introduce barriers of this kind, and indeed national variations in standards may genuinely reflect differences in national preferences with regard to risk, quality etc. To infer, as some studies have done, that a high proportion of Tre...er's (1995) 'missing trade'\textsuperscript{13} is due to horizontal regulatory barriers is probably incorrect. Indeed, the absence of international cooperation is actually likely to lead to over-regulation of standards which increases, rather than reducing, trade volumes.

It is likely that regulation will be higher in sectors which are dominated by imports: this is more likely to be ostensibly for reasons of raising consumer utility, though where the cost of such regulations falls largely upon foreign rms there is an incentive to over-regulate (there is a parallel with the tax competition literature). However, this over-regulation will probably increase, not decrease trade volumes.

In the light of these arguments, it may be that policymakers have been too ready to view quality regulations simply an issue of protection, to be dealt with through international

\textsuperscript{13} 'Missing' in the sense that trade generally falls far short of what gravity models predict
trade negotiations. It may be more appropriate to view it as an issue of international policy
coordination, to avoid a natural bias towards overregulation where production is global but
regulation is national, but also to avoid a bias towards underregulation (which may show up
as inadequate testing or labelling or the deliberate introduction of product incompatibilities)
where standards are set primarily by the exporting country.

This latter point implies a good deal of scepticism is needed regarding the fashionable
idea that mutual recognition is necessarily welfare-improving. When standards are reduced
by producers for classical oligopoly reasons, introducing mutual recognition may lead regu-
lators to side with their own producers, and cause a downward bias in quality. This efect
has been missed in previous studies. Mutual recognition needs to be assessed on a case-by-
case basis: there are certainly circumstances in which it can reduce welfare at least in the
importing country and possibly global welfare.

Policy distortions will also be affected by the degree of exibility producers have to
change specifications to supply different markets. Where there is little such exibility, then
there may be a bargaining game between different countries in setting regulations between
those (primarily importing) countries who favour over-regulation and those (exporters) who
favour underregulation. Trade may temporarily be obstructed as part of this bargaining
process (as in the GM foods case in recent years), but to interpret this just as protection on
the part of the importing countries is to miss the strategic bias in policies of the exporting
countries, as well.

A few cautions should be added at this point. There are aspects of trade under im-
perfect competition which require some further investigation. For example, many industry
standards are produced either by industry associations or by the industry in conjunction
with government bodies (the latter in the cases where compulsory regulations are applied).
However, it would be too simplistic to assume that regulatory standards are fully voluntary
and protectionist\textsuperscript{14} by the industry players themselves: rst, they may be simply a response to the threat of legislation. Moreover, there is a question why a government should rubber stamp welfare-reducing standards. However, there may well be scope for analysing the regulatory process as a principal-agent game, where the government desires higher quality for its citizens but only the rms concerned possess the relevant information.

There is also some scope for analysing the effects of limit pricing by a colluding oligopoly - depending upon whether national standards make entry easier or harder. Both these topics go somewhat beyond the scope of this paper.

\textsuperscript{14}There is a possible argument that quality standards are a means of imposing higher \textit{xed costs} on new entrants. However, against this, centrally imposed standards may increase product compatibility, hence making entry easier.
References


Appendix 1: Figures

Figure 1: Imposition of a minimum quality standard Q_R by a regulator. Qu and Yu are the unregulated quality and quantity.
Figure 2: choice of quality-adjusted output under a regulatory minimum quality standard.
**APPENDIX 2: Derivation of equations (For the benefit of the referees)**

Equations (4)-(5):

\[ C_U = aX U^{1-w} Q_U^{\frac{1}{1-w}} + bQ \]
\[ dC_U = dQ_U = 0 \Rightarrow ((1 \cdot \bar{r} \cdot 1) = \bar{r}) aX U^{1-w} Q_U^{\frac{1}{1-w}} = b \]
\[ Q_U = ((a=b(1 \cdot \bar{r} \cdot 1) = \bar{r}) X^U \]
\[ C_U = aX U^{1-w} ((a=b(1 \cdot \bar{r} \cdot 1))^{-1} X U^{\frac{1}{1-w}} + b ((a=b(1 \cdot \bar{r} \cdot 1))^{-1}) X^U \]
\[ = X^U (a=b^{-1}((1 \cdot \bar{r} \cdot 1) = \bar{r})^{-1} (a + b(a=b)((1 \cdot \bar{r} \cdot 1) = \bar{r}) \]
\[ = X^U (a=\bar{r}) ((a=b((1 \cdot \bar{r} \cdot 1) = \bar{r}))^{-1} \]

**Equation (6):**

\[ C^R = aX^R^1 Q^R^{\bar{r} \cdot 1 w} + bQ^R \]
\[ dC^R = dX^R = (a=\bar{r}) X^R^{1-w} Q^R^{\frac{1}{1-w}} \]

Differentiating \( dC^R = dX^R \) with respect to \( Q^R \)
\[ d=dQ^R (dC^R = d) = (a=\bar{r}) (X^R/Q^R) = ((a=b(1 \cdot \bar{r} \cdot 1) = \bar{r}) ) X^R^{1-w} Q^R^{\frac{1}{1-w}} \]
which will be negative for
\[ 0 < \bar{r} < 1; X^R; Q^R > 0 \text{ and } a > 0: \text{ Hence raising the regulatory quality lowers marginal costs. Further, if the regulator sets the same regulatory quality as the monopolist would anyway choose unconstrained, } (X^R/Q^R) = ((a=b(1 \cdot \bar{r} \cdot 1) = \bar{r}) ) \]

Substituting into
\[ (6) \]
we get
\[ dC^R = dX^R = (a=\bar{r}) ((a=b((1 \cdot \bar{r} \cdot 1) = \bar{r})))^{-1} \]
so marginal costs are the same for a regulated as an unregulated rm when quality is set at the unregulated level, but falls as \( Q^R \) is raised.

**Equation (7):**
Setting marginal utility equal to marginal cost

\[ X \cdot R \cdot i \cdot 1 = M C^R \]

\[ = (a=\bar{a})(X^R = Q^R)(i \cdot 1) = \]

\[ X \cdot R \cdot (i \cdot 1) = (a=\bar{a})(Q^R)(i \cdot 1) \]

and rearrange

Equation (8): set marginal cost equal to average cost

\[ MC^{RF} = (a=\bar{a})(X^{RF} = Q^{RF})^{(i \cdot 1)} = \]

\[ AC^{RF} = aX^{RF}(1 \cdot 1) = Q^{RF}(i \cdot 1) + bQ^{RF} = X^{RF} \]

\[ \Rightarrow (a=\bar{a})(X^{RF} = Q^{RF})^{(i \cdot 1)} = a(X^{RF} = Q^{RF})(i \cdot 1) + bQ^{RF} = X^{RF} \]

\[ (Q^{RF} = X^{RF})^{1} = (a=\bar{a})(i \cdot 1) = \]

But from equation (6) \[ X^{RF} = (\bar{a} = a)(Q^{RF})(i \cdot 1) \]

So \[ Q^{RF}((\bar{a} = a)(i \cdot 1) = (Q^{RF})(i \cdot 1) = ((a=\bar{a})(i \cdot 1) = \) \]

\[ (Q^{RF})(i \cdot 1) = ((\bar{a} = a)(i \cdot 1) = ((a=\bar{a})(i \cdot 1) = \)

and rearrange

Equation (12):

\[ Y = X^{1} = Q^{(1 \cdot 1)} = \]

Hence \[ C = aX^{1} = Q^{(1 \cdot 1)} + bQ + dX^{1} = Q^{(2 \cdot 1)} = \]

\[ dC = dX = (a=\bar{a})X^{(1 \cdot 1)} = Q^{(1 \cdot 1)} + (d=\bar{a})X^{(1 \cdot 1)} = Q^{(2 \cdot 1)} = \]

\[ d = dQ(dC = dX) = (a=\bar{a})(X^{(1 \cdot 1)} = Q^{(1 \cdot 1)} = 1 + d(2 \cdot 1)(i \cdot 1) = \]

\[ = (1-\bar{a})X^{(1 \cdot 1)} = Q^{1} + (a\bar{a})(i \cdot 1) + (d \cdot 1)Q) \]

When this equals zero, \( a(1 \cdot i) = d(2 \cdot i) \)

Equation (13)

A monopolist will minimise costs for a given level of output (unless constrained).

Hence \[ dC = dQ = 0: \]
But \( dC = dQ = a(\bar{1} - 1)X^{1-\bar{1}}Q_1^{1-\bar{1}} + b + d(\bar{1} - 1)Q_1^{1-\bar{1}}X^{1-\bar{1}}Q_1^{1-\bar{1}} \)

\( \Rightarrow (1/\bar{1})X^{1-\bar{1}}Q_1^{1-\bar{1}}(a(\bar{1} - 1) + d(\bar{1} - 1)Q_1^{1-\bar{1}}) = i \ b \)

But the LH term is \( \bar{1} (dC = dX) \):

Hence for \( \bar{1} > 0 \) and \( b > 0 \), \( dC = dX < 0 \):

It follows that raising \( Q \) would, at the margin, lower marginal costs (and so lead a monopolist to increase output.

**Equation (15):**

Revenue \( R_{f,1} = X_{f,1}P_x \)

But \( P_x = \sigma Z_f^{i.i} = \sigma (X_{1,1} + X_{2,1}) \),

\( R_{f,1} = \sigma (X_{1,1} + X_{2,1})^{i.i} X_{f,1} \)

\( dR_{f,1} = dX_{f,1} = \sigma (\bar{1} - 1)(X_{1,1} + X_{2,1})^{i.i} X_{f,1} + \sigma (X_{1,1} + X_{2,1})^{i.i} X_{f,1} \)

**Equation (16):**

\( MR_{f,1} = \sigma Z_f^{i.i}((\bar{1} - 1)Z_1^{\bar{2} + Z_1}) \)

set \( M R = M C \) and rearrange equation (11) \( Z_f^{i.i = 1} = ((1 + \bar{1})Z_1^{\bar{2}}(\sigma)^{i.i = 1} MC \)

**Equation (17):**

since \( MC_{f,1} = (a = \bar{1})(X_{f,1}^{R_f,1} + \bar{Q}_1^{R_f,1})^{i.i = 1} = (a = \bar{1})(Z_f^{\bar{2}Q_1^{R_f,1}})^{i.i = 1} \)

\( Z_f^{i.i = 1} = ((1 + \bar{1})Z_1^{\bar{2}}(\sigma)^{i.i = 1}(a = \bar{1})(Z_f^{\bar{2}Q_1^{R_f,1}})^{i.i = 1} \)

\( Z_1^{R_f,1}((\bar{1} - 1)Z_1^{\bar{2}}(\sigma)^{i.i = 1}) = ((1 + \bar{1})Z_1^{\bar{2}}(\sigma)^{i.i = 1}(a = \bar{1})(2Q_1^{R_f,1})^{i.i = 1} \)

**Equation (23):**

given perfect competition we can relate the price facing consumers to those received by the two producers

\( P_{x_f,1} = P_{x_1} + T_f \) where \( T_f = 0 \) for \( ..rm 1 \) and \( T \) for \( ..rm 2 \)

\( MR_{f,1} = dX_{f,1}(P_{x_f,1} = X_{f,1}^{H_f,1} + T_f \)

\( P_{x_1} = \sigma Z_1^{H_f,1} \)

Hence \( (dP_{x_1} = dX_{f,1}^{H_f,1} = \sigma (\bar{1} - 1)H_1^{H_f,1}Z_1^{H_f,1} \)

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\[ M R^H_{i;1} = \phi(\zeta; i, 1) H^H_i(Z^H_1) \zeta^{i+1} + \phi(Z^H_1) \zeta^{i+1} T_f \]

Equation (29):

Unregulated marginal costs (from equation (5))

\[ MC_1 = (a_1 = b_1) ((1 - i) = \bar{a}) \zeta^{i+1} = (a_2 = b_2) ((1 - i) = \bar{a}) \zeta^{i+1} = MC_2 \]

Equation (30):

Unregulated quality chosen by supplier \( f \) is \( Q^D_f = ((a_1 = b_1) (1 - i) = \bar{a}) \zeta X^D_f \)

But we assume unregulated costs for the two ..rms are initially the same, so they produce the same quantity. Hence

\[ Q^D_1 = Q^D_2 = (a_1 = b_1) (a_2 = b_2) = (a_1 = a_2) = (b_1 = b_2) = \bar{A}(1 - i) = \bar{A} \]

Equation (31):

Marginal cost of the lower quality ..rm 2 is given by \( MC_2^R = (a_2 = \bar{a}) (X_2^R = Q^D_2) (1 - i) = \bar{w} \)

Set \( Q^R_2 = Q^D_1 \)

Then \( MC_2^R = (a_2 = \bar{a}) (X_2^R = Q^D_2) (1 - i) = \bar{w} \)

\[ MC_1 = MC_2 = (a_1 = a_2) (X_1^R = X_2^R) (1 - i) = \bar{w} \]