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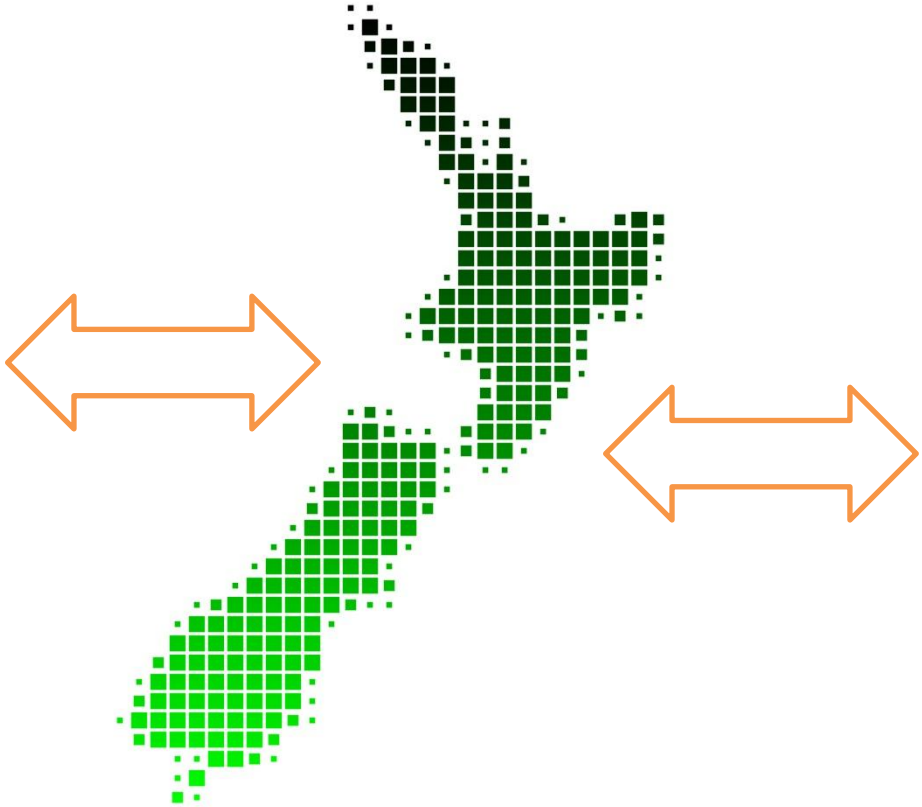

Review of export elasticities

NZIER public discussion document

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NZIER was established in 1958.

Authorship

Each year NZIER devotes some of its resources to undertake and make freely available economic research and thinking aimed at promoting a better understanding of New Zealand's important economic challenges. The preparation of this paper was funded from those resources.

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Key points

Assumptions on export elasticities can have a big impact on CGE model results, especially at the industry level

Export elasticities measure the responsiveness of demand for a country's exports to a change in the world price. The greater the elasticity, the greater the change in export demand following a price shift.

We find that the size of the export elasticities has an important impact on the magnitude of Computable General Equilibrium (CGE) modelling results. We use CGE models to assess the impacts of shocks, such as a major policy change, on measures of welfare like real consumption or GDP.

The export elasticity determines the amount of export revenue for a given change in export volumes. The change in revenue flows through the economy and influences measures of welfare like real consumption or GDP. The scale of the elasticities can have a material impact on these results. The results, in turn, influence whether a policy or event is thought to be 'good' or 'bad' for an economy.

Understanding where these elasticities came from, how robust they are, and how they might be re-estimated is therefore important.

But there are no recent New Zealand-specific estimates of these elasticities

The elasticities used in the MONASH-NZ model, NZIER's CGE model of the New Zealand economy, are based on Australian estimates. Conceptually this is not ideal, given differences in our economies. There is little empirical research in New Zealand to provide a ready substitute for these Australian elasticities, nor any indication whether they are suitable for New Zealand.

There are some individual commodity-level export demand elasticities for New Zealand, but they date from the late 1980s and may no longer be suitable. There certainly is no comprehensive set of economy-wide disaggregated estimates.

Re-estimating these elasticities is a big job with huge data requirements…

The international literature provides well-recognised methodologies for re-estimating New Zealand's export elasticities. The synthetic method is the most appropriate.

The synthetic method is data intensive. It calls for data on: consumption; production; imports; exports; and consumer, producer, and export prices. More problematic is that it also requires indicators of foreign supply and demand responses, and the responsiveness of foreign prices to changes in global prices.

…so some prioritisation and pragmatic assumptions will be required

In the face of this huge data requirement, the literature commonly makes informed, but strong assumptions or focuses on a few elasticities and aggregates other variables.

In this paper we investigate what the impact of such an approach would be as the way ahead for updating New Zealand's elasticities. For instance, we would focus on

commodities of greatest export interest to New Zealand, such as primary products (e.g., dairy, beef and lamb, fish, kiwifruit, wine, wool), some manufactured goods (e.g., petrol, aluminium, wood products, coal) and key services industries such as tourism-related activities and education. The remaining commodities' elasticities could be grouped together and determined using judgement about suitable proxies.

Updating elasticities this way does not alter key welfare measures much, but does affect results at the commodity level

In this paper we test whether changes in specific commodities' elasticities have an impact on welfare, by updating the elasticities for commodities of export interest to New Zealand – accounting for 50 percent of New Zealand's 2007 export profile.

On a trade-weighted average, the updated elasticities are more elastic than the original elasticities. The model shows that using these updated elasticities do have a significant impact on production and resources for the respective commodities. However, the macro-level welfare measures of real GDP and consumption are similar using either the existing and updated elasticities.

This gives us comfort that the current assumptions in the CGE model produce credible results. It would of course be desirable to produce a comprehensive updated and New-Zealand specific set of export elasticities. But given the costs of doing so, and the limited impact on macro-level indicators of welfare, we consider it best to update the elasticities for each commodity gradually when that sector is being examined for specific projects.

Contents

Tables

Figures

Appendices

1. Introduction

Computable General Equilibrium (CGE) models are increasingly being used to analyse the economic effects of policy decisions in New Zealand. NZIER provides general equilibrium analysis via a range of CGE models.

These models include:

- MONASH-NZ, a single-region dynamic CGE model of the New Zealand economy including 131 industries and 210 commodities, with projections out to 2025 and beyond
- GTAP, a multi-region comparative static CGE model commonly used to analyse international policy changes, such as trade agreements
- NZ-Green, an extension of the MONASH-NZ model that incorporates greenhouse gas emissions and can be used for climate change policy analysis
- ORANI-NZ, a comparative static version of the MONASH-NZ model.

CGE models have been criticised for the sensitivity of their results to changes in behavioural parameters set within the model. In New Zealand there has been some recent discussion about the sensitivity of research outcomes to the model's export elasticity parameters.

This paper informs this discussion by presenting the origins of elasticities used in the MONASH-NZ model.[1] It also reviews studies which have estimated these elasticities in New Zealand and abroad. Based on this review, recommendations relating to methodologies to update New Zealand's estimates are made.

[1] We focus on the MONASH-NZ model, as it is used for most of NZIER's CGE policy analysis.

2. The role of export elasticities in CGE models

CGE model results are determined by the underlying economic theory, base data, and behavioural parameters. As noted by Hertel (1997), none of these individual components can be said to be more important than the others. A criticism of CGE models is that the outcomes are sensitive to the parameters which guide the behaviour of agents in the models (Hertel et al (2003), McKitrick (1996)). Export elasticities are an example of a behavioural parameter.

Definition

An export elasticity measures the change in global demand for New Zealand's exports following an increase in the world price of New Zealand's exports. Dixon and Rimmer (2008) define an export-demand elasticity as:

> *"the percentage change in foreign demand caused by a one percent increase in the foreign-currency f.o.b. price"*

In CGE models, the export elasticity helps to determine the size of any policy shock-related changes in export volumes and the terms of trade, with flow on effects to GDP and consumption.

Elasticities of demand range along a scale from perfectly elastic to perfectly inelastic. The elasticity of demand determines the slope of the demand curve, which has a number of product-related implications. To discuss some of these implications, we provide two simple diagrams representing perfectly elastic and perfectly inelastic export demand curves. We use these diagrams to show the effect of a price increase on the quantity demanded.

Perfectly elastic export demand

Perfectly elastic export demand has an infinite elasticity ($\eta=\infty$) and, as shown in Figure 1, is represented by a horizontal line. This suggests that a country can export an unlimited quantity of a product at a price (P1), however, it is unable to export any at a slightly higher price (P2).

Products that exhibit this type of elasticity are usually similar to a lot of other products, or are produced by small countries. The presence of close substitutes implies that consumers can easily switch to another product following a price increase. Being produced by a small country implies that there are many other, larger players in the market, and any change in the small country's supply will have no effect on the world supply and thus world price.

In a CGE context, this type of elasticity would allow a country to increase the quantity of its exports at a fixed export price. This is important in situations where a policy shock leads to increased import demand. Increased import demand depreciates the exchange rate. A lower exchange rate lowers the relative price of a country's exports, which increases export volumes. Perfectly elastic export demand means that the increased export volumes face a constant price. The constant price ensures that the additional export revenues are higher than if export demand was downward sloping. These terms of trade gains lead to higher consumption and GDP.

Perfectly inelastic export demand

At the other end of the scale is perfectly inelastic export demand. This type of elasticity is shown in Figure 2 as a vertical line. Here a price increase has no effect on the quantity demanded, implying that a fixed quantity of a product can be sold at any price.

Products that face relatively inelastic demand are likely to be unique, and difficult to substitute away from. Producers are also likely to have market power, implying any changes in production *will* have an effect on the market price.

Figure 1 Perfectly elastic export demand

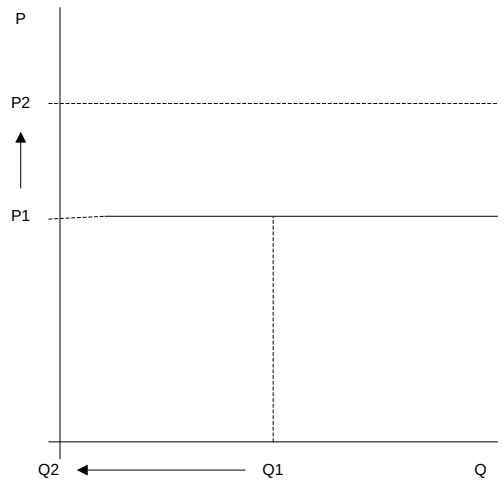
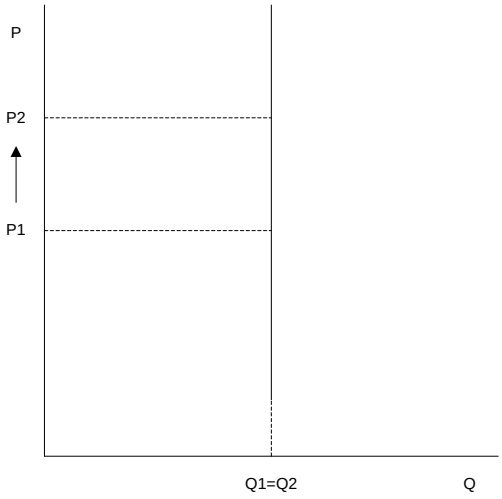


Figure 2 Perfectly inelastic export demand



Source: NZIER

Implications for CGE modellers

The choice of elasticities used in any CGE model partly reflects the modeller's view of a country's level of pricing power in a specific product market. The traditional view is that a small country has no influence over the world market and will be a price taker.[2] This suggests that its export elasticities should be infinite, implying that its level of exports have no influence on the world price. Lower export elasticities suggest that a country exhibits some degree of power in a specific market.

The value of these export elasticities can have an important bearing on the modelling results. Ballingall et al (2010) used the MONASH-NZ CGE model analysis to consider the effects of unilaterally removing New Zealand's tariffs. As discussed below in section 3, this model has downward sloping export demand curves. The paper finds that following liberalisation New Zealand's GDP increases but welfare, as measured by private consumption, falls.

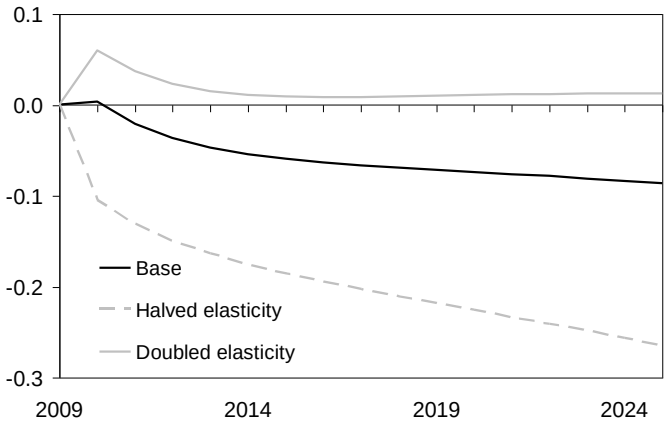
This seemingly counter-intuitive result can be explained as follows. Imports become cheaper following tariff liberalisation. Households initially increase their consumption of imported products. Export volumes must increase to fund these additional imports. The only way to increase export volumes is to move down the demand curve and offer them a lower price. Consequently, export prices fall by more than import prices and the terms of trade deteriorates. Lower terms of trade erode consumer purchasing power, which in this case has a larger negative effect than the increase in incomes (GDP) due to allocative efficiency gains.

[2] The New Zealand Treasury's CGE model, as set out in Szeto (2002), assumes New Zealand is a small country with no market power. KITT, the RBNZ model, has two export products, a commodity and a manufactured product. The export demand elasticity for the commodity is assumed to be perfectly inelastic, as it is assumed that the foreign sector demands a fixed quantity of the commodity regardless of price. Manufactured goods producers are assumed to have some market power (Beneš et al (2009)).

Ballingall et al carry out some sensitivity analysis by changing the scale of the export elasticities in the model. Figure 3 presents the graphical results of the sensitivity testing done by Ballingall et al, which halved and the doubled the model's export elasticities. Interestingly, the authors find that the welfare loss from halving the elasticities in much greater than the welfare gain from doubling the elasticities. A positive welfare effect is found when the export elasticities are doubled. Doubling the elasticity means that the export price falls less dramatically for the required amount of exports, which lessens the negative terms of trade effect.

Figure 3 Sensitivity of CGE results to changes in export elasticities

% deviation from baseline



Source: Figure 5 from Ballingall et al (2010)

In an attempt to explain differing CGE results, Valenzuela et al (2007) perform a series of tests to show the sensitivity of CGE results to changes in key assumptions. One of the tests is to compare the results from a baseline scenario with the results from a scenario with doubled trade elasticities.

The authors use the GTAP model and the baseline scenario removes all tariffs and trade subsidies. The global welfare gain from full liberalisation is estimated to be US$86 billion. Doubling the trade elasticities leads to a global welfare gain of US$176 billion, approximately double the gains from the baseline scenario.

It is clear that the size of the export elasticities can have an important bearing on CGE modelling results. These examples raise a number of questions regarding the appropriate size of the export elasticities in the MONASH-NZ model, how they were estimated, and whether there is benefit in re-estimating these parameters. This paper is intended to address these questions. The next section discusses the MONASH-NZ model, and summarises the export elasticities used within it.

3. MONASH-NZ elasticities

The approach to export elasticities differs across CGE models. The New Zealand Treasury's CGE model assumes New Zealand has no market power (Szeto, 2002). The RBNZ model assumes that export demand for commodities are perfectly inelastic, while New Zealand's manufactured exports have some market power.

The elasticities used in the well-used Global Trade Analysis Project (GTAP) model are econometric estimates of import demand elasticities from Hertel et al (2003). The approach followed in the MONASH-NZ model is detailed below.

Summary of model's elasticities

MONASH-NZ is a New Zealand implementation of the well-known Monash model.[3] The MONASH-NZ model has two main categories of exports:

- traditional (mainly agricultural and mineral products)
- non-traditional (mainly manufactured goods and services).

The model's designers used this breakdown to reduce the requirements to calculate parameters for each commodity. For simplicity, the export demand elasticities for the non-traditional exports are assumed to be -4. This implies that a one percent increase in export price lowers export demand by four percent.

The export elasticity is calculated separately for each traditional export, based on an set of assumptions about how the rest of the world responds to a change in export price.[4]

[3] Here we only consider the export-related aspects of the model. For further information see Dixon and Rimmer (2002).

[4] The elasticities for Monash's predecessor, ORANI (Dixon et al (1997)), were taken from Freebairn (1978) and implicitly assumed homogenous commodities, no transport costs and no effect from trade policy. This type of approach was criticised by Cronin (1979) and Bredhal et al (1979). Cronin highlighted the importance of these assumptions by showing that the elasticity for Australian beef exports could be either 4, or 67. In response to this criticism the method for estimating export elasticities was changed for the Monash model, as explained in Dixon and Rimmer (2002, and 2008).

The calculation method is detailed in Dixon and Rimmer (2002, and 2008) and falls within the synthetic method. The synthetic method derives an export-demand elasticity based on foreign supply and demand response to a price change (see section 0).

Dixon and Rimmer calculated these elasticities for the Australian economy. The MONASH-NZ model applies these same elasticities to New Zealand.

The elasticities for the traditional exports range from -1.46 (relatively inelastic demand) to -20 (relatively elastic demand). Table 1 shows the distribution of all export elasticities in the MONASH-NZ model. It shows that, in terms of trade weighting, most of New Zealand's exports have an elasticity greater than 4, but less than 8. A significant group of commodities have elasticities under 4.

Table 1 Summary of MONASH-NZ export elasticities

Export demand elasticity	Number of commodities	Exports ($NZ m)	Exports (% of Total)	Major products
>8	14	3,421.3	8%	Wool, Other Metals, Domestic Appliances
>4<8	67	21,962.0	53%	Logs, Meat Products, Dairy Products, Natural Textiles, Paper
4	71	808.9	2%	Newspapers, Financial Services, Management Consulting Services, Other Personal Services
<4	58	14,994.6	36%	Processed Fish, Shipping, Fruit and Vegetables, Precious Metals
	210	**41,186.8**	**100%**	

Source: MONASH-NZ Database

Other research on New Zealand export elasticities

The remainder of this section presents the elasticity estimation results from a small number of New Zealand focussed studies.

As contributions to a discussion on the level of an optimal tariff, Scobie (1973) and Finlayson et al (1988) provide estimates for 5 and 9 commodities, respectively. Scobie follows the framework established by Horner (1952), while Finlayson et al follow the approach set out in Cronin (1979).

Their results are shown in Table 2 below, along with a comparison to the elasticities included in the MONASH-NZ model. With the exception of wool, the estimated elasticities from Scobie (1973) and Finlayson et al (1988) are all significantly larger than the

MONASH-NZ model.[5] These large numbers suggest that New Zealand is a global price taker, and effectively faces a horizontal export demand curve.

Table 2 Summary of findings from Scobie (1973) and Finlayson et al (1988)

Commodity	Scobie (1973)	Finlayson et al (1988)	MONASH-NZ
Beef	-173	-161	-5.1[3]
Lamb	-43[1]	-9	-5.1[3]
Butter	-23	-18	-5.6[4]
Cheese	-42	-111	-5.6[4]
Wool	-1[2]	-6	-10
Newsprint		-339	-4
Wool yarn		-352	-6.7
Aluminium		-67	-8.0

Notes: [1] Includes mutton and lamb
[2] Includes cross-bred wool only
[3] Meat Products
[4] Other Dairy Products

Source: Scobie (1973), Finlayson et al (1988), MONASH-NZ Database

As part of a PhD thesis, Blyth (1983) estimates the export elasticity of demand for New Zealand's sheep meat. Blyth presents results across a range of situations relating to the size of price transmission elasticities and the foreign demand and supply elasticities. The results from Blyth (1983) are shown below in Table 3.

The MONASH-NZ export elasticity of -5.1 is well within the range of estimates provided by Blyth (1983).

The elasticities in the MONASH-NZ model are generally lower than the previous New Zealand based elasticities. This is related to three points. First, the range of estimates could be due to different time periods, data availability, or assumed values in the calculation. Secondly, the practicalities of the Monash model limit the size of the elasticities. The model is unable to solve and generate results with very large export elasticities. The model also interprets relatively small elasticities as highly elastic. Consider a product with an elasticity of -10 in the model. This means that a five percent increase in price will lead to a 50 percent fall in exports, which is an elastic response. This suggests that the Monash model does not need very large numbers to show that a product is highly elastic. Finally, the designers of the Monash model believed that New Zealand has some market power in exports for some of these commodities.

[5] It should be noted that Scobie (1973) does not include any effects from price transmissions.

Table 3 The elasticity of demand for New Zealand's sheep meat exports, Blyth (1983)

		Price Transmission Effects		
Foreign Supply and Demand Response		Free trade	Estimated	Restricted
	High	-10.2	-9.5	-6.8
	Estimated	-6.6	-6.2	-3.3
	Low	-4.2	-3.9	-2.7

Source: Blyth (1983)

To our knowledge, there are no more recent estimates of New Zealand's export elasticities. The New Zealand economy has developed and changed since these estimates were calculated. This suggests that these existing elasticities may not be reflective of New Zealand's current export performance.

So we are faced with a choice of using the MONASH-NZ estimates, which are based on Australian calculations, or re-estimating the elasticities for New Zealand. The next section examines how the latter might take place.

4. Estimating elasticities

Options for estimation

There are two commonly used methods to estimate an export demand elasticity: the synthetic method, and the direct estimation method.

The synthetic method derives the export demand elasticity from a country's export demand equation. In this method a country's export demand is related to the level of global demand and supply for that commodity. The elasticity of that demand is a function of the responsiveness of global demand and supply to changes in price. It also considers the insulating effect on foreign prices of trade policy and transport costs.

The direct approach estimates the direct response of export volumes to changes in border prices. This is the most common estimation approach. However it is usually applied at a country-wide aggregate level (i.e. for large groupings of goods and services, rather than individual products as we require in MONASH-NZ). These estimates are generally used for balance of payment type analysis, and examining the effects of currency devaluation. Examples of this approach include Goldstein and Khan (1985), Fullerton et al (1999), and Hooper et al (2000).

As noted in Ahmadi-Esfahani (2009), Gardiner and Dixit (1986) find that the direct approach tends to report lower estimates than those from the synthetic method. Ahmadi-Esfahani (2009) suggests that the difference could be due to government policies, such as specific tariffs or quotas or state-trading agencies, which insulate internal prices from international prices.

Three relevant weaknesses associated with the direct approach are that it does not consider:

- foreign supply responses to price changes
- government policies that may partly insulate a domestic economy from the impacts of a global price change
- product differentiation, instead it assumes that all types of a commodity are perfect substitutes.

The synthetic method allows for global supply responses, product differentiation, and the effect of government policies, which will provide a richer story for CGE analysis. For these reasons this section will focus on the synthetic approach.

Synthetic method

The synthetic method has developed over more than 50 years and has been commonly used to estimate elasticities at an aggregated commodity level. Due to these relatively detailed estimates, this approach is preferred in CGE models. Both the Monash model, and its predecessor ORANI, use estimates based on the synthetic approach.[6]

Deriving the Equation

Under the synthetic method, the elasticities are calculated from an equation that is derived initially from the demand for a country's exports. Most of the literature follows similar derivation, with Horner (1952) and Cronin (1979) providing two useful examples. A derivation following the approached taken in Cronin (1979) is provided in Appendix A.

This derivation show that the price elasticity of demand for a commodity from a specific country depends on:

- that country's share of the world export market
- the elasticity of supply in competing countries
- the elasticity of demand in the export market
- the responsiveness of foreign consumer and producer prices to changes in the country of interest's export price (referred to in the literature as price transmission effects).

There are complications with using the synthetic approach, and there have been a number of different approaches to address these in the literature. The most frequent complications are:

- including price transmission effects
- estimating global supply and demand elasticities
- data issues.

We discuss each in turn below.

Price transmission effects

Price transmission effects indicate the level of insulation foreign markets have from global price shocks. In practice this insulation could be due to transport costs, or restrictive trade policies imposed in these markets.

These price transmission effects show how responsive foreign prices are to changes in the world price, which is essentially a price transmission elasticity. An elasticity of one indicates that there is perfect price transmission, such as in free trade, while zero represents complete market insulation.

[6] Further details on the Monash and ORANI models are available in Dixon and Rimmer (2002) and Dixon et al (1997), respectively.

The assumptions made regarding these effects can have a significant impact on the reported export elasticities. A criticism of the use of Freebairn's (1978) estimates in the original ORANI model was that they were based on an implicit assumption of perfect price transmission. Cronin (1979) showed that Australian beef exports could have an export demand elasticity of between 4 and 67, depending on related assumptions.

In the MONASH-NZ model, the price transmission effect is assessed by the share of the Free-On-Board (FOB) price in the foreign consumption price. This is essentially used as a scalar for the export elasticity calculation. The share of FOB price in the foreign consumption price is determined for each commodity.

The difficulty in obtaining data make it difficult to calculate estimates for more than a specific group of commodities. The most common way to address price transmission effects is by including a range of possible values. Devadoss et al (1988) presents two scenarios, one with perfect price transmission, and one where foreign countries are insulated to some degree. The difference between the two scenarios is significant, with the export demand elasticities in the second scenario reducing, in some cases, to a tenth of their previous value.

Bredahl et al (1979) calculates export demand elasticities for five United States agricultural exports across three insulation scenarios, from highly restricted to completely free. The results vary significantly. In the most restricted scenario, export demand is actually inelastic, with none of the reported elasticities above -0.4. Under the free trade scenario, the elasticities range from -1.12 to -5.50.

Blyth (1983) provides a range of scenarios, one of which is an estimated price transmission elasticity. Blyth's estimates are based on a model that incorporates differences between FOB and consumption prices, transport costs and other differentials. The estimates were close, in value, to the free-trade scenario.

Finlayson et al (1988) estimate the price transmission elasticities for selected New Zealand exports to selected countries. The elasticities were estimated by regressing the foreign consumption price on the New Zealand export price. If data for a country was not available, then similar countries were used as proxies. These results differ by country and by product. The authors note that some estimates between 0.7 and 1 are expected due to low trade barriers. Other estimates in that range are higher than expected due to the high trade barriers on those products.

Zheng (2010) estimates the effect on local prices in major importers of three United States crop products from a 1 percent change in the United States export price. The three products are wheat, soybeans, and corn. Most of these results were between 0.3 and 0.5, however, as with Finlayson et al (1988), the results differ by product and region.

Econometrically estimating the price transmission elasticities would provide the most robust estimates. The literature suggests that this is only possible for selected commodities. Data restrictions mean that providing a range of scenarios, or simplifying assumptions are most likely necessary. This implies that any updated elasticity will likely be guided by assumed simplifications. This approach makes it difficult to determine whether any updated estimates are better than the existing estimates.

Estimating foreign supply and demand elasticities

Including foreign supply and demand responses to price changes is the key point of difference between this synthetic approach and other more direct approaches. The literature shows three main approaches to sourcing these elasticities:

- using recent relevant estimates
- using a range of scenarios
- assuming values.

Estimates of foreign elasticities are becoming more common in the literature. However, finding estimates for all countries at the required level of aggregation is difficult. Proxies are commonly used. Scobie (1973) uses estimates from a major market as a proxy for each commodity. For instance, the estimate for foodstuffs is taken from the United States and the estimate for wool is taken from the United Kingdom. On the supply side Scobie uses estimates from Australia as a proxy for all suppliers, as Australia is a major supplier in the relevant commodities.

Devadoss et al (1988), Bredahl et al (1979), and Scobie and Johnson (1979) follow values used in previous export demand elasticity estimations.

Another approach is followed by Finlayson et al (1988). They obtain country aggregates for demand and supply elasticities from the OECD. Estimates at this level are likely to be more common than commodity specific estimates. Using these, however, will sacrifice variance across commodities for each country.

Blyth (1983) provides a range of three foreign responses from low to high. This is completed as an exercise in sensitivity analysis. The results shows that the export demand elasticity for New Zealand sheep meat can nearly triple, depending on the level of assumed foreign response.

When relevant estimates have not been available some studies have formed assumptions about the likely scale of foreign responses. Freebairn (1978) and Dixon and Rimmer (2002) follow this approach. To inform these assumptions, Freebairn reviews in detail the global situation in each of the 19 commodities that are estimated. These reviews consider factors causing shifts in global supply and demand, and incorporates the situation in major producing and consuming countries. Dixon and Rimmer (2002) appear to rely on institutional knowledge to inform the estimates of foreign response used in the Monash model.

Zheng (2010) estimates domestic demand elasticities for either seven or eight countries across three crop products. The data for these estimates is sourced from the USDA website. Generally speaking, Zheng's demand elasticity estimates are relatively inelastic. The largest estimate is -1.24 for wheat in the Korean market. Zheng also estimates domestic supply elasticities for these three products. Again using data from the USDA, Zheng finds supply elasticities ranging from 0.0 to 1.53.

The number of foreign response estimates required to update the elasticities used in Monash model elasticities is likely to be prohibitive. Reducing the required amount of data through aggregation or assumption is a plausible way to simplify the estimation process and deliver reasonable estimates.

Data issues

Estimating disaggregated export demand elasticities is data intensive. Consider the equation that is derived in Appendix A:

$$\eta_{x_\alpha} = \Sigma_i \eta_{ii} \phi_{i\alpha} \frac{C_i}{X_\alpha} - \Sigma_j \varepsilon_{jj} \theta_{j\alpha} \frac{S_j}{X_\alpha}$$

Table 4 shows the required data, and possible data sources, for every commodity that New Zealand exports (210 included in the MONASH-NZ model).

Table 4 Required data and possible sources

Title	Variable	Possible source
Bilateral exports to all trading partners	X_α	UN COMTRADE
Consumption for every consuming country	C_i	
Production in every producing country	S_j	
New Zealand export price	$\phi_{i\alpha}, \theta_{j\alpha}$	Could calculate unit values from UN COMTRADE
Consumption price for every consuming country	$\eta_{ii}, \phi_{i\alpha}$	
Producer price for every producing country	$\varepsilon_{jj}, \theta_{j\alpha}$	
Consumption price transmission elasticities for every consuming country	$\phi_{i\alpha}$	Could assume $\phi_{i\alpha} = \theta_{j\alpha}$ Estimate from data
Producer price transmission elasticities for every producing country	$\theta_{j\alpha}$	Could assume $\phi_{i\alpha} = \theta_{j\alpha}$ Estimate from data
Foreign demand elasticities for every consuming country	η_{ii}	Literature Search
Foreign supply elasticities for every producing country	ε_{jj}	Literature Search

To indicate the scale of the data needs, consider the consumption price requirements. MONASH-NZ has 210 commodities, and if we assume that they are consumed in 150 different countries, then 31,500 separate pieces of data are needed. This is just for one year, if the estimates were strengthened through time-series analysis then this requirement increases.

These data requirements are likely to be prohibitive for the level of detail required to update the MONASH-NZ model.

A solution is to look at aggregating and simplifying the number of required elasticities. Dixon and Rimmer (2002 and 2008) separated the model into traditional and non-traditional exports and focused on the former. This lowered the number of commodities to be calculated.

Restricting the focus to just major consuming or trading countries also lowers data requirements. When estimating price transmission elasticities, Finlayson et al (1988) focussed on New Zealand's three or four largest export markets for each commodity.

For foreign response elasticities, sourcing recent estimates is likely to be the most effective approach. Where recent estimates are not available for specific countries, proxies can be used, and failing that, general assumptions.

Elasticity estimates from international studies

We reviewed a number of papers that had provided some estimates of export demand elasticities. For simplicity, Table 5 presents the study, the country of focus, the results, and how the study approached the price transmission effects, global supply and demand elasticities, and the data issues.

The key points to take from the table are that:

- existing estimates of export elasticities vary considerably
- there is no source that we can draw on to compare or update a wide range of commodity-level the MONASH-NZ elasticities.

Table 5 Overview of reviewed estimates

Study	Country	Products	Results	Price transmission	Global elasticities	Data issues
Scobie (1973)	NZ	5 ag commodities	-1.45 to -173.94	Not included	Existing estimates	Limited products and countries
Freebairn (1978)	AUS	19 ag and primary products	Negligible to greater than -20	Not included	Informed by review of global markets	Limited products and countries
Bredahl et al (1979)	US	Selected ag products	-0.09 to -5.50	Range of scenarios	Existing estimates	Limited products and countries
Scobie and Johnson (1979)	AUS	Selected food products	-4.7 to -254.2	Not included	Assumed demand of -0.1 and supply of 0	Limited products and countries
Blyth (1983)	NZ	Sheepmeat	-2.7 to -10.2	Range of scenarios	Range of scenarios	Limited products and countries
Devadoss et al (1988)	US	Selected ag products	-0.05 to -97.4	Range of scenarios	Existing estimates	Limited products and countries
Finlayson et al (1988)	NZ	8 products	-5 to -395	Estimated for study	Average of existing estimates	Limited products and countries
Dixon and Rimmer (2002, 2008)	AUS/NZ	All	-1.3 to -20	Share of FOB price in foreign consumption price	Institutional knowledge	Institutional knowledge
Zheng (2010)	US	Crop exports	-1.04 to -4.79	Estimated for study	Estimated for study	Limited products and countries

5. Impact of updated elasticities

The process to update the elasticities is likely to be arduous. Its costs may outweigh any potential benefits as the updated elasticities may not have a significant impact on the model's results.

The sensitivity analysis discussed in section 0 focused on the impact of uniformly moving all of the export elasticities in the same direction. It is unlikely that an update would shift all of the elasticities in the same direction. The size of the elasticity for some may increase, some are likely to be relatively accurate and not change, and for a few commodities, where New Zealand does impact on global markets, may even decrease. The macroeconomic impact of a commodity-specific update will depend on which commodities are changed, and how.

To test whether changes in specific commodities' elasticities have an impact on welfare, we undertake a simple update of the elasticities for commodities of export interest to New Zealand. The products that were updated accounted for 50 percent of New Zealand's 2007 export profile. On a trade-weighted average, the updated elasticities are more elastic than the original elasticities, increasing from -5.18 to -5.34. The process followed to update these elasticities is presented in Appendix B. These updated elasticities are introduced into the ORANI-NZ model, a comparative static version of the MONASH-NZ model, and shocked with a 10 percent increase in export demand.

Table 6 compares the macroeconomic results of a 10 percent export demand shock across the updated elasticities, the original elasticities, and double and half the original elasticities.

A 10 percent increase in export demand for all New Zealand's exports has a positive impact on the New Zealand economy. An increase in exports reallocates resources towards the exporting industries and also generates investment. Consumption increases because of the higher terms of trade, which is a result of increased export prices. The welfare measures of real GDP and consumption are similar between the existing and updated elasticities.

Table 6 Export demand shocks

Percent change over baseline

	10% export demand shock			
Metric	**Updated elasticities**	**Original elasticities**	**Double original elasticities**	**Half original elasticities**
RGDP	0.44	0.42	0.25	0.75
Consumption	0.90	0.84	0.49	1.54
Export volumes	0.42	0.55	0.32	0.91
Export prices	2.28	2.11	1.21	3.94
Import volumes	2.35	2.35	1.30	4.31
Balance of trade/GDP	-0.42	-0.39	-0.22	-0.72
Real wages	1.60	1.58	0.88	2.88
Terms of trade	2.28	2.11	1.21	3.94
Exchange rate	2.57	2.49	1.42	4.50
CPI	2.00	1.96	1.10	3.60

Source: NZIER

The main difference across the simulations is in the change in export volumes and prices. The updated elasticities lead to a higher export price but with a lower volume than the simulation with the original elasticities. This counter-intuitive result suggests that the export demand shock is also impacting factor prices, which is causing a shift in the export supply curve. It is more obvious in the updated elasticities simulation because of the specific commodities that were updated.

We would expect an increase in export demand to lead to higher export prices and quantities. Export prices do increase for all commodities while quantities fall for some. This is because there are limited resources in an economy and without an accompanying productivity shock, increased exports (and output) in some industries must be traded off with less output in other industries. Figure 4 shows that of the commodities that we updated, those made more elastic exported less in the updated simulation than in the original.

In the ORANI-NZ model output shifts towards the commodities that experience a relatively high price increase. As export demand shifts out, the price of commodities with inelastic demand increases relatively more than the commodities with inelastic demand. This suggests that the inelastic commodities have a relatively high price increase, and output will shift towards those products.

Figure 4 Differences in commodity exports

Difference between original and updated simulations

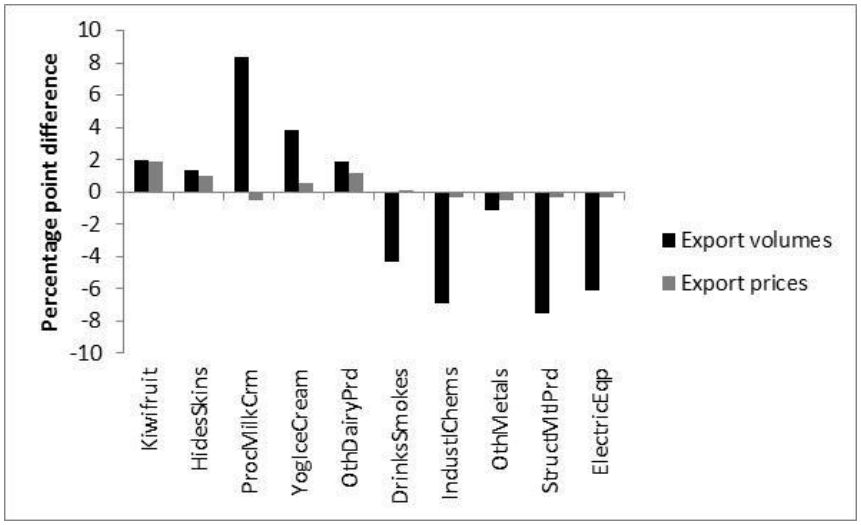
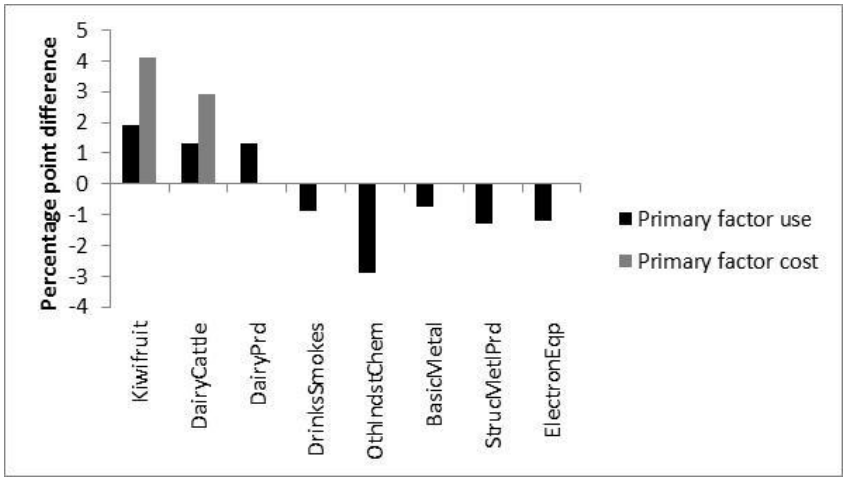


Figure 5 Differences in factor use and cost

Difference between original and updated simulations



Source: NZIER

This change in commodity supply is best shown through the change in use of primary factors of production. Figure 5 shows the differences in factor use and cost of the main industries that were modified between the original and updated simulation. It shows that the industries that produce the more elastic products have used less primary factors, suggesting a contraction in those industries. The industries that produce the less elastic commodities are using more primary factors, but do so at a higher price.

The difference in factor costs across industries is due to significant increases in land rental. This impacts the industries that use land intensively, in this case kiwifruit and dairy farming. The higher land rental causes a supply contraction that leads to the macro result of New Zealand exporting relatively less but at a higher price in the updated simulation than under the original simulation.

These results suggest that while macro welfare measures have not changed significantly, the commodity level impacts on production and resources is significantly influenced by the elasticities that were updated. This suggests that commodity level export elasticities do matter for the outcomes of the model. Due to the complexity of the process to robustly estimate new elasticities, it may be best to update the elasticities for each commodity gradually when that sector is being examined for specific projects.

6. Conclusions

Updating the export demand elasticities included in CGE models would increase the confidence placed in the analysis based on these models. The actual outcomes from an update may not impact significantly on the model's performance, which questions the usefulness of an update.

Commodity-level export demand elasticities for New Zealand have not been updated since the late 1980s. Economy-wide disaggregated estimates for New Zealand do not exist. Updating the existing estimates, and developing elasticities for more products will improve the reliability of CGE policy analysis in New Zealand.

The most appropriate approach to estimate these elasticities is the synthetic method. This method provides commodity level estimates and takes into account foreign responses and non-perfect price transmission.

The synthetic method is data intensive and as a result it is common to make strong assumptions regarding key variables. It would be simplest to follow this approach but, where necessary, make informed assumptions or aggregations. For instance, it would be appropriate to follow the approach used in the MONASH-NZ model and focus on New Zealand's main export products, grouping the remainder together.

The net effect of an update will depend on the commodities that are updated, and how they are changed. It seems more appropriate to continue with the current set of elasticities and review the specific commodity's elasticities as projects in those areas arise.

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Appendix A Deriving export demand elasticity

Under the synthetic method, the elasticities are calculated from an equation that is derived initially from the demand for a country's exports. Most of the literature follows a similar derivation, with Horner (1952) and Cronin (1979) providing two useful examples. This appendix follows the approach taken in Cronin (1979).

At a given export price the demand for a country's exports of a commodity is equal to the total demand of the export market less the level of supply from all other countries. This can be represented by:

$$X_\alpha = \Sigma_i C_i - \Sigma_j S_j \quad i, j \neq \alpha$$

Where:

$X_\alpha =$ Export quantity demanded for a commodity in country α

$C_i =$ Quantity demanded for a commodity in all country i

$S_j =$ Supply of commodity from country j

Measuring the response of the export demand to a change in country α's export price yields:

$$\frac{dX_\alpha}{dP_\alpha} = \Sigma_i \frac{dC_i}{dP_\alpha} - \Sigma_j \frac{dS_j}{dP_\alpha}$$

Or in the form of elasticities:

$$\eta_{x_\alpha} = \Sigma_i \left(\frac{dC_i}{dP_\alpha}\right) \frac{P_\alpha}{X_\alpha} - \Sigma_j \left(\frac{dS_j}{dP_\alpha}\right) \frac{P_\alpha}{X_\alpha}$$

$$= \Sigma_i \frac{dC_i}{dP_i} \cdot \frac{P_i}{C_i} \cdot \frac{dP_i}{dP_\alpha} \cdot \frac{P_\alpha}{P_i} \cdot \frac{C_i}{X_\alpha} - \Sigma_j \frac{dS_j}{dP_j} \cdot \frac{P_j}{S_j} \cdot \frac{dP_j}{dP_\alpha} \cdot \frac{P_\alpha}{P_j} \cdot \frac{S_j}{X_\alpha}$$

This collapses to:

$$\eta_{x_\alpha} = \Sigma_i \eta_{ii} \phi_{i\alpha} \frac{C_i}{X_\alpha} - \Sigma_j \varepsilon_{jj} \theta_{j\alpha} \frac{S_j}{X_\alpha}$$

Where:

$\eta_{x_\alpha} =$ elasticity of export demand for commodity X from country α

$P_i =$ consumer price in country i

$P_j =$ producer price in country j

$\eta_{ii} =$ own − price elasticity of demand in country i

$\varepsilon_{jj} =$ own − price elasticity of supply in country j

$\phi_{i\alpha} =$ elasticity of consumer price in i to the export price in α

$\theta_{j\alpha} =$ elasticity of producer price in j to the export price in α

These equations show that the price elasticity of demand for a commodity from a specific country depends on its share of the world export market $\left(\frac{X_\alpha}{C_i}\right)$, the elasticity of supply in competing countries (ε_{jj}), and the elasticity of demand in the export market (η_{ii}).

The remaining two elasticities, $\phi_{i\alpha}$ and $\theta_{j\alpha}$, show how responsive foreign consumer and producer prices are to changes in the country of interest's export price. These are referred to in the literature as price transmission effects.

Appendix B Simple update of elasticities

We reviewed elasticities for 23 commodities that were of greatest export interest to New Zealand[7]. We then compared New Zealand's share of global exports in these commodities with Australia's global share.

If New Zealand's share of global exports was significantly higher (lower) than Australia's, then the export elasticity for those commodities was halved (doubled). No changes were made to the elasticities of commodities that had similar shares of global exports[8].

Of the 23 commodities, the elasticities for six commodities were doubled, five were halved and the remaining twelve remained unchanged. The specific changes are presented in Table 7 over the page.

[7] These are the commodities that represent more than 1 percent of New Zealand's merchandise export profile in 2007. These commodities represented approximately 67 percent of New Zealand's merchandise exports in that year, and approximately 51 percent of New Zealand's exports in the MONASH-NZ model. The difference is due to the MONASH-NZ model incorporating services trade.

[8] This simple approach was based on the assumption that the original Monash elasticities for Australia are accurate. It also assumes that the commodities produced in New Zealand and Australia are similar so the differences in global shares can influence the size of the export elasticities.

Table 7 Results of simple update

Commodity	NZ Share of Global Trade	Aus Share of Global Trade	Old Elasticity	New Elasticity	Change
Other dairy products	10.1%	3.4%	-5.58	-2.79	Halved
Meat and meat products	3.7%	6.9%	-5.14	-5.14	No change
Iron and steel	0.2%	2.7%	-4	-8	Doubled
Pulp, paper and paperboard	0.4%	0.4%	-5.18	-5.18	No change
Crude petroleum and natural gas	0.1%	1.3%	-20	-20	No change
Electric equipment	0.1%	0.2%	-8.39	-16.78	Doubled
Wood	1.4%	1.7%	-5.47	-5.47	No change
Spirits, wines, beer, tobacco	0.7%	3.1%	-1.92	-3.84	Doubled
Other chemical products	1.2%	1.3%	-5.97	-5.97	No change
Processed milk and cream	10.1%	3.4%	-5.58	-2.79	Halved
Kiwifruit	7.9%	0.8%	-2.45	-1.225	Halved
Hides and skins	2.5%	4.9%	-7.42	-3.71	Halved
Other metals	0.2%	2.7%	-8.04	-16.08	Doubled
Prepared fish	0.9%	0.7%	-3.3	-3.3	No change
Domestic appliances	0.1%	0.2%	-8.39	-8.39	No change
Yoghurt, buttermilk, ice-cream	9.4%	3.3%	-5.58	-2.79	Halved
Fish	1.5%	2.0%	-2.02	-2.02	No change
Plastics	0.1%	0.3%	-5.97	-5.97	No change
Bakery products	0.7%	0.6%	-3.3	-3.3	No change
Panels and boards	0.5%	0.2%	-5.47	-5.47	No change
Other food products	0.8%	1.0%	-3.3	-3.3	No change
Structural metal products	0.1%	0.7%	-6.72	-13.44	Doubled
Industrial chemicals	0.1%	0.3%	-5.97	-11.94	Doubled

Source: NZIER