

**“Quality Standards Under Classical Oligopoly and Trade:  
Regulatory Protection or Just Over-Regulation.”**

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# **Quality standards under classical oligopoly and trade: regulatory protection or just over-regulation?**

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## **Non-Technical Summary.**

There is a widespread belief among economists and policymakers that, while formal trade barriers may have been reduced greatly in recent years, there may be growing barriers –whether intentional or unintentional- resulting from the imposition by nation states and by international blocs of technical regulations on product safety, labelling, environmental emissions, hygiene and the like. It is increasingly suggested that these barriers may be being manipulated by national authorities as an alternative, and potentially costly, way of discriminating against import suppliers in favour of their domestic industries, and that trade rules need tightening to reduce such protectionism.

Such a sentiment underlies the Annexes on Technical Barriers to Trade (TBTs) and Sanitary and Phytosanitary Standards (SPSs) to the World Trade Organisation Agreement from the Uruguay Round. The WTO Agreement Annex on TBTs recognises that countries have legitimate reasons for introducing product regulations, but that such regulations must not ‘be more trade-restrictive than necessary to fulfil a legitimate objective, taking account of the risks non-fulfilment would create’. Attempts to reduce perceived TBTs also underlie the European Union’s Single Market initiative and several recent trade agreements. Nevertheless, there is still considerable disagreement between those (particularly developing country lobbyists) who argue that regulations are still highly obstructive to trade and those who feel countries’ sovereignty and the environment and quality of life of their citizens would be at risk from loosening regulations.

Looking at this from an economic angle, the case that there may be much hidden protection embodied in national standards and regulations has been argued forthrightly by Richard Baldwin and others involved in a current World Bank study (See Maskus and Wilson reference). There have also been strong arguments in support of the idea that the simplest way to reduce such 'regulatory protection' barriers is by introducing mutual recognition agreements, where a group of countries agree that, if goods judged satisfactory for sale by the authorities in their country of origin, all countries would treat them as acceptable. This mutual recognition principle effectively underlies much of the legislation underpinning the European Union's Single Market and the Asia Pacific Economic Community.

The problem is that economic arguments to back up this increasingly popular policy prescription have little formal theoretical basis at present. What work has been done has often been either (i) rather narrow case-studies of technology within individual industries, (ii) very ad hoc studies based upon the assumption that if two countries trade less than simple econometric models would indicate, this must be because of 'regulatory protection' or (iii) a few very complicated models of product choice.

There are strong reasons to be sceptical about the current literature on 'regulatory protection'. For a start, minimum standard regulations are rarely introduced primarily for protectionist reasons. Rather they serve important purposes in protecting consumers in cases where there are product compatibility problems ('network externalities' such as the different technical standards for TV or telecoms equipment), informational problems (so that 'bad' suppliers may drive out 'good' ones), safety and disease control issues or issues of monopolistic supply. We cannot always be sure when such standards are really being distorted in order to benefit one country at the expense of its trading partners. Nor can we always conclude that such distortions will be trade-reducing – quite the contrary, it is conceivable that a country may be tempted to use legislation in such a way that its neighbours are induced to sell it more goods at lower price. The assumption that such regulations necessarily form large trade barriers in practice, and that trade fora such as the WTO are the appropriate place to determine national quality regulations is not really supported by much theoretical analysis.

Against this background, this paper sets out to examine in a more rigorous theoretical way the issue of quality regulations, particularly minimum quality standards (eg for safety or reliability) for goods in an open economy, where the motive is to correct an underprovision of quality by a monopolistic or oligopolistic industry. I show that, on reasonable assumptions, a monopoly or duopoly will tend to produce goods of less-than-optimal quality (selling substandard goods is really just another way a monopoly raises its profit margins). This provides a justification for governments to set minimum quality standards by regulation benefiting consumers.

The issue then becomes one of how regulators' choice of standard is affected when an economy is open to trade. It is shown that when a monopoly supplier is foreign, the importing country's government has an incentive to set higher-than-optimal standards, which induce the foreign company to sell it more goods at a lower price, benefiting consumers at the expense of profits. This same strategic policy distortion happens when two countries with one firm in each engage in trade: regulators set higher-than-optimal product standards, in order to benefit their own consumers at the expense of foreigners' profits.

However, an important point arises: these strategic distortions in policymakers' choice of standards actually increase, rather than reducing, international trade, and do not necessarily favour one country's producers over another's. It follows that, while policy may not be optimal, it is not protectionist in the sense that it is an obstacle to trade.

Further, mutual recognition agreements can themselves introduce policy distortions. If a monopolistic producer in one country can raise its profits by selling substandard goods to foreigners, then it may benefit its home country to allow it to do so, even if this also reduces the quality of goods sold at home. It follows that when countries agree to enter a mutual recognition agreement, regulatory standards, which are set too high under noncooperation, will become too low.

The paper then looks at what happens when different countries have technological differences. In this case, it has often been argued that, since when there is imperfect competition suppliers can make profits on all goods sold, governments have a strong

incentive to introduce regulations which increase their home firms' share of the local market at the expense of foreigners. This is called 'profit-shifting', and can lead to protectionism.

While there is some validity in this argument, this paper makes some contrary points ignored in the existing literature:

- 1) There is little incentive to use regulatory protection if other, less costly methods of protection like tariffs are available to policymakers.
- 2) The analysis in the first part of my paper shows that, in the absence of a mutual recognition agreement, policymakers have a strong incentive to force up producers' quality standards, benefiting consumers at the expense of producers. This may well leave profit margins much lower than previous studies have estimated, and as a result the incentives to introduce protectionist barriers for profit-shifting motives are greatly reduced, or even totally eliminated.

The conclusions of this paper are, therefore, that while there is indeed a problem of policy biases in setting quality standards on traded goods, this may well not take the form of protectionism. To assume that such policies may interfere with trade to the extent that they should be dictated by international trade bodies (rather than by other forms of international negotiation) may result in excessive interference in countries' internal policies. Even the current consensus in favour of mutual recognition agreements may be misplaced in some circumstances.

# Quality standards under classical oligopoly and trade: regulatory protection or just over-regulation?

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## Abstract

Recent trade policy debates have focused increasingly on the supposed barriers caused by differing country regulations, and at proposed remedies such as mutual recognition agreements. There are several motives for setting minimum quality standards in an open economy. This paper examines the motive of correcting an undersupply of quality when an industry is monopolistic, and sets up a theoretical model of regulatory setting of minimum vertical quality standards in a classical two-country cross-hauling duopoly model with identical firms and consumers. It is shown that, in the absence of cooperation between the two national regulators, there will be a tendency to strategic over-regulation, benefiting consumers at the expense of firms compared to the globally optimal solution. This overregulation leads to excessive, rather than inadequate trade. Further, when a mixture of horizontal and vertical quality standards is introduced, the profit-shifting incentive noted in previous studies to set horizontal technical barriers to trade which discriminate against foreign suppliers is either greatly reduced or totally eliminated. It is also noted that the commonly-supported policy response to technical barriers to trade, mutual recognition, is not socially optimal as previous studies had indicated, but

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instead leads to underregulation, with higher-than-optimal company profits and lower consumption and trade.

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## 1 Introduction

This paper examines the issue of quality regulations in an open economy, where the motive is to correct an underprovision of quality by a monopolistic or oligopolistic industry. This motive provides a justification for governments to set minimum quality standard regulation, which can be shown to benefit consumers, and which is largely ignored in the current literature. However, when such regulations are set in an open economy there may well be distortions in the regulator's choice of quality levels (as the existing literature recognises). In this paper I set up a theoretical partial equilibrium model, in order to examine the biases in regulatory decisions and the implications for trade. I conclude that when countries do not cooperate there will be strategic distortions leading to overregulation. However in the first simple model I consider, with identical firms, the strategic distortions are not really protectionist, since the higher quality standards do not reduce trade volumes. Even in more complicated models where firm characteristics differ across countries, the protectionist motivations are much reduced compared to the conclusions of other papers. Further, mutual recognition agreements (such as the European Single Market), which previous studies had indicated lead to improved welfare, may in fact produce a problem of underregulation.

### 1.1 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 standards and so on - as a potential form of protectionism. Indeed, the idea that independent setting of regulations by EU governments might be hampering trade and competition internationally has been a major rationale for institution of the Single Market project, and subsequently 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 Technical Barriers to Trade and Sanitary and Phytosanitary Standards (SPS) in the WTO Agreement from the Uruguay Round, and the General Agreement on Trade in Services. 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 trade-restrictive than necessary to fulfil a legitimate objective, taking account of the risks non-fulfilment would create.'

Notwithstanding these agreements, there has been considerable concern voiced at the recent Cancun summit (eg by the International Centre for Trade and Sustainable Development<sup>1</sup>, or the UNICE) that the TBT and SPS agreements do not go far enough, particularly from the viewpoint of developing countries. Against that, there is of course considerable resistance by many countries to seeing their policies on safety, environmental emissions, labour standards etc subject to trade treaties.

The major problem with economic assessment of TBTs is that they are potentially much more complicated to analyse than tariffs or quotas. As the WTO Agreement itself recognises, there are 'legitimate reasons' for such

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'Most governments have realised that trade restrictions of this nature may be necessary and appropriate to ensure food security as well as animal and health protection. However, the increasing and arbitrary use of such measures by developed countries, often to protect domestic industry, has caused great concern among developing countries. Further, firms from developing and less-developed countries often face considerable difficulty in conforming to the high standards and technical regulations set by the industrialised countries'.

- From the notes to the ICTSD special session at the Cancun summit.  
<http://www.ictsd.org/ministerial/cancun/tds/Session-1-3.htm>

barriers, and deciding to what extent barriers observed are in practice legitimate or constitute an 'obstacle to trade'<sup>2</sup> is not a simple task. First the issue of definition. 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'. This goes beyond the definitions of 'obstacles to trade' in the WTO Agreements, and if applied it would mean a maximalist role for the WTO (and the General Agreement on Trade in Services), which would impinge severely upon what are usually seen as legitimate areas for national public choice.

Consequently, for this paper I prefer a narrower definition of protection: a regulation is non-protectionist if it 1) does not reduce traded volumes and 2) does not favour the profits of local against 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 profit) by both domestic and foreign producers. In this case, there are much stronger parallels between international standards coordination and the issue of international tax competition, rather than with tariffs or quota policies. It may well be that such distortions, where they do not directly discriminate against importers, are best dealt with by national governments in fora other than the WTO, GATT or GATS.

Turning to specific cases, and asking whether regulations are 'legitimate' or constitute 'regulatory protection', a few conclusions can be drawn from the literature to date. Where regulations clearly apply to conditions of production abroad which differ from those at home (e.g. bans on goods produced under bad labour or environmental conditions) there may indeed be a serious case for saying that an import ban is also serving a protectionist purpose. However, many of the regulations imposed by governments apply both to production at home and to imports (though, if there are fixed costs involved, compliance with many different countries' varying standards is of course potentially an expense for companies which trade in many countries against those trading in just one). Moreover, there may be ostensibly valid economic reasons for their institution. Indeed, while a government would have some scope for introducing pure cost-increasing regulations as a strategic trade policy (see Wallner, 1998), it seems unlikely substantial use would be made of a policy which imposes high resource cost on consumers unless other means

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<sup>2</sup>Or 'regulatory protection' (see e.g. Baldwin, 2001), the terminology henceforth used in this paper.

(eg tariffs) which impose a much smaller deadweight loss are ruled out, e.g. by trade agreements, or unless that policy were initially instituted for other reasons, and the changes for trade reasons were at the margin.

Strictly speaking, 'regulations' are applied by governments, while 'standards' tend to be voluntarily agreed by industries (Sykes, 1995). This paper ignores the difference. In 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. This paper concentrates on the simpler case of government regulation, which is assumed to aim at maximising net utility in the home country.

Regulatory differences between countries can in principle be broadly defined as either 'horizontal' or 'vertical'. The former impose different technologies or different, and often incompatible means of achieving a given set of results: such as insisting on certain plug sizes for appliances. By contrast, 'vertical' standards are where a regulator clearly insists that goods achieve at least a certain minimum standard of, say, 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 insisting they achieve this by use of catalytic converter technology (or choosing a set of emissions standards which can only be achieved by catalytic converters, while perhaps ignoring other pollutants which converters do not touch).

The most widely-recognised reason why horizontal regulation may be called for is network externalities (see, eg Gandal, 2001). This is the situation where the goods used by large numbers of people need to be compatible with one another (e.g. television sets working on a PAL or NTSC system). Neither system may be inherently superior, but there is a substantial potential efficiency gain if all consumers in one country use a compatible technology. There may be a good economic reason for the government to impose one technology, rather than letting different technologies fight a costly battle for supremacy. However, the scope for distorting such a system for protectionist purposes is also clear: if technologies are not easily compatible, the government can favour home rather than foreign producers.

In the case of vertical quality, the literature to date recognises three main reasons why the government may wish to impose minimum quality controls. Possession of unreliable or dangerous goods may impose externalities upon other people (e.g. a dangerous car endangers other road users): whether or not other means of ensuring these are dealt with (e.g. compulsory insurance)

are adequate is perhaps a side issue - in practice the state usually does insist on goods meeting certain standards. The most extreme case of externalities justifying quality standards (including trade barriers) is disease control, which is the main justification for Sanitary and Phytosanitary Standards (SPS).

A second reason is informational differences: purchasers of goods may not easily be able to distinguish the quality. In this case (see e.g. Akerlof, 1970, Leland, 1979) adverse selection may mean that bad goods drive out the good ones, unless there is either an effective central labelling scheme or some minimum quality standard.

The third motivation is where consumers have diverse tastes in terms of quality, and where supply is oligopolistic. In this case (see eg Shaked and Sutton, (1982), Das and Donnenfeld (1989), Lutz (1996(1) and (2)), firms may reduce price competition between themselves by choosing to make their goods excessively diverse, and minimum quality standards which force the lower-quality firms to raise standards can increase competition between firms. In general, in this model, a minimum quality standard will increase competition in the medium- and higher-quality ends of the market, though low quality (poorer) consumers will suffer, and may reduce purchases. Lower-quality producers in particular will suffer lost profits, and if these are foreign companies, there will be a temptation on the regulator to set excessively high minimum standards. In this model (see Lutz, 1996(1)) mutual recognition benefits both countries, particularly the lower-quality producer.

However, the above papers, which focus on newer theories of diverse quality under oligopoly, have been set up in a market with a fixed number of consumers buying at most one good each. This means they tend to ignore a key feature of the classical monopoly or oligopoly model: namely that producers can raise prices by restricting output. Where quality differences substitute with diminishing returns for quantity of consumption, there may be a scope for producers to increase profits at consumers' expense, not just by restricting output volumes, but also by reducing quality. This provides a fourth possible justification for minimum quality standards: to correct the underprovision of quality by monopolistic or oligopolistic firms.

## 1.2 Outline of This Paper

This paper concentrates on the fourth justification for vertical regulations:

as a response to the underprovision of quality by a classical monopoly. Section 2) examines the issue of 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 consumers have identical preferences 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 is optimal, and cross-country harmonisation benefits welfare. A mutual recognition regime tends to result in the opposite tendency: for standards to be set below the global optimum - this is a point not picked up in the previous literature based on the Shaked/Sutton model.

Section 3) considers the issue of more clearly protectionist pure horizontal quality standards, imposing a resource cost on foreign producers only. In line with Wallner and Baldwin, it is shown that such protectionist standards may be imposed from a profit-shifting motive (though only when other forms of protection, such as tariffs, are ruled out). However, when the model incorporates vertical protection, this reduces profits substantially: hence the profit-shifting motive is greatly reduced. Where countries differ in quality of production, there may in some circumstances be a profit-shifting motive for the higher-quality country to raise minimum vertical standards, but again the circumstances and scope for this are more limited than the previous literature has suggested.

Finally, in section 4) I review briefly the Shaked/Sutton-style diverse consumers model. I suggest that the diverse consumers and classical oligopoly model are not mutually exclusive, and that, if variable consumption levels are allowed (unlike in the literature mentioned above), many of the results of the classical monopoly model investigated in this paper still carry across to a hybrid model.

## **2 A Theoretical Model of Vertical Quality Regulation**

Unlike much of the literature to date, in this paper I am interested in vertical quality regulations: ie regulations which improve the minimum quality experienced by consumers. I show that, in the absence of regulations, on rea-

reasonable assumptions imperfect competition reduces the quality of goods on offer to consumers, but that in the presence of trade there may be strategic distortions affecting the decisions of single country regulators if they do not collaborate.

I start by looking at the simplest case: where goods are produced by a monopolist. This is because many of the features of the monopoly model carry over to oligopoly. It is assumed that consumers are identical in tastes and incomes, and initially a single country case is considered. The paper uses a partial equilibrium approach, concentrating on just one good.

Firms produce output with two features, quality,  $Q$ , and quantity,  $Y$ . I assume that the total cost of production,  $C$ , is a linear function of  $Q$  and  $Y$ , with  $a$  and  $b$  denoting the linear scalars

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

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

$$X = Y^\beta Q^{1-\beta} \tag{2}$$

where  $\beta$  is a nonlinear 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,  $X$ , of a residual aggregate of other goods,  $Z = \bar{M} - P_X X$  (where  $\bar{M}$  is an exogenously given endowment) in a quasilinear fashion—thus eliminating income effects. For simplicity, total income,  $\bar{M}$ , is assumed constant—implying  $Z = \bar{M} - P_X X$ —and the marginal valuation for the good in question is assumed to have a constant demand elasticity—implying a constant elasticity of demand

$$U = \bar{M} - P_X X + \gamma X^\eta. \tag{3}$$

## 2.1 Monopoly Equilibrium under Quality Regulation

We shall begin our analysis by focusing on the case of a quality regulated monopolist. The monopolist’s profit mark-up will be a decreasing function

of demand elasticity  $\eta$ . For a finite mark-up we need to assume  $\eta$  lies between zero and unity.

We start by considering the behaviour of an unregulated monopoly. We denote the behaviour of the unregulated monopoly with a subscript u. For a given level of  $X = X_u$ , we can obtain the cost-minimising value of  $Q (= Q_u)^3$ . This yields a constant marginal cost

$$MC_u = (a/\beta)((a/1)((1 - \beta)/\beta))^{\beta-1} \quad . \quad (5)$$

Now introduce a minimum quality regulation which fixes  $Q \geq Q_R$ . In practice, if  $Q_R > Q_u$  then the firm 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 rather than in a natural monopoly case).

By contrast with the unregulated case, marginal cost is now a function of  $Q$  and  $X$ :

$$MC_R = (a/\beta)(\chi_R/\chi_u)^{(1-\beta)/\beta} \quad (6)$$

where  $\chi$  denotes the output/quality ratio  $X/Q$ . This implies that as  $Q$  is increased by regulation, the marginal cost of quality-adjusted output  $X$  will fall (unless  $X$  rises as fast as  $Q$ , which will not happen with a downward-sloping demand curve). This leads to our first result.

**Proposition 1** *If a monopolist is constrained by regulation 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, which deals with the firm's unconstrained and constrained choice of crude output. Given free choice of quality and quantity the firm will choose  $(Q_u, Y_u)$  on the ray  $Q_u/Y_u = k$ . However, the firm is not now free to choose  $Q < Q_R$ : it follows that for quantities of quality-adjusted output up to  $X_F$  the firm is forced to incur higher cost  $C$  for a given level of quality-adjusted level of output  $X$  than it would freely choose. However, as output increases the total cost line approaches the ray  $Q_u/Y_u = k$ . This suggests that imposing a quality standard of  $Q_R > Q_u$  means the marginal cost of increasing  $X$  is less than it would be if the firm

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 fixed cost  $CF(Q_R)$  on the firm.

Since we are assuming a constant demand elasticity  $1/(\eta - 1)$  for the firm's produce, the monopolist will set a fixed proportional markup over marginal cost. It follows that the introduction of  $Q_R > Q_u$  will lead to lower prices (at least per unit of quality-adjusted output), and hence to higher consumer 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 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 firm continues to produce.*

$X$  is related to  $Q_R$  by setting marginal cost equal to marginal revenue and solving:

$$X_R = (\beta\gamma\eta/a)^{\beta/(1-\beta\eta)} Q_R^{(1-\beta)\cdot(1-\beta\eta)} \quad . \quad (7)$$

This confirms that for positive  $\beta, \gamma$  and  $\mu$  and  $1 > \beta\eta > 0$ ,  $X_R$  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 from the diagram that consumer surplus is increased. By differentiating (3) we can see that since  $0 < \eta < 1$ , 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.*

The next question is what standard a regulator will set, given that it is assumed to be able to regulate the minimum quality standard, but not



prices or output? 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  $\pi_R = 0^4$ .

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

$$dW^D/dQ_R - d\pi^D/dQ_R = (dU^D/dX^D)(dX^D/dQ_R). \quad (9)$$

We know that 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  $\pi^D$  decreases with  $Q_R$ . From the discussion above, we can conclude that at the unregulated monopoly quality,  $Q_u$ , the marginal social gain to raising  $Q_R$  above this level will be positive.

By double differentiating equation (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  $0 < \eta < 1$ . It follows that the difference between marginal social and private net gains from raising  $Q_R$  will decline as  $Q_R$  rises. It is therefore probable 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.

There will therefore be a social optimum for setting  $Q_R$ , when the monopolist is domestic, and this level  $Q_R^{*D} > Q_u$  the unregulated monopoly level.

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<sup>4</sup>This can be shown to equal:

$$Q_R^{*F} = ((a/b)((1 - \beta)/\beta))^{(1-\beta\eta)/(1-\eta)} (\beta\gamma\eta/a)^{1/(1-\eta)}. \quad (8)$$

If at this level  $Q_R^{*D}$ , the profits of the firm are still greater than their reservation level, then the regulator will not impose as high standards as if the firm were foreign. This is an important point, since it implies that often, once we allow that some consumption is foreign-produced, there may 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  $Q_R^{*D} > Q_R^{*F}$  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 regulator is foreign exceeds the socially optimal standard chosen when the monopolist is domestic, unless parameter values are such that the socially optimal standard produces zero profits.*

Propositions 1-5 have shown that, when there is a single unregulated monopolist, there is a tendency to undersupply both quality and crude quantity, but that when quality regulation is introduced there can be a bias in regulation where the monopolist is foreign: namely that a regulator will choose to impose excessively high quality standards on a foreign monopolist. Much of this analysis carries across to the case of oligopoly.

## 2.2 Quality Regulation in a Cross-Hauling Cournot

### Duopoly

We now assume that, instead of a single monopolist, there are two identical firms in the industry:  $f = f_1$  and  $f_2$ , set in countries  $c = c_1$  and  $c_2$  respectively. All consumers in both countries have identical tastes, and the two firms produce products which are perfect substitutes, with identical production functions.

As before, we assume consumers' utility in country 1 depends on total consumption, which we now denote  $Z_1$ ,

where  $Z_1 = X_{11} + X_{21}$ , the aggregate of the quality-adjusted sales of the two firms to country 1.

Utility is given by

$$U_1 = \bar{U} + \gamma Z_1^\eta - P_{X1} Z_1 \quad (10)$$

where  $P_{X1}$  is the price of the quality-adjusted output in country 1 (which is the same for both suppliers, since they both produce goods which are perfect substitutes).

Again,  $X_{11}$  and  $X_{21}$  are Cobb-Douglas aggregates of quality  $Q$  and crude quantity  $Y$ , and cost  $C_{fc}$  is a linear function of  $Y_{fc}$  and  $Q_{fc}$ .

We are crucially assuming that firm  $f$  chooses its quality to supply to each market separately, and that quality chosen to supply to country 1 has no effect on the costs of quality in country 2.

Since the cost side of the model is unchanged from that of the monopoly above, we can proceed by analogy with the earlier analysis. When a firm is unregulated the marginal cost of increasing quality-adjusted output  $X$  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  $(Q_{f,c1}/X_{f,c1})$  rises, as indicated by equation (7).

The demand side is somewhat more complicated. For maximum utility, consumers will consume up to the point where marginal utility from consumption equals quality-adjusted price:

For maximum profit, firm  $f$  will set marginal revenue in market 1 equal to marginal cost. This involves some sort of assumption about the behaviour of the rival firm: we assume each firm  $f$  assumes its rival will keep quality-adjusted output  $X$  constant in response to changes in  $f$ 's output<sup>5</sup>. It can be shown that marginal revenue for a given level of output is greater in the duopoly case than for a monopoly<sup>6,7</sup>, and that therefore combined output is set at a level somewhat greater than in a monopoly, both for a regulated and for an unregulated and unregulated duopoly:

$$Z_{u1} = ((1/2)(1 + (1/\eta))^{1/1-\eta} X_{u1}; \quad (11)$$

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<sup>5</sup> ie we are assuming a Cournot-Nash duopoly

<sup>6</sup>Setting marginal revenue for each firm equal to price,

$$MR_{1f} = \gamma\eta(X_{11} + X_{21})^{\eta-2}((\eta - 1)X_{1f} + x_{11} + X_{12})$$

<sup>7</sup>Since the two firms are identical

$$MR_{1f} = (1/2)^{1/\eta} \gamma \eta^2 Z^{\eta-1}$$

$$Z_{R1} = ((1/2)(1 + (1/\eta))^{\beta/1-\beta\eta}) X_{R1}. \quad (12)$$

This implies that the combined duopoly sales,  $Z_{R1}$ , for a given level of  $Q_{R1}$ , exceed monopoly sales by a constant proportion. Also, combined duopoly sales are a rising function of  $Q_{R1}$ . This means that, as with the monopolist, consumer utility  $U_{R1}$  will rise monotonically with  $Q_{R1}$ . We can therefore produce the first propositions to the cournot duopoly case by analogy with the monopoly case:

**Proposition 6** *If a cournot duopoly of identical firms is constrained by regulation 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 cournot duopoly of identical firms 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 regulation standards, the analysis can proceed along similar lines to where there is a monopoly. Total welfare in country 1 is

$$W_1 = U_1 + \pi_{11} + \pi_{12}, \quad (13)$$

where  $\pi_{11}$  is the profit made by firm 1 in country 1, and  $\pi_{12}$  is the profit firm 1 makes in country 2 and remits to country 1.

The implication here is that, for each regulator, one of the two supplying firms is foreign. While raising the quality standard benefits consumers at the expense of the firms' profits, only the one firm's profits (ie half total profits) 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 country 1 is assumed to depend only on consumer surplus and firm 1's domestic profits:

$$dW_{R1}/dQ_{R1} = (dU_{R1}/dZ_{R1})(dZ_{R1}/dQ_{R1}) + d\pi_{R11}/Q_{R1} > d\pi_{R11}/Q_{R1} \quad (14)$$

It follows by analogy with the signs of first and second differentials we established in the monopoly case that, that if firms are forced to produce above their unregulated choice of quality, profits will fall increasingly in relation to  $Q_{R1}$ . This should lead to a non-cooperative welfare-maximising choice of standard for the regulator (which is either the point at which the marginal cost to firm 1 alone equals the marginal loss of consumer surplus, or else the point at which firms exit the market).

Compare this non-cooperative solution to a globally optimal solution. In this case, global welfare,  $GW$  is the sum of  $W_1$  and  $W_2$ . Differentiating this with respect to  $Q_{R1}$ :

$$dGW_{R1}/dQ_{R1} = (dU_{R1}/dZ_{R1})(dZ_{R1}/dQ_{R1}) + 2d\pi_{R11}/Q_{R1} \quad (15)$$

assuming (by symmetry) that  $d\pi_{R21}/dQ_{R1} = d\pi_{R11}/dQ_{R1}$ .

Once more it will be worth increasing  $Q_{R1}$  beyond  $Q_{u11}$ , the quality

which maximises private profits. However, beyond this point, this time the regulator takes into account the decline in both firms' profits as he increases  $Q_{R1}$ : consequently total global welfare peaks with respect to  $Q_{R1}$  rather faster than country 1's welfare, and the regulator will set a more modest standard in this case, unless again the global welfare-maximising standard is still high enough to cause firms to exit.

**Proposition 9** *The quality standards chosen in an identical cross-hauling*

*cournot duopoly when the two regulators do not cooperate exceed the socially optimal standard which would be chosen by a global regulator, unless parameter values are such that the socially optimal standard produces zero profits. This overregulation benefits consumers at the expense of both firms.*

The point at which the firms exit the market can be deduced by analogy to equation (8): again the issue of whether or not this sets a practical ceiling to the level at which the regulators set standards is an empirical matter depending on parameter values.

We now look at the case where the two countries make a mutual recognition agreement, under which each country will set its own independent quality standard for production, but will accept any goods produced by the other country's producer which are acceptable to its own regulator. With mutual recognition, we assume the regulator in country 1 assumes firm 1 will sell goods at quality  $Q_{R1}$  in both markets, but at the same time, firm 2's product standards will not change in either market. This means that the regulator is assumed to calculate that only firm 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 company 1's exports to country 2. Again we can say (by symmetry of the two countries and companies):

$$d\pi_{R12}/dQ_{R1} = d\pi_{R11}/dQ_{R1}$$

Consequently, the marginal welfare effect to country 1 of changing  $Q_{R1}$  is:

$$dW_1^{MR}/dQ_{R1} = dGW/dQ_{R1} - (1/2)(dU_1^{MR}/dZ_1^{MR})(dZ_1^{MR}/dQ_{R1}) \quad (16)$$

By contrast, the increase in global welfare from raising  $Q_{R1}$  in this case will include the gains to consumer utility in country 2 from higher quality of exports from country 1. Since we can again write (by symmetry)  $dU_2^{MR}/dZ_2^{MR} = dU_1^{MR}/dZ_1^{MR}$  and  $dZ_2^{MR}/dQ_{R1} = dZ_1^{MR}/dQ_{R1}$ , it follows that the marginal welfare gain to country 1 from raising product standards is less than the global welfare 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 will be lower when there is a*

*mutual recognition than the socially optimal standard which would be chosen by a global regulator.*

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 with identical consumers and firms does not alter the market shares of domestic versus foreign firms, and increases rather than decreasing trade volumes compared to the global optimum. Consequently on the definition in the introduction it should be considered strategic over-regulation rather than regulatory protectionism. Mutual recognition leads to strategic underregulation.*

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

### **3 A model of vertical and horizontal quality regulation**

The discussion above has concentrated on vertical quality regulations: ie ones which quantitatively raise some measure of quality experienced by consumers for all goods within an industry. By contrast, much of the literature on Technical Barriers to Trade (TBTs) focuses on 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.

The reason why a country should impose horizontal TBTs is not immediately apparent. After all, a horizontal TBT against imports 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's government. It follows that pure horizontal TBTs are only likely to appeal to a government 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, with constant returns to scale, 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, be of appeal to regulators in four circumstances, where the alternative of tariffs is ruled out:

1) Where there is monopolistic profit in an industry, there may be a profit-shifting motive. In this case, any policy measure which raises domestic suppliers' market share will also tend to raise their profits, and in the absence of cooperation it may be worth a country using such measures at the margin even when they involve imposing a real resource cost on consumers.

2) There may be agglomeration economies in the industry, which mean that a country which raises its domestic output by imposing TBTs can either lower local production costs (which may benefit consumers in a model with transport costs) or raise local factor rents.

3) There may be agency capture so that the regulator is acting on behalf of local producers rather than the importing country as a whole .

4) Horizontal legislation may to some extent be inevitable where there are network externalities (see the discussion in the introduction).

In this paper we consider the first of these motives only.

### **3.1 Pure Horizontal Technical Barriers to Trade**

Consider first the motives for introducing 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 under consideration imported into country 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 the two countries have agreed not to impose tariffs or quotas on trade between them, so that a horizontal TBT is the only form of protection available for the domestic firm.

From equation (5), 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 firm 2 selling to country 1 are now

$$MC_{h21} = MC_u + T \quad (17)$$

where the subscript  $h$  denotes the case with horizontal barriers.

If we assume firm  $f$ 's market share is  $\theta_{hf1}$ , we can show that the firm's marginal revenue declines with its market share<sup>8</sup>. We can also show that the quality-adjusted price facing consumers in country 1 rises with the market share for the domestic producer firm 1<sup>9</sup>. It follows that, for the effects of the introduction of a pure horizontal TBT on imports from firm 2 to country 1 of  $T$  per quality-adjusted unit output  $X$ , marginal costs for firm 2 supplying to country 1 will be raised, and consequently, firm 2 will reduce its market share (which raises its marginal revenue, according to equation (21)). Correspondingly firm 1's market share will rise, so its marginal revenue will fall somewhat. But, since marginal costs are constant, firm 1 cannot allow its marginal revenue to fall, so it too will restrain production. The resulting equilibrium will give lower total sales (and hence a higher  $P_x$ ) but a higher market share to firm 1 than initially (while firm 2 has a higher marginal revenue than initially, reflecting its cutback in sales, and equating to its raised marginal cost).

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<sup>8</sup>To be precise, for each supplier

$$MR_{hf1} = \gamma\eta.Z_{f1}^{\eta-1}(1 - (1 - \eta).\theta_{hf1}) \quad (18)$$

<sup>9</sup> This relationship is given by

$$MR_{hf1} = \gamma\eta.Z_h^{\eta-1}(1 - (1/\eta)\theta_{hf1})$$

For the welfare implications of this pure horizontal TBT, consider total welfare in country 1, which consists of consumer surplus plus firm 1's profits at home and abroad. We assume  $\pi_{12}$ , the profits made by the domestic firm on its exports, is unaffected by any TBTs introduced by country 1. Consequently, this term disappears when we differentiate  $W_1$  with respect to  $T_1$ .

$$dW_{h1}/dT_{h1} = \Phi1 + \Phi2 + \Phi3 + \Phi4 \quad (19)$$

$$\Phi1 = (MU_{h1} - Px_{h1})dZ_{h1}/dT_{h1} \quad (20)$$

$$\Phi2 = +\theta_{h11}(Px_{h1} - MC_u)dZ_{h1}/dT_{h1} \quad (21)$$

$$\Phi3 = -(1 - \theta_{h11})Z_{h1}dPx_{h1}/dT_{h1} \quad (22)$$

$$\Phi4 = +Z_{h1}(Px_{h1} - MC_u)d\theta_{h11}/dT_{h1} \quad (23)$$

$\Phi1$  is the difference between consumer price and social costs times the change in consumption. Since we are assuming there are no indirect taxes, and since consumers are assumed to be utility-maximising, this will equal zero.  $\Phi2$  is the home firm's share in the total change in output times its profit margin (this will be zero or negative as  $Z_{h1}$  falls with  $T_{h1}$ ).  $\Phi3$  is the cost of the increased price to consumers of the initial volume of imports from firm 2. This also yields negative welfare, since the price of imports rises.  $\Phi4$  represents the profit shift, since  $\theta_{h11}$ , the home firm's share, will rise with  $T_{h1}$ , and this will yield extra profits, if the profit markup  $\mu_{h11}$  is positive. This profit-shifting gain is the only potential welfare gain from introducing the horizontal TBT in our model, and yet it clearly only applies when there is a positive profit markup - indeed a large enough profit markup to outweigh the other two terms (and since the first term, which reduces welfare, also increases with  $\mu_{h11}$  the chances on the TBT raising welfare are still further reduced).

**Proposition 12** *In the case where basic production costs of the two firms are the same, if the regulator maximises domestic welfare, a pure horizontal barrier will only be introduced where initial (pre-barrier) profits are positive and the profit shift is large enough to outweigh 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, Proposition 13 can be deduced:

**Proposition 13** *In the case where basic production costs of the two firms are the same, if the regulator also introduces vertical standards to maximise domestic welfare, the incentive on the regulator to introduce horizontal TBTs is either reduced or completely eliminated.*

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 firms have the same marginal costs of producing quality-adjusted output  $X$  when unregulated (ie  $MC_{u1} = MC_{u2}$ ). Let us define  $b_2 = \psi b_1$ , in which case raising quality is more expensive for firm 2 than firm 1 if  $\psi > 1$ . If unregulated marginal costs are the same, it is easy to show that  $a_2 = \psi^{\beta-1} \cdot a_1$ .

In this case, in the absence of regulation, the less quality-suited firm 2 will set a lower quality than firm 1:

$$Q_{d1}/Q_{d2} = \psi^\beta \tag{24}$$

To analyse what happens in this case, first, consider a situation where the globally optimal regulatory standard  $Q_{R1}^*$  in country 1 lies between  $Q_{d2}$  and  $Q_{d1}$ . In this situation, raising  $Q_{R1}$  at the margin will raise the costs of the importing firm  $F_2$ , lowering its market share and profits, but not affect the costs of  $F_1$ . As in this situation demand will shift towards  $F_1$ , this firm's profits will actually improve as  $Q_{R1}$  is raised (up to the point where  $Q_R = Q_{d1}$ ). In the absence of international cooperation, the regulator will only take account of the (rising) consumer welfare and  $F_1$ 's (rising) profits,

and hence will keep raising  $Q_R$  at least to  $Q_{d1}$ , even if this is above the globally optimal level. In this case,  $Q_{R1} > Q_{R1}^*$  and we clearly have not just strategic distortion but (on our narrow definition) protectionism as well, since the higher standard reduces trade and benefits local profits at the expense of foreigners.

What about the case, though, where  $Q_{R1}^* > Q_{d1}$  ? It is fairly easy to show that, once  $Q_{R1}$  is raised above  $Q_{d1}$ , market shares of the two firms cease to change any more. The ratio of marginal costs of the firms will be constant beyond this point<sup>10</sup>, and since prices depend only on marginal costs and profit markup, the shares of the two firms and  $\eta$ , once  $Q_R$  rises above  $Q_{d1}$ , further rises in  $Q_R$  will not affect firms' market shares, with marginal costs and prices rising at proportionally the same rate for both firms, so there is no profit-shifting motive. Hence our last Proposition:

**Proposition 14** *Where firms' marginal costs of raising quality differ, there may be a profit-shifting motive for the regulator to raise vertical standards above the global optimum in the country where the marginal cost of raising quality is lower, but this motive only exists if the global quality optimum lies below what the domestic firm in that country would choose if unregulated. Otherwise, the regulator will only raise minimum standards to the point where the foreign firm is forced to supply at the same quality as the domestic firm freely chooses.*

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, Wallner).

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<sup>10</sup>The ratio of marginal costs is given by:

$$MC_1/MC_2 = (a_1/a_2)(\theta_{11}/(1 - \theta_{11}))^{(1-\beta)/\beta}. \quad (25)$$

## 4 Models with heterogeneous consumers

One further question is the effects of introducing heterogeneous consumers, in the sense of different quality preferences. As explained in the introduction, several papers (Das/Donnenfeld, Lutz (1) and (2)) have applied a Shaked/Sutton duopoly model to the issue of minimum quality standards and trade. This model does not allow consumers to vary consumption (other than choosing not to buy the good concerned) and so is very limited in terms of price (or quality-adjusted price) elasticities, consequently failing to pick up many of the classical monopoly effects outlined in this paper.

Nevertheless there are some interesting results, shown on figures 3a-b (appendix). Quality preferences are assumed to be distributed uniformly across the range  $Q_L$  to  $Q_H$ .

Without regulation (the top row of the diagram), the firms space themselves out producing  $Q_1$  and  $Q_2$ . It is assumed the home firm ( $F_1$ ) has the higher quality. This spacing is partly to reduce the price elasticities the firms face, and so will happen even if they face identical costs. Consumers to the right of  $Q_0$  will all choose to consume the good, and the split of demand between the two firms is shown.

When a minimum quality floor  $Q_M$  (assumed to be greater than  $Q_2$ ) is introduced, firm 2 is forced to increase its quality. Firm 1 will also slightly increase its quality in order to keep some product differentiation. Nevertheless, the differentiation of the two firms' products is reduced, leading to increased price competition. This benefits consumers, though there is a loss of utility to the lowest-quality consumers, some of whom (left of  $Q_0$ ) cease to purchase the good at all - so overall sales go down. Trade volumes will probably decrease, particularly if firm 2's costs are greatly increased by being forced to raise quality. However, unless the cost differences between the two firms are very great, 2's market share will rise, not fall. Firm 1's profits will be reduced by raising the minimum quality standard.

In these circumstances, there is likely to be an incentive on the regulator in country 1 to raise the minimum quality threshold excessively high, since it ignores the loss of profits to firm 2. Lutz (1996, (1)) shows that in these

circumstances a mutual recognition agreement between the two countries (which tends to reduce quality standards) is welfare-improving.

In principle it would be possible to combine the diverse consumers model with the classical monopoly model outlined in sections 2-4 of this paper, though this would be a somewhat complicated exercise. It is likely in such a hybrid model that the classical monopoly effect means that a mutual recognition would lead to suboptimal standards, though numerical analysis would be needed to ascertain how important this effect.

## 5 Conclusion

The WTO Agreements recognise the need to avoid regulatory protection when setting national technical standards and regulations, but also acknowledge that such standards are often introduced for legitimate reasons. This leaves a considerable area of ambiguity for policymakers, which has not currently been filled satisfactorily by the economic literature. This literature to date has tended to be dominated by case studies, anecdotes and empirical studies which have tended to assume that a particular form of regulatory protection - pure cost-increasing standards aimed to protect domestic firms against foreign firms - is dominant. At the other end of the literature is a relatively small amount of theoretical work, mainly based on the Shaked/Sutton differentiated consumers model of an oligopoly, which indicates that strategic distortions in regulatory policy will be likely in the presence of trade, and suggests that mutual recognition will be welfare-increasing.

In contrast to previous studies, this paper looks at the more classical types of monopolistic distortion (which may not necessarily be incompatible with the differentiated consumers model). In this model, unregulated monopoly power leads to suboptimal quality as well as quantity of goods produced. It is shown that regulation increases both quantity and quality of goods available, and therefore that there is 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 demand an excessive minimum standard, reducing profits (home as well as foreign) but benefiting consumers.

This strategic distortion, however, does not conform to traditional ideas of protectionism, as it leads to excessive, rather than suboptimal trade volumes, and does not necessarily involve bias against foreign rather than domestic producers.

While mutual recognition does remove the strategic distortion in favour of excess standard setting (and so, paradoxically, can actually reduce trade volumes), unlike previous approaches this study shows that it is not necessarily welfare-increasing, since under mutual recognition there is an incentive to regulators to allow lower than optimal domestic standards, to boost exporters' profits at the expense of foreign consumers.

The paper also shows that there may be some incentive to impose pure cost-increasing standards on foreign firms, as others (eg Wallner or Baldwin) have indicated, but this is only the case where tariffs are ruled out. Also, the gains to a country from this kind of profit-shifting horizontal barrier are greatly reduced when the tendency to produce higher vertical regulatory standards is also taken account. In many circumstances, there may be little, if any foreign profit for a protected domestic firm to capture. Even mixed horizontal/vertical barriers may only prove attractive in limited circumstances.

A brief assessment of the alternative Shaked/Sutton model of competition under oligopoly (with diverse consumers but inelastic total demand) shows a number of similar conclusions to the classical oligopoly model in this paper. Regulation reduces prices and profits (by forcing producers to produce more similar goods), and raises welfare (though, unlike the classical oligopoly it does not raise sales). Again, there is an incentive to overdo this regulation (reducing foreigners' profits), even though this strategic distortion may well increase, rather than reducing trade. Unlike the classical monopoly model (to which it may be complementary to some extent) mutual recognition is always welfare-improving: however, in a more complicated model which incorporated elastic overall demand, this result might well not hold.

As for assessing current regulations: actually disentangling how much of these regulations really consists of TBTs or 'regulatory protection' may not be an easy task. This paper casts a somewhat sceptical light on the tendency to assume that many technical 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 large 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 Treffer's (1995) 'missing trade' ('missing' in the sense that trade between nations generally falls far short of what gravity models predict) is due to horizontal regulatory barriers is probably incorrect. Indeed, national regulations in the presence of trade and the absence of international cooperation are actually likely to lead to over-regulation of standards which increases, rather than reducing, trade volumes. There is some empirical evidence to support this view, such as Moenius' (1999) finding that increasing numbers of quantitative regulations tend to be correlated with increasing volumes of both imports and exports.

It may well be likely that regulation will be higher in sectors or subsectors

which are dominated by imports: however, our analysis would suggest that this is more likely to be for reasons of raising consumer utility. Where the cost of such regulations falls largely upon foreign firms there is an incentive to over-regulate (there is a parallel with the tax competition literature, see eg Mieszkowski and Zodrow, 1989 ). 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 as a trade protection issue, to be dealt with through international 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.

As for the recommendation (eg Lutz) that mutual recognition is always a

welfare-improving response to trade-induced strategic distortions, some cautions must be added. When standards are reduced by producers for classical oligopoly reasons, introducing mutual recognition may lead regulators to side with their own producers, and cause a downward bias in quality: this effect has been missed in previous studies .



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## Appendix: Figures

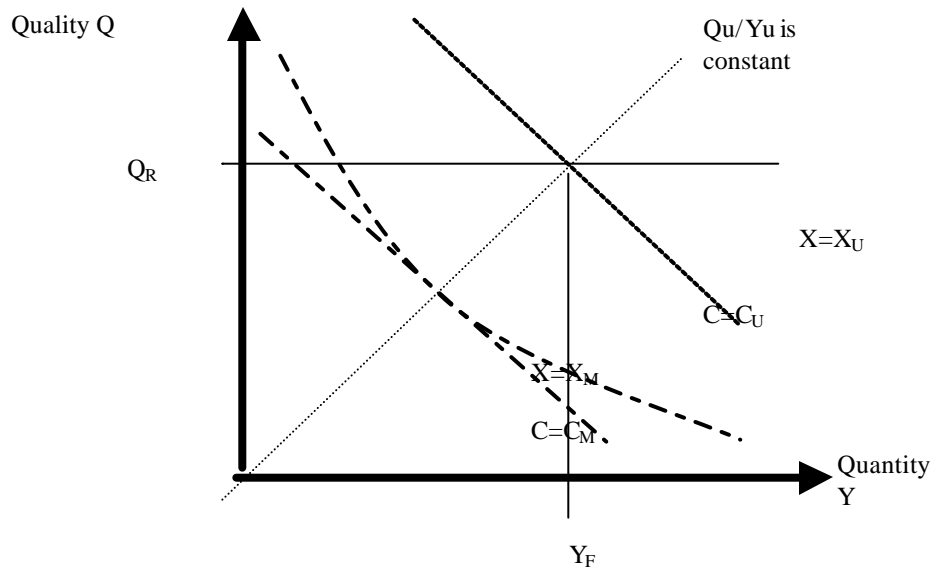


Figure 1: Imposition of a minimum quality standard  $Q_R$  by a regulator.  $Q_U$  and  $Y_U$  are the unregulated quality and quantity.

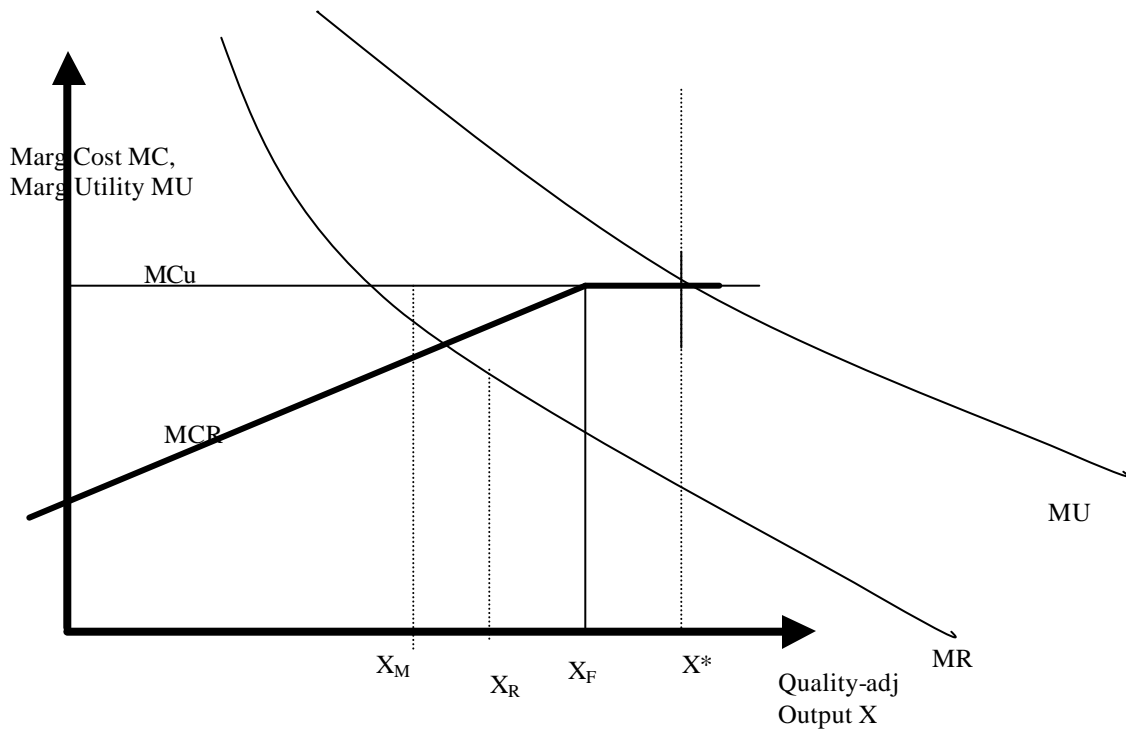
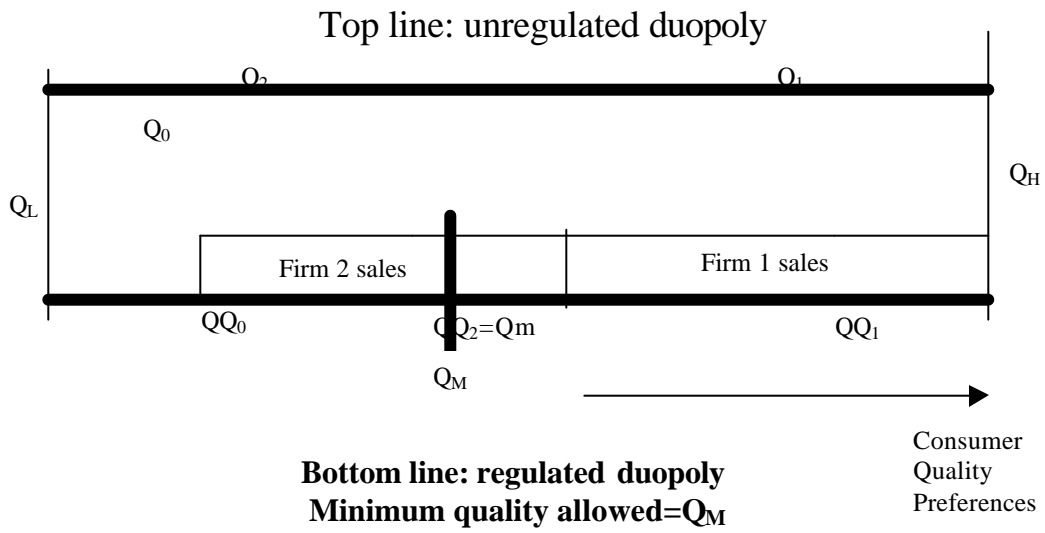


Figure 2: choice of quality-adjusted output under a regulatory minimum quality standard.



Figures 3 a-b: quality choices of an unregulated and a regulated duopoly facing diverse consumers.