

On the need for more economic assessment of quarantine policies[†]

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Quarantine policy reviews are becoming more sophisticated yet they still focus primarily on the effects of restrictions solely on import-competing producers. A fuller analysis that includes the consumers demonstrates that even if imported diseases were to wipe out a local industry, the gains to consumers might outweigh the losses to import-competing producers from removing a ban on imports. This article provides the simplest partial equilibrium framework for thinking more about the economics of quarantine policy measures using an empirical analysis of Australia's ban on imports of bananas.

1. Introduction

One of the less-publicised but nonetheless significant impacts of the signing of the Uruguay Round (UR) agreements, and the consequent coming into force of the World Trade Organization (WTO) in 1995 to supersede the GATT, has to do with the previously low-profile issue of quarantine or SPS policies. There was a concern among agricultural exporters that the benefits to them from the UR agreement would be reduced by current farm protectionist measures being replaced by alternative measures such as quarantine restrictions. Hence an agreement on Sanitary (human and animal health) and Phytosanitary (plant health) measures was also negotiated to ensure that any such SPS import restrictions are imposed only to the extent necessary to ensure food safety and animal and plant health on the basis of scientific information, and are the least trade-restrictive measures available to achieve the risk reduction desired (GATT 1994a; Stanton 1996). As well, a much tougher dispute settlement body (DSB) was put in place to allow

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aggrieved parties effective legal recourse through the WTO. Already the DSB has been used successfully to outlaw excessive SPS measures.

Food-exporting countries such as Australia can expect to gain substantially from these developments. Indeed, through the Cairns Group, Australia was a key protagonist for these changes. To remain influential in the ongoing evolution of these institutional innovations, however, Australia needs to be perceived by other WTO members as a country that not only has low levels of farm subsidies but also has quarantine restrictions that are not unduly restrictive and costly to our trading partners.

The SPS agreement, like most countries' national quarantine policies, pays virtually no attention to the impact of SPS trade restrictions on consumer prices. This seems surprising to economists, who are used to thinking of import barriers as equivalent to a consumption tax and a producer subsidy. But it is a natural consequence of quarantine policy-making being simply reactive to producers' (and increasingly environmental groups') complaints about the risk of imported products carrying disease with them, and/or to counter-claims by would-be importers. If scientific analysis reveals a significant plant or animal health risk associated with importing a product, then a quarantine restriction tends to be imposed or retained with little thought given to whether its cost to others outweighs the benefit to those lobbying for the restriction. In this sense, looking only at the direct effects and using command-and-control measures rather than also looking at indirect effects and using benefit-cost thinking, SPS policy assessment currently is about where environmental policy assessment was two or three decades ago.

Now is an appropriate time for economists to try to influence quarantine policy the more.¹ This is not only because of the Uruguay Round outcomes but also because food safety and environmental concerns (including plant and animal health) by consumers and voters are increasing with income and more people and products are moving internationally. The timing is especially right in Australia, given the release in late 1996 of the Nairn Report on Australian quarantine and the subsequent allocation to the Australian Quarantine and Inspection Service (AQIS) of an additional A\$76 million over the four years from 1997 (DPIE 1997). This reflects a growing community interest in, and government commitment towards, improving

¹ There have been relatively few economic assessments of quarantine policies in Australia to date. Among the general ones are IAC (1987), CIE (1988), and Hinchy and Fisher (1991), in addition to which there are specific ones relating to particular enquiries. An early example is Hinchy and Low (1990) on fire blight and apples. More recent studies have been on Newcastle disease and poultry (Hafi *et al.* 1994), Atlantic salmon (IC 1996) and pilchards (Thorpe *et al.* 1997). See also MacLaren (1997) on the issue of grain imports, and Tanner (1997) on the principles of Australian quarantine policy.

Australia's own quarantine/SPS policies, those SPS policies restricting Australia's markets abroad, and the WTO rules governing the use of SPS import restrictions.

Perhaps the simplest way of demonstrating the contribution that economic analysis could make is provided in the next section. That partial equilibrium analysis shows, among other things, that even if disease importation were to be so severe as to destroy the profitability of a local industry, it is conceivable such importation, through lowering prices, might benefit consumers (including industries using the good as an input) more than it would harm import-competing producers and environmental groups. To illustrate the usefulness of this approach, section 3 examines empirically the effects of removing Australia's prohibition on banana imports. The results suggest that such a reform may well be beneficial for Australia. The final section of the article draws out the broader implications both for Australia's own quarantine policies as well as for its bilateral and multilateral commercial diplomacy in the SPS area.

2. The economics of quarantine policy options: background

Quarantine is a protective measure in the truest sense of the word: it is designed to protect citizens, animals, plants and the environment from the problems that can arise through importing pests and diseases via possible carrier products. The concern of producers and consumers about human, animal and plant health is genuine and justified in many cases and, to this end, quarantine activities can provide an essential and beneficial screening service.

However, quarantine restrictions, like many other technical barriers to trade, usually also provide economic protection to domestic producers of import-competing products.² They can thus have much the same economic effects as other, more traditional, import restrictions, except for the potential additional consequences for human, animal or plant health or food safety. These latter externalities, and in particular the risks and uncertainty associated with them, make quarantine analysis somewhat more complicated than standard economic policy analysis (MacLaren 1997).

The economic welfare gains from importing risky products should be weighed against any expected economic losses associated with those additional potential health consequences. Furthermore, costs of alternative ways of reducing the health risks from importation need to be considered.

²Not all quarantine policies have a trade-protective effect. For example, restrictions on imports of noxious weeds or undesired exotic wildlife serve no obvious protectionist purpose (Hinchy and Fisher 1991, p. 14).

The latter is important because even if an import ban is judged to boost national economic welfare relative to free trade, there may be economically superior ways to manage the risk other than applying an import ban. For example, spraying a product before exporting or unloading it may be less costly to society than an outright import ban; or the costs of mitigating the adverse effects, were they to occur, may be quite low compared with the consumer benefits from freer trade. These policy alternatives have differing effects on the incomes of the various groups involved of course, which is why they are often contentious and subject to lobbying pressures.

A key point from the theory of distortions and welfare is that the 'first-best optimal policy . . . involves making the appropriate correction as close as possible to the point of [the distortion]' (Corden 1974, p. 28). In a case where imports of a good would be expected to create a net welfare loss from carrying a by-product disease, the optimal policy measure is unlikely to be a restriction on imports of that good. Less costly possibilities are measures to reduce the risk of disease importation or the damage if it is imported. For example, it may be possible through agricultural research efforts to produce cost-effectively a more disease-resistant plant variety, or to isolate the good on an island for a period of time, or to require pre-shipment inspection and, if necessary, fumigation of the carrier product.

Part of the difficulty in assessing quarantine policies is the uncertainty surrounding the risks which quarantine seeks to mitigate. For instance, it may be difficult to find empirical estimates of the probability of disease entry and the damage to production and marketing opportunities, were entry to occur. Also, the extent to which quarantine provision reduces the likelihood of catastrophe may not be clear. Indeed, the CIE (1988) identifies three reasons why more stringent quarantine policies could *increase* the risk of a disease outbreak having catastrophic consequences: quarantine may lower the natural immunity of plants and animals to disease, the greater the import restriction, or it may encourage smuggling which undermines the effectiveness of safeguards, or it may lead farmers into a false sense of security concerning diseases and they may lower their spending on precautionary measures such as spraying or planting more-resistant varieties of crops.

Quarantine affects not only the mean level of prices in an economy but also the stability of prices. The more imports of a product are restricted, the less capacity there is for imports to adjust to fluctuations in domestic demand or supply of that product. In the case of foods that are difficult to store and are subject to wide intra- and inter-seasonal yield variations, quarantine can lead to a marked increase in the variance of their domestic price within and between years.

2.1 Analytical framework³

The simplest way to examine the economic welfare effects of quarantine is to use a standard comparative-static partial equilibrium approach for a single commodity market. While not robust enough to include income and second-round resource allocation effects, or dynamic adjustment in the industry (which may be quite important for disease-resistance changes), this approach nonetheless provides a useful framework for discussing benefits and costs of various outcomes, and links between trade restrictions, prices and welfare.

To keep the analysis as simple as possible, it is helpful to begin with several assumptions, some of which are relaxed later.⁴ First, assume there is a single homogeneous product in this industry's market and that the product's world price is lower than the equilibrium domestic price that would prevail under autarky. Second, suppose the import price, the exchange rate, and the domestic markets for other products are unchanged for all conceivable changes in this product's domestic market (the small-country and small-industry assumptions). Third, the domestic market is assumed to be perfectly competitive, so any gains from trade are restricted to conventional gains and there are no pro-competitive gains. Fourth, society is assumed to be risk-neutral. It is also assumed that any pests or diseases imported will be host-specific, that is, they raise marginal costs for import-competing domestic producers in this industry but they do not alter the marginal costs of producers in other industries, nor do they affect consumers of this or other products or the natural environment. Changes in technology and/or disease resistance and tastes are also assumed to be absent. Finally, in cases where imports are allowed in conditionally, it is assumed that the most cost-effective quarantine inspection/fumigation/isolation, etc. services are adopted and that the costs involved are charged to the importer which adds a proportional amount, q , to the per unit cost of importing the product. Assuming that the effectiveness of quarantine is an increasing function of q , then the larger q is, the lower is the probability of disease importation (and perhaps the smaller the upward shift in the producers' marginal cost curve should some diseases still be imported, although this latter possibility is ignored in what follows).

³ This section builds on the final section of Anderson (1998).

⁴ For a more complex approach involving Markov chain techniques, see Hinchy and Low (1990), Hafi *et al.* (1994) and MacLaren (1997). See also Pollack (1995) for a survey of literature in general on regulating risk. There is a cost to moving to a more complex approach, in the form of greater difficulty in communicating the results to the non-economists involved in this multidisciplinary policy area. However, in cases that are less clear-cut than the banana case considered in this article, that more complex approach may be necessary to clarify whether a particular restriction is warranted.

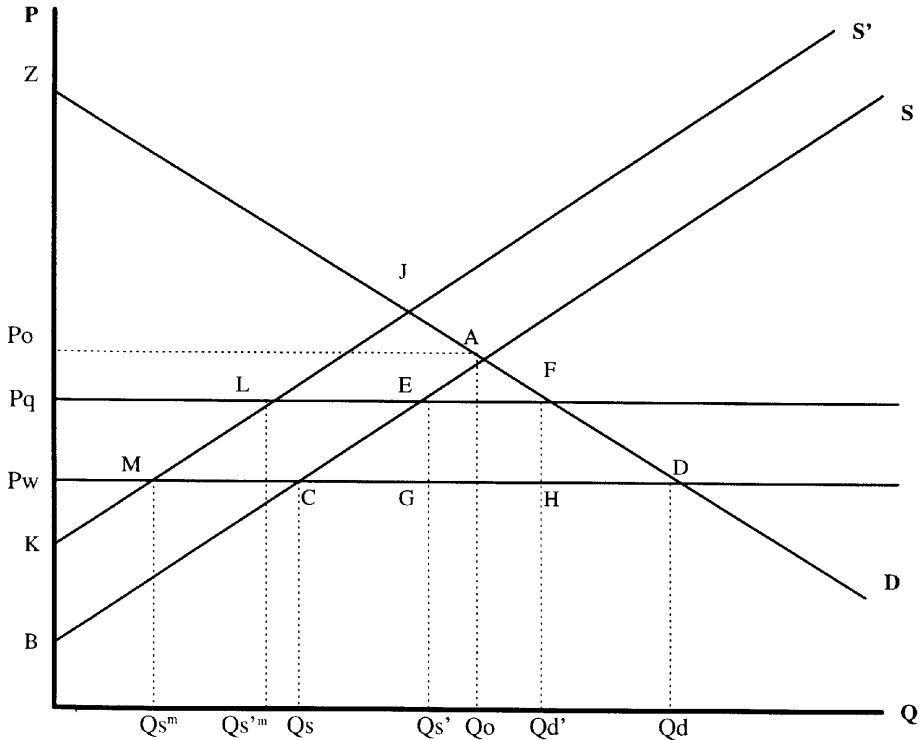


Figure 1 Market for an importable subjected to quarantine regulations

First, consider case 1 where an economy moves from no trade (i.e., a total import ban) to free trade (no quarantine restrictions) in a particular product which is at first assumed to be disease-free, and assume to begin with that no disease is imported. Figure 1 shows that initially the domestic industry supplies the entire domestic market with quantity Q_o at price P_o , where S and D are the domestic supply and demand curves. Producer surplus is the area $P_o A B$ and consumer surplus the area $P_o A Z$. After lifting the import ban, the world supply curve becomes relevant and, for this small economy, that is completely elastic at the world price P_w . The domestic industry then supplies OQ_s at this price and consumers demand quantity OQ_d , so imports are $Q_s Q_d$. Consumer surplus is now equal to $P_w D Z$ and producer surplus $P_w C B$. The net welfare change between the two regimes is therefore the change in producer surplus ($-P_o A C P_w$) plus the change in consumer surplus ($P_o A D P_w$). There is thus a net welfare gain of $A C D$ — the standard gains-from-trade triangle. Under these conditions it is always better to allow free trade.

Next consider case 2 involving a movement from an import ban with zero trade to partially quarantine-restricted trade, while still assuming zero disease

entry so the social supply curve is the same as the private supply curve, S . Changing the quarantine policy from a trade ban to one which is not prohibitive effectively lowers the price of the product for domestic agents from P_o to Pq , where $Pq = P_w(1 + q)$ is the world price plus the cost of conformance (due, for example, to mandated spraying or to temporary isolation, or being prohibited from sourcing from the lowest-cost regions because they are deemed excessively risky). The import quantity becomes $Qs^m Qd'$. Consumer surplus is now $ZFPq$ and producer surplus $BEPq$. Compared with the free-trade case 1, consumers lose P_wDFPq and producers gain P_wCEPq . The net gain in economic welfare, EFA , is therefore less in case 2 than in case 1, by $CDFE$. This is similar to the effect of imposing a tariff, except that the area $EFHG$ is not tariff revenue but expenditure on quarantine conformance. And, as with a prohibitive tariff, if quarantine conformance costs raise the import price above the autarky price P_o , that would ensure that the conformance requirements had the same effect as an import ban.

Cases 1 and 2 as laid out above assume no disease is imported and hence leave out the reality of uncertain externalities. If, following liberalisation of the quarantine policy, a disease *is* imported, then that would raise costs of domestic production of this good (e.g., because more disease-prevention or control spraying programs are required). Suppose that shifts the domestic supply curve up from S to S' . The price facing domestic producers and consumers, and consumer surplus, would still be as in cases 1 or 2 above, but production is less and hence imports are greater ($Qs^m Qd$ for modified case 1 and $Qs^m Qd'$ for modified case 2). Producer surplus is reduced to KMP_w and $KLPq$, respectively (or $KMCB$ and $KLEB$ less, respectively, than in the original cases 1 and 2 where there is no disease importation). Hence allowing for the externality ensures that the change in net economic welfare from removing the import ban need not be positive.

Allowing also for uncertainty complicates the analysis even more. For not only is the probability of disease entry less than 100 per cent, but also it is likely to be higher in the full-liberalisation case 1 (say p) than in the partial-liberalisation case 2 (say, $f(q)p$, where $f(q)$, the proportion by which p is reduced through temporary quarantine or inspection, is a fraction of unity that tends to be smaller the larger is q). Those probabilities, together with the extent of the increase in marginal costs when disease *is* imported (the vertical distance between S and S'), ensure that it is an empirical question as to which is the optimal policy. The net national economic benefit from liberalising imports becomes as follows:⁵

⁵This assumes society is risk-neutral. To the extent that society is risk-averse with respect to food safety and environmental issues, the gains from removing the import ban will be less than suggested in what follows.

for full liberalisation: $(1 - p)CDA + p(CDA - KMCB) = CDA - p(KMCB)$, and
 for partial liberalisation: $EFA - f(q)pKLEB$

The net welfare effects are therefore ambiguous: the sign of both these changes could be positive or negative. Furthermore, unlike with regular trade policy reform where more trade freedom is better for a small country, it is even conceivable that the gain from partial liberalisation could be larger than from full liberalisation if q and $f(q)$ were sufficiently small.

However, notice that if area $PwCB$ (producer surplus under free trade) is less than area CDA , this economy would be better off by fully rather than partially liberalising even if disease enters and the industry disappears (assuming still that such diseases only affect this industry). More generally, the net economic welfare change from fully liberalising is more likely to be positive:

- the less internationally competitive are domestic producers (i.e., the lower is Pw relative to Po);
- the more price elastic are the demand and supply curves below point A ;
- the smaller are losses from any disease importation (i.e., the smaller the shift in the supply curve from S to S'); and
- the lower is p , the probability of disease entry in the absence of any quarantine restrictions.

Moreover, full liberalisation is more likely to be welfare superior to partial liberalisation, the larger the cost impost of inspection/temporary quarantine/restrictions on allowable supplying regions (i.e., the larger is q and so the smaller is area EFA relative to area CDA) and the smaller is its impact on reducing the probability of disease entry (i.e., the larger is $f(q)$).

2.2 Some qualifications

If domestic consumer confidence in the safety of the food product concerned is less when imports are allowed, and more so under free trade than partial liberalisation involving, say, inspection prior to importation, this would affect the economic welfare calculations that determine the ranking of policy options. Specifically, the demand curve would be closer to the vertical axis of figure 1 the less restricted are imports, reducing the gains to consumers from partial and especially complete import liberalisation.

Second, if the imported good is not a perfect substitute for the domestically produced good in the view of consumers, then the country could be both an importer and an exporter of this product. In that case the importation

of disease might have the additional effect of reducing demand for exports of the domestically produced good, in the limit wiping them out. In that case the maximum additional loss from removing the import ban is the difference between the producer surplus gain to domestic producers less the consumer surplus loss to domestic consumers from exports of the domestically produced good.⁶

Third, quarantine is more likely to provide a net benefit to the country if disease importation has adverse spillover effects to other industries, human health or the environment, that is, the less industry-specific is that imported 'bad'. Spillovers to other industries would raise their production costs with (at least for tradables) no offsetting rise in their product's domestic price. Similarly, any adverse consequences for the country's natural environment (like the case of Newcastle disease) or for human health would lower the net welfare gain from relaxing the quarantine policy. As well, the above partial equilibrium approach ignores any economic spillovers of the sort that can be captured only with a general equilibrium analysis.

Fourth, if the per unit cost impost of temporary quarantine decreases as import volumes increase because of economies of scale in quarantine provision, then the horizontal line starting at Pq in figure 1 would instead be downward sloping and approaching the Pw line as quantity increases. In that case there is more likely to be a net benefit from partial import liberalisation. An alternative possibility is that, because of congestion, per unit cost impost may increase with the volume of imports.

Finally, the diagram suggests that costs of disease to producers are a constant amount (BK) per unit, but should control costs be less for lower-cost producers such that S' is not parallel to S but closer to S at K , then $KMCB$ and $KLEB$ would be smaller which further increases the probability of a positive net welfare change from moving from a ban to a less severe quarantine restriction and especially to free trade.

3. Case study: Australia's banana market: background

Australia has quarantine bans on the importation of many agricultural products, one of which is bananas. Whether for that reason, and/or because of its isolation or its good luck, Australia's banana industry is relatively free

⁶If other export industries also enjoy lower entry costs and more market opportunities abroad, the more disease-free in general the exporting country is perceived to be, this may add further to the cost of liberalisation (Hinchy and Fisher 1991, p. 15). This is particularly so if a country's quarantine regulations effectively provide itself and/or the subset of countries approved as suppliers with some market power to influence the prices of the goods traded (Sumner and Lee 1997).

of serious diseases that afflict numerous banana-producing countries.⁷ It is also characterised by relatively high and variable prices. During the past decade, the annual average price of bananas has varied between 163 and 312 cents per kg at the retail level, and even more so at the producer level where the highest-price year averaged three times that of the lowest-priced year (ABARE 1996, tables 22 and 134). Meanwhile, within each year the weekly wholesale price in Sydney has ranged between \$7 and \$23 per 13 kg carton during the past five years (the average annual coefficient of variation being 0.28).⁸ Both the within- and between-year price variations would be much less if imports were allowed in off-seasons and in poor crop years. Moreover, the mean retail price for the past decade of just over \$2 per kg in Australia is as much as two or more times that in countries such as the United States and New Zealand where imports are unrestricted. Not surprisingly, therefore, per capita consumption of bananas is considerably lower in Australia, at 13.9 kg per year, than in comparable countries such as New Zealand (20 kg) and Sweden (17.5 kg).⁹

In the light of these data, and another possible challenge to Australia's policy, is a defence of the protection provided for this small industry¹⁰ economically justified? Now that Ecuador — the world's largest exporter of bananas — has joined the WTO and has successfully used the WTO's dispute settlement mechanism (in arguing against the European Union's illegal restrictions on banana imports), it may well re-visit its 1991 request that Australia liberalise its banana imports (see AQIS 1991). Before Australia risks being challenged at the WTO over yet another SPS issue and going to the expense of defending the import ban, it makes sense to find out whether the potential benefits to domestic banana growers are sufficient to warrant the costs to domestic consumers of that ban.

⁷ For a description of the various diseases that might be imported with bananas, see James (1997, appendix). Moko disease, Papaya Fruit Fly, Spiralling Whitefly and Black Sigatoka can cause serious banana crop losses and are difficult and expensive to control. (The first three can affect other crops also.) On the other hand, Bract mosaic virus can cause high production losses but is relatively easy to contain.

⁸ Based on data kindly provided by the New South Wales Department of Agriculture's Market Reporting Service.

⁹ Inferred from FAO production and trade data for 1992–94 (FAO 1996a, b).

¹⁰ The value of banana production at the farm gate was barely \$200 million in 1996 and there are only 2 400 growers, several hundred of whom are no more than hobby farmers (ABGC 1997).

3.1 Empirical estimates

To estimate the economic welfare consequences of lifting the import ban on fresh bananas, it is necessary to introduce the reality of marketing margins, which for fresh horticultural products are quite sizeable. According to industry sources, the farm-gate price of bananas averages about one third below the wholesale price after transport, ripening and spoilage costs are covered, while the retail price averages about 50 per cent above the wholesale price.¹¹ The analysis of figure 1 can be readily modified to incorporate those margins, but the modification depends on whether the margins are assumed to remain constant in cents per kg, remain constant in proportional terms, or rise proportionately but fall in cents per kg because of economies of scale from handling the larger volume of sales under free trade.

Assuming the marketing margins would remain constant proportionately over the relevant price range, then the appropriate diagram is as in figure 2. There S_f is the growers' supply curve, D_r is the retail demand curve, and D_w and D_f are the derived demand curves at the wholesale and farm-gate levels, respectively. The initial equilibrium quantity is Q_0 where D_f and S_f intersect. With that level of domestic production and a ban on imports, the farm-gate, wholesale and retail prices are P_f , P_w and P_r , respectively. Once imports are allowed, the wholesale price drops to the import price P_i and the quantity available on the domestic market rises to Q_d' . At that new equilibrium the farm-gate and retail prices are P_f' and P_r' and the quantity produced domestically falls to Q_s' . The fall in producer welfare is given by area CDP_fP_f' and the rise in consumer welfare is given by BAP_rP_r' . The difference between those two areas is the net economic welfare gain in the absence of externalities and in particular the importation of pests and diseases.¹²

Several pieces of data including estimates of the price elasticities of banana demand and supply are required to quantify these impacts. Stuckey and Anderson (1973) provide estimates of the demand curve for bananas in Sydney. Their short-run price elasticity of demand for the early 1970s was -0.39 in winter and -0.33 in the rest of the year. In the light of their study and an absence of others to draw on, we decided to take -0.5 as a

¹¹ Occasionally much lower retail prices have been observed, but that is because supermarket chains especially tend to use bananas as a 'loss leader' to attract consumers to the store. The above marketing margins for Australia are not dissimilar to those in the United States and Western Europe (FAO 1996c).

¹² If the marketing margins were constant in cents per kg, the diagram would look very similar to figure 2 but the demand curves at the retail and farm-gate levels would be parallel to the wholesale demand curve while still passing through A and D , respectively.

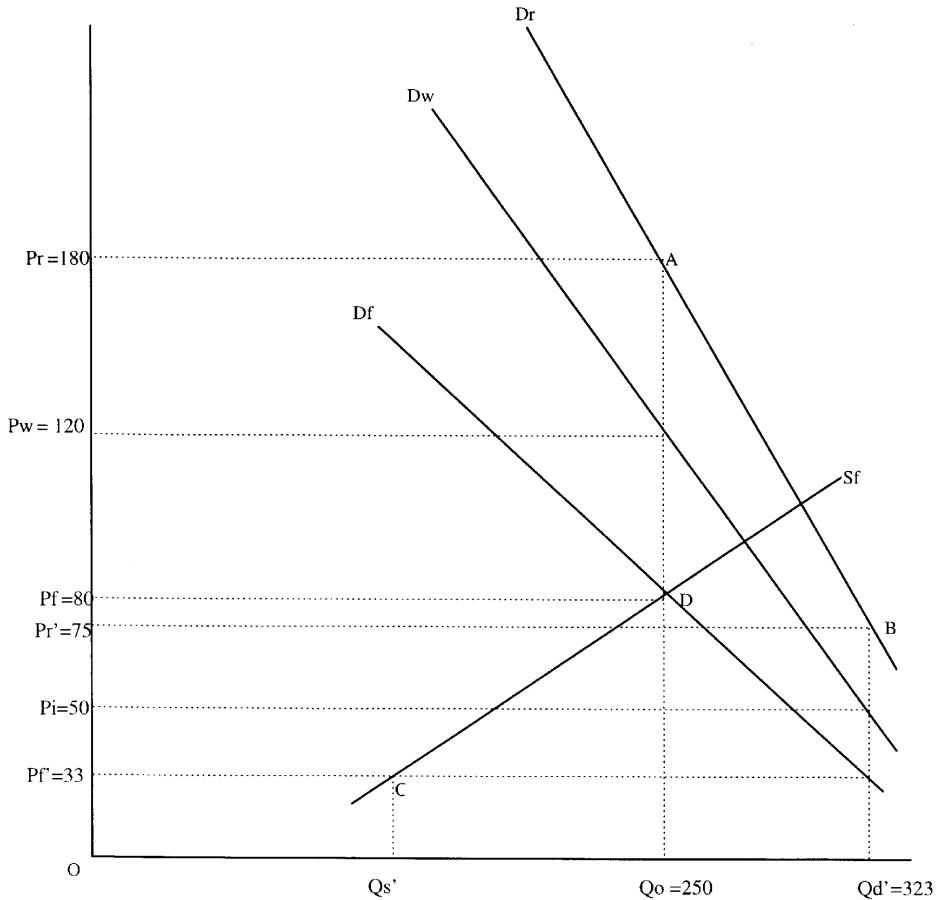


Figure 2 Effects on Australia's banana market of removing the import ban when marketing margins are fixed in proportional terms, 1996

conservative guesstimate for the long-run price elasticity of demand (keeping in mind that there are many more fruits for consumers to choose among now than in the early 1970s).

The unit value of banana imports into the United States and New Zealand in 1992–94 (the latest available data) averaged the equivalent of A\$0.35 and A\$0.69 per kg, respectively (FAO 1996b). Economies of size in marketing and shipping costs should ensure that Australia's import price is below New Zealand's but above that of the United States. Hence we assume a cif import price of 50 cents per kg. The 1996 average autarchic domestic wholesale price was 120 cents per kg, implying a producer price of 80 cents and a retail price of 180 cents according to the marketing margins mentioned above. The sales volume for 1996 was 250 kt net of post-harvest losses from spoilage.

Based on anecdotal evidence and details about the production process of bananas, the elasticity of supply is assumed to be quite high for a large downward price movement such as would follow removal of the Australian import ban. Bananas are mostly grown on hillsides in sub-tropical Australia (to prevent frost damage) on land that has few alternative uses, while some are grown on flatlands in tropical far north Queensland that would otherwise be used for growing sugarcane. The labour used on hillside plantations earns a low return at present prices, and may well shift to other (including non-farm) activities if banana growing became less profitable. In the absence of econometric studies, we assumed a long-run price elasticity of supply for bananas of 0.5 for a very conservative lower bound and 1.0 or more as a more likely value.¹³

Given these historical data and assumptions, we are able to estimate the production, consumption, trade and welfare effects of moving from a ban to free trade in bananas assuming no pests or diseases are imported. These are shown in table 1 under two alternative constant marketing margin assumptions. If those margins were constant in cents per kg, removing the import ban would cause the producer price to fall 88 per cent to just 10 cents per kg. It seems most unlikely that any growers would survive such a change. Indeed, if the price elasticity of supply was more than 1.14 over that price range, none would remain in production. In that case (column 2 in table 1), consumption would increase 20 per cent, consumer welfare would rise A\$192 million, producers would lose A\$88 million (implying a value-added share of output of 44 per cent, which is about average for Australian agriculture), and so Australia's net economic welfare would improve by A\$104 million per year assuming any imported pests or diseases only affect banana growers.

The results assuming marketing margins are constant in proportional terms are shown in the remaining columns of table 1. In that case consumption would increase 29 per cent to 323 kt, or 17.9 kg per capita. The volume of production would decrease by 29 or 58 or 100 per cent depending on whether the supply elasticity is assumed to be 0.5 or 1.0 or more than 1.7.¹⁴ The value of production would fall much more than the volume, however, because of the wholesale price dropping to the import price. At the farm-gate level aggregate gross revenue would be reduced by more than two-thirds — although the number of growers would then be fewer, so the

¹³ Valdes and Zietz (1980, table 7) assume 0.4 and -0.4 for banana supply and demand elasticities for all countries in a model of global food markets used for estimating the responses to relatively small international price changes. Since in this case we are examining responses to large price changes, this justifies somewhat higher assumed elasticities.

¹⁴ Even if the supply elasticity is assumed to be as high as 1.71, that implies a current value-added share of output of 29 per cent which is low but not excessively so by the standards of Australian agriculture.

Table 1 Effects of removing the ban on banana imports assuming no diseases are imported, Australia, 1996^{a,b}

	With ban on	With import ban removed when there are:			
	1996, actual	(a) specific marketing margins: supply elasticity of > 1.14	(b) ad valorem marketing margins: supply elasticity of 0.5 supply elasticity of 1.0 supply elasticity of > 1.71		
	(1)	(2)	(3)	(4)	(5)
Wholesale price (cents per kg)	120	50	50	50	50
Producer price (cents per kg)	80	10	33	33	33
Retail price (cents per kg)	180	110	75	75	75
Consumption (kt)	250	299	323	323	323
Consumption per capita (kg)	13.9	16.6	17.9	17.9	17.9
Consumption expenditure, retail (\$m)	450	328	242	242	242
Production marketed (kt)	250	0	177	105	0
Production value at farm gate (\$m)	200	0	59	35	0
Imports (kt)	0	299	146	218	242
Imports (\$m)	0	150	73	109	121
Self-sufficiency (%)	100	0	55	32	0
Change in consumer welfare (\$m)	na	192	301	301	301
Change in producer welfare (\$m)	na	-88	-100	-82	-59
Change in net economic welfare (\$m)	na	104	201	219	242
Remaining producer surplus (\$m)	na	0	50	18	0

Notes:

^a Welfare calculations assume straight-line supply and demand curves between the current and alternative prices; if the curves were actually bowed above (below) those lines, the producer and consumer welfare changes will be underestimated (overestimated).

^b Assuming the price elasticity of demand is -0.5. If it is -0.75, the increase in consumption would be 50 per cent larger and consumer and net economic welfare would be greater by \$8 million (with specific marketing margins) or \$19 million per year (with ad valorem marketing margins).

revenue decline per farm for any remaining growers would be less. Imports would amount to between 150 and 323 kt or up to A\$160 million per year, implying a fall in the self-sufficiency ratio to half or less. Consumer welfare would be boosted by A\$300 million per year while producer welfare would fall by between A\$60 and A\$100 million, so net economic welfare would increase by A\$200 to A\$240 million per year, out of which there would be ample to fully compensate the growers' losses.¹⁵

Even if the fall in the farm-gate price was not enough to eliminate domestic production, the bottom row of numbers in table 1 suggest there would be little or no extra producer surplus to be lost if pests or diseases were to be imported from abroad and they raised banana growers' costs. In any case the upper limit on what banana growers would have left to lose is much less than the gains from trade reform. Clearly, it would be in Australia's economic interest to remove the ban and enjoy the estimated A\$90–240 million net gain from trade per year, unless it can be shown that there would be adverse impacts from disease importation on other producers and/or the natural environment with an *expected* net cost of more than that (taking into account that the probability of disease importation is less than 100 per cent).¹⁶ Even then, one would need to weigh against those possible costs to others the benefits from allowing some banana plantation areas to be spared soil erosion and chemical damage from pesticide and fertiliser use as banana growers allow those areas to revert to scrubland.

Without data on the costs of inspection, certification, and/or temporary isolation, it has not been possible for us to evaluate the alternative of partial liberalisation of banana imports. Nor have we evaluated the risk of disease entry should banana imports be allowed. However, the gains from full liberalisation estimated above appear to be so large that the next task might be to explore overseas sources of low-risk bananas and assess the likelihood and expected economic costs of their fruit carrying pests and diseases that would harm other plants or the Australian environment. Should those costs be low, liberalisation would seem warranted forthwith.

¹⁵ The above results assume the long-run price elasticity of demand is -0.5 . If it was -0.75 , the increase in consumption would be 50 per cent higher and per capita production would rise to 19.9 kg, or about the same as New Zealand. The increase in consumer and net economic welfare would be up to \$19 million more per year, depending on the assumption made concerning marketing margins.

¹⁶ It is true that this assessment looks only at the banana market. However, prices received by other Australian farmers are unlikely to be affected by the fall in the domestic price of bananas because there are no close substitutes or complements in consumption (nor do bananas tend to be used as an input to production) and, in any case, if there were substitutes and they were traded internationally, their international price would be unchanged by a change in Australia's banana import policy.

4. Conclusions

The simple analysis of section 2 has shown circumstances under which it may be unnecessary to carry out expensive quarantine risk analysis of the type described in Nunn (1997). In short, they are when consumer gains from freer trade would outweigh the maximum possible loss to producers and others from importation of that good and any associated pests and diseases. Included among 'others' are groups concerned for the natural environment as well as producers of other goods that might be affected if those pests and diseases are not host-specific.

The empirical case study of section 3 calls into question the wisdom of Australia's ban on banana imports. It shows that the consumer gain from removing that ban is likely to far outweigh any loss to banana growers, even if diseases were to wipe out the industry. Allowing imports would not only lower the mean price of bananas but also its variance, because Australian consumption would no longer be constrained to the volume of domestic production (which is subject to wide fluctuations both within and between seasons). Even in the extreme situation where domestic production is eliminated, there would be an unequivocal welfare gain from lifting the ban given recent prices and the elasticities assumed in table 1, assuming no externalities are imposed on other industries. And the risk of such externalities from imported pests can be minimised by importing bananas from countries with area freedom status (regions designated as free of particular pests or diseases).¹⁷

A decision to free imports of bananas would undoubtedly be objected to by banana growers and their communities. Offering full compensation out of consolidated revenue would be an affordable way to reduce that opposition, given the relatively large gains to consumers shown in table 1.

Moreover, consumers are not the only group that would gain from such a reform. Certainly wholesalers/ripeners and retailers of bananas would enjoy an expanded demand for their services in this particular case. But more generally, export industries would gain in two important, albeit indirect, ways. One is that, as with any protectionist policy reform, all exporters gain because an import tax is equivalent to a tax on exporters (Lerner 1936; Clements and Sjaastad 1984): it bids resources away from the economy's more-efficient industries and overvalues the currency. Second, by removing an excessive quarantine restriction the country is less vulnerable to being challenged under the SPS Agreement at the WTO. The more that is done, the more persuasively the country's trade negotiators (a) can argue against

¹⁷ For example, AQIS (1991) identified the Costanera region in Ecuador to be free of the most serious banana diseases, Moko and Black Sigatoka.

excessive quarantine restrictions abroad that are inhibiting Australian farm exports and (b) can take the high moral ground in seeking improvement to SPS rules when the agreement comes up for review at the end of this decade.

The best way to ensure that Australia meets its international obligations while maintaining a sufficient degree of protection from pest and disease importation is to make its quarantine decisions transparent to the public and to have an inclusive, consultative approach to reviews. Following the release of the Nairn Report (1996), the Australian Government has responded positively to many of its recommendations (DPIE 1997), including the need for public consultations. However, economic analysis such as that presented above does not appear to be given much recognition as a necessary input into the process for routine cases¹⁸ — even though it might reduce or remove the need for the much more expensive technical risk analysis.

Given the above results for bananas, a case might even be made for doing similar economic analyses for all of Australia's scores of industries that are subject to quarantine policies,¹⁹ just as was undertaken by the Industries Assistance Commission in its the systematic review of Australian tariffs in the 1970s. As with the tariff review, such a system-wide review is especially valuable when there are links between industries. An obvious case in point is Australia's intensive livestock industries, which (at least in some years of shortfall) may have to pay higher feed prices because of the quarantine ban on grain imports. Some of them in turn were successful in seeking bans on meat imports (chicken, pork), but those are now being challenged by WTO members under the SPS Agreement. If a more lenient policy towards grain imports were to result from such a review,²⁰ Australia's intensive livestock producers would have a better chance of coping with the increase in meat

¹⁸ For 'non-routine' import requests, a Risk Analysis Panel is chaired by an AQIS officer and involves two working parties: one scientific and led by a specialist from the Bureau of Resource Sciences, the other economic and led by a specialist from the Australian Bureau of Agricultural and Resource Economics (Nunn 1997, p. 567).

¹⁹ GATT (1994b, table IV.5) identifies 151 Australian agricultural industries currently subject to plant quarantine restrictions, many of which are much larger than the banana industry, most notably grains. In addition, there are numerous quarantine restrictions on birds, animals, meat and meat products, dairy products, and fish products (DPIE 1997).

²⁰ See the discussion in MacLaren (1997) on the scope that was found for low-risk importation of grain during Australia's 1994–95 drought. Australia's grain industry is much larger than its fed-livestock industry, however, so the potential cost to grain growers of importing diseases, weeds or other pests may be large relative to the gains to producers and consumers of intensively fed livestock from being able to import feedgrain. Another recent example of linked industries affected by quarantine has to do with pilchards which are used as feed for southern bluefin tuna farming (Thorpe *et al.* 1997).

import competition that has begun recently and is likely to increase in the years ahead. Moreover, such a review should not be a one-off event because changes in comparative advantages as well as in risks of disease entry and in technologies for managing those risks, which are ongoing, will alter the economic calculus through time.

Having done that economic analysis at home, much the same could be done abroad to expose excessive quarantine restrictions to Australia's export markets. This is something the US government has begun doing recently as part of a review of all technical barriers to US agricultural exports in their key markets (Roberts and DeRemer 1997). As with a review at home, such reviews abroad contribute to policy transparency and thereby alter the political economy of policy-making in favour of a more liberal regime. The potential economic benefits from reform that might follow such reviews, both to the implementing country and to its trading partners, are likely to far more than outweigh the relatively small cost involved.²¹

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²¹ The Roberts and DeRemer (1997) survey, for example, reports more than 300 technical barriers to imports in 63 countries that are believed to threaten, constrain or block almost US\$5 billion of US farm exports. For more on the myriad types of technical barriers to agricultural trade, see Hillman (1991).

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