# Should we cut automotive tariffs?

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LateralEconomics

CAPABLE, INNOVATIVE, RIGOROUS

## *Executive Summary*

A Lateral Economics modelling project with Monash University shows that Australia's economy will not benefit, and would most likely suffer some small harm from further tariff cuts on cars.

The results of the project are presented in this document and its attachment which reports the modelling in detail. Tariffs have two effects. They impose costs by distorting production activities away from their most efficient patterns. But in constraining trade, they also constrain the presence of Australian produce on world markets and this can lift export prices. Especially for a country with a small share of many export markets, this 'terms of trade effect' is usually small, so when tariffs are high the effect is outweighed by the cost of tariffs.

Once tariffs are relatively low however, at some point the terms of trade effect will outweigh the resource allocation effect.

Thus there will be an 'optimal tariff' where these two effects are in balance. Below that point, further tariff cuts will do more harm (by increasing trade and so reducing export prices) than they will do good (by improving the efficiency of production).

This project used the MONASH model to explore the impact of car tariffs on Australia's economy.

For many years, Australian economic models assumed that, as a small country, Australia was a price taker in export markets – that, as is the case with the simple models in Economics 101, we could sell any amount of our produce at the going 'world price' on international markets. This assumption allowed Australia's economic modellers in the 1970s and 80s to show Australia's optimal tariff as near zero.

But a new realisation of the degree to which our exporters are specialised into specific niches and an analysis of Australia's trade mix suggest that while demand for Australia's exports remains elastic, that elasticity has its limits.

In addition, tariff revenue lost through tariff reductions must also be replaced by income from other sources, such as income tax. Increasing revenue collections to replace tariff revenue creates its own inefficiencies, which were also modelled to better understand the effects of tariff changes.

These conclusions have been integrated into the MONASH model of the Australian economy to estimate optimal tariffs for Australia.

Our results show that one would need to make a number of implausible assumptions for the modelling to yield a result in which cutting tariffs from 10% to 0% or even to 5% did not do more harm to Australia's economy than leaving them where they are.

Even assumptions that might be used to justify lower tariffs, such as the idea that tariff cuts induce spontaneous productivity growth in manufacturing as a result of a "cold shower" effect, do little to restore the conclusion that we should reduce tariffs from the point they are now at.

It is important to remember that the modelling does not dismiss the value of reducing tariffs further, providing it is possible to trade further tariff reduction for the lowering of trade barriers in other markets.

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## 1. Introduction

> Why are economists free-traders? It is hard not to suspect that our professional commitment to free trade is a sociological phenomenon as well as an intellectual conviction, that is, that there is more to it than our altruistic desire to persuade society to avoid deadweight losses. After all, if social welfare were all that were at stake, we should as a profession be equally committed to, say, the use of the price mechanism to limit pollution and congestion. However, support for free trade is a badge of professional integrity in a way that support for other, equally worthy causes is not. By emphasizing the virtues of free trade, we also emphasize our intellectual superiority over the unenlightened who do not understand comparative advantage. In other words, the idea of free trade takes on special meaning precisely because it is someplace where the ideas of economists clash particularly strongly with popular perceptions.
>
> Krugman, 1993, p. 362

Trade barriers like tariffs have occupied a central place in the imagination of economic pundits since the dawn of modern economics. As economists like Krugman have observed (see above), one reason for this is the way in which attitudes to tariffs offer a symbolic site of disagreement between the rigours of informed, properly trained professional opinion and the plausible, but ultimately misguided fallacies of what David Henderson calls 'do-it-yourself economics'. Tariffs make obvious sense to the layman as a means of promoting industries, yet we've known since Ricardo's work on the subject emerged shortly after the battle of Waterloo, this intuition is subtly but devastatingly wrong.

There is also a political dimension because, as Adam Smith reminded his readers, the case for intervening in trade to promote some industry or other is defended not only by appeals to the misguided "prejudices of the public" but also by "what is much more unconquerable, the private interests of many individuals" who seek individual gain at the expense of public wellbeing.

As a result, the contest between protection and free trade has often taken on a symbolic role in public debate as an iconic demarcation between professional opinion and the misinformation of knaves and the fools who fall for their special pleading. But as is the way with scientific discussion, in making out the general case for free trade, economics has also clarified the conditions in which free trade might not be beneficial.

In fact the conditions to indubitably demonstrate the benefits of free trade are too onerous for anyone to be able to demonstrate its superiority unambiguously. A range of objections have been raised to free trade in the last twenty years. Strategic trade theory focuses on scale economies and the scope that they create for countries to advantage themselves by advantaging their scale sensitive firms in their strategic interactions with competitors in other countries.

But this literature is a double edged sword for those seeking interventions in trade. Not only are the necessary interventions horrendously difficult for governments to calculate – assuming (unrealistically) that they had sufficient information to do so – they typically yield relatively small benefits. And they fly in the face of a crucial paradox. Scale economies may make the optimality of free trade more difficult to prove. But, once one admits that governments have imperfect information – leaving aside the possibility that they might on occasions be less than perfectly motivated – scale economies strengthen the case for free trade.[1]

For free trade will generally maximise the scope for industrial specialisation, including international specialisation. Scale economies may make it harder to prove that free trade is the optimal policy – indeed they make it next to impossible – but at the same time they demonstrate that there's more to trade than the relative resource costs faced by one's firms. And so they strengthen the case for ensuring that interventions in trade do not, as they often will, undermine one's firms' access to scale economies. With more gains to trade the case for free trade is made

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[1] See for instance the Productivity Commission:

> The issues raised by strategic trade theory emphasise the importance of considering market structure when seeking to assess the effects of removing tariffs. For example, the existence of oligopolistic domestic industry structures usually reflects economies of scale in the industries concerned. In many instances, this tends to strengthen the case for free trade as is evidenced by the quantitative general equilibrium modelling by Harris and Cox (1984) which suggests that economies of scale can substantially increase the gains from trade.

Productivity Commission, 2002, p. 27.

stronger rather than weaker, at least for governments with imperfect information.

However there are a class of arguments that are much more prosaic and for that reason robust. They do not depend on difficult knife edge judgements but on a weighing of a range of commonsensical economic arguments. The first two arguments to be considered are as follows:

On the one hand we may presume that tariffs impose costs by interfering with the resource allocation decisions that would otherwise be made in the economy. Most particularly they obstruct imports from entering the country and ensuring that those goods and services we do use Australian resources to produce are used in the most efficient way they could be.

Tariffs interfere with our economy's capacity to specialise in what it is most efficient at producing. To take the industry under study in this inquiry, at the margin, automotive tariffs impose costs by encouraging the production of more automotive goods – and so less of other goods and services – than would be produced without that intervention. If those tariffs were reduced, we would import more cars and the resources released from the automotive industry could be expected to flow to industries in which they would be used more productively (because they would not require assistance to be used in their new uses).

On the other hand, other things being equal, an increase in imports leads to a reduction in Australia's exchange rate. Thus as tariffs fall, the exchange rate can be expected to depreciate in response. And as Australian exporters expand their exports in response to their newfound competitiveness they will slightly depress the prices of the markets into which they are selling. Accordingly as trade expands in response to tariff cuts, the terms of trade deteriorate somewhat.

Now Australia is a small country and, as a result, it commands a small share of the world's markets. This means that it faces relatively elastic demand in its export markets. If one has a market share of 2%, it will usually not take much of a reduction in price for one to take some market share from the other 98% of suppliers to the market.

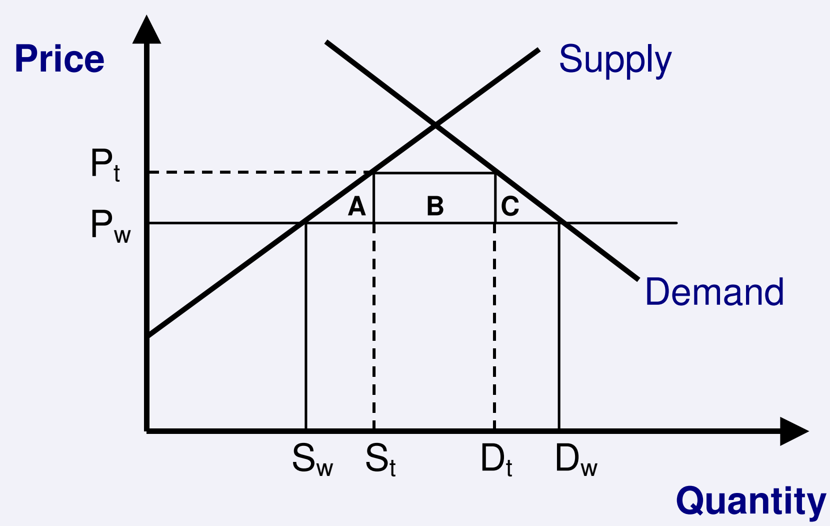
The net effect on the Australian economy depends on how these two effects interact. Here a simple principle of considerable importance comes into play. For reasons illustrated in the following diagram, the welfare costs of a tariff in distorting the allocation of production in importables are approximately proportional to the *square* of the tariff. In consequence as tariffs fall the extent to which they improve allocative efficiency falls.

**Box 1: The allocative efficiency cost of tariffs is proportional to the square of the tariff rate**

The diagram below illustrates the economics of tariff assistance. Two schedules map price and quantity outcomes against each other. The higher the price, the more is produced by the local industry and the less is demanded – producing some equilibrium where supply meets demand. Superimpose on this a world price ($P_w$) that is lower than the point at which the domestic supply and demand schedules cross.

According to the diagram, domestic supply is now at $S_w$, with domestic demand at $D_w$. The tariff increases the domestic price, increasing domestic supply to $S_t$ and reducing demand to $D_t$.. Both of these moves away from the optimal position involve allocative losses – losses in diverting the community's productive resources or its capacity for consumption away from their most efficient configuration.

Thus triangle A represents the increase in production above the efficient level drawing resources – labour and capital – from more efficient production. And triangle C represents the reduction in consumption that the community forgoes because of higher prices. (Rectangle B measures tariff revenue).




The allocative inefficiency of tariffs is measured by the area of the two triangles A and C. If the supply and demand curves are linear, the area of the triangles is strictly proportional to the *square* of the tariff. To the extent that the curves deviate from linearity, this rule will be a reasonable approximation, particularly where the tariff changes contemplated are not large.

To illustrate, at the time of the introduction of the Button Plan some quotas were auctioned and achieved an *ad valorem* tariff of over 90%.

As that rate was cut by two thirds to 30% policy achieved eight ninths of the benefit of moving to free trade. It has been cut by two thirds again since then capturing eight ninths of the remaining gains from moving to free trade.

In fact some tenders of import quotas went for rates of over 100%, in the mid 1980s. If this is taken as the true rate of protection afforded by quotas, the remaining allocative efficiency gains to be had from cutting tariffs from their current 10% level to zero are around 1% of the gains we have made in cutting tariffs so far.

Against these diminishing returns to tariff reductions, there is no presumption of diminishing marginal costs in the case of the terms of trade effect whereby Australian firms expand exports by slightly lowering their prices on world markets. In fact, as is the case with allocative efficiency effects as tariffs fall, the precise quantum of the effect at any point in the reform schedule cannot be determined without detailed knowledge of demand and supply curves. However there is no presumption that the terms of trade effect becomes more attenuated for each percentage point reduction in tariffs as tariffs fall.

These circumstances disclose a situation in which the welfare benefits from cuts to tariffs at high levels will outweigh the terms of trade costs of tariff reductions down to some point at which the terms of trade costs will begin to outweigh tariff cuts. The crucial parameter in determining this relationship is the elasticity of export demand faced by Australian exporters.

## 2. *Export elasticities of demand*

The export elasticity of demand governs the magnitude of the terms of trade effect as exports expand in response to more competitive trading conditions. Though precise quantification of the effect requires comprehensive knowledge of the economy – something to which a computable general equilibrium (GCE) model aspires – a simple and robust approximation can be derived algebraically from simple economic models.

As demonstrated in the attached more technical paper, a simple model enables the specification of a simple formula which identifies the saddle point in a tariff reduction program at which the (beneficial) efficiency effects begin to be outweighed by the (costly) terms of trade effects.

That formula is as follows.

$$T_{optimal} = -\frac{1}{1+\varepsilon}$$

Where:

$T_{optimal}$ is the tariff rate and
$\varepsilon$ is the elasticity of export demand.

Given its increasing policy importance since tariffs have been reduced from the high levels of the late 1970s, it is not surprising that the value given to the parameter $\varepsilon$ has become highly controversial. For on its value hangs the question of when we should call a halt to a unilateral tariff reduction program. Unfortunately for methodological reasons it is exceptionally difficult to accurately measure elasticities of export demand – particularly the long run elasticities that we are really interested in. There is too much 'noise' from other effects for researchers to be confident that anything they have observed is really the result of a stable elasticity of export demand – rather than some other chance in conditions – or indeed, a change in the elasticity of export demand over time rather than a new reading on a more constant value.

Citing Orcutt, the Productivity Commission comments as follows (2002, p. 305).

> The key problem is that data on actual export prices and quantities will reflect a combination of both demand and supply influences. Unless the supply influences are adequately controlled for, the estimates of export demand elasticities will be seriously biased downwards.

For this reason a good deal of the debate on the issue happens at the level of economists' competing intuitions and their resulting disciplinary 'commonsense'. In the 1970s, in the wake of a generation of trade theory in which imperfect competition became all but invisible, economists tended to think that because Australia was a small country it must face infinitely elastic elasticities of export demand – as in the simplest model of a small open economy. As a result these numbers were encapsulated in models with very high elasticities of export demand (infinite levels produced model instabilities).

Today professional economists working with the MONASH and Murphy models are more sceptical that export elasticities are as high as they were assumed to be when trade theorists spent most of their time modelling trade in perfectly competitive circumstances.

MONASH modellers who produced the attached report believe it is possible that Australia faces an average elasticity of export demand which is as low as -4. One objection to such a low figure is that it seems counterintuitive that reducing tariffs below 30% has done damage to our economy.[2] Commenting on such low average elasticities of export demand for the Australian economy in its last report on the automotive industry, the Productivity Commission cited new work which sought to finesse the problems itemised by Orcutt.

> More recent econometric estimates have either controlled explicitly for supply effects, or have modelled specific influences that would only affect demand.

The Commission goes on to cite Head and Ries (2001, p. 864) at length. They then conclude that Head and Ries' estimates "are of the same order as the central estimates used in the MONASH and MM 600+ models" (Productivity Commission, 2002, p. 305-6). Now the "central estimates" were -10 which would in the simple model yield an optimal tariff of 11%.

We are comfortable with the assumption made in the Murphy model that the elasticity of many of our commodity exports would be of the order of -12. Nevertheless as will be made clear below, over half of Australia's exports are likely to face substantially less elastic export demand conditions than that. The elasticity of export demand of many of these export industries are modelled as -4 or -6 in the Murphy model.

Accordingly we think it safe to conclude that Australia's average elasticity of export demand is smaller than -12. It may indeed lie below -8, but we

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[2] One happy by-product of the research done for this project has been the development of a possible way to reconcile lower elasticities of export demand with a method of estimating optimal tariffs which arrives at much lower figures than would be produced in the simple model. As discussed below and in the technical paper, if the 'cold shower' effect proposed by the Productivity Commission in its 2000 modelling of general tariff levels encounters diminishing marginal returns as tariffs fall, it would help illustrate why gains were experienced as tariffs were reduced below levels of 20 and 30%, even if export elasticities of demand were as low as -4. This prospect is considered at the end of this paper and in the appendix to the attached technical paper.

think it appropriate to err on the side of caution and conclude that it lies between -8 and -12. As amply demonstrated below we think it very unlikely that the export demand facing Australia as a whole is as elastic as -16 which would imply that we could double our exports if we were able to lower their world price by just 4.2%.

The table below illustrates a range of export elasticities, what they mean in terms of the price reductions that would lead to a doubling of exports, and the optimal tariff rates that can be derived from the formula outlined above which is derived from the simple model. As will be seen in the attached paper, the results obtained from the MONASH model are similar although with higher levels of domestic/import elasticity for PMVs, the optimal tariffs at higher elasticities are slightly above the optimal tariffs generated in the simple model.

**Table One**

| Elasticity of export demand | Percentage reduction in fob price to allow a doubling of demand (%) | Optimal Tariff - Simple Model (%) |
|---|---|---|
| **-4** | **-15.9** | **33.3** |
| -5 | -12.9 | 25.0 |
| -6 | -10.9 | 20.0 |
| -7 | -9.4 | 16.7 |
| **-8** | **-8.3** | **14.3** |
| -9 | -7.4 | 12.5 |
| -10 | -6.7 | 11.1 |
| -11 | -6.1 | 10.0 |
| **-12** | **-5.6** | **9.1** |
| -13 | -5.2 | 8.3 |
| -14 | -4.8 | 7.7 |
| -15 | -4.5 | 7.1 |
| **-16** | **-4.2** | **6.7** |
| -17 | -4 | 6.3 |
| -18 | -3.8 | 5.9 |
| -19 | -3.6 | 5.6 |
| -20 | -3.4 | 5.3 |

## 3. Some indicative explorations of our export markets

It is certainly not surprising that export elasticities of demand are very high for numerous Australian export commodities. Australia occupies a small fraction of the world economy and accordingly enjoys a small market share in most of the markets into which it exports. Where commodities are relatively homogenous and export market shares are small, this is a recipe for very high elasticities of export demand. Australia is very close to being a 'price taker' in world markets, selling as much as it is able to export at the world price without having much effect on it.

It is true that in many commodities, Australia is a substantial exporter. But in many commodities Australian exports are competing not just with exports from other countries but also with domestic production in the export market. Thus for instance Australia is a substantial sugar exporter exporting over 4 million tonnes. Yet world consumption of sugar is over thirty times this figure.

In such circumstances and in the absence of convincing empirical estimates, it seems likely that export demand for Australia's sugar is highly elastic. Then again, with one thirtieth of the world market, how much would one need to lower prices to double our exports? Would export demand be more elastic than -12 which implies that one would need to lower prices by a little over 5%? It is not clear that it would be this high. Then again, we cannot be sure that it is not higher.

But even a commodity like sugar provides an important 'reality check' on our thinking. Because, if Australia's export markets were all like the market into which we export our sugar, and its elasticity of export demand was -12, as we have seen, the tariff rate at which a tariff reduction program goes from helping our economy to harming it is $1/(1+\varepsilon) = 1/(1-12) = 9.1\%$.

In other words making fairly moderate assumption that *all* export markets exhibit an elasticity of export demand of -12, the current rate of automotive tariffs is already around the optimal point, and a move to 5 or even 7.5% will harm Australia more through its effect on our export prices than it will benefit us with a more efficient production base. Indeed, if we take automotive tariffs as being at an average rate of around 8% as is suggested in the attached paper, it may be that we have already cut tariffs beyond the optimal point.

We stress that modelling such as that undertaken in this study – like most economic modelling – should not be taken as more than broadly indicative. As a result we would be cautious about using it to conclude that we should increase tariffs on motor vehicles or other commodities. But it should give us pause that the clearest thinking we can do suggests that a course of action which many commentators take as a precondition of good policy intent – a kind of a badge of policy seriousness – seems more likely to harm than help our economy.

And yet the assumptions on which we arrived at an optimal tariff of 9.1% (or somewhat higher in some plausible MONASH simulations) seem to place the arguments for further reductions of tariffs in their best light. In fact however, the evidence is overwhelming that Australia's average export elasticity is substantially below the elasticity of export demand for sugar and similar relatively homogeneous commodities.

***Markets in which elasticity of export demand is not very high***

Australia's most substantial export commodities by a substantial margin, and certainly at current prices, are iron ore and coal. In each case there is evidence that export demand is substantially less elastic than it would be for sugar. Thus for instance in iron ore, Australia is a massive exporter along with Brazil, but Australia's iron ore enjoys freight advantages into China over Brazil which have grown substantially in recent years. Australia also exports some very high quality iron ore. As a result, the elasticity of export demand for iron ore seems unlikely to be very high. In one study of Australian exports to China (Tcha and Wright, 1999, p. 147) it was found that "when the relative real price of iron ore between Australia and the world average increases by 1%, China reduces its imports of iron ore from Australia by about 1.13%".

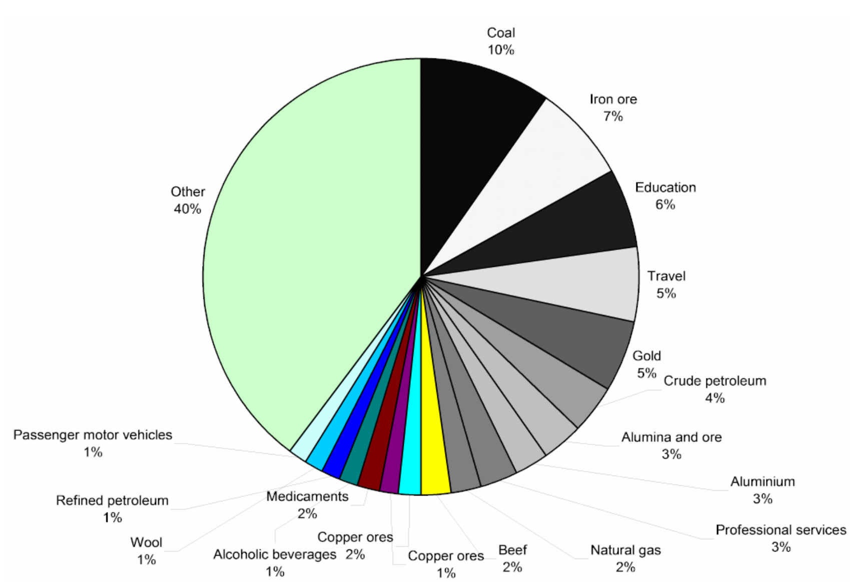
In the case of coal, Australia is a major exporter. However although Australian coal represents around 20 percent of the world's coal exports this volume makes up only a little more than 5 percent of the world's coal production. With relatively high costs of transport as a share of value, coal is not as highly traded as many commodities. However, as one would expect, trade is much more prominent in specific types of coal, particularly higher value coal. Thus for instance Australia produces very highly valued metallurgical coal and is the dominant global exporter of metallurgical coal. It is hard to imagine that our elasticity of export demand is particularly high in this circumstance.

With iron ore and coal being Australia's largest export industries, education and travel are the next biggest respectively. Each of these areas is characterised by finely and qualitatively differentiated product offerings and thus to very imperfect competition. In each area it seems most unlikely that elasticities of export demand are very high.

Export elasticities in the area of tourism were last subject to substantial public scrutiny during the debates over the GST in 1999. There, the export elasticity of demand for tourism was assumed to be in the vicinity of -2 to -3, not -8 or -16. Those championing the GST at the time argued that the figure was even lower again than the figures used in the MONASH and Murphy modelling.

Other commodities likely to be characterised by lower elasticities of export demand include fine wool (because of our high share of world fine wool markets), beef (because we are a major exporter and some of our exports face trade barriers including quotas which apply specifically to Australian exporters) and natural gas (because of high transport costs limiting exports to the region). These comprise another 5% of our total exports each of which would be likely to have elasticities of export demand that were lower than commodities more generally.

**Figure One: The commodity composition of Australia's exports**



In summary, commodities which cannot be expected to have very high elasticities of export demand elaborated above amount to somewhere between 15-20% of our total exports. In addition services amount to 22% of exports and elaborately transformed manufactures contribute another 14% (DFAT – STARS database.)

In other words, over fifty percent of Australia's exports face elasticities of export demand that are substantially lower than the textbook cases in which Australia exports a homogenous commodity with very low export market shares. Recent and expected price rises for iron ore and metallurgical coal bring the figure to over 60%.

### 4. Replacing lost revenue

Modelling can never be perfect. Indeed the point of modelling is to leave out aspects of the world so that we can rigorously trace out the logic of the way in which various economic forces operate 'assuming other things were held constant'. There is another critical issue which has received surprisingly little attention in studies of tariff reform. Generally where tariff reform is modelled, in order to hold other things constant, it is assumed that the revenue that is lost from reduced tariffs is replaced in a costless way. This is unrealistic. Just as tariffs impose costs on an economy, so too do the taxes which will substitute for the revenue that a tariff raises.

In fact, the way this works in the world is not that an explicit decision is ever made to replace tariff revenue with some other source of revenue. Rather the loss of revenue over time imposes constraints on governments when they next come to consider the revenue resources available to them and the tax cuts that can be safely afforded.

In this context, where there is less tariff revenue available, the scope to reduce other taxes is constrained. Since governments regularly return some share of 'bracket creep' as income tax cuts, a reduction in tariff revenue will constrain governments capacity to fund such tax cuts.

Given its significance and its straightforwardness – unlike some of the more contentious claims drawn from strategic trade theory, there is broad consensus that taxes have substantial costs – it is worthwhile bringing this issue into explicit consideration in determining policy. If we do not, we are introducing a systematic bias into our model. We know that raising revenue with income tax is far from costless. Those who have attempted to do so (Freebairn, 1995, Campbell and Bond, 1997) have typically found inefficiencies of around 20 percent or more. In other words, according to the studies that have been done, for each dollar of income tax we raise, economic inefficiencies associated with raising that revenue cost the economy around 20 cents or more.

Now a large proportion of the total economic costs of the tariff – namely the allocative inefficiencies to which tariffs give rise – are integrated into the modelling done for this project. Thus the model is already capturing a substantial portion of the economic cost imposed by the collection of tariffs. Yet the modelling does not capture a range of other distortions induced by tariffs.

There is a broad consensus in Australian policy making circles that there is a strong efficiency cost of moving further away from indirect taxation towards greater direct (income) taxation. Indirect taxes are relatively low – the main items being GST and payroll taxes while effective marginal income tax rates are much higher. The prevalence of family payments generates high effective marginal tax rates (EMTRs) as incomes rise and benefits are withdrawn.

The following table is indicative.

**Table Two: EMTRs for Income Unit Heads by Income Unit Type and Income Unit Income Decile.**

| | *Upper boundaries of EMTR categories* | | | | | | | | | | | | *Average* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *10* | *20* | *30* | *40* | *50* | *60* | *70* | *80* | *90* | *100* | *> 100* | *EMTR* |
| Couple | 25 | 1 | 3 | 2 | 40 | 18 | 2 | 4 | 3 | 2 | 0 | 2 | 32.40 |
| Couple and dependant | 10 | 1 | 2 | 0 | 33 | 21 | 19 | 8 | 2 | 1 | 3 | 1 | 50.04 |
| Single female | 47 | 0 | 6 | 1 | 29 | 7 | 1 | 4 | 2 | 0 | 0 | 2 | 24.08 |
| Single male | 36 | 0 | 6 | 2 | 38 | 8 | 1 | 4 | 2 | 0 | 0 | 4 | 33.34 |
| Sole parent | 48 | 0 | 2 | 0 | 15 | 9 | 11 | 12 | 3 | 0 | 0 | 0 | 29.59 |
| Total | 31.70 | 0.43 | 4.16 | 1.22 | 33.86 | 12.55 | 5.09 | 5.40 | 2.22 | 0.63 | 0.71 | 2.04 | 33.85 |
| Decile 1 | 86 | 0 | 2 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 7 | 9.99 |
| Decile 2 | 79 | 0 | 6 | 0 | 0 | 1 | 2 | 4 | 0 | 0 | 0 | 7 | 15.79 |
| Decile 3 | 51 | 1 | 11 | 6 | 2 | 10 | 0 | 15 | 3 | 0 | 0 | 1 | 36.92 |
| Decile 4 | 58 | 0 | 10 | 1 | 18 | 6 | 1 | 2 | 2 | 0 | 0 | 3 | 23.08 |
| Decile 5 | 25 | 1 | 1 | 1 | 50 | 4 | 2 | 5 | 7 | 2 | 0 | 0 | 34.78 |
| Decile 6 | 12 | 1 | 2 | 1 | 58 | 7 | 3 | 8 | 4 | 2 | 2 | 0 | 37.48 |
| Decile 7 | 7 | 0 | 4 | 1 | 55 | 5 | 9 | 10 | 4 | 1 | 4 | 1 | 55.81 |
| Decile 8 | 2 | 0 | 3 | 1 | 56 | 9 | 23 | 3 | 1 | 1 | 1 | 0 | 40.67 |
| Decile 9 | 1 | 0 | 2 | 0 | 57 | 24 | 10 | 3 | 2 | 0 | 0 | 0 | 39.84 |
| Decile 10 | 1 | 0 | 1 | 0 | 35 | 57 | 1 | 5 | 1 | 0 | 0 | 0 | 40.60 |
| Total | 32.29 | 0.45 | 4.04 | 1.10 | 33.18 | 12.62 | 5.23 | 5.47 | 2.38 | 0.58 | 0.71 | 1.96 | 33.45 |

*Source: Kelb, 2007, p. 190. See also Buddelmeyer et al 2004.*

Given that taxes impose efficiency costs roughly in proportion to the square of the tax rate, dollars recouped from increases in income taxes (or more precisely reduction in the size of future income tax cuts) are likely to come at substantially higher costs than the dollars currently raised from tariffs.

We do not include the cost of administration and compliance with income tax as a net cost, because it is not clear that it is lower per dollar of revenue raised than tariff administration and compliance. However there is a range of other matters that would add to the efficiency costs of the tax mix switch that tariff reduction would bring about.

As Campbell and Bond observe their own modelling of the costs of income taxation did not include lifetime labour supply, human capital formation and changes in savings and investment behaviour (p. 33) all of which are also likely to mean that the standard estimates of the costs of income taxation are underestimates, perhaps to a substantial extent and all of which would either not apply, or apply with much less force to indirect taxation.[3]

Given all this, we suggest that a substantial proportion of the original 20 plus percent efficiency cost of income taxation would also survive as the net cost of replacing tariff revenue with revenue from income tax. In addition there are the costs of avoidance which are also excluded from Freebairn and Campbell and Bond's estimates. Tariffs are very difficult to avoid, whereas avoiding income tax is a national pastime and a privately remunerative one at that. US studies that capture some aspect of avoidance report dramatically higher marginal costs of income taxation (see for instance, Feldstein, 1999).

Given all this, the attached study errs very much on the side of conservatism in exploring some scenarios in which 'revenue replacement' cost of just 5 cents in the dollar is imputed to tariff cuts. Because over the intervals around 10% tariffs under consideration, this 'revenue replacement cost' increases the optimal tariff in all scenarios into which it is introduced and makes reducing tariffs from 10% to 5% welfare reducing in all reasonable cases.

## 5. Assumptions which reduce optimal tariffs

We explored a number of assumptions which reduce optimal tariffs. Notwithstanding these efforts we were only able to rescue the proposition that we should reduce tariffs below the average rate of 8% in outlying cases.

### *Monopolistically priced exports*

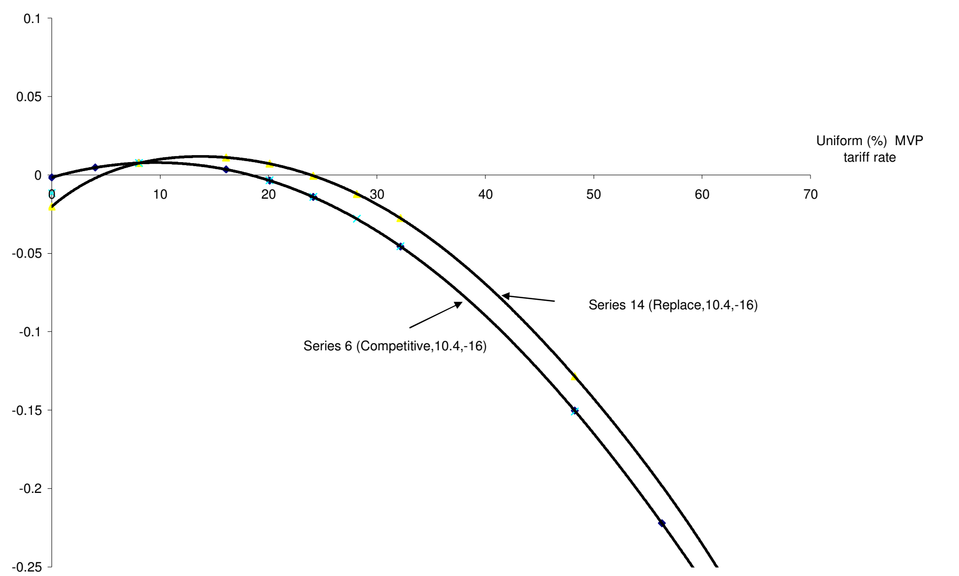
We first examined whether optimal tariffs were substantially reduced by the assumption that parts of the mining sector may be able to exercise some monopoly power. Though this might seem to be the case to buyers of coal and iron ore right now, with huge price rises being negotiated even from the very high price levels of today, by two huge exporting firms all the evidence points to Australian firms doing their utmost to expand production, not to their constraining production with a view to exerting

[3] Campbell and Bond also mention "family size and composition decisions", and we leave this out of our comparison between direct and indirect taxation.

monopoly power. New entrants are also entering the market. Nevertheless we investigated how this might affect optimal tariffs.

The simulations indicate that monopolistic pricing of some exports substantially reduces the optimal tariff where elasticities of export demand are at the low end of -4 but have a negligible effect on the optimal tariff at higher elasticities of export demand. The net effect of the last two effects – revenue replacement and monopoly power amongst exporters – in increasing optimal tariffs at high export elasticities is represented in the next diagram in the contrast between series 6 and series 14 of the simulations.

**Figure Two: Percentage effects on aggregate consumption of moving MVP tariff rates away from their present levels (averaging 8): MONASH series 6 and series 14.**




### *Cold shower effects*

One reason why tariff reduction has been a success in Australia has been that manufacturers have responded to tariff reductions by improving their productivity. This is hard to explain using simple economic models, because producers are assumed to be maximising their profits in all situations, and it seems that the international competition unleashed by tariff reductions does lead some manufacturers and/or their employees to find better ways of doing things.

There is now a substantial, though not uncontroversial, literature detailing productivity growth that accompanies tariff reform – so called 'cold shower' effects – in various countries. Such productivity growth has been documented in Australia and the Productivity Commission incorporated it into a report proposing that Australia's general tariffs of five percent be reduced to zero.

The specification and parameterisation of this modelling was based on Chand *et al (1998 – see also* Chand, 1999*).* Using manufacturing industry data at the 2-digit ANZIC level for 1968-69 through 1994-95 supplemented by information on assistance levels, domestic R&D spending, human capital stocks and public spending on infrastructure, Chand *et al.* (1998, p. 240) [4] found that "declining assistance is positively related to manufacturing industry productivity growth, and that this relationship is not sensitive to changes in alternative data series or econometric techniques." This 'cold shower' effect was subsequently introduced into Productivity Commission simulations of reducing tariffs on all but automotive and apparel industries from 3-5% to zero.

The inclusion of these cold shower effects was sufficient to overcome the dominance of the terms of trade effect over the allocative efficiency effect in moving to zero tariffs. While the attempt to incorporate a 'cold shower' effect into the modelling was, in principle not just defensible but welcome, this first attempt at modelling the effect raised a number of important issues.

Firstly, because the mechanism is not well understood, it is difficult if not impossible to formally model what is driving it – its 'micro-foundations'. Nevertheless there is little doubting that the productivity gains in manufacturing have exceeded what the standard models would have predicted.

Perhaps more importantly, there were numerous problems ensuring statistical robustness leading to the authors of the original study on which the cold shower effect was parameterised to the following conclusion (1998, p. 261):

> Despite the evident need to interpret the industry results with caution due to low degrees of freedom and the poor representation

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[4] Chand, S. *et al.* (1998), 'Trade liberalisation and manufacturing industry productivity growth,' in Microeconomic Reform and Productivity Growth, Workshop Proceedings, Productivity Commission and ANU.

of statistically significant coefficients, some interesting insights can be obtained from these regressions.

Of greatest significance in the current circumstances is the decision to model and estimate the 'cold shower' effect as a productivity response to tariff reductions that was industry specific in magnitude and uniform in its effects irrespective of the levels from which tariffs were being reduced. As the Commission later commented, this latter assumption was essentially unsupported by the data:

> [T]he elasticities are based on evidence for the whole period, which included times of relatively high and low assistance. The data were not rich enough to detect any variation in the estimated elasticities according to the level of assistance. The available estimates could overstate the impact of future assistance reductions if most of the benefits from opening the economy have already been reaped (2000a, 64).

The PC did not model the 'cold shower' effect in subsequent reports.

We think the more plausible specification for the 'cold shower' effect is one which makes the strength of the effect fall as tariffs fall and as competition from imports intensifies. Accepting that the data supported neither the Commission's assumption nor our own assumption to the level of statistical significance – often defined as within a confidence interval of 95% or more – the evidence seems to support our own proposed specification more firmly than the Commission's.

We think it makes more sense intuitively. As Dixon and Rimmer observe in the attached paper:

> We think it is reasonable to suppose that when imports take their first 20 per cent of the domestic market, then this encroachment will cause much greater reforms among domestic producers than when imports take the next 20 per cent. The first 20 per cent will eliminate the most easily removed slack practices by domestic producers, making further reforms to meet import competition successively more difficult.

Now it is true that the Productivity Commission later commented that the original study found "that effects estimated over the latter half of the sample period were similar to those estimated for the period as a whole",. Yet at the same time it found that its estimates of the cold shower effect were largest in the two industries where effective protection had been highest and which remained relatively high at the end of the period studied.

Further, all the industries that generated the lowest coefficients of increased value added for each 1 percent reduction in their tariffs received below the manufacturing industry average assistance throughout the period under study whilst all the industries that received large coefficients began the period with above the manufacturing industry average level of assistance.

Indeed, Chand *et al* themselves drew attention to the plausibility of the conclusion to which we are pointing (1998, p. 261):

> These more detailed results are suggestive that the level of assistance and industry structure play a part in determining the responsiveness of output to assistance changes at the industry level.

***A cold shower effect which exhibits diminishing returns to tariff reduction***

The attached paper provides an exploration of a 'cold shower' effect which is specified in quadratic form – so that the extent of the cold shower effect is higher when tariffs are high and diminishes, like allocative efficiency effects as tariffs fall. Like the Productivity Commission's modelling it is no more than indicative. But we think the specification is more plausible and it has the welcome ability to render the world closer to our intuitions. For in this case, it seems at least as plausible that continuing reductions in protection will generate reductions in automotive productivity as they will generate improvements.

Given current and expected future commodity prices, it is not clear that automotive manufacturing will be viable in Australia at free trade in the long run. In that situation it strikes us quite likely that reducing low levels of protection is just as likely to reduce productivity growth by starving the industry of investment as it is to increase productivity gains with a 'cold shower'.

Integration economies would seem to be well entrenched – with 80 percent of the local market occupied by imports – and the domestic content of locally produced vehicles falling fast, and the industry is making losses. It seems unlikely that making the shower colder than it is now would lead to the discovery of slack in the industry as it might well have done when tariffs were much higher and imports enjoyed the 20 percent market share that domestic vehicles enjoy today. On the other hand, one can imagine reasons to believe that further reductions in tariffs could reduce productivity not just through loss of scale but also as a result of increasing uncertainty and a consequent faltering in investment.

In addition, as outlined in the attached paper, a quadratic specification of the cold shower effect enables us to reconcile our intuition that cutting tariffs below 30% has been beneficial with the possibility that elasticities of export demand are lower than we thought.

As we indicated above, we suspect that the average elasticity of export demand facing Australia is substantially higher than -4. But some of those we respect think -4 may be the right number. With a quadratic cold shower effect, there is little point in pursuing tariff reductions unilaterally beyond some point, but that is at a point at which tariffs are already relatively low. Above that point, the environment is not competitive enough to ensure that the managers and employees of our firms have sufficiently motivated to leave no stone unturned to improve their productivity.

Finally, there is something paradoxical in the idea that cold shower effects are exhibited with such variation between manufacturing industries. It is implausible that there is something intrinsic to the automotive industry that gives it particular susceptibility to the cold shower effect, which gives the apparel industries twice the automotive industry's susceptibility to the effect, whilst there is virtually no effect in food beverages and tobacco or in petroleum. We think the industry average cold shower effect used in the Productivity Commission's 2000 modelling – around half the cold shower effect detected for the automotive industry – more plausible for two reasons.

Firstly it has been estimated from a larger pool of data and is more reliable on that account – and more statistically significant for that reason. Secondly the productivity improvement observed in the automotive industry reflects in substantial part changes in the quality of the assistance regime as much as reductions in the industry's average level of assistance.

Thus for instance in the late 1970s, in addition to quantitative restrictions, the local content plan was mired in rules which constrained firms flexibility. Thus for instance the 'non-reversion' rule prevented any manufacturer from ‘reverting’ to imports when it had been sourcing specific components locally, without a government committee providing sanction for doing so on the grounds that such ‘reversion’ would not cause undue disruption. Permission was not lightly – or quickly – given.

Likewise before 1983 vehicle producers achieving above 85% local content in large cars like Commodores and Falcons were unable to ‘spend’ their surplus content importing built up vehicles but were instead forced to buy component packs to assemble in Australia – often at prices that were at or near the price they would have paid for built up vehicle imports. The Button Plan’s permission of built up imports within the local content plan saw the Australian assembly of Lasers, Geminis and Colts phased out once they’d run their model cycles.

## 6. Conclusion

We conclude by emphasising the modesty of the position outlined here. It is true that if the considerations explored in this paper were the only considerations before us, that it would be possible to take the arguments we have developed and deploy them to argue for targeted export taxes. One could also use them to argue for increases in tariffs which are already lower than 10%. We have not argued this because our own understanding of what the modelling has established is much more limited than this.

Because they operate via the terms of trade effect on exports the arguments here are quite general. So in some senses not proceeding with tariff cuts to the automotive industry is ‘unfair’. But the nation is not considering whether to impose export taxes, or whether it should reverse tariff reductions on other industries like whitegoods.

The current policy question is what to do with automotive tariffs. The current argument is not that the authors of the report are such experts that they can divine the precise optimal tariff and that this discloses a level to which all tariffs should be put. Far from it. And it is certainly not an argument that we should impose export taxes at a time when other countries’ export taxes on agricultural products are driving up global food prices outside the major agricultural exporters and threatening the integrity of the world trading system.

Further it is not an argument that there are no circumstances that would justify a move by Australia to zero tariffs. We should always be prepared to negotiate our trade barriers down, in return for commensurate benefits from negotiating better access to other countries' markets as we have sought to do in various multilateral and preferential trading agreements in the past.

Our argument can be summarised by the following propositions.

- Any economic gains from lowering tariffs are likely to be small.
- Against this there are clear costs.
- These costs are also relatively small. However the first effect is likely to be stronger at higher tariffs and the latter will begin to dominate at some point as we get closer to free trade.
- Accounting for both effects it is sensible to believe that lowering tariffs from 10% to 5% is much more likely to involve (small) net costs than (small) net benefits.
- Because the effects are relatively small, and the precise point at which the optimum is situated is subject to considerable uncertainty, the modelling supports the policy *status quo*.

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**Welfare effects of unilateral changes in tariffs on Motor vehicles and parts**

**by**

**Peter B. Dixon and Maureen T. Rimmer**

**Centre of Policy Studies**

**Monash University**

**June 1, 2008**

## Summary

(1) The government is currently conducting an inquiry, the Bracks Inquiry, into the Motor vehicles and parts (MVP) sector. Among other things, the Inquiry will consider whether MVP tariffs should be cut. This paper sets out the theory of how changes in tariffs affect economic welfare and provides quantification via the MONASH model for the case of MVP tariffs in Australia.

(2) Tariff reductions have two well-known welfare-changing effects: the efficiency effect and the terms-of-trade effect.

(3) The efficiency effect refers to changes in Australia's ability to consume arising from changes in the efficiency with which a fixed amount of resources (aggregate capital and labour) is allocated between different activities. With reductions in protection, Australia can save resources by substituting export activities for import-competing activities. The saved resources are then available to produce extra goods thereby enhancing consumption.

(4) The terms-of-trade effect refers to changes in Australia's ability to consume arising from changes in the prices paid by foreigners for Australia's exports relative to the prices paid to foreigners by Australians for imports. With reductions in protection, Australia increases both its exports and imports. Provided that foreigners have downward-sloping demand curves for Australian products and upward-sloping supply curves for the products that they sell to Australia, unilateral cuts in protection by Australia will reduce the foreign-currency price of exports and increase the foreign-currency price of imports. This negative movement in the terms of trade will reduce Australia's ability to consume.

(5) At high levels of tariffs, efficiency gains from tariff cuts tend to outweigh terms-of-trade losses. However, at low levels, efficiency gains tend to be outweighed by terms-of-trade losses. Consequently, while it is clear that Australia benefitted from the initial movements in the 1970s towards free trade from high levels of protection, it is not clear that Australia would benefit from unilateral cuts in protection from the present low levels.

(6) The average elasticity of demand for exports across all products is the key parameter in determining the tariff rate at which the negative terms-of-trade effects of tariff cuts begin to dominate the positive efficiency effects.

(7) There is a considerable divergence of views concerning export-demand elasticities. The builders of the MONASH model use numbers averaging about -4. The Productivity Commission suggests that export demand is highly responsive to price movements, and favours numbers more like -20.

(8) An export-demand elasticity of -4 means that a doubling of supply from Australia would reduce the export price of the Australian product by 15.9 per cent. An export demand elasticity of -20 means that a doubling of supply from Australia would reduce the export price of the Australian product by 3.4 per cent.

(9) A survey of the relevant literature reveals no support for the very high elasticities favoured by the Productivity Commission.

(10) The Productivity Commission is uncomfortable with export-demand elasticities smaller in absolute size than 10, let alone 4, because in simple models these relatively low elasticities imply that the optimal tariff for Australia is quite high, more than 30 per cent in some cases.

(11) A detailed study of export-demand elasticities is urgently required for Australia. Such a study would provide valuable information in the formation of trade policy. It would also be valuable in the formation of all other policies. This is because the effect of any policy on economic welfare depends partially on how it influences trade flows.

(12) With export-demand elasticities at anything smaller in absolute size than about 10, terms-of-trade losses caused by a reduction in MVP tariffs from their present levels (averaging 8 per cent) will exceed efficiency gains.

(13) When deadweight losses associated with the collection of taxes to replace lost tariff revenue are included in the calculations, the impression that Australia's economic welfare would be reduced by cuts in MVP tariffs is strongly reinforced.

(14) A possible counter argument is the cold-shower effect. Under the cold-shower hypothesis, resources (capital and labour) in import-competing industries are used more productively if tariffs are low than if they are high. However the introduction of cold-shower effects is unlikely to overturn the conclusion that cuts in MVP tariffs would be welfare reducing.

(15) In our analysis, the cold-shower effect operates strongly at high tariff rates. Its inclusion sharply reduces optimal tariff rates. With what we consider a realistic setting for the export-demand elasticity, -4, the optimal tariff rate comes down from 36.2 per cent to 17.2 per cent.

(16) Perhaps the inclusion of the cold-shower effect will take some of the heat out of the debate on export-demand elasticities. With a cold shower, it is possible to reconcile empirically supportable values for export-demand elasticities with optimal tariff rates of moderate size.

**Welfare effects of unilateral changes in tariffs on Motor vehicles and parts**

by

**Peter B. Dixon and Maureen T. Rimmer[*]**

**June 1, 2008**

## 1. Introduction

Starting in the 1970s, Australia has followed an ambitious program of unilateral reductions in protection. The majority of imports are now subject to tariffs of no more than 5 per cent. However tariffs of 10 per cent apply to most imports of Motor vehicles and parts (MVP). The government is currently conducting an inquiry, the Bracks Inquiry, into the MVP sector. Among other things, the Inquiry will consider whether MVP tariffs should be cut. The aim of this paper is to set out the theory of how changes in tariffs affect economic welfare and to provide quantification for the case of MVP tariffs in Australia.

There can be no doubt that Australia's initial movements in the 1970s towards free trade were welfare enhancing. However, it does not follow that unilateral reductions in protection to eliminate Australia's remaining tariffs would enhance welfare. As explained in standard trade texts [e.g. Kindleberger (1963, Chapter 12) and Caves and Jones (1973, chapter 12)], tariff reductions have two principal welfare-changing effects: the efficiency effect and the terms-of-trade effect. These effects work in opposite directions and their relative strengths depend on the level of the tariff.

The efficiency effect refers to changes in Australia's ability to consume arising from changes in the efficiency with which a fixed amount of resources (aggregate capital and labour) is allocated between different activities. With reductions in protection, Australia can save resources by substituting export activities for import-competing activities. The saved resources are then available to produce extra goods thereby enhancing consumption.

The terms-of-trade effect refers to changes in Australia's ability to consume arising from changes in the prices paid by foreigners for Australia's exports relative to the prices paid to foreigners by Australians for imports. With reductions in protection, Australia increases both its exports and imports. Provided that foreigners have downward-sloping demand curves for Australian products and upward-sloping supply curves for the products that they sell to Australia, unilateral cuts in protection by Australia will reduce the foreign-currency price of exports and increase the foreign-currency price of imports. This negative movement in the terms-of trade will reduce Australia's ability to consume.

In a leading special case in which the demand for imports is a linear function of the landed-duty-paid price, the efficiency effect of a 1 percentage point reduction in the tariff rate applying to a given import is proportional to the initial rate of the tariff. Thus,

[*] We thank Nick Gruen for inspiring this project and for innovative suggestions. We also thank Patrick Jomini, Peter Forsyth, Phil Hagan, Max Corden and Mark Picton for valuable discussions and assistance. However, we bear sole responsibility for the contents of the paper.

for example, reducing the tariff rate on Motor vehicles and parts from 80 per cent to 79 per cent has an efficiency effect that is 8 times larger than the efficiency effect of reducing the tariff from 10 per cent to 9 per cent. On the other hand, the terms-of-trade effect is independent of the initial tariff rate. Thus, for example, the terms-of-trade effect of reducing the tariff rate on Motor vehicles and parts from 80 per cent to 79 per cent is the same as the terms-of-trade effect of reducing the tariff from 10 per cent to 9 per cent. Consequently, in applied work we find that at high tariff rates (e.g. 80 per cent), the favourable efficiency effect of reducing the tariff generally outweighs the unfavourable terms-of-trade effect. On the other hand, at low tariff rates (e.g. 10 per cent), the unfavourable terms-of-trade effect generally outweighs the favourable efficiency effect. This suggests that there is an optimal level for tariff rates at which small reductions generate efficiency gains that are exactly offset by terms-of-trade losses.

In this paper, we use the MONASH model to evaluate the long-run welfare effects on the Australian economy of unilateral changes in tariffs applying to Motor vehicles and parts. Consistent with the theory of the efficiency and terms-of-trade effects, we find in our central simulations that Australia would not benefit from unilateral reductions in these tariffs from their present low levels. Our simulations identify the optimal level of tariff rates which, under plausible assumptions, are considerably in excess of those currently in place.

The remainder of the paper is organized as follows. In Section 2 we set out the basic theory of the welfare effects of reductions in protection. This theory establishes the elasticity of foreign demand for exports as a key parameter in the determination of the optimal tariff rate. Section 3 reports results of MONASH simulations of the effects of changes in the tariff rates applying to Motor vehicles and parts. These simulations are conducted under the standard assumption that firms in Australia's export industries behave in a perfectly competitive manner, treating the price that they receive for their products as their marginal revenue. In other words, in making their profit maximising decisions, firms in these industries do not take into account reductions in the foreign-currency price of Australian exports associated with increases in export volumes. Section 4 reports MONASH results in which the competitive assumption is relaxed. We develop a new formula for the optimal tariff to explain these results. In Section 5 we take explicit account of the costs of raising revenue to replace tariff collections that are lost when tariffs are cut. Again, we explain these results via a new formula for the optimal tariff. Having identified in earlier sections the critical role of export-demand elasticities, in Section 6 we discuss the current state of knowledge concerning these parameters. Section 7 concludes that models encompassing only efficiency, terms-of-trade and revenue-replacement effects will inevitably show welfare reductions from cutting MVP tariffs from their present low levels. This leads to a discussion of what other factors could operate. In the Appendix we consider one possibility, the cold-shower effect. We find that the introduction of cold-shower effects is unlikely to overturn the conclusion that cutting the MVP tariff will be welfare reducing.

## 2. Efficiency effects, terms-of-trade effects and the optimal tariff in a simple model

The aim of this section is to derive the relationship between economic welfare and the tariff rate in a simple theoretical model in which Australia exports one good and imports another good. This relationship, and elaborated versions to be developed in Sections 4 and 5, will help us to interpret the results from the MONASH model.

Assume that the foreign demand curve for the export good is given by

$$E = (P_E)^{\varepsilon} \qquad (1)$$

where

E is the volume of exports,
$\varepsilon < -1$ is the foreign elasticity of demand for exports, and
$P_E$ is the fob price. For simplicity we will assume that the exchange rate is fixed at 1 so that $P_E$ is both a domestic- and foreign-currency price.

Assume that Australia's demand for imports is given by

$$M = [P_{CIF} * (1+T)]^{\eta} \tag{2}$$

where

M is the volume of imports,
$\eta < 0$ is Australia's elasticity of demand for imports,
$P_{CIF}$ is the cif price of imports, and
T is the tariff rate so that $P_{CIF} * (1+T)$ is the price paid by Australian consumers of imports (the landed-duty-paid price).

In this paper, including the MONASH simulations reported in Sections 3 to 5, we adopt the small-country assumption for imports. That is, we treat $P_{CIF}$ as an exogenous variable, determined independently of changes in tariff rates. This seems a reasonable assumption for Australia which accounts for only a small fraction of exports from most countries. Under this assumption, the terms-of-trade effect of a tariff reduction is purely the result of a decrease in export prices associated with an increase in export volumes.[1] There is no additional effect via import prices. With $P_{CIF}$ fixed, we can assume without loss of generality that its value is one. This is convenient because it allows us to drop it from the algebra.

Finally, assume that trade is balanced, i.e.,

$$M = P_E * E \quad . \tag{3}$$

Now change the tariff rate by a small amount $\Delta T$. The change in welfare is given by

$$\Delta W = \Delta M * T + \Delta P_E * E \quad . \tag{4}$$

The first term on the RHS of (4) is the efficiency effect. This can be worked out from Figure 2.1 which shows Australia's demand curve from imports as DD. When the tariff is reduced by $\Delta T$ from its initial level of T, imports increase by $\Delta M$. On the assumption that the demand curve reflects values that Australian consumers put on units if imports, the increase in the volume of imports generates a benefit worth area ecba. The cost of this benefit to Australia is the cif value of the extra imports, area fgba.[2] Thus the net benefit to Australia of the extra imports, the efficiency effect, is area ecgf. In writing this as $\Delta M * T$, we ignore the small triangle cde. The second term on the RHS of (4) is the terms-of-trade effect. It takes account of the loss of revenue that Australia suffers through the change in the price of exports.

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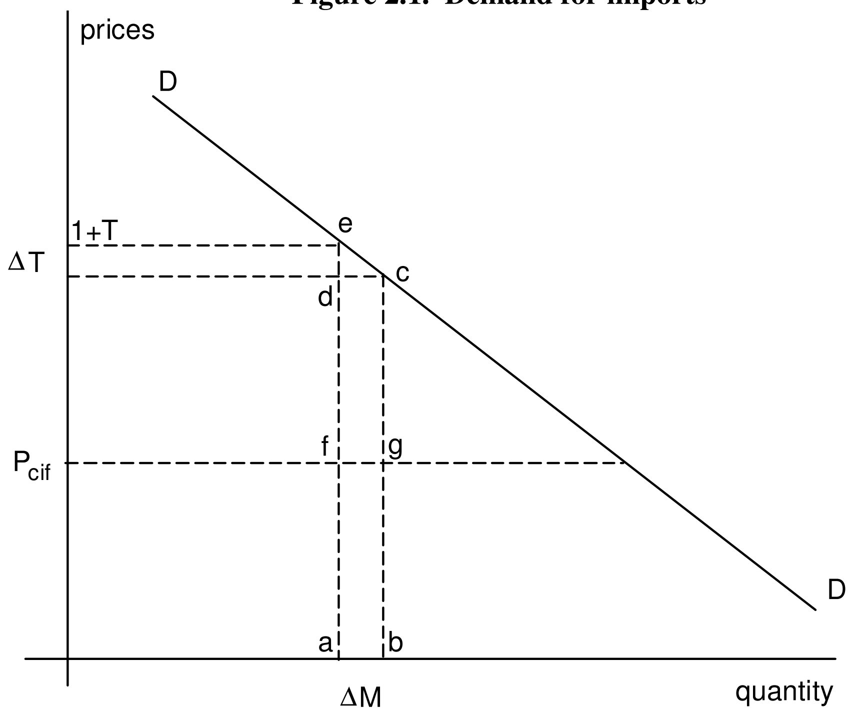
[1] There is a body of literature that emphasises the possibility that a country's tariff cuts, even those by a small country, can increase the cif prices of its imports, see for example Broda *et al.* (2006),. Thus the assumption that terms-of-trade effects flow purely from the export side may be too generous to people who advocate unilateral cuts in tariffs.

[2] An implicit assumption here is that when the import bill increases by $P_{CIF} * \Delta M$ we need to divert resources that were producing consumption goods worth this much to the production of goods for export. We examine this assumption in Section 4.

**Figure 2.1. Demand for imports**




By working with (1) – (3) and substituting into (4) we can obtain an expression for $\Delta W$ in terms of $\Delta T$. The coefficients in this expression are functions of the tariff rate T and the two elasticities $\varepsilon$ and $\eta$. In deriving the expression we start by totally differentiating of (1) - (3):

$$\Delta E = \varepsilon * P_E^{\varepsilon-1} * \Delta P_E \quad , \tag{5}$$

$$\Delta M = \eta * (1+T)^{\eta-1} * \Delta T \quad , \tag{6}$$

$$\Delta M = \Delta P_E * E + P_E * \Delta E \quad . \tag{7}$$

Multiplying (5) by $P_E$ and using (1) gives

$$\Delta E * P_E = \varepsilon * P_E^{\varepsilon} * \Delta P_E = \varepsilon * \Delta P_E * E \quad . \tag{8}$$

Combining (7) and (8) gives

$$\Delta M = \Delta P_E * E * (1+\varepsilon) \quad . \tag{9}$$

Substituting into (4) we obtain[3]

$$\Delta W = \Delta M * T + \Delta M * \left(\frac{1}{1+\varepsilon}\right) \quad . \tag{10}$$

Finally, we combine (6) and (10) to give our desired expression for $\Delta W$ :

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[3] In the special case in which M is a linear function of T (so that $\partial M / \partial T$ is a constant), equation (10) supports the assertion in Section 1 that the efficiency effect (first term on the RHS) of a given small reduction in the tariff rate is proportional to the initial rate of the tariff whereas the terms-of-trade effect (second term on the RHS) is independent of the initial tariff rate. Although we do not assume that M is a linear function of T [instead we adopt (2)] the assertion is still a suggestive approximation.

$$\Delta W = \eta * (1+T)^{\eta-1} * \left( T + \frac{1}{1+\varepsilon} \right) * \Delta T \quad , \tag{11}$$

or equivalently

$$\frac{\partial W}{\partial T} = \eta * (1+T)^{\eta-1} * \left( T + \frac{1}{1+\varepsilon} \right) \quad . \tag{12}$$

Because $\eta * (1+T)^{\eta-1}$ must be negative, we can conclude from (12) that

$$\partial W / \partial T \begin{cases} > 0 & \text{if } T < -\dfrac{1}{(1+\varepsilon)} \\ < 0 & \text{if } T > -\dfrac{1}{(1+\varepsilon)} \\ = 0 & \text{if } T = -\dfrac{1}{(1+\varepsilon)} \end{cases} \tag{13}$$

implying that increases in the tariff rate from a low level [less than -1/(1+ε)] increase economic welfare but that increases in the tariff rate from a high level [greater than -1/(1+ε)] reduce economic welfare. The optimal tariff rate is given by

$$T_{optimal} = -\frac{1}{1+\varepsilon} \quad . \tag{14}$$

Figure 2.2 is a sketch of the relationship between W and T given by (12) for the case in which ε = -4 and η = -0.6. We have assumed that the starting tariff rate is 8 per cent. These values closely mirror those in our central MONASH simulation (Section 3) in which the average over all commodities of the export-demand elasticities is -4, the import demand elasticity for Motor vehicles and parts is about -0.6 and the average tariff rate applying to imports of Motor vehicles and parts is 8 per cent.

## 3. MONASH simulations for the welfare effects of unilateral changes in tariffs on Motor vehicles and parts

We conduct six series of MONASH-model[4] simulations of the long-run effects of changes in the tariff applying to motor vehicles and parts (MVP). As shown in Table 3.1, the series differ with respect to assumptions concerning:

(a) the substitution elasticity between domestically produced and imported MVP products; and

(b) the average across all products of the value of the foreign-demand elasticity for Australian exports.

The series-1 elasticity values are the standard values used in MONASH simulations for the Productivity Commission[5] and other users of the model. In the other series of experiments we investigate the effects of much larger elasticities.

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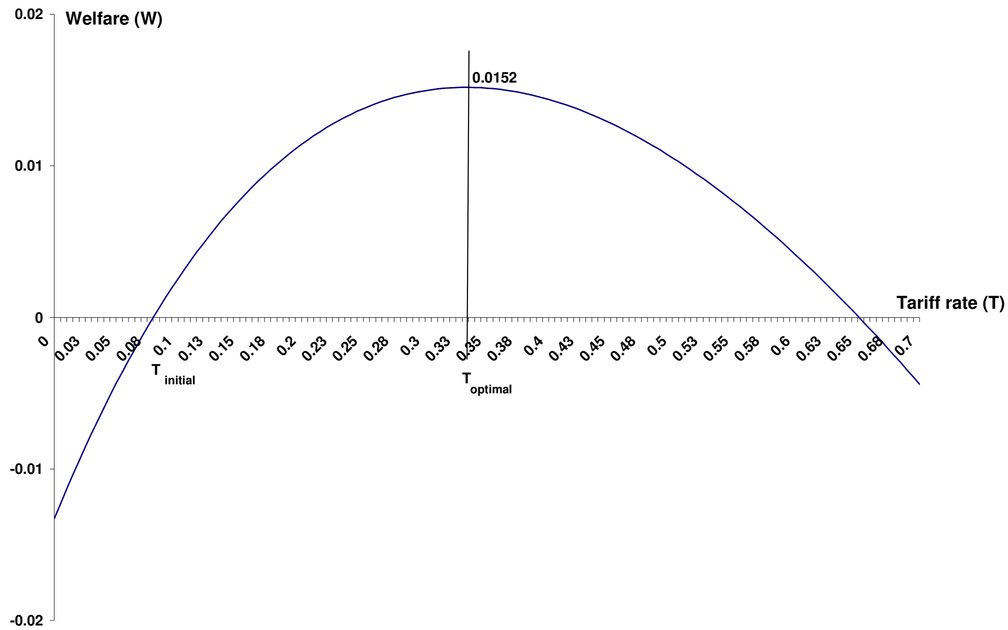
[4] MONASH is a well-known CGE model of Australia that has been applied in a large number of studies for governments and businesses. The model is described in Dixon and Rimmer (2002).

[5] See for example Industry Commission (1996, 1997) and Centre of Policy Studies (2003).

**Figure 2.2. Welfare effect of moving the tariff on imports away from 8 per cent in the simple model with ε = -4 and η= -0.6**




In interpreting the numbers on the vertical axis, it is useful to recognise that the cif value of imports in the simple model is initially 0.955 (= $1.08^{-0.6}$). The gain from moving from the initial tariff of 0.08 to the optimal tariff of 0.333 is 0.0152, that is 1.59 per cent of the initial cif value of imports (= 100*0.0152/0.955). In MONASH, imports of Motor vehicles and parts are worth 2.1 per cent of GDP. Therefore we would expect the welfare gain in MONASH from moving to the optimal tariff for Motor vehicles and parts to be about 1.59 per cent of 2.1 per cent of GDP, that is 0.0334 per cent of GDP. Public and private consumption is about 80 per cent of GDP. Thus we would expect the consumption gain to be about 0.042 per cent (= 0.0334/0.8).

**Table 3.1. Elasticity assumptions**

| | Domestic/import MVP substitution elasticity* | Average export-demand elasticity over all products |
|---|---|---|
| Series 1 | 5.2 | -4 |
| Series 2 | 10.4 | -4 |
| Series 3 | 5.2 | -8 |
| Series 4 | 10.4 | -8 |
| Series 5 | 5.2 | -16 |
| Series 6 | 10.4 | -16 |

* The import demand elasticity(η in section 2) is approximately proportional to the substitution elasticity. With the substitution elasticity at 5.2, MONASH behaves as if the import demand elasticity is about -0.64 and with the substitution elasticity at 10.4, MONASH behaves as if the import demand elasticity is about -1.28. These may seem surprisingly low (close to zero) price elasticities. However, a large part of Australia's MVP imports are used without much domestic competition as inputs to the MVP industry.

Figures 3.1, 3.2 and 3.3 show results from the six series for the effects of MVP tariff changes on private and public consumption (which are assumed to move together). The model is set up in a simple way with aggregate employment, aggregate capital, aggregate investment, industry technologies and the balance of trade held fixed. Under these assumptions, the movement in consumption is a legitimate measure of the overall welfare effect of the tariff changes. It reflects two effects identified in Section 2: the efficiency effect and the terms-of-trade effect.

All of the figures show the effects of moving MVP tariffs away from their present levels which average 8, Table 3.2. Our modelling recognizes that this average reflects different rates applying to different countries of supply. Consistent with Table 3.2, we allowed for three sources of supply: one which supplies at zero tariff; one which supplies at 5 per cent tariff; and one which supplies at 10 per cent tariff. In the movements away from this initial situation, we assume that MVP tariffs are equalized, at zero per cent, at 8 per cent, at 16 per cent, at 20 per cent etc.

The theoretical argument in Section 2 suggests that economic welfare is maximized when tariff rates are set according to (14). This formula gives an optimal tariff rate of 33 per cent if $\varepsilon = -4$, 14 per cent if $\varepsilon = -8$ and 7 per cent if $\varepsilon = -16$. As can be seen from Figures 3.1 to 3.3, our results are highly consistent with this elementary theory.

Other prominent features of the results are:

(a) that there are consumption gains at the tariff rate of 8. These gains arise from equalizing the tariff rates, thereby eliminating distortions in Australia's choice between foreign suppliers.

(b) that the substitution elasticity plays an accentuating role. With a larger substitution elasticity (10.4 instead of 5.2) tariff movements cause larger changes in MVP imports and thus (via the balance of trade assumption) larger changes in exports. This accentuates both the terms-of-trade and the efficiency effects of tariff movements.

(c) that higher export-demand elasticities (-8 and -16 rather than -4) reduce the positive terms-of-trade effect without affecting the efficiency effect. Thus, with high export-demand elasticities, the gains from moving even to the optimal tariff are small and the losses from moving to high tariffs can be significant.

(d) that the welfare effects of reducing tariffs are moderate. Five of the six series show negative effects from equalizing the MVP tariffs at zero. The largest of these negative effect, -0.04 per cent or about $320m, occurs in series 2. Series 5 gives a welfare gain from moving the tariff rates to zero of 0.0049 per cent or about $39m. In series 5, the welfare benefit of equalizing MVP tariffs at 8 slightly outweighs the welfare loss of moving the tariffs from 8 to zero.

**Figure 3.1. Percentage effects on aggregate consumption of moving MVP tariff rates away from their present levels (averaging 8): MONASH series 1 and 2**

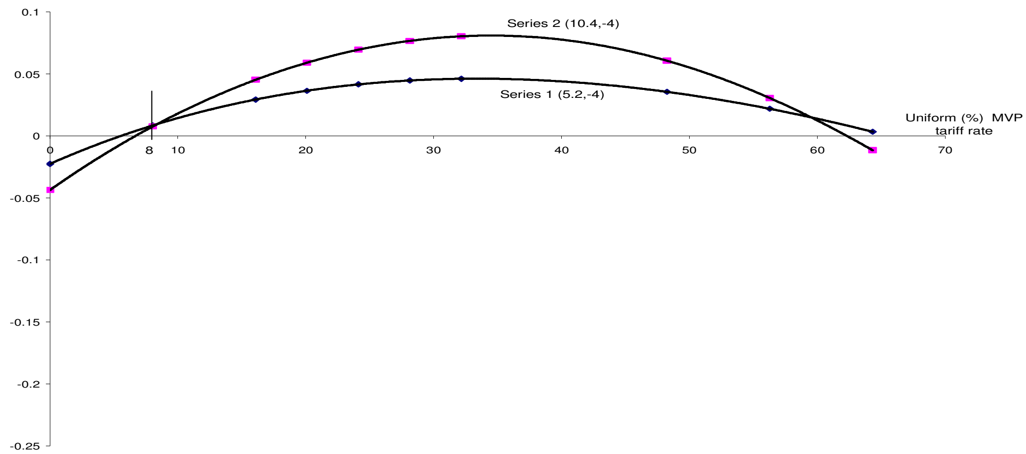



**Figure 3.2. Percentage effects on aggregate consumption of moving MVP tariff rates away from their present levels (averaging 8): MONASH series 3 and 4**

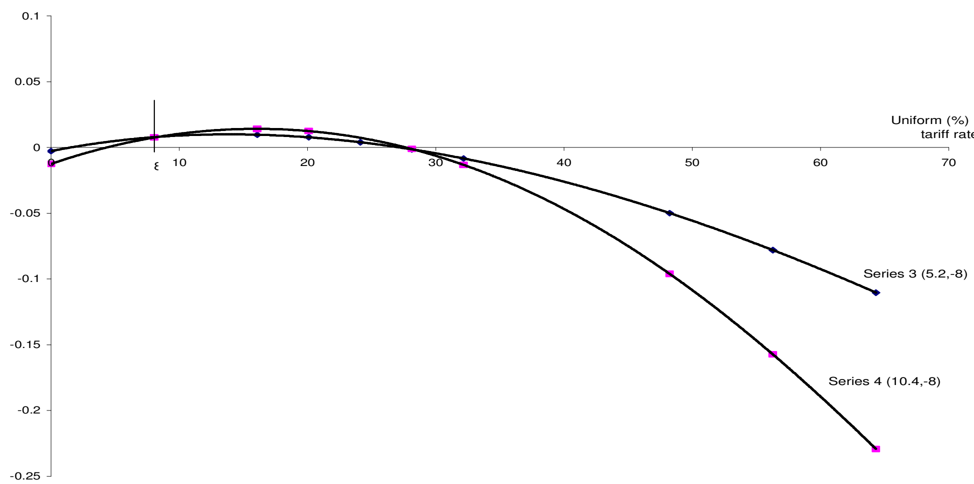



**Figure 3.3. Percentage effects on aggregate consumption of moving MVP tariff rates away from their present levels (averaging 8): MONASH series 5 and 6**

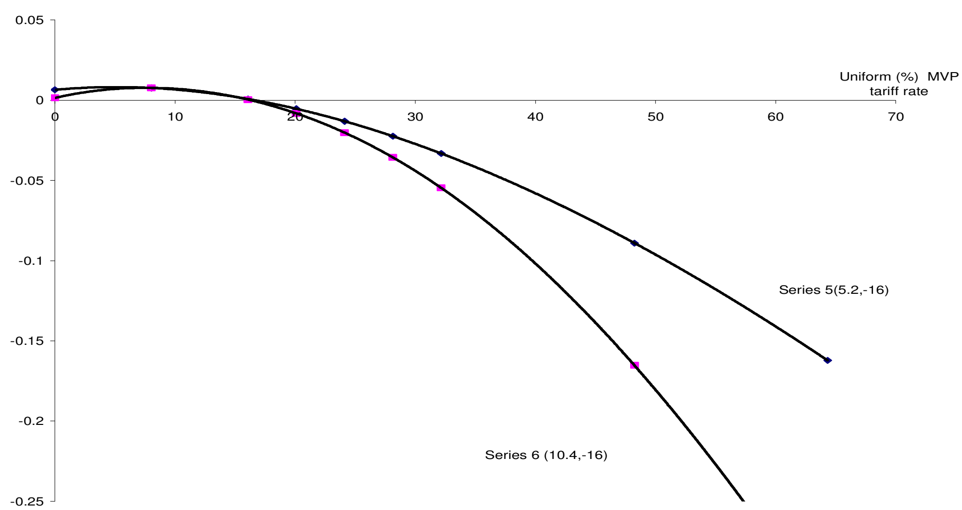


**Table 3.2. Tariff rates for MVP imports, 2005+**

| | Tariff rate (%) | Per cent of MVP cif imports |
|---|---|---|
| | 0 | 3.7* |
| | 5 | 31.7 |
| | 10 | 64.5 |
| Average | 8 | |

+ Derived from data extracted by the Productivity Commission from World Integrated Trade Solutions.
* Includes a very small amount of imports with tariff rate of 2.5 per cent.

## 4. MONASH simulations of the welfare effects of unilateral changes in tariffs on Motor vehicles and parts: the implications of non-competitive export behaviour

### *4.1. Theory*

When we cut MVP tariffs, the extra MVP imports must be paid for via extra exports of minerals, agricultural products, etc. Under our balance-of-trade assumption, the extra exports have a fob value that is equal to the cif value of the extra imports. A fundamental assumption of the theoretical analysis in Section 2 is that the resources used to produce the extra exports have an opportunity cost equal to the fob value of the extra exports and thus equal to the cif value of the extra imports (see Figure 2.1 and footnote 2). However, this may not be a satisfactory simplification. Consider, for example, the situation in which exports are taxed by the exporting country. In this case, the fob value of the extra exports will be greater than the opportunity cost of the resources used to produce the extra exports, and our analysis is Section 2 will underestimate the net benefit to Australia of extra imports. In terms of Figure 2.1, the efficiency gain from cutting tariffs is greater than area ecgf because the exporting country gives up consumption worth less than area fgba to pay for the extra imports.

In the Australian case export taxes are not a major consideration. However, export taxes are not the only possible reason for supposing that the opportunity cost of resources used in additional exporting might be less than the value of the exports. Corden (1997, pp. 89-90) draws attention to the potential role of non-competitive behaviour by exporters. For example, assume that Australian exporters of a given commodity are able to organize themselves so as to maximise industry profits. With the foreign elasticity of demand for their product being ε, they will set their export price ($P_E$) according to the formula:[6]

$$\frac{P_E}{MC} = \frac{\varepsilon}{1+\varepsilon} \quad , \tag{15}$$

where MC is their marginal cost of production. For long-run analysis of the type presented in Section 3, it is reasonable to suppose that marginal costs are equal to average costs. Under this assumption, (15) can be rewritten as:

$$AC = \frac{1+\varepsilon}{\varepsilon} * P_E \quad . \tag{16}$$

---

[6] The industry will set its price and quantity so that marginal revenue (MR) equals marginal cost (MC). Under (1), the industry's revenue, $P_E$*E, is equal to $E^{(1+1/\varepsilon)}$. From here we find that

$$MR = (1+1/\varepsilon) * E^{1/\varepsilon} = \frac{1+\varepsilon}{\varepsilon} * P_E \quad ,$$

quickly leading to (15).

With AC representing the opportunity cost of a long-run unit expansion of exports, equation (16) implies that the value of consumption that must be given up to pay for extra imports is only the fraction (1+ε)/ε of the cif value of the extra imports. Thus, for example, if ε = -4, then extra imports with a cif value of $1 can be paid for by exports that absorb resources with a value of only $0.75 in alternative uses. Put another way, if (16) is applicable then the fundamental assumption of Section 2 (that extra imports are paid for by extra exports whose production has an opportunity cost equal to the cif value of the extra imports) generates an under-estimation of the welfare value of the extra imports worth 1/(-ε) times their cif value.

We doubt that monopolistic profit-maximizing behaviour of the type leading to (15) is a realistic description of pricing in Australia's agricultural, manufacturing and service industries. For mining though, it may be more applicable. In any case, where S is the share of Australian exports in which monopolistic pricing is applicable, we can take account of this behaviour in our theoretical welfare analysis by modifying equation (4) to

$$\Delta W = \underbrace{\left\{ \Delta M * T + \Delta M * \left( \frac{S}{-\varepsilon} \right) \right\}}_{\textit{efficiency effect}} + \underbrace{\Delta P_E * E}_{\textit{terms-of-trade effect}} \quad . \tag{17}$$

The extra term [ ΔM*S/(-ε)] in the efficiency effect corrects for the under-estimation of the welfare value of the extra imports inherent in the original formula, (4).

Using (5) – (7) we can derive from (17) a new expression for $\partial W/\partial T$ to replace (12):

$$\frac{\partial W}{\partial T} = \eta * (1+T)^{\eta-1} * \left( T + \frac{1}{1+\varepsilon} - \frac{S}{\varepsilon} \right) \quad . \tag{18}$$

Recalling that $\eta * (1+T)^{\eta-1}$ is negative, we conclude from (18) that with the recognition of monopolistic export pricing

$$\partial W / \partial T \begin{cases} > 0 \quad \text{if } T < -\dfrac{1}{(1+\varepsilon)} + \dfrac{S}{\varepsilon} \\ < 0 \quad \text{if } T > -\dfrac{1}{(1+\varepsilon)} + \dfrac{S}{\varepsilon} \\ = 0 \quad \text{if } T = -\dfrac{1}{(1+\varepsilon)} + \dfrac{S}{\varepsilon} \end{cases} \tag{19}$$

implying that the optimal tariff rate in the monopoly-pricing model, $T^M_{\text{optimal}}$, is

$$T^M_{\text{optimal}} = -\frac{1}{1+\varepsilon} + \frac{S}{\varepsilon} \quad . \tag{20}$$

S/ε is less than zero. Consequently, with monopoly export pricing the optimal tariff is reduced. It is also clear from (18) that at any value of T the recognition of monopoly pricing reduces $\partial W/\partial T$. Thus, referring to Figure 2.2, we would expect the introduction of monopoly pricing to cause the W-T curve to peak at a lower value for W.

In Figure 4.1 we have sketched the relationships between W and T given by (12) and (20) for the case in which ε = -4 and η = -0.6. As in Figure 2.2, we have assumed that the starting tariff rate is 8 per cent. For relationship (20) we have assumed that S = 0.267. This is the share of Australia's exports accounted for by mining in the database for the MONASH model. As can be seen from Figure 4.1, the introduction of monopoly pricing causes the W-T curve to shrink to the south west.

### *4.2. MONASH simulations with monopoly pricing*

We conduct two further series of MONASH-model simulations of the long-run effects of changes in the tariffs applying to MVP, series 7 and 8. In these series we assume that monopolistic pricing, equation (15), applies to Australia's mining industries which account for 26.7 per cent of exports. In both series, export-demand elasticities average -4 over all commodities and are exactly -4 for the commodities in which monopoly export pricing applies. We do not report monopolistic series for ε = -8 and ε = -16: at these values monopoly power has a negligible impact on the welfare effects of tariff changes. As shown in Table 4.1, series 7 and 8 differ with respect to assumptions concerning the substitution elasticity between domestically produced and imported MVP products.

Results from series 7 and 8 are given in Figures 4.2 and 4.3. To assist comparison, these figures also show earlier results from series 1 and 2. As expected on the basis of our theoretical analysis, the introduction of monopoly pricing for mining exports causes the W-T curves to shrink towards the south west. Nevertheless, the optimal MVP tariff still remains well above the average current level of 8. In both series 7 and 8 the optimal tariff is about 27 per cent, closely consistent with the theoretical formula (20).

**Figure 4.1. Welfare effect of moving the tariff on imports away from 8 per cent in the simple model with ε = -4 and η= -0.6: monopolistic versus competitive pricing**

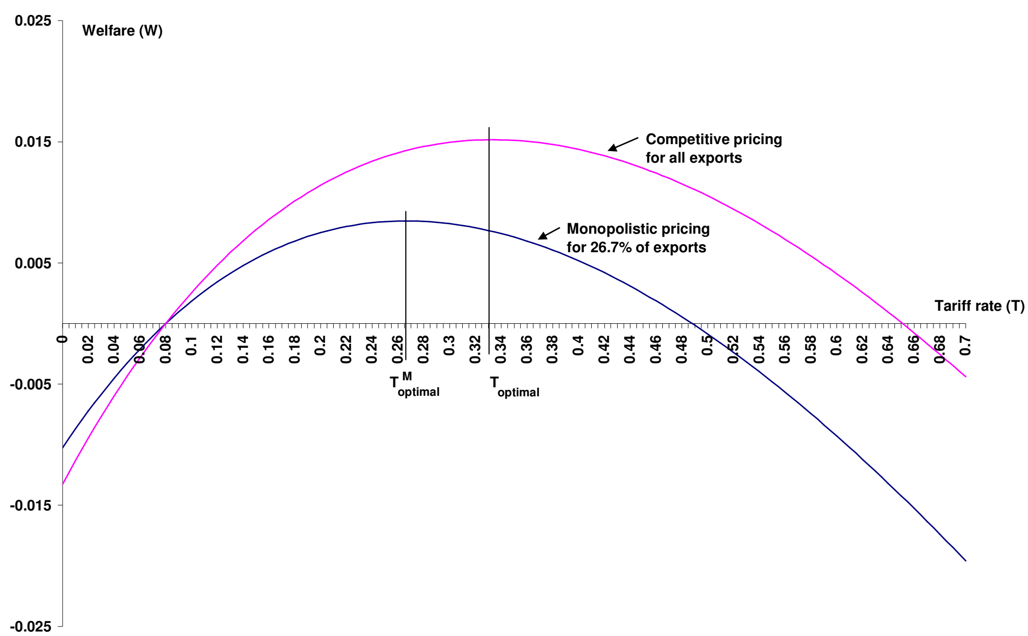


**Figure 4.2. Competitive versus Monopolistic export pricing, % effects on consumption of moving MVP tariff rates from their present levels: MONASH series 1 and 7**

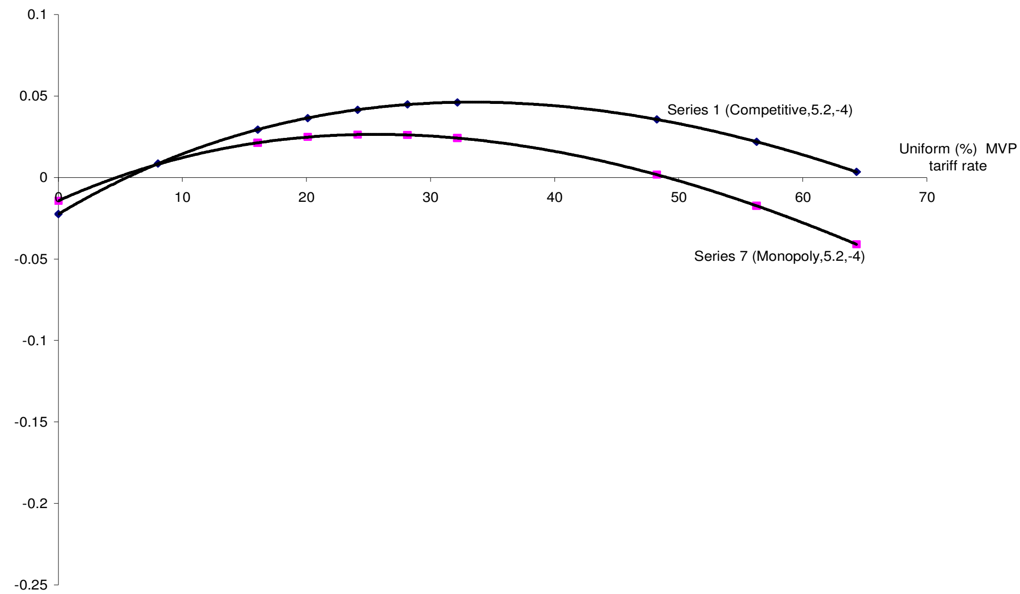



**Figure 4.3. Competitive versus Monopolistic export pricing, % effects on consumption of moving MVP tariff rates from their present levels: MONASH series 2 and 8**

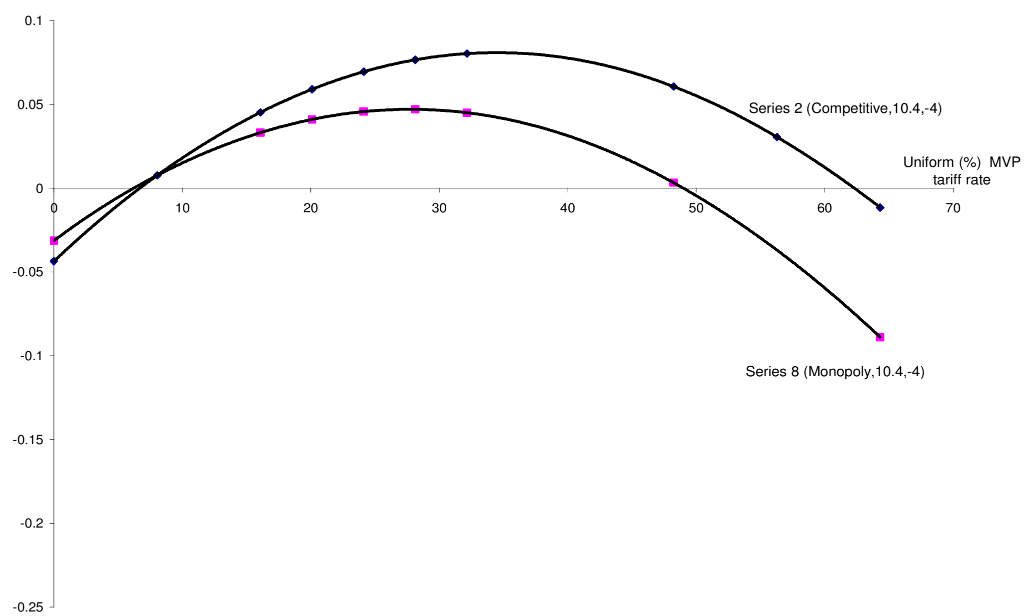


**Table 4.1. Elasticity and competitiveness assumptions**

| | Competitiveness of Australian exporters | Domestic/import MVP substitution elasticity | Average export-demand elasticity over all products |
|---|---|---|---|
| Series 7 | Mining industries monopolistic, others competitive | 5.2 | -4 |
| Series 8 | Mining industries monopolistic, others competitive | 10.4 | -4 |

## 5. MONASH simulations for the welfare effects of unilateral MVP tariff changes: the implications of dead-weight losses in revenue collection

### *5.1. Theory*

Cuts in tariffs are just like cuts in any other taxes in that they cost the government revenue. In the simulations discussed in Sections 3 and 4 we have implicitly assumed that this revenue is replaced in a way that causes no further *net* welfare-affecting distortions beyond those concerned with the allocation of resources between export and import-competing activities. We have ignored distorting effects of both tariffs and replacement taxes on incentives to work (labour-leisure choice) and on resource-consuming avoidance and evasion activities.

Ignoring these distorting effects would be justified if we were confident that the distortion-reducing effect of raising $x less revenue from tariffs is exactly offset by the distortion-increasing effect of raising $x more revenue via the replacement tax. However, we cannot be confident about this.

In the MONASH simulations we assume that replacement of lost tariff revenue is achieved by an across-the-board increase in the income-tax rate. The MONASH simulations reported in Sections 3 and 4 do not take account of distorting effects of taxes on incentives to work or avoidance/evasion activities. However, research by Freebairn (1995), Campbell and Bond (1997) and others suggest that these effects may, at the margin, impose deadweight losses worth 20 to 30 per cent of revenue raised.[7] That is, if we raise $1 of extra revenue via an across-the-board increase in income tax rates, then the welfare of households is reduced by an amount that is equivalent to what would happen with the imposition of a poll tax (distortion free) of between $1.20 and $1.30. Even higher numbers have been obtained for other countries. For example, in a prominent U.S. study, Feldstein (1999) concludes by saying that

> "*the analysis implies that a marginal increase in tax revenue achieved by a proportional rise in all personal income tax rates involves a deadweight loss of two dollars per incremental dollar of revenue*".

To get a number as high as two, we need to believe in a strong Laffer effect (the idea that increases in a tax rate strongly reduce the tax base).[8] In this case, increases in income-tax rates raise rather little revenue while at the same time causing distortions, so that the ratio of extra deadweight loss to extra revenue can be very large.

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[7] Numbers such as these are also mentioned in popular discussions, see for example Kerin (2008).
[8] For an exposition of the Laffer effect, see Laffer (2004).

We know of no Australian estimates of the marginal deadweight losses (beyond trade-distorting effects) of tariff revenue. Sources of deadweight loss that come to mind are that increased tariff rates could induce resource-using smuggling efforts or efforts to avoid/evade tariffs by redirecting imports through countries having an FTA with Australia. However, for low tariffs such as the current MVP tariffs, we suspect that non-trade-related distorting effects are low.

To help us speculate about the potential importance of revenue replacement, we extend the algebra of subsection 4.1 by assuming that the difference between the marginal deadweight loss of revenue raised via an across the board increase in income-tax rates and the marginal deadweight loss (beyond trade-distorting effects) of revenue raised via tariffs is D.[9] Then (17) becomes

$$\Delta W = \underbrace{\left\{ \Delta M * T + \Delta M * \left( \frac{S}{-\varepsilon} \right) \right\}}_{\textit{efficiency effect}} \quad + \quad \underbrace{\Delta P_E * E}_{\textit{terms-of-trade effect}} \quad + \quad \underbrace{D * \Delta(T * M)}_{\textit{revenue-replacement cost}} . \tag{21}$$

The additional term recognises that replacement of the lost tariff revenue imposes a deadweight loss of D times the lost revenue. Using the differential form

$$\Delta(T*M) = \Delta T*M + T*\Delta M \tag{22}$$

we can quickly rework the algebra in subsection 4.1 to obtain

$$\frac{\partial W}{\partial T} = \eta * (1+T)^{\eta-1} * \left( T * [1 + D*(1+\eta)/\eta] + \frac{1}{1+\varepsilon} - \frac{S}{\varepsilon} + \frac{D}{\eta} \right) . \tag{23}$$

In interpreting (23), it is reasonable to restrict attention to situations in which

$$\eta < \frac{-D}{1+D} . \tag{24}$$

This condition is comfortably met if D is between 0 and 1 and $\eta$ = -0.64 or -1.28 as assumed for MVP imports in the MONASH simulations. Under (24), $[1+D*(1+\eta)/\eta]>0$. Recalling that $\eta*(1+T)^{\eta-1}$ is negative, we can conclude from (23) that

$$\partial W/\partial T \begin{cases} >0 & \text{if } T < \left[ -\frac{1}{(1+\varepsilon)} + \frac{S}{\varepsilon} - \frac{D}{\eta} \right] \Big/ [1+D*(1+\eta)/\eta] \\ <0 & \text{if } T > \left[ -\frac{1}{(1+\varepsilon)} + \frac{S}{\varepsilon} - \frac{D}{\eta} \right] \Big/ [1+D*(1+\eta)/\eta] \\ =0 & \text{if } T = \left[ -\frac{1}{(1+\varepsilon)} + \frac{S}{\varepsilon} - \frac{D}{\eta} \right] \Big/ [1+D*(1+\eta)/\eta] \end{cases} \tag{25}$$

implying that the optimal tariff rate in the theoretical model with both monopolistic export pricing and revenue-replacement costs, $T_{optimal}^{M\&R}$, is

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[9] We treat D as a parameter. Ideally, we should allow D to fall as the tariff rate rises and the rate of the replacement tax falls. We have omitted this complication because: (a) we focus on what seems to be a very low value of D (0.05); and (b) we are concerned mainly with the effects of tariff changes around their present value.

$$T_{optimal}^{M\&R} = \left[ -\frac{1}{1+\varepsilon} + \frac{S}{\varepsilon} - \frac{D}{\eta} \right] \Big/ \left[ 1 + D*(1+\eta)/\eta \right] \quad . \tag{26}$$

Assuming that D > 0 (that is, apart from trade distortions tariffs are a relatively benign tax) then (23) implies that the recognition of the cost of replacement taxes in our analysis raises the value of $\partial W/\partial T$ at all values of T, raises the optimal tariff, and moves the W-T relationship in a north-easterly direction.[10] In Figure 5.1 we have sketched the relationships between W and T given by (12), (20) and (23) for the case in which $\varepsilon$ = -4, $\eta$ = -0.6, S = 0.267, the starting tariff is 8 per cent and D is set at a seemingly moderate value of 0.05. With this setting for D, we are assuming that the marginal deadweight loss of collecting $1 from income taxes is only 5 cents higher than marginal deadweight loss (apart from trade distortions) of collecting $1 from tariffs.

A final noteworthy implication of assuming that D > 0 is that the optimal tariff can be significantly above zero even if the export-demand elasticity is very large in absolute size (the small country case). For example, if $\varepsilon = -\infty$, $\eta$ = -0.6 and D = 0.05, then for any value of S, (26) gives the optimal tariff as 8.6 per cent.

### *5.2. MONASH simulations with monopoly pricing and costs of revenue replacement*

To illustrate the potential effects of deadweight losses associated with replacement of lost tariff revenue, we modified the MONASH model by adding an equation specifying a reduction in economy-wide total-factor productivity of 5 per cent of the change in tariff revenue. In terms of the algebra in subsection 5.1, we set D at 0.05. As mentioned earlier, we think this is a conservative assumption when replacement is done by an across-the-board change in income-tax rates.

With this modification in place, we ran six additional series of MONASH simulations, see Table 5.1. Results from these additional simulations together with those from earlier simulations are shown in Figures 5.2 to 5.7.

The inclusion of revenue-replacement costs in the MONASH simulations has the effects that could be anticipated on the basis of the theory in subsection 5.1. In each case, revenue-replacement costs move the W-T curve to the north east. In Figure 5.2, revenue-replacement costs happen to approximately offset the effects of monopoly pricing in mining, so that the W-T curve for series 9 is close to that for series 1 (the simplest simulation, without monopoly or revenue-replacement costs). In Figure 5.3, the inclusion of revenue-replacement costs has a less pronounced effect on the W-T curve than it had in Figure 5.2. With a higher demand elasticity for MVP imports, increases in tariff rates generate smaller increases in tariff revenue. Consequently as we move from series 9 in Figure 5.2 to series 10 in Figure 5.3, increases in tariffs have less advantage in terms of providing revenue with low avoidance and incentive costs.

In Figures 5.4 to 5.7, we compare competition results with monopoly-plus-revenue-replacement results. We leave out the monopoly case because with high export-demand elasticities (-8 and -16) the results for this case are almost indistinguishable from those for the competition case. As mentioned in subsection 4.2, if export-demand elasticities are high, then monopoly power is largely irrelevant.

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[10] From (23), $\partial^2 W/\partial D \partial T = (1+T)^{\eta-1} * [T*(1+\eta)+1)]$. For relevant values of T and $\eta$, (say T<0.5 and $\eta$>-3) $\partial^2 W/\partial D \partial T > 0$. Thus, introducing a positive value for D increases $\partial W/\partial T$ at all relevant values of T.

**Figure 5.1. Welfare effect of moving the tariff away from 8 per cent in simple models with ε = -4 and η= -0.6: competitive pricing, monopolistic pricing and monopolistic pricing plus cost of revenue replacement**

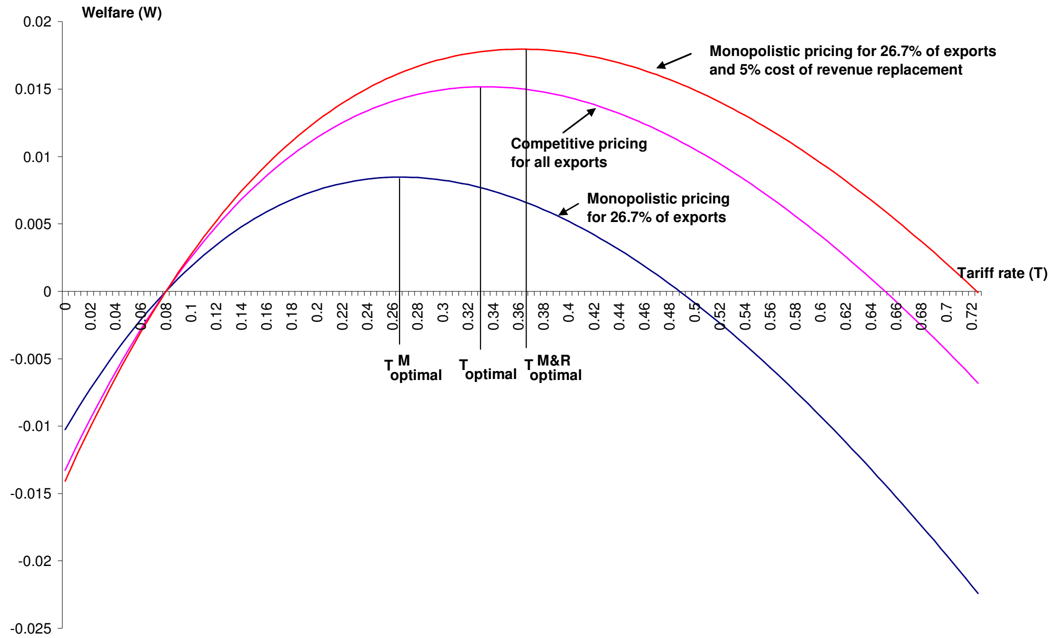



**Table 5.1. Elasticity and competitiveness assumptions**

| | Revenue replacement cost (D) | Competitiveness of exporters | Dom/imp MVP substitution elasticity | Ave. export-demand elasticity |
|---|---|---|---|---|
| Series 9 | 0.05 | Mining monopolistic | 5.2 | -4 |
| Series 10 | 0.05 | Mining monopolistic | 10.4 | -4 |
| Series 11 | 0.05 | Mining monopolistic | 5.2 | -8 |
| Series 12 | 0.05 | Mining monopolistic | 10.4 | -8 |
| Series 13 | 0.05 | Mining monopolistic | 5.2 | -16 |
| Series 14 | 0.05 | Mining monopolistic | 10.4 | -16 |

**Figure 5.2. Percentage effects on consumption of moving MVP tariff rates from their present levels: series 1, 7 and 9**

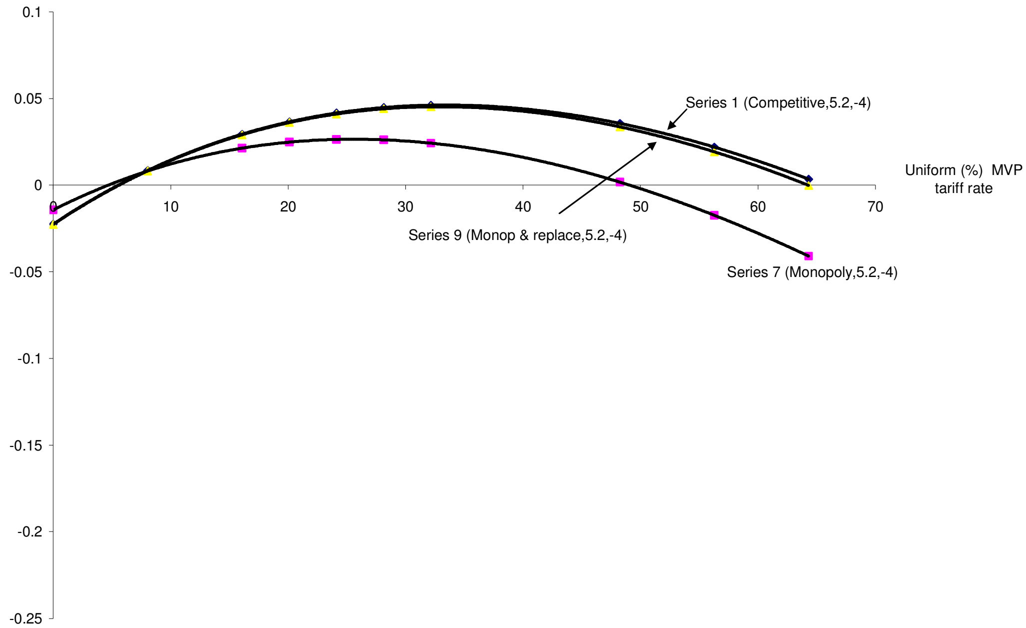



**Figure 5.3. Percentage effects on consumption of moving MVP tariff rates from their present levels: series 2, 8 and 10**

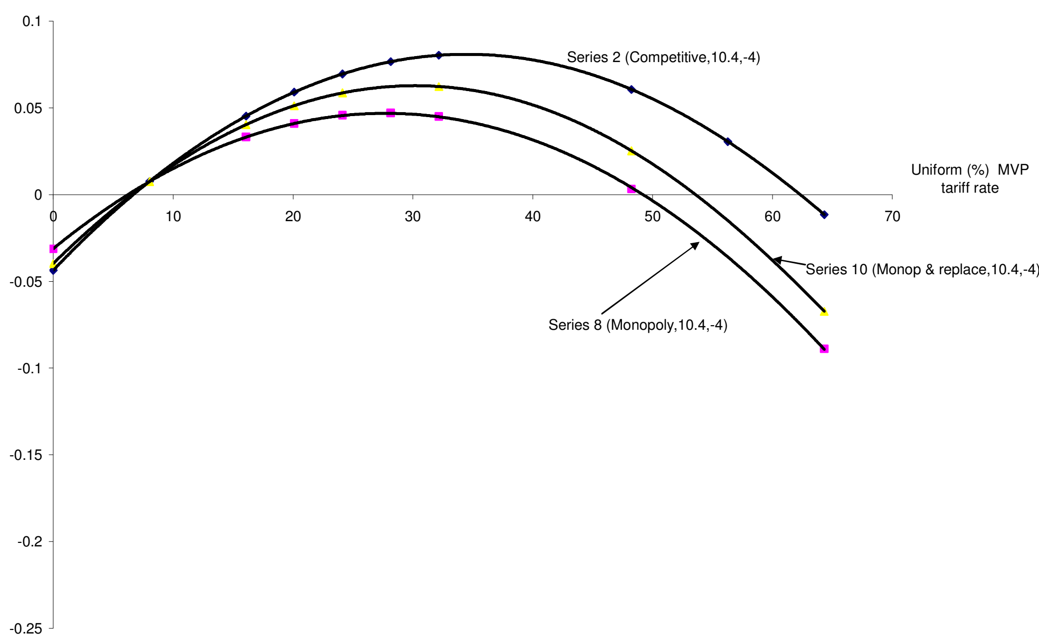


**Figure 5.4. Percentage effects on consumption of moving MVP tariff rates from their present levels: series 3 and 11**

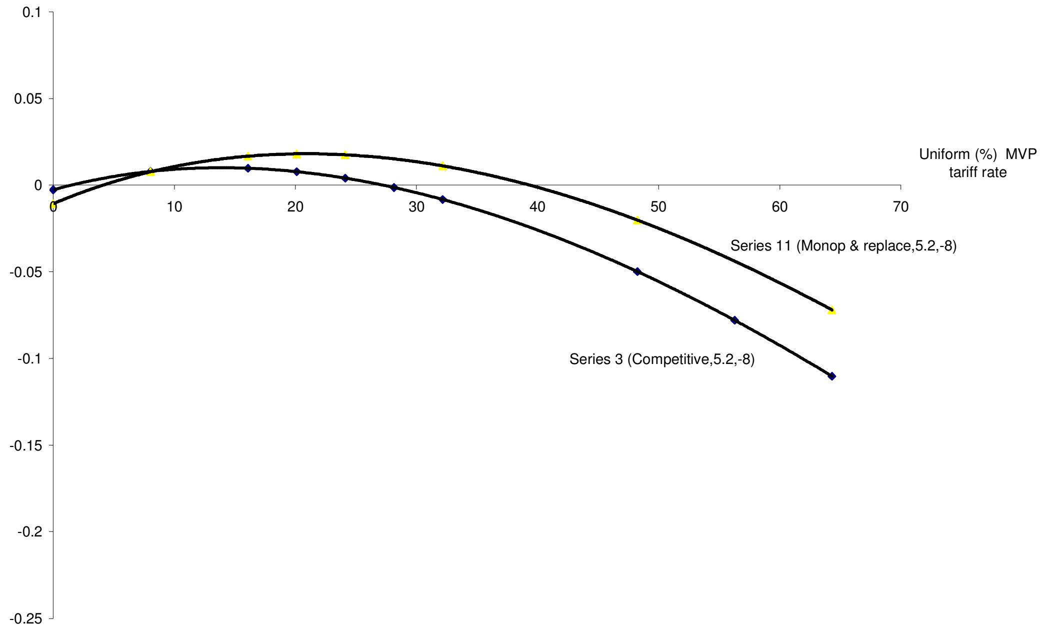



**Figure 5.5. Percentage effects on consumption of moving MVP tariff rates from their present levels: series 4 and 12**

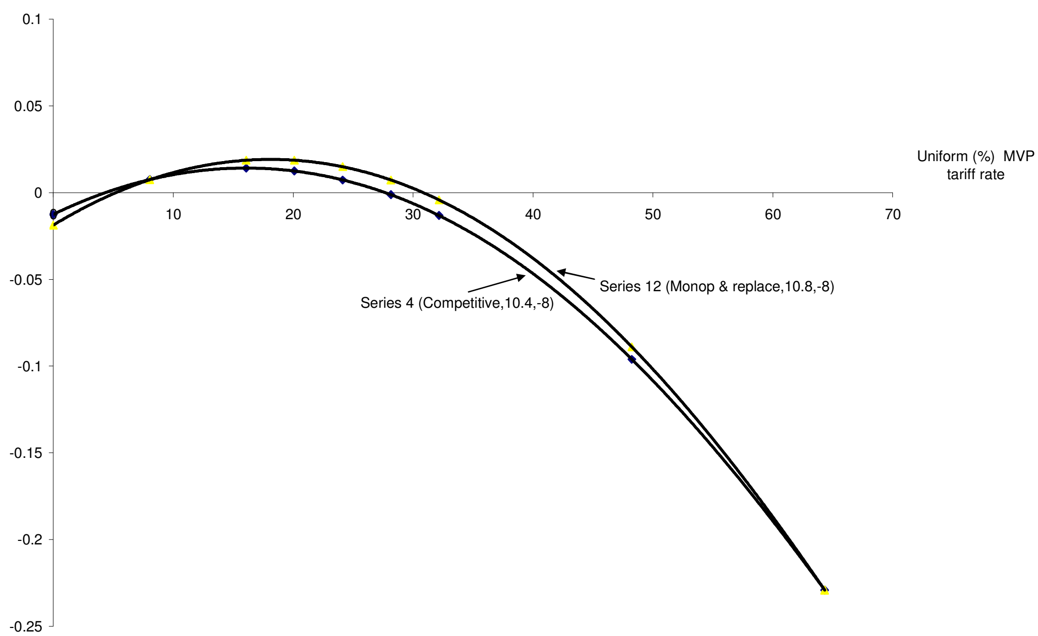


**Figure 5.6. Percentage effects on consumption of moving MVP tariff rates from their present levels: series 5 and 13**

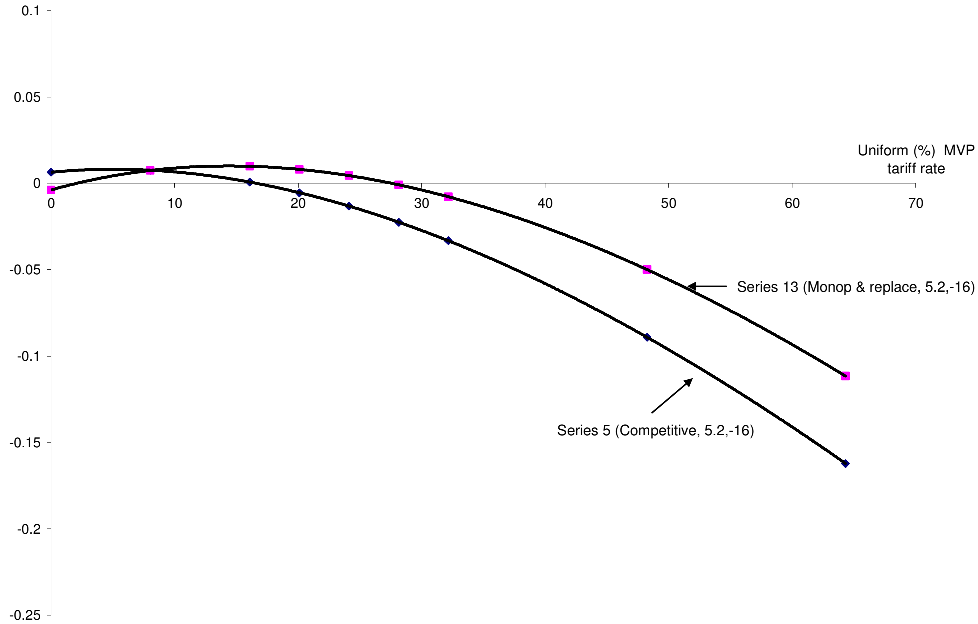
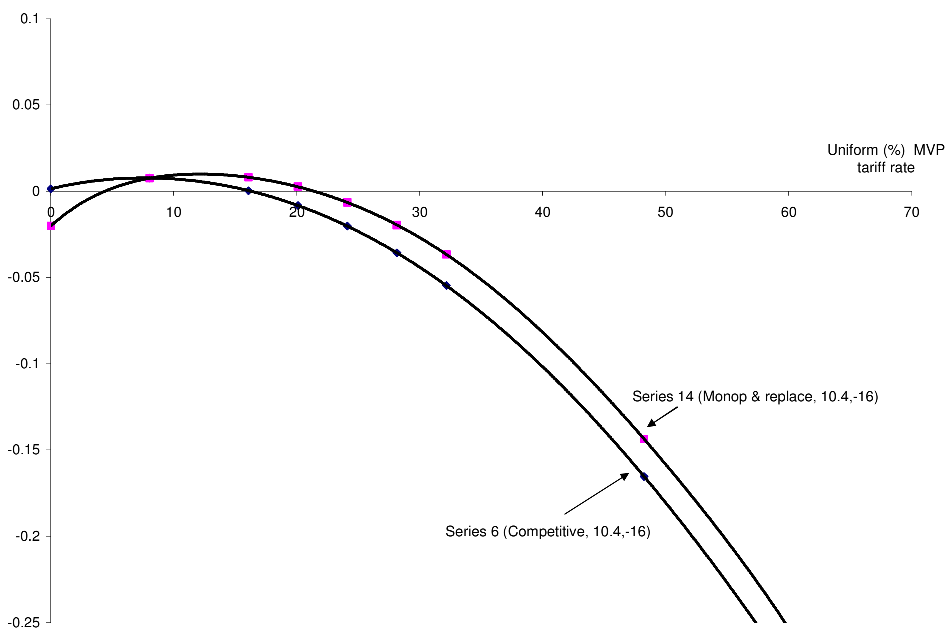



**Figure 5.7. Percentage effects on consumption of moving MVP tariff rates from their present levels: series 6 and 14**



The results in Figures 5.4 to 5.7 confirm that revenue-replacement costs can imply optimal tariff rates that are significantly above zero even if export-demand elasticities are very high. For example, series 13 and 14, with export-demand elasticities at -16, imply optimal tariff rates of about 14 per cent.

## 6. What do we know about export-demand elasticities for Australia?

It is easy to write down a definition of the export-demand elasticity for a commodity: it is the percentage change in foreign demand caused by a one per cent increase in the foreign-currency fob price. Table 6.1 helps us to interpret what this really means. Consider for a moment the currently booming price of Australia's iron ore exports, reflecting strong foreign demand and infrastructure-constrained supply. According to Table 6.1, an export-demand elasticity of -16 means that if Australia could relax supply constraints sufficiently to double its exports, then this extra supply would reduce the price by only 4.2 per cent. On the other hand, if the export-demand elasticity is -3, then a doubling of supply would reduce the price of the Australian product by 20.6 per cent. Where on Table 6.1 should we locate Australian products?

In describing the setting of export-demand elasticities for the ORANI model, Dixon *et al.* (1982, p. 195) wrote that

> *"Substantial differences of opinion exist among Australian economists as to the extent to which Australia can exert market power for individual export commodities. Little convincing econometric evidence is available to assist in resolving these differences."*

In similar vein, in commenting on estimates of export-demand elasticities, Corden (1997, p. 96) wrote

> *"There are great statistical problems, and it is apparent that not too much reliance can be placed on any of the figures that have been calculated; curves shift, circumstances change, and other things are, regrettably, never equal."*

Despite the uncertainties, for quantitative modelling we cannot avoid making judgements about export-demand elasticities. The builders of the ORANI model generally came down on the side of high elasticities. They were guided by Freebairn (1978) who calculated export-demand elasticities via formulas in which Australia was viewed as exporting commodities that are indistinguishable from those of foreign competitors. Under this assumption, export-demand elasticities must be high for all commodities in which Australia has only a small share of the world market. Consequently in the ORANI model export-demand elasticities were set at numbers between -10 and -20 for all commodities except wool and prepared fibres (a derivative of wool). The use of high export-demand elasticities in ORANI was criticized vigorously by Cronin (1979).

Since the construction of the ORANI model in the 1970s no definitive econometric evidence has been found to resolve the issue of export-demand elasticities. However, the market place has changed and economic theory has moved on. Branding, including country of origin identification, has become ever more important in the market place and product differentiation now plays a dominant role in modern trade theory. Products in which differentiation is clearly important, such as tourism, education, wine and seafood, have become major components of Australia's exports. Even for traditional mineral and agricultural exports, we now recognize that Australian varieties are distinguishable from those produced in the rest of the world. For example, Australian black coal has distinguishing properties of environmental relevance.

**Table 6.1. Interpreting export-demand elasticities***

| Export demand elastities (ε) | Percentage reduction in fob price to allow a doubling of demand |
|---|---|
| -1 | -50.0 |
| -2 | -29.3 |
| -3 | -20.6 |
| -4 | -15.9 |
| -5 | -12.9 |
| -6 | -10.9 |
| -7 | -9.4 |
| -8 | -8.3 |
| -9 | -7.4 |
| -10 | -6.7 |
| -11 | -6.1 |
| -12 | -5.6 |
| -13 | -5.2 |
| -14 | -4.8 |
| -15 | -4.5 |
| -16 | -4.2 |
| -17 | -4.0 |
| -18 | -3.8 |
| -19 | -3.6 |
| -20 | -3.4 |

* Numbers in the second column are computed as 100*(P-1) where $P = 2^{(1/\varepsilon)}$.

In view of these developments, the builders of the MONASH model in the 1990s set the export-demand elasticities using a formula that recognises the role of product differentiation.[11] As a starting point for their formula they imagined that agents in foreign countries determine their imports of Australian product i by solving a cost-minimising problem of the form:

chose $X_a(i)$ and $X_o(i)$

$$\text{to minimize } P_a(i) * X_a(i) + P_o(i) * X_o(i) \tag{27}$$

$$\text{subject to } R(i) = CES\left(\frac{X_a(i)}{B_a(i)}, \frac{X_o(i)}{B_o(i)}\right) \tag{28}$$

where

$P_a(i)$ and $P_o(i)$ are the purchasers' prices in foreign countries of good i from Australia and good i from alternative sources;
$X_a(i)$ and $X_o(i)$ are foreign demands for good i from Australia and good i from alternative sources;
$B_a(i)$ and $B_o(i)$ are variables allowing for changes in foreign preferences for good i from Australia and good i from alternative sources;
R(i) is foreign requirements for good i; and
CES(...) denotes constant-elasticity-of-substitution function.

[11] The Productivity Commission (2002, p. 305) misrepresents the MONASH approach to setting export-demand elasticities. They imply incorrectly that these elasticities were estimated by a statistical technique debunked by Orcutt (1950).

Next, they specified the purchasers' price to foreigners of good i from Australia as a combination of the fob price [PE(i), the price at the port of exit from Australia] and of costs [Q(i)] that are incurred between the port of exit and the final destination. These separating costs include transport and insurance between Australia and foreign ports, foreign tariffs, foreign sales taxes and transport and insurance costs incurred between foreign ports and foreign users of Australian products. The specification they used was:

$$P_a(i) = PE(i)^{S_{fob}(i)} * Q(i)^{1-S_{fob}(i)} \quad . \tag{29}$$

where

$S_{fob}(i)$ is the share of the purchasers' price in foreign countries of Australian export i accounted for by the fob price.

The final step in the theory underlying the MONASH formula for export-demand elasticities is the specification of world demand for commodity i according to:

$$R(i) = G_i\left(PW(i), \text{other factors}\right) \tag{30}$$

and

$$PW(i) = P_a(i)^{S_a(i)} * P_o(i)^{1-S_a(i)} \tag{31}$$

where

$PW(i)$ is the average purchasers' price of good i in foreign countries; and

$S_a(i)$ is the share of foreign expenditures on good i devoted to the Australian variety.

On the basis of (27) to (31) the builders of MONASH derived an equation for the foreign demand curve for Australian exports of i of the form:[12]

$$x_a(i) = \varepsilon(i) * pe(i) + f(i) \quad . \tag{32}$$

where

$x_a(i)$ and $pe(i)$ are percentage changes in $X_a(i)$ and PE(i);

f(i) is a variable that shifts the position of the foreign demand curve in response to movements in:

the prices of i from alternative sources [ $P_o(i)$ ];

preferences [ $B_a(i)$ and $B_o(i)$ ];

separating costs [Q(i)]; and

factors apart from prices that drive world requirements for i [R(i)] ;and

$\varepsilon(i)$ is the foreign elasticity of demand for Australian exports of i determined according to the formula

$$\varepsilon(i) = \left[\delta(i) * S_a(i) - \phi(i) * (1 - S_a(i))\right] * S_{fob}(i) \quad . \tag{33}$$

In this formula,

$\delta(i) < 0$ is the foreign elasticity of demand for commodity i, that is the response in (30) to movements in PW(i), and

$\phi(i) > 0$ is the elasticity of substitution in foreign countries between the Australian variety of i and other varieties, that is the substitution parameter in the CES function specified by (28).

[12] For details of the derivation see Dixon and Rimmer (2002, pp. 222-225).

Formula (33) is the MONASH formula for setting export-demand elasticities. The part of the formula in square brackets recognises that an increase in the purchasers' price to foreigners of the Australian variety of good i has two effects on demand for Australian exports of i. The first effect comes from the increase in the overall price of good i. If the purchasers' price of the Australian variety increases by one per cent, then the overall price of i to foreigners increases by $S_a(i)$ per cent. This translates into a percentage change in foreign demand for good i, including the Australian variety, of $\delta(i)*S_a(i)$. The second effect comes from the increase in the price of the Australian variety relative to the price of other varieties. Holding the price of other varieties constant, a one per cent increase in the purchasers' price of the Australian variety induces a substitution effect that reduces foreign demand for the Australian variety by $\phi(i)*(1-S_a(i))$ per cent.[13] The final term on the RHS of (33), $S_{fob}(i)$, recognises that $\varepsilon(i)$ is the foreign elasticity of demand with respect to the *fob price* of the Australian variety. A one per cent increase in the fob price causes less than a one per cent increase in the purchasers' price. Assuming, reasonably, that separating costs are determined independently of fob prices, a one per cent increase in the fob price of Australian product i causes an increase in its purchasers' price in foreign countries of $S_{fob}(i)$ per cent.

In most foreign markets, Australian commodities account for only a small share of sales [$S_a(i)$ is close to zero]. Consequently, the first term in the square brackets on the RHS of (33) has little effect. The builders of MONASH accepted that most Australian products face considerable competition from substitutes produced in other countries. They attempted to reflect this by choosing values for $\phi(i)$ (known as the Armington elasticity[14]) at the upper end of the range supported by empirical research. Typically they set $\phi(i)$ at 6. They thought that a realistic value for $S_{fob}(i)$ is 0.7, so that with $S_a(i)$ close to zero they obtained a typical value for $\varepsilon(i)$ of -4.

For a few commodities (most notably wool), the Australian variety is both distinctive [$\phi(i)$ is low] and occupies a major share of foreign markets [$S_a(i)$ is comparatively large]. For such commodities, values for $\varepsilon(i)$ smaller in absolute size than 4 are appropriate. For example, if $\phi(i)$ = 3.2, $S_a(i)$ = 0.5, $S_{fob}(i)$ = 0.7 and $\delta(i)$ = -0.5, then $\varepsilon(i)$ = -1.3. This is the value currently in MONASH for the export-demand elasticity for wool.

In their 2002 and 2003 reviews of automotive and TCF assistance, the Productivity Commission were clearly unhappy with the standard MONASH export-demand elasticities. For example, in their automotive report (Productivity Commission, 2002, pages 304 and 305), they comment that

> "*the low value of 4 … , which is the standard value adopted in the MONASH model for non-traditional[15] exports, may be appropriate in a short run forecasting context, but is likely to significantly overstate the extent to which Australian producers can differentiate their products in overseas markets in the*

[13] A one per cent increase in the purchasers' price of the Australian variety relative to those of other varieties reduces the ratio of purchases from Australia to purchases from elsewhere by $\phi(i)$ per cent. This is made up of a reduction in demand for the Australian variety of $\phi(i)*(1-S_a(i))$ per cent and an increase in demand for other varieties of $\phi(i)*S_a(i)$ per cent.

[14] See Armington (1969 and 1970).

[15] In fact values like -4 are used in the MONASH model for nearly all exports.

*longer term. The intermediate value of 10 is close to the average adopted in the MM 600+ model. The high value of 20 is close to the average now preferred in the GTAP multi-country model … . High values are preferred there because:*

- *they imply a degree of product differentiation consistent with observed engineering measures of economies of scale; and*
- *they better enable multicountry models to reproduce observed historical changes in global trade patterns.*"

Surprisingly, the Commission cites no evidence to support any of this comment.

It is clear from Murphy (2002, p. 10) that his use of high elasticities in MM600+ is a judgement, not supported by empirical evidence. We also note that in Murphy's econometrically estimated macro model the standard value for the export-demand elasticity is -3.4 (see Powell and Murphy, 1997, page 205).

We do not know the basis of the Commission's comment about values of 20 being the preferred GTAP export-demand elasticities.[16] The GTAP website describing the data for the GTAP 5 model lists values for inter-source or Armington elasticities [$\phi(i)$ in (33)] for 57 products, see chapter 20 of Dimaranan and McDougall (2002). A simple average of these 57 values is 5.0. For GTAP 6, Hertel *et al.* (2007) have provided a new set of $\phi(i)$ values, most of which are econometrically estimated. A simple average of these new values is 6.3. Via (33), we see that these GTAP estimates certainly do not support the use of numbers like -20 for Australian export-demand elasticities. In fact they support standard MONASH-style numbers.

We guess that in making their comment about "the degree of product differentiation" and "observed engineering measures of economies of scale" the Commission had in mind a model of monopolistic competition in which each firm in an export oriented industry earns zero pure profits (price equal to average costs) and sets its price at $\varepsilon/(1+\varepsilon)$ times marginal cost, where $\varepsilon$ is the elasticity of demand for its product.[17] If $\varepsilon = -4$, then in this view of the world, export-oriented firms operate with their average cost 33 per cent higher than their marginal cost. To us, this doesn't obviously imply an unrealistic level of scale economies. More importantly, a value of -4 for the foreign export-demand elasticity for an Australian product does not necessarily imply that each Australian exporter of the product faces an elasticity of demand of -4. The Australian industry could be purely competitive with each Australian firm behaving as if the elasticity of demand for its product is extremely high, so that its average-cost/marginal-cost ratio is close to one. Collectively, however, the industry can face an export-demand elasticity of -4.

Again we can only guess what the Commission had in mind with their comment about high elasticities and reproduction of observed changes in trade patterns. Perhaps they were referring to a well-known paper by Gehlhar (1997). He used the GTAP model to explain changes in Pacific rim trade patterns between 1982 and 1992. In his conclusions he comments that

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[16] Models such as GTAP do not include export-demand elasticities. Exports from any country are specified via imports of partner countries. Thus we assume that the Commission is referring to inter-source or Armington elasticities in GTAP. As can be seen from (33), these provide an upper bound on the negative of export-demand elasticities.

[17] See equations (15) and (16).

*"There is also some indication of a small improvement in the correlation results [between simulated and observed movements in trade flows – not in the original] by increasing the trade elasticities in the GTAP model."*

The improvements were indeed small and the increase in the trade elasticities was 20 per cent, certainly taking them nowhere near values that would justify the use of export-demand elasticities for Australia of -20.

The Commission (2002, page 305 and 306) quotes Head and Reis (2001) who summarize results from several studies of estimates of Armington elasticities and related parameters. Some of these studies suggest higher values for $\phi(i)$ than the 6 used in (33) in setting the MONASH export-demand elasticities, but others suggest lower values. Certainly none of the quoted studies seems to support export-demand elasticities for Australia with absolute values as high as 10, let alone 20. Another paper containing a review of Armington elasticities is McDaniel and Balistreri (2003). Again, there is nothing in this review which supports the use of high export-demand elasticities for Australia.

Following the motor vehicle and TCF inquiries of 2002 and 2003, the Commission has undertaken considerable theoretical research on Armington models.[18] Researchers at the Commission appear to be searching for a new theoretical approach that will support the Commission's apparent view that cutting tariffs is always a good idea: that negative terms-of-trade effects of tariff cuts are outweighed by positive efficiency effects. Zhang (2008), for example, includes in his overview of the Armington approach the following:

*"What are the drawbacks?*

*There are two well-known features of Armington models:*

*1. larger than expected changes in inter-country relative prices, which result in excessive terms of trade effects, especially for small countries*

*2. smaller-than-expected changes in inter-industry relative prices and, therefore, in national outputs, leading to an underestimate of possible reallocation efficiency gains from trade liberalization …"*

Apart from producing the "wrong result", no indication is given of the standard by which terms-off-trade results from Armington models are being judged as excessive or efficiency gains are being judged as underestimated. In any case, it is not the Armington approach, as such, that determines the simulated trade-off between terms-of-trade and efficiency effects. As we have demonstrated in Sections 2 to 5, this trade-off is determined by the values used for key parameters.

As well as theoretical work, the Commission has conducted empirical work on Armington elasticities. This is reported in Zhang and Verikios (2003) and Shomos (2005). Nothing in this work suggests that export-demand elasticities of -10 and -20 are appropriate for modelling the effects on the Australian economy of tariff cuts. If we have interpreted Zhang and Verikios's Tables 4 and 5 correctly, their estimates under one method give an average substitution elasticity between Australian and foreign products in Australia's export markets of 3.5. Under another method this average works out at 8. Translated via (33), the Zhang and Verikios numbers suggest average export-demand elasticities for Australian products of about -2.45 or -5.6.

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[18] See, for example, Lloyd and Zhang (2006) and Zhang (2006 and 2008).

## 7. Concluding remarks

This paper suggests that under empirically justifiable assumptions concerning export-demand elasticities, aggregate welfare in Australia would be reduced by a unilateral cut in MVP tariffs. In reaching this conclusion, we have undertaken three types of analysis.

The first type was purely theoretical. We derived a series of formulas for the derivative of welfare with respect to the rate of tariff, $\partial W / \partial T$. We started with a simple model in which all export industries are competitive. Next we modified the formula for $\partial W / \partial T$ to allow for the possibility that firms in some export industries behave monopolistically. Finally, we derived a formula that included monopolistic pricing and the costs of replacing revenue lost via tariff cuts.

Table 7.1 sets out some implications of these formulas. If we are cutting tariffs from 8 per cent (the average rate applying to MVP), then under competitive assumptions welfare is increased only if export-demand elasticities are less than -13.5 (that is, larger in absolute magnitude than 13.5). Equivalently, welfare is increased only if export demand for the average Australian product is sufficiently elastic that a doubling of export sales could be achieved with a reduction in fob price of less than 5.0 per cent.

The introduction of monopoly pricing for some exports makes a welfare improvement from a tariff cut more likely. If monopoly applies to 26.7 per cent of exports (the mining share), then our formula with monopoly pricing indicates that cuts in tariffs from 8 per cent will increase welfare only if export-demand elasticities are less than -10.5. Equivalently, welfare is increased only if export demand for the average Australian product is sufficiently elastic that a doubling of export sales could be achieved with a reduction in fob price of less than 6.3 per cent.

Our final theoretical formula with allowance for revenue-replacement costs, indicates that there may be no value of export-demand elasticities at which cutting tariffs from 8 per cent would increase welfare. As indicated in Table 7.1, this applies even when revenue replacement costs are as low as 5 per cent. A value this low seems quite conservative when replacement of lost tariff revenue is via an across-the-board increase in income-tax rates.

The theoretical formulas, especially the final formula incorporating replacement costs, imply that the optimal level for tariff rates is likely to be very much higher than the rates currently applying to Australian imports. However, this finding is not of practical importance. There is no significant support in Australia for sizable across-the-board increases in tariffs. Such a policy would be inconsistent with Australia's stance in international forums and would, in any case, run the risk of provoking retaliation by trading partners.

Our second type of analysis was simulations with the MONASH model. These simulations add empirical detail to the theoretical analysis. For example, they recognize that MVP imports enter Australia under several tariff rates (averaging 8 per cent) and that there are welfare effects from equalizing these rates. However, none of the empirical detail included in the MONASH simulations upsets the qualitative conclusions derived from the theoretical analysis. The MONASH simulations confirm the conclusions that reductions in MVP tariffs from their present levels are likely to reduce overall welfare and that optimal tariff rates are considerably in excess of current rates.

**Table 7.1. Conditions under which cutting tariffs from 8 per cent improves welfare**

| Model | Export-demand elasticities (ε) | Reduction in price from doubling supply (%)[d] |
|---|---|---|
| Competitive[a] | < -13.5 | < 5.0 |
| Monopoly for 26.7% of exports[b] | < -10.5 | < 6.3 |
| Monopoly for 26.7% of exports and 5% replacement costs[c] | No values | n.a. |

[a] Calculated via (12). [b] Calculated via (18). [c] Calculated via (23) with $\eta = -0.6$. [d] See Table 6.1.

The main contribution of the MONASH simulations is to provide a quantitative dimension that is lacking in the purely theoretical analysis.[19] The simulations show that MVP tariffs are not an important instrument in the determination of Australia's economic welfare. For example, the most comprehensive simulations, those incorporating both monopoly effects and revenue-replacement costs, show losses in Australia's welfare from reducing MVP tariff rates to zero ranging from 0.005 per cent (about \$40m) to 0.04 per cent (about \$320m). While these amounts are small, they should not be simply sacrificed by implementation of faulty policy.

Our third type of analysis was a critical review of the literature relevant to understanding the likely magnitudes of export-demand elasticities for Australian products. On our interpretation, this literature implies that the standard MONASH values of -4 are reasonable. We found no empirical support for values that would be large enough in absolute size to challenge the conclusion that efficiency gains from further unilateral cuts in Australia's tariffs would be dominated by terms-of-trade losses, let alone losses associated with replacement of foregone tariff revenue.

Given the present state of knowledge concerning export-demand elasticities, we are confident that the use of numbers such as -4 in policy simulations for Australia is appropriate. However, the present state of knowledge is unimpressive. In the 1970s, the Industries Assistance Commission, through the IMPACT Project, supported a major economic study of import-domestic substitution elasticities.[20] The study absorbed several person-years of work. It required assistance from data experts in both the Industries Assistance Commission and the Australian Bureau of Statistics and involved painstaking mobilization of detailed data on quantities and prices of imported and domestic goods in the Australian market place. The payoff was a statistically supported set of import-demand elasticities that helped to inform policy makers about the likely adjustment implications of reducing tariffs from the high levels that then applied. An updating and broadening of that study to include export-demand elasticities is long overdue.

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[19] Models such as MONASH can provide quantification across a wide range of variables including employment by industry, occupation and region. For broad-ranging MONASH analyses of the effects of tariff cuts, see for example Dixon and Rimmer (2002, chapter 2), Centre of Policy Studies (2003) and Dixon *et al*. (1997). These broad-ranging studies have been useful in demonstrating that Australia can undertake tariff reductions without significant adjustment costs. For this paper, we have taken that as given and concentrated solely on overall welfare effects.

[20] The main papers from the study are Alaouze (1976, 1977a and 1977b) and Alaouze *et al.* (1977). For an overview, see Dixon *et al.* (1982, subsection 29.1). Estimates from the study were picked up and used by modellers throughout the world. Rather disgracefully, for want of a better alternative, the estimates are still being used in Australia and elsewhere.

In the absence of a detailed, up-to-date, authoritative, peer-reviewed study of export-demand and related trade elasticities, the Australian policy debate will continue to be plagued by self-serving assertions. Organizations supporting unfettered free trade will continue to cling to the notion that Australia has insignificant scope to influence the prices of its exports. On the other hand, supporters of export promotion schemes such as the Export Market Development Grant Scheme[21] will maintain that Australia faces limited export markets (implying low or moderate export-demand elasticities). The subsidization provided in these schemes of promotion expenses incurred by firms at international trade fairs, in export advertising and in implementing other export marketing strategies would be pointless in a world in which Australia could sell any quantity at the going price.

It is not only in the formation of trade policy that Australia would benefit from a high-quality set of estimates of export-demand elasticities.[22] Consider, for example, the GST debate. The modellers[23] found that implementation of the government's GST plans would have quite serious negative implications for Australia's tourist industry. This was because unlike Australia's other exports, it was planned that tourism exports (sales in Australia to foreign visitors), would be subject to GST. The modellers' estimates of damage were based on judgments that the foreign elasticity of demand for tourism services from Australia was between -2 and -3. The government was quick to produce an expert witness[24] willing to assert that

> *"elasticities of 2 or 3 applying to all tourists overstates and gives a misleading impression of the impact of the ANTS package on tourism."*

This was backed up by research, not subject to rigorous peer review, undertaken by the Department of Tourism, Transport and Business Development. Subsequently, that research was shown to be potentially seriously misleading (see Dixon and Rimmer 1999, pages 194-6).

Without a convincing set of estimates of export-demand elasticities, the Bracks Inquiry will nevertheless need to make a recommendation on MVP tariff policy. With plausible assumptions concerning export-demand elasticities and revenue-replacement costs, it is clear that modellers would need to call on factors beyond those described in this paper to produce results supporting unilateral cuts in MVP tariffs from their present levels.

One possible factor is the "cold shower" effect (the idea that industries respond to tariff reductions by improving their productivity performance). However, arguments along this line need to be considered critically. The Productivity Commission drew on the "cold shower" effect in their Review of Australia's General Tariff Arrangements (Productivity Commission, 2000) to produce modelling results showing welfare gains from reducing tariffs from levels as low as 5 per cent. In specifying the relationship between tariff cuts and productivity gains, the Commission relied on a linear extrapolation of econometrically-estimated relationships between these variables for the period 1968/9 to 1994/5. In particular, they assumed the same percentage improvement in MVP productivity per percentage point reduction in MVP tariff rates would apply to

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[21] For a description and analysis of this scheme, see Centre for International Economics (2005).

[22] This point is developed in detail by Dixon and Rimmer (2005). What it means is that even if we agree with Krugman (2008) that trade policy is unimportant relative to economic policies in other areas, we may still think that an expensive study of trade elasticities would generate major benefits.

[23] See Dixon and Rimmer (1999) and Econtech (1999).

[24] See the evidence given by Geoff Carmody to the Senate Employment, Workplace Relations, Small Business and Education References Committee (1999, page 121).

future tariff reductions as appeared to apply to past tariff reductions. The Commission's econometric work indicated a particularly strong relationship between tariff cuts and productivity for the MVP industry, see Chand *et al.* (1998). While it seems plausible that a MVP industry that was isolated from the world by high levels of protection in 1968/9 could have experienced significant productivity improvements from exposure to international competition, it is doubtful that the same linear relationship is relevant today. The MVP industry is now exposed to intense competition with about half the Australian market accounted for by imports. In the appendix we investigate the cold-shower effect through an extension of the theoretical model described in Section 2 and subsections 4.1 and 5.1. We find that the introduction of cold-shower effects has the potential to sharply reduce the optimal tariff rate. However, with a plausible non-linear extrapolation of the Commission's tariff/productivity relationship and with an empirically justifiable setting for the export-demand elasticity, our analysis continues to show, even in the presence of cold-shower effects, that aggregate welfare in Australia is likely to be reduced by a unilateral cut in MVP tariffs.

**Appendix. Extending the theoretical model to encompass cold-shower effects**

The cold-shower hypothesis is that resources (capital and labour) in import-competing industries are used more productively if tariffs are low than if they are high. It is difficult to set out a formal behavioural model that supports this hypothesis.[25] Nevertheless, it seems plausible that exposure to import competition could induce an industry to improve its management practices, to produce products more in line with customer preferences, to modernize its production processes, and to become generally more amenable to innovative ideas. While the underlying theory remains a little vague, the hypothesis has considerable empirical support, see for example Chand *et al.* (1998), Chand (1999), Bloch and McDonald (2002), Palangkaraya and Yong (2007).

We think the hypothesis makes most sense in a non-linear form. In this appendix we investigate the implication of the following specification:

$$CS = \alpha * T^2 \qquad \text{(A1)}$$

where

T is the tariff rate expressed as a fraction;

$\alpha$ is a positive parameter; and

CS, the cold-shower effect, is the tariff-related wastage of resources in an import-competing industry expressed as a fraction of the resources used. Thus, for example, if $\alpha = 0.24$ and the industry is protected by a tariff of 60 per cent, then (A1) means that adoption of best practice by the industry (practice that is adopted if the tariff is zero) would allow the industry to increase the output from the resources it is using by 8.6 per cent (= $100*0.5*0.6^2$). On the other hand, if the industry is protected by a tariff of 30 per cent, then it its resource wastage is only 2.2 per cent [ = $100*0.24*0.3^2$].

Underlying our choice of a non-linear specification such as (A1) is the idea that there are diminishing returns to import penetration in imposing competitive discipline on an import-competing industry. We think it is reasonable to suppose that when imports

[25] A notable success along these lines is Melitz (2003). He produces a theoretical model in which an import-competing industry is specified as monopolistically competitive. Each firm has a productivity level that is randomly selected at the beginning of its life. Firms with different productivity are able to survive because they produce differentiated products. However, reductions in tariffs drive out the low-productivity firms whose products are replaced largely by imports. In this way, tariff cuts increase productivity in the industry.

take their first 20 per cent of the domestic market, then this encroachment will cause much greater reforms among domestic producers than when imports take the next 20 per cent. The first 20 per cent will eliminate the most easily removed slack practices by domestic producers, making further reforms to meet import competition successively more difficult.

A more formal model that might underlie a non-linear specification involves profit sufficing. In Figure A1, $\Pi_{min}$ is the minimum amount of profit per unit of output that firms need for satisfying their shareholders. When tariffs are zero, firms can just achieve this with best practice. When tariffs rise, if firms continue to adopt best practice then their profit per unit output will increase in a linear fashion with the tariff rate and thereby follow the line AB. However, if shareholders put less and less pressure on management as profit per unit of output rises, then actual profit follows a path such as AD, with an increasing share of the gap between best-practice profit and minimum profit being absorbed in an easy life for management. The declining slope of AD ensures that CS, the gap between the AB and AD lines, increases at a faster rate than T.

Under (A1), we can expand the definition given in (21) for the change in welfare caused by a change in the tariff rate to include the cold-shower effect:

$$\Delta W = \underbrace{\left\{ \Delta M * T + \Delta M * \left( \frac{S}{-\varepsilon} \right) \right\}}_{\textit{efficiency effect}} + \underbrace{\Delta P_E * E}_{\textit{terms-of-trade effect}} + \underbrace{D * \Delta(T * M)}_{\textit{revenue-replacement cost}} \underbrace{- \Delta(\alpha * T^2 * V)}_{\textit{cold-shower effect}} . \tag{A2}$$

where V is the quantity of resources devoted to the import activity.

Before we can use (A2) we need to deal with two issues: the determination of a value for $\alpha$ and the specification of the behaviour of V.

In determining $\alpha$, we draw on the work of Chand *et al.* (1998). Their econometrics covers the period 1968/9 to 1994/5. In a panel study, they found that a one percentage point reduction[26] in a typical manufacturing industry's tariff rate caused a 0.15 per cent increase in the industry's productivity.[27] During the period tariff rates for individual industries varied over the range from 1 per cent (for chemicals in 1994/5) to 62 per cent (for TCF in 1985/6).[28] We interpret this as meaning that

$$\frac{CS(0.62) - CS(0.01)}{62 - 01} = 0.0015 \ , \tag{A3}$$

that is, as the tariff rate falls by 61 percentage points (from 62 per cent to 1 per cent), productivity improves per percentage point of tariff reduction by the fraction 0.0015. Substituting from (A1) into (A3) gives

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[26] Chand *et al.* (1998) write as though their estimates refer to the effects of a 1 per cent change in a tariff rate. We think they actually mean the effects of a 1 percentage point change. We assume that they don't mean that a 50 per cent cut in a tariff rate for an industry from 2 per cent to 1 per cent would have the same effect on the industry's productivity as a 50 per cent cut in the tariff rate from 60 per cent to 30 per cent.

[27] Chand *et al.* (1998) also give results for individual sectors. However, we prefer to use their overall result for manufacturing. We see no reason to suppose that MVP productivity is related to the MVP tariff by a different function than that for other manufacturing industries.

[28] See Industry Commission (1995) and Productivity Commission (1998). These sources show separate tariff rates for Textiles and Clothing & footwear. Chand *et al.* (1998) dealt with the aggregate sector TCF. In calculating TCF tariffs we have taken an output weighted average of the weights applying to Textile and Clothing & footwear.

$$\frac{\alpha * \left(0.62^2 - 0.01^2\right)}{62 - 1} = 0.0015, \tag{A4}$$

generating $\alpha$ =0.24.

In specifying V, we assume that

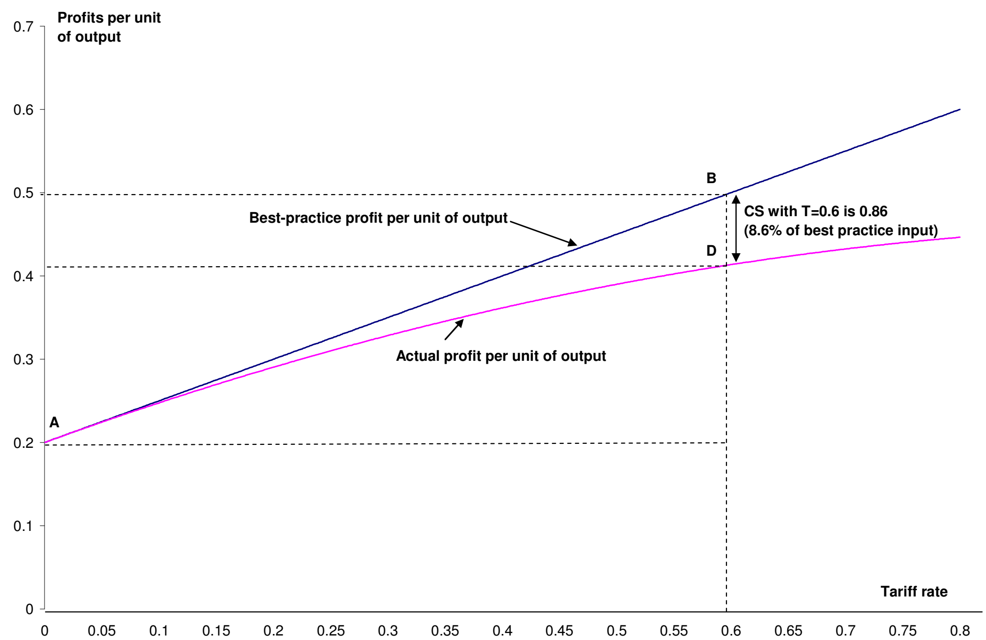
$$V = R - M \ , \tag{A5}$$

where M is the quantity of imports and R is the economy's requirement for the importable commodity. This requirement can be satisfied by domestic production or imports. For simplicity we will assume that R is fixed and that reductions in imports caused by tariff increases translate directly into increases in resources devoted to import-competing activities. In our numerical calculations we assume that the initial value for R is twice the initial value ( $\bar{M}$ ) for M, that is

$$R = 2 * \bar{M} \ , \tag{A6}$$

implying that imports initially satisfy half the demand for the importable product. From (2) we can evaluate R as $2*(1+\bar{T})^{\eta}$ where $\bar{T}$ is the initial tariff rate.

**Figure A1. Cold-shower effects in a profit sufficing model**




With best practice, \$1's worth of resources is required per unit of output. This is accounted for by best-practice costs of BPC and minimum profits of 1 – BPC. As the tariff increases from zero, firms are able to increase the price of the domestic product by $\beta$*T. If firms continue to operate at best practice, then their profit per unit of output also increases by $\beta$*T. Actual profits ($\Pi$) per unit of output are given by:

$$\Pi = (1 + \beta * T) - BPC - CS \quad .$$

The diagram is drawn for the case in which: $\beta$ = 0.5, BPC = 0.8 and CS is specified according to (A1) with $\alpha$=0.24.

Using (A5) we can rewrite (A2) as

$$\Delta W = \left\{ \Delta M * T + \Delta M * \left( \frac{S}{-\varepsilon} \right) \right\} \quad + \quad \Delta P_E * E \quad + \quad D * \Delta(T * M)$$
$$- \alpha * 2 * T * (R - M) * \Delta T + \alpha * T^2 * \Delta M \quad . \qquad (A7)$$

From here we can follow steps similar to those used in deriving (12), (18) and (23) to obtain

$$\frac{\partial W}{\partial T} = (1+T)^{\eta-1} * \left( a * T^2 + b * T + c \right) - 2\alpha R * T \qquad (A8)$$

where

$$a = \alpha(\eta + 2) \quad , \qquad (A9)$$

$$b = \eta * \left( 1 + D + \frac{D}{\eta} + \frac{2\alpha}{\eta} \right) \quad \text{, and} \qquad (A10)$$

$$c = \eta * \left( \frac{S}{-\varepsilon} + \frac{1}{1+\varepsilon} + \frac{D}{\eta} \right) \quad . \qquad (A11)$$

Using integration by parts twice on (A8) gives

$$\Delta W(T_{final}) = \left[ \begin{array}{l} \frac{(1+T)^{\eta}}{\eta} * \left( aT^2 + bT + c \right) - \frac{(1+T)^{\eta+1}}{\eta(\eta+1)} * (2aT + b) \\ + \frac{(1+T)^{\eta+2}}{\eta(\eta+1)(\eta+2)} * (2a) \; - \alpha R T^2 \end{array} \right]_{\overline{T}}^{T_{final}} \quad . \qquad (A12)$$

where $\Delta W(T_{final})$ is the change in welfare generated by moving T from $\overline{T}$ to $T_{final}$ .

In Figures A2 to A4 we use (A12) to trace out the effects on welfare of moving the tariff away from 8 per cent in the model incorporating the cold-shower effect. The elasticity of demand for imports ($\eta$) is set at -0.6 (the value implied for MVP imports in the MONASH simulations). The elasticity of demand for exports ($\varepsilon$) is set at -4 in Figure A2, -8 in Figure A3 and -16 in Figure A4. To aid comparison, the figures include results from the three previous versions of the theoretical model: the version with competitive pricing for all exports; the version with monopolistic pricing for 26.7 per cent of exports; and the version with monopolistic pricing plus 5 per cent cost of revenue replacement. The optimal tariff rates for all four versions of the model and for the three values of the export-demand elasticity are recorded in Table A1.

With export-demand elasticities of -4 and -8 (Figures A2 and A3), introduction of the cold-shower effect does not upset the conclusion that reducing tariffs from 8 per cent is welfare reducing. Only when export-demand elasticites are very high (-16 in Figure A4) do we get a small welfare increase when tariffs go very slightly below 8 per cent.

A striking feature of the results in Figures A2 to A4 and Table A1 is the implications of the cold-shower effect for the optimal tariff rate. With our non-linear specification, the cold-shower effect operates strongly at high tariff rates. Thus its inclusion sharply reduces optimal tariff rates (compare the third and fourth lines of Table A1). With what we consider a realistic setting for the export-demand elasticity, -4, the optimal tariff rate comes down from 36.2 per cent to 17.2 per cent. Perhaps the inclusion of the cold-shower effect will take some of the heat out of the debate on export-demand elasticities. With a cold shower, it is possible to reconcile empirically supportable values for export-demand elasticities with optimal tariff rates of moderate size.

**Table A1. Optimal tariff rates in theoretical models with $\eta$= -0.6**

| Model | Export-demand elasticity | | |
|---|---|---|---|
| | -4 | -8 | -16 |
| Competitive | 33.3 | 14.2 | 6.7 |
| Monopoly for 26.7% of exports | 26.9 | 11.0 | 5.0 |
| Monopoly for 26.7% of exports and 5% replacement costs | 36.2 | 19.9 | 13.8 |
| Monopoly for 26.7% of exports, 5% replacement costs and cold shower | 17.2 | 10.1 | 7.3 |

**Figure A2. Welfare effect of moving the tariff away from 8 per cent in four versions of the simple model with ε = -4 and η= -0.6**

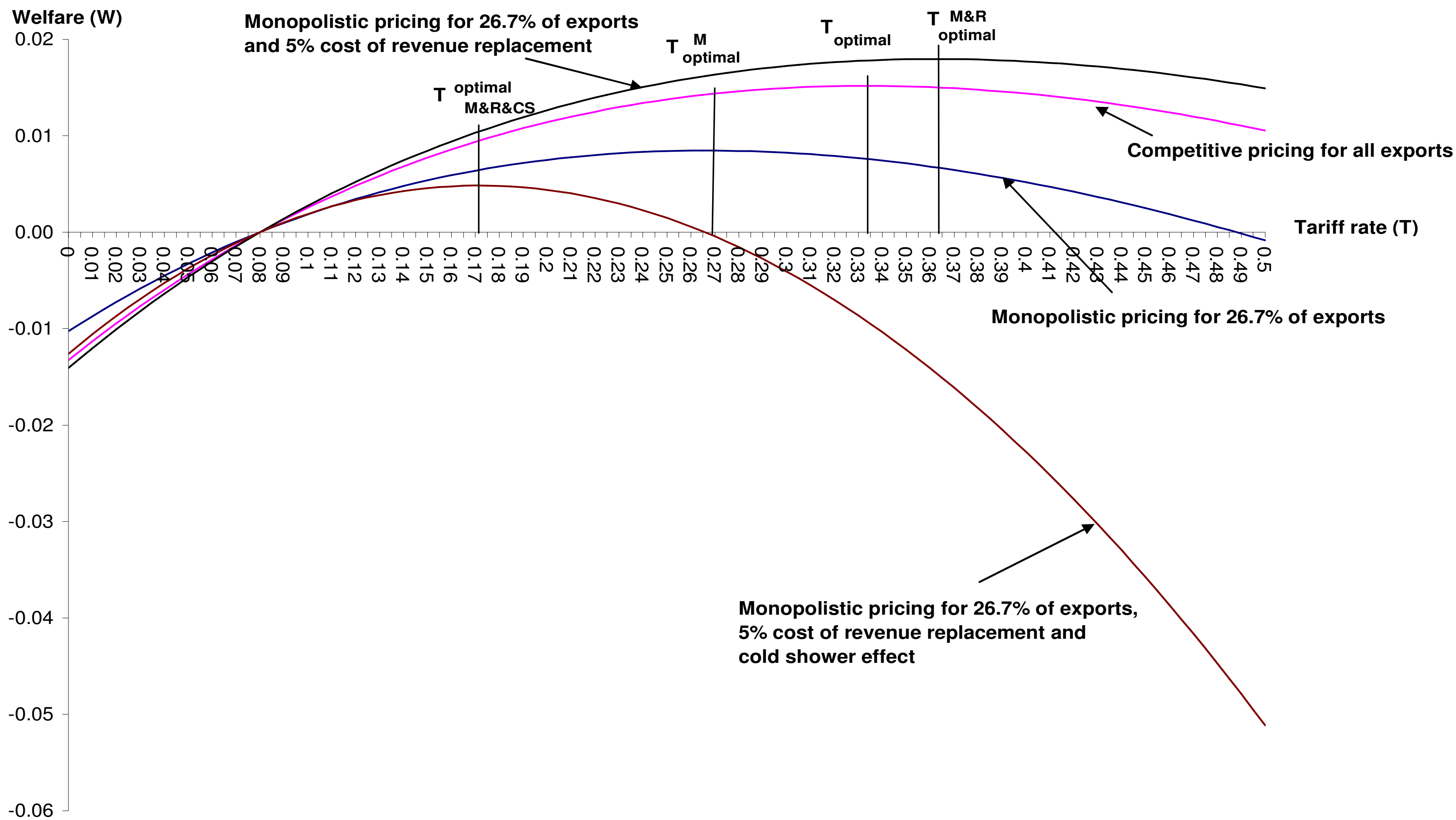


**Figure A3. Welfare effect of moving the tariff away from 8 per cent in four versions of the simple model with ε = -8 and η= -0.6**

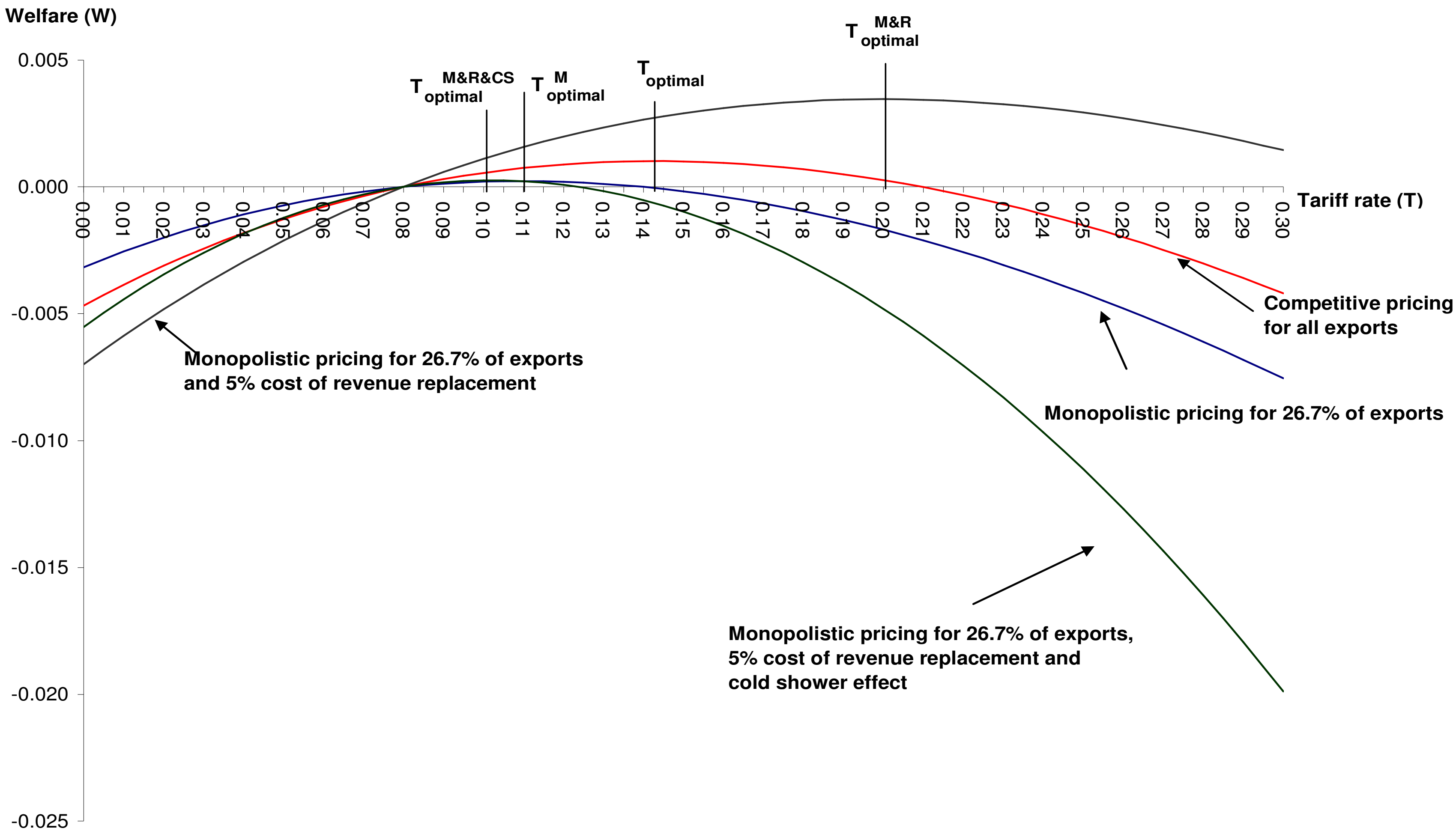
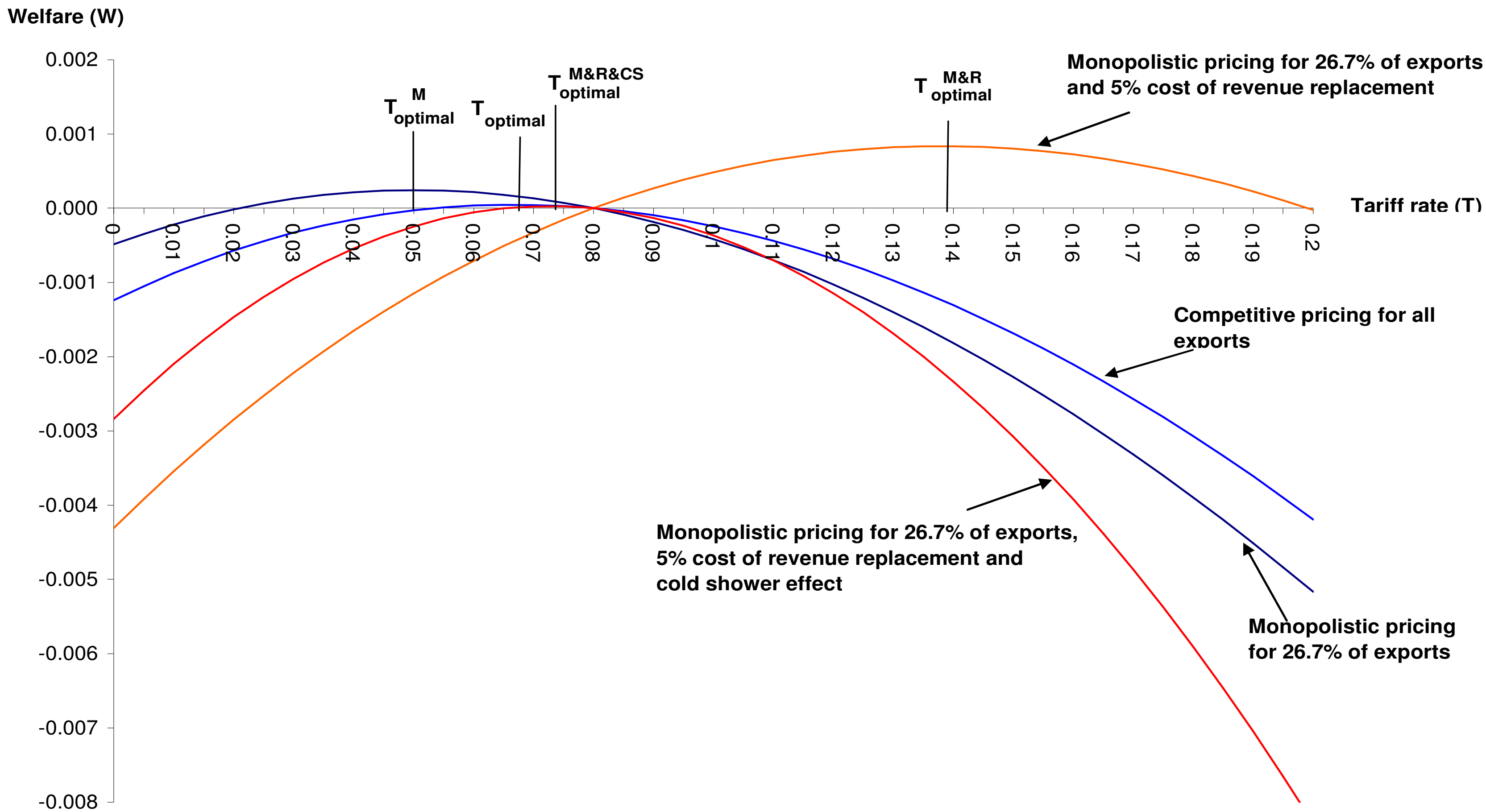


**Figure A4. Welfare effect of moving the tariff away from 8 per cent in four versions of the simple model with ε = -16 and η= -0.6**



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