Economic benefits of MRA-AEOs

Part 3: Focus on SES exports and 0.5 days' time saving

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Authorship

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Key points

Trade facilitation is valuable

Trade facilitation has measurable economic benefits.

Mutual recognition arrangements facilitate trade

New Zealand has mutual recognition arrangements (MRA) with eight partner nations for customs clearance. These enable approved firms to generate these benefits for themselves and global economies.

Secure Export Scheme members in New Zealand are one type of approved firms.

Iceberg method is used as a proxy to estimate impacts of trade facilitation

We use the 'iceberg method' of the Global Trade, Assistance and Production model as a proxy to estimate the benefits of trade facilitation for global economies in terms of:

- gross domestic product
- consumer welfare
- imports
- exports.

The iceberg method has strengths and weaknesses. Its use is reasonable to measure MRA impacts because both the iceberg method and MRAs are concerned with small changes in import costs at borders.

Impacts of MRAs – empirical modelling

We investigate two scenarios where MRAs are assumed to produce a time saving of 0.5 days:

- Time saving occurs for all New Zealand exports
- Time saving occurs for all New Zealand imports and only SES exports.

Empirical modelling using the iceberg method shows that over the long term (7 to 10 years):

- Annual consumer welfare, increases for all MRA economies
- Annual gross domestic product increases for New Zealand by 0.30 US$ billion.

We also investigated impacts for imports and exports. These are relatively small effects and likely to be greatly influenced by the iceberg method. We present these as illustrative results in an appendix.

Table 1 Change[1] in annual economic measures

US$ billion

	GDP	Consumer Welfare
New Zealand	0.30	0.19
Australia	0.18	0.03
Canada	-0.01	0.00
China	-0.04	0.01
Hong Kong	0.00	0.00
Japan	0.01	0.02
Korea	0.00	0.00
Singapore	0.00	0.00
United States	-0.04	0.01

1 Results are for scenario 2, where only SES exporters and all importers are assumed to generate the MRA benefits. Base year of change is 2018 except for Consumer Welfare for which the base year is 2007. This is because 2007 data are used in the GTAP model and Consumer Welfare results for 2007 are not translatable into 2018 values.

Source: NZIER modelling

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1 Introduction

1.1 Purpose

This study is part three in our development of modelled estimates of global economic impacts from trade facilitation in customs border clearance and builds on our prior work (Williams and Maralani 2019a, 2019b).

1.2 Trade facilitation from mutual recognition arrangements

Trade facilitation is one of the benefits from New Zealand's mutual recognition arrangements (MRAs) with authorised economic operators (AEOs) that we have with eight partner economies. Our study and others quantify this type of trade facilitation as a removal of a non-tariff measure. Specifically, in this study, we account for it as a time saving in customs border clearance.

We assign a value to this time saving. We reduce the import cost of goods in New Zealand's bilateral trade with MRA partners by this value.[1] We then compare the state of global economies with and without the value adjustment. This reveals the value of trade facilitation due to New Zealand's MRAs.

The Secure Export Scheme (SES) of the New Zealand Customs Service (NZCS) is an AEO arrangement for New Zealand exporters.

This study updates our prior estimates of the time-saving measures. In a forthcoming study, we refine these estimates further and report insights from firms who say that the MRA benefits we assess amount to more than time saving in customs border clearance.

1.3 Methodology – GTAP model

Using the Global Trade, Assistance and Production (GTAP) model, we modelled the impacts of time saving with values representing falls in import costs of traded goods in bilateral trade between New Zealand and its MRA partners. We do not consider other trade of MRA partners. Hence, we are estimating the marginal impact on global trade of New Zealand's MRA arrangements and not the impact of all such arrangements.

1.4 Policy interest – impacts of time saving and SES membership

We change two main assumptions from our previous analysis:

- The duration of time saving from 1 day to 0.5 days – a conservative estimate based on initial consultations with selected exporters and freight forwarders.
- The composition of exporters who receive MRA benefits from all exporters to SES exporters only.

We are interested in accounting for each of these impacts separately as they are distinct variables of interest in modelling and each can inform future policy. For example, future

1 Using an ad valorem equivalent, a proportion of import value.

benefits from extending the SES to a wider group of firms will be influenced by the composition effect but not necessarily the duration effect.

Accordingly, we develop the modelling in two distinct scenarios (see below) that link to our previous work.

1.5 Iceberg method – a proxy for trade facilitation in the GTAP model

Our modelling approach within the GTAP model is called the 'iceberg method'. It is used as a proxy for trade facilitation.

The introduction of the MRAs lowers import costs. This is conceptualised as an efficiency improvement associated with time saving from the facilitation associated with the MRAs. This is a necessary abstraction of the theoretical model. In reality, the change in the costs of imports happens through shifting supply and demand factors in each economy. But those costs are not observed and the assumption of an efficiency change makes the scenario tractable in the model used.

Falls in import costs mean firms and consumer households in the importing country increase their productivity and consumer welfare. They demand more imports and import volumes rise. This is the main effect. The increased productivity is achieved because the initial inefficiency (time delay) has been reduced.

In the iceberg method reduction in import costs is conceptualised as consisting of two opposing effects: (a) expansion of import volume and (b) price substitution towards the lower priced imports. Expansion of import volume (a) results in reduced, effective (i.e. efficiency-inclusive) import demand, while price substitution (b) works in the opposite direction and increases import demand, through a price-induced substitution effect in favour of the cheapening supplier.

1.6 Robustness of the iceberg method

In the GTAP model, demand elasticities (called Armington elasticities, refer Appendix A.4.1) are high so that the elasticity of substitution to lower priced imports is always greater than 1. The price substitution effect dominates the expansion effect. The latter is assumed to lower demand for imports. Overall, more imports are demanded from a given partner—unless another MRA partner provides cheaper imports.

One shortcoming of the iceberg approach is the conceptualisation that the importer is assumed to have lower effective demand, under the expansion effect. This is a stylised effect used in order for the model to process the falls in import costs. Essentially it does not happen. It is unlikely to affect the model's significant results. It can however, have a proportionately large influence on results of small magnitude.

Falling import costs result in cheaper production costs, including for exports, making them more internationally competitive. Overall, in the case of sufficiently high import demand, the importing nation experiences rises in import and export value and increases in productivity, consumer welfare and output volume.

The main strength of the iceberg approach is that it appropriately models the time saving as a small reduction in the real cost of imports for the importing firm at the border. It is also a simple technical solution compared to the technical complexity required for modelling supply and demand effects in the GTAP model. The main weakness of the iceberg approach is that it attributes a large part of productivity gains to the importer. This likely overstates the actual consumer welfare and increases in real gross domestic product (GDP) of the importing country from productivity improvements.

Acknowledging our caveat about its weakness, we consider our use of the iceberg approach to be reasonable as we are concerned with small changes in real costs of imports at the border.

1.7 This modelling builds on previous work

Previously we modelled global trade facilitation impacts arising from time saving in customs border clearance using the approach initiated by Hertel, Walmsley and Itakura (2001) and others. In our prior research, we stylised the trade facilitation value for each combination of commodity group and nation as:

- a saving of a notional 1 day of time in transit of cargo due to reduced customs compliance
- an ad valorem value for this time saving for all exports and all imports, using reported empirical data (Minor and Hummels, 2013).

In addition, we also discussed (Williams and Maralani 2019a) wider trade facilitation benefits beyond time saving through MRA-AEOs conferring:

- a signal of quality of merchandise
- confidence to consumers
- a signal of security of supply.

1.8 Two scenarios refine prior analysis

In this study, we have two scenarios:

- Scenario 1 where the time saving applies to all imports and all exports. This:
  - is a point of comparison with our previous work
  - updates our prior scenario with 2018 trade data
  - updates our prior scenario with a new time-saving estimate
  - includes two new MRAs
  - assesses the key imports and exports of MRA partners contributing to the MRA benefits.
- Scenario 2 is similar to Scenario 1 except it more accurately assumes MRA benefits accrue only for SES exports.

We also include a technical outline on the theoretical underpinnings of the modelling approach.

Hence, including our prior work, we have three modelled solutions showing the impact of distinct assumptions of interest. In this report, we also include a technical outline on the theoretical underpinnings of the modelling approach. This speaks about our assumptions and the merits and shortcomings of them.

2 Data

We used the GTAP framework and GTAP database (Appendix A.1) to estimate global economic impacts.

Using the concordance reported by Aguiar et al. (2016), we aggregated relevant 2019 Harmonised System Level 6 (HS6) bilateral commodity trade data for New Zealand supplied by NZCS into the respective GTAP commodity groups, by trading partner, for imports and exports. This allowed us to identify the proportions of trade by commodity group associated with SES exporters. This enabled us to specifically apply the ad valorem equivalent exclusively to trade of SES exporters in Scenario 2.

We aggregated the data for each of the nine MRA economies (including New Zealand) and selected other geographic regions of interest, such as the European Union.

We used ad valorem values for each day of time saving that we believe are representative of New Zealand trade. However, these are confidential to NZIER because some of them are associated with commercially sensitive values.

We assumed a time saving from improved border clearance processes of 0.5 days. This results from consultation with freight forwarders and SES firms and non-SES firms to get a conservative estimate of a measure of time saving that we could attribute to trade facilitation from the MRAs. In our prior work, we used a notional value of 1 day for all trade. From our consultation, we concluded that a time saving measure of 0.5 days was reasonable and conservative.

As with our prior work, now using the 0.5 days estimate, we assigned ad valorem values of impacts on import costs for respective commodity groups.

3 Results

3.1 Introduction

This section presents the GTAP model results for macroeconomic impacts for New Zealand and its eight MRA partners arising from a time saving of 0.5 days due to trade facilitation from New Zealand’s MRA-AEO arrangements. We interpret these results with the guidance of selected relevant reports discussed in Appendix A. In Appendix B, we present illustrative results for impacts on imports and exports. In Appendix C we provide more detailed data for other countries or regions. Table 11 and Table 12 in Appendix C show GDP impacts for price and quantity as percentages of GDP.

We report the impacts for global economies as changes in annual values of GDP, consumer welfare, trade balance and values of imports and exports. The changes are assumed to occur over the long term (7 to 10 years). We report the changes in the annual values of these economic variables. That is the change in annual values over the long term. The change does not occur annually.

As explained in Appendix A.1.3, we express results in terms of changes in 2018 US dollars or percentages, except for consumer welfare results which are stated in 2007 US dollars for technical reasons.

3.2 Sensitivity analysis

In the tables in this report, we include standard deviations for the results to show their robustness. These are derived using the systematic sensitivity analysis methodology (Appendix A.6) in the GTAP model.

In summary, for this analysis, we have used a conservative approach in specifying a triangular distribution for sampling with central values being the value of time saving for each commodity time value with 10 percent upper and lower bounds. This accords with Hertel's (2012) description. It is likely to be superior to assigning arbitrary error margins for time saving for each commodity.

Hence, we can construct a 95 percent confidence interval using the standard deviations that we quote for each result.

3.3 Scenarios 1 and 2

We show results from the two different scenarios:

- Scenario 1 where time savings from efficiency shocks are assumed to be achieved by all imports to New Zealand and all exports from New Zealand (SES and non-SES exports).
- Scenario 2 where time savings from efficiency shocks are assumed to affect all imports but only the proportion of exports due to SES exporters.

As expected, with more firms assumed to provide benefits, Scenario 1 impacts are larger than those for Scenario 2. Scenario 1 results usefully provide a point of comparison with our prior work.

3.4 Consumer welfare – change

Change in consumer welfare[2] (Appendix A.5) is an important economic impact from trade facilitation (Hertel 2012).

Table 2 shows gains of US$186 million (in 2007 $US) achieved in the long term for annual consumer welfare for New Zealand under Scenario 2. This can potentially increase to US$285 million if MRA benefits are assumed to additionally apply to non-SES exporters.

Welfare gains are noticeable for Australia, Japan and the United States. Welfare gains are associated with increased consumption opportunities from falls in import costs and consequent productivity improvements of importing firms.

Welfare impacts for all MRA partners are positive. This is expected in part because of incorporating the iceberg approach to our modelling:

- The impact of the MRAs is modelled as an efficiency shock that lowers import costs.
- This import cost change flows through to exports and hence to all MRA trade.

By comparison, welfare losses are incurred by all non-MRA economies (Table 15 in Appendix C). This is an inter-regional terms of trade effect on welfare arising from lower import costs for MRA partners.

[2] Consumer welfare (Appendix A.5) is a measure of how much better or worse off a consumer is after a change, measured in terms of what they can purchase with their income levels.

Table 2 Consumer welfare – change[1]

2007 US$ million

Country	Change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	284.81	185.68	3.73	2.91
Australia	59.06	27.55	2.62	1.89
Canada	0.10	2.02	0.26	0.18
China	19.62	6.88	1.68	1.04
Hong Kong	1.54	0.53	0.09	0.02
Japan	24.33	16.87	1.45	0.91
Korea	9.98	4.98	0.73	0.43
Singapore	3.44	2.14	0.22	0.16
United States	16.42	13.46	1.29	1.09

1 Base year of change is 2007. This is because 2007 data are used in the GTAP model and consumer welfare results for 2007 are not translatable into 2018 values. Change is expressed in terms of annual results and occurs over the long term.

Source: NZIER modelling

3.5 GDP – change

New Zealand experiences the largest positive long term change under both scenarios (Table 3 and Table 4) in annual GDP climbing 0.15 percent (US$0.30 billion) under Scenario 2 and 0.40 percent (US$0.81 billion) under Scenario 1.

Changes in nominal GDP are composed of changes in the GDP price deflator (Table 11) and GDP quantity (Table 12 Appendix C). These are influenced by: (Appendix A.4.2):

- Productivity increases enabled from lower import costs for MRA economies – this tends to result in a rise in the volume of GDP and a fall in its price level.
- Increased exports due to falls in prices of imported inputs.
- Increased costs of capital effects from higher investment demand for production that in turn raises the rate of return.

Real GDP (quantity) changes (Table 12) are positive for all nine economies in both scenarios. Price changes are positive only for New Zealand, Australia, Japan and Singapore.

Table 3 GDP – change[1]

2018 US$ billion

Country	GDP	Change	
		Scenario 1	Scenario 2
New Zealand	205	0.81	0.30
Australia	1,432	0.25	0.18
Canada	1,713	-0.03	-0.01
China	13,608	-0.16	-0.04
Hong Kong	363	0.00	0.00
Japan	4,971	0.00	0.01
Korea	1,619	0.00	0.00
Singapore	364	0.00	0.00
United States	20,494	-0.20	-0.04

1 Base year of change is 2018 for nominal GDP. Change is expressed in terms of annual results and occurs over the long term.

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

Table 4 GDP – percentage change[1]

Percent

Country	Change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	0.397	0.148	0.006	0.002
Australia	0.017	0.013	0.001	0.001
Canada	-0.001	-0.000	0.000	0.000
China	-0.001	-0.000	0.000	0.000
Hong Kong	0.000	0.000	0.000	0.000
Japan	-0.000	-0.000	0.000	0.000
Korea	-0.001	-0.000	0.000	0.000
Singapore	-0.002	-0.000	0.000	0.000
United States	0.001	0.001	0.000	0.000

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

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Appendix A Aid to interpretation of the GTAP model results

This Appendix provides a selection of insights from reported literature to aid the interpretation of the GTAP model results. Comprehensive discussions are available including recent work of Corong et al. (2017) and Aguiar et al. (2016 and 2019).

A.1 GTAP model and GTAP database

A.1.1 GTAP model

The analysis in this research uses the GTAP model (Hertel and Tsigas 1997; Corong et al. 2017). This model is a CGE model. It consists of a mathematical system of equations and real-world data. The theoretical system represents the simultaneous investment, production and consumption of all economies in the world and shows their mutual responsiveness to changes (shocks) affecting the global equilibrium. The system is combined with real-world data providing a snapshot of the global economy, in equilibrium, in a given year. The resulting model (system and data) finds a global equilibrium where prices and quantities clear the supply and demand for consumption, savings, investment, government expenditure and bilateral trade flows.

Changes to the global equilibrium, such as from the removal of non-tariff measures (NTMs), are represented as perturbations or shocks to the initial equilibrium. The GTAP model calculates economic settings for a global equilibrium before and after the shock. Hence, we can assess the impact of the shock on global economies.

The GTAP model calculates this new equilibrium in a systematic and detailed way at a disaggregated level. Hence, the GTAP model provides insights into the direction and magnitude of changes in production, consumption, trade and economic welfare resulting from real-world events.

A.1.2 GTAP database

In this study, we use the GTAP version 9 database, which is explained in detail by Aguiar et al. (2016). The full database contains information on 140 regions and 57 commodities and has base years for different nations at 2004, 2007 and 2011. The New Zealand data have a 2007 base year.

The GTAP simulations in this study are based on an aggregated version of the data consisting of 57 commodity groups (Williams and Maralani 2019b) and the regions shown in the tables in Appendix B of that report.

A.1.3 Currency units

The GTAP model produces estimates of changes in global economic variables. These are expressed either in nominal 2007 US dollars or as percentages of changes from 2007 values. In the cases of GDP, import values and export values, we applied 2007 percentages changes to the respective 2018 US dollar values to derive estimates of change appropriate for 2018. In the case of consumer welfare, the GTAP model produces changes in 2007 US dollars, not percentages. It is not possible to express these 2007 changes in 2018 equivalent units. Hence we report these 2007 values in the text and tables.

A.1.4 Closure condition

The long run closure in GTAP implements full factor employment with perfect factor (labour and capital) mobility across sectors within each region. That is, the timeframe is long enough for capital to move inter-sectorally. Each region's factor (including capital) supply is fixed, so capital does not contribute to GDP changes on the income-side. Each region contributes their savings to a global savings pool collected by a so-called 'global bank'.

The global bank allocates these savings (in the form of investment) across regions until the percentage change in the global rate of return equalizes with the percentage change in each region's expected rate of return. Proportionate changes in the expected regional rates of return to investment are achieved.

A.2 GTAP modelling approaches

A.2.1 Trade facilitation is a kind of non-tariff measure (NTM)

Trade facilitation is expected to have impacts on the quantities and potentially the prices of traded goods and therefore fits the broader definition of an NTM (Walmsley and Minor 2016). Pre-shipment inspection is classified as an NTM in section C of the classification of United Nations Conference on Trade and Development (2019). Trade facilitation is mitigation of this NTM and is a kind of negative NTM.

A.2.2 NTM effects

The three main kinds of economic effects that NTMs generate are protection, supply and demand (Fugazza and Maur 2008).

- Protection effects are cost-raising and trade-restricting and act at the border.
- Supply effects occur when regulations are applied to comply with international standards (e.g. phytosanitary) and can include specifying the production process.
- Demand effects occur following changes in the willingness to pay for traded goods due to a change in some attribute of the good.

A.2.3 Modelling NTM effects in the GTAP environment

Supply and demand effects are complex to analyse and require functional forms for supply and demand functions. Protection effects can be modelled in the GTAP model by:

- Estimating ad valorem equivalents (AVEs) – the part of the difference between world and domestic prices at the border not explained by tariff measures.
- Introducing the AVEs into the GTAP model in two main ways:
  - as tariff equivalents (or export tax equivalents if on the export side)
  - introducing non-revenue-generating price wedges (iceberg costs).

CGE models such as GTAP use AVEs as inputs to the model to estimate the impact of removing the barrier on an economy or on economic variables such as wages, employment, GDP and welfare.

AVEs for removal of NTMs can be negative. An example is the removal of sanitary and phytosanitary standards that hinder trade through reducing confidence in safety of goods.

A.2.4 Tariff equivalents

We can model NTMs as a tariff. NTMs are not usually associated with taxes or fees, but it can be argued (Fugazza and Maur 2008) that the NTM causes economic rents, most likely due to imperfect competition, that accrue to either the importing or exporting country and that changes in rents from the existence of NTMs can be modelled as changes in import and export taxes. The key concern with this tariff approach is the adjustment of the tariff revenue and accounting for where it goes.

A.2.5 Iceberg costs

Alternatively, we can model the NTM as an iceberg trade cost that drives a wedge between world and landed prices much like a tariff, although it does not generate any revenue. The fact that there are no revenues involved with iceberg trade costs creates a major technical advantage. No adjustments need to be made to the underlying equilibrium data of the GTAP model.

A.3 Modelling MRA impacts with the iceberg approach

A.3.1 MRA impacts are appropriately modelled as efficiency shocks

Fugazza and Maur (2008) describe MRAs as a form of trade facilitation whose impact on the price of traded goods can be modelled as an AVE in the GTAP model. MRAs remove hindrances or 'sand in the wheels' of trade such as customs inspections. To make the GTAP model tractable, this is stylised as an exogenous efficiency improvement. This results in falls in import costs at the border. Consequently, the productivity of the importer increases.

A.3.2 The iceberg approach for MRAs

Iceberg method at a glance

Our modelling approach within the GTAP model is called the 'iceberg method'. It is used as a proxy for trade facilitation.

The introduction of the MRAs lowers import costs. This is conceptualised as an efficiency improvement associated with time saving. This is a necessary abstraction of the theoretical model. In reality, the change in the costs of imports happens through shifts in supply and demand factors in each economy. But those costs are not observed and the assumption of an efficiency change makes the scenario tractable for the CGE model employed here.

Falls in import costs mean firms and consumer households in the importing country increase their productivity and consumer welfare. They demand more imports and import volumes rise. This is the main effect. The increased productivity is achieved because the initial inefficiency (time delay) has been reduced.

In the iceberg method reduction in import costs is conceptualised as consisting of two opposing effects: (a) expansion of import volume and (b) price substitution towards the lower priced imports. Expansion of import volume (a) results in reduced, effective (i.e. efficiency-inclusive) import demand, while (b) price substitution works in the opposite direction and increases import demand, through a price-induced substitution effect in favour of the cheapening supplier.

Robustness of the iceberg method

In the GTAP model, demand elasticities (called Armington elasticities) are high so that the elasticity of substitution to lower priced imports is always greater than 1. The price substitution effect dominates the expansion effect. The latter is assumed to lower demand for imports. Overall, more imports are demanded from a given partner—unless another MRA partner provides cheaper imports.

One shortcoming of the iceberg approach is the conceptualisation that the importer is assumed to have lower effective demand, under the expansion effect. This is a stylised effect used in order for the model to process the rise in importer efficiency. Essentially it does not happen. It is unlikely to affect the model's significant results.

Falling import costs result in cheaper production costs, which in turn raises the competitiveness of exports. Overall, in the case of sufficiently high import demand, the importing nation experiences rises in import and export value and increases in productivity, consumer welfare and output volume.

Acknowledging our caveat about its weakness, we consider our use of the iceberg approach to be reasonable as we are concerned with small changes in real costs of imports at the border.

Strength and weakness

The main strength of the iceberg approach is that it appropriately models the time saving as a small reduction in the real cost of imports for the importing firm at the border. It is also a simple technical solution compared to the technical complexity required for modelling the supply and demand effects in the GTAP model.

Fugazza (2013) notes that:

> *standard applied general equilibrium models (such as GTAP) do not offer many ways to include demand -shift and supply-shift effects and none of them are fully satisfactory.* (Fugazza, 2013)

The main weakness of the iceberg approach is that it attributes significant productivity gains to the importer. This likely overstates the actual consumer welfare and increases in real GDP from productivity improvements.

With the caveat about the weakness of the modelling approach, we consider our use of the iceberg approach to be sound as we are concerned with small changes in real costs of imports at the border.

Hertel et al. (2001) were the first to introduce a technology shock variable in GTAP to simulate the impact of lower non-tariff trade costs, such as customs clearance costs, in the free trade agreement between Japan and Singapore. Walmsley and Minor (2016) note that the CGE community has tended to adopt the technology shock methodology when modelling trade facilitation.

A.3.3 Critiques of the iceberg approach

There are useful critiques of use of the iceberg approach that arise from the assumption that the change in import costs is a result of exogenous efficiency change. These are instructive rather than destructive.

Productivity shock critique

Walmsley and Minor (2016) question whether the assumption of an efficiency shock is relevant for households and governments:

> *From a firm's perspective, the increased quantity of goods imported is equivalent to a technological change to the importing firm, akin to a reduction in the production costs. While this explanation may find some basis in a firm's supply chain, the role of a productivity shock for households and government is difficult to reconcile. It's important to note here that an often-used explanation for the productivity shock on government and households is that it can be interpreted as a change in quality. However, this explanation is inconsistent with the impacts on real GDP that the productivity shock creates and is not consistent with standard definitions of real GDP.* (Walmsley and Minor 2016)

GDP impact critique

Walmsley and Minor (2016) conclude that the iceberg method attributes a significantly larger increase in real GDP due to productivity gains than would be obtained with other approaches. They comment that the assumed technology change is assumed to be pervasive throughout the economy of the importing country. They report that in global models based on the GTAP database (Narayanan, Aguiar and McDougall 2012), all firms will receive the import-augmenting technological change shock.

Efficiency effect critique

Fugazza and Maur (2008) conclude that the iceberg method overstates efficiency gains in the economies. They argue that the impact of falls in import prices from removal of NTMs will not entirely be translated into efficiency gains:

> *The efficiency assumption implies that the price differential calculated by the AVEs [ad valorem equivalents] is entirely explained by the efficiency losses due to the presence of NTBs. That is unlikely to be the case, and conceptually it is not completely clear whether trade liberalization related to technical regulations is best represented by a reduction in efficiency impediments.* (Fugazza and Maur 2008)

Consumer welfare effect critique

Hertel (2012) cautions that the inherent framework of the GTAP model can introduce excessive terms of trade effects that can influence consumer welfare effects. This is due to the transmission mechanism for terms of trade effects. This is the Armington structure (refer Appendix A.4.1 below) – a GTAP model feature derived from the work of Armington (1969).

The Armington structure of the GTAP model can influence estimates of welfare, for example. This is because change in the relative prices of exports and imports influence the inter-regional distributions of goods and services between regions. Terms of trade effects therefore influence welfare because of the high Armington elasticities used. The terms of trade impact on welfare can be reduced by using low Armington elasticities. Hertel (2012) explains the economic mechanisms underlying the terms of trade (ToT) influences.

> *The underlying economic mechanism driving the large ToT effects in GTAP is quite straight forward: tariff reductions lead to increased imports; assuming little change in the country's trade balance, exports are required to increase; in order to increase exports, prices must fall; this increase in international competitiveness is*

achieved via a real depreciation which, in turn lowers the prices of all exports, and raises import costs, sufficiently to restore external balance. (Hertel 2012)

A.3.4 Overall

In summary, the GTAP iceberg approach is a theoretical model. Like many theoretical models it abstracts from the real world in ways that affect its outputs. It contains a stylised effect of a technology change that is:

- not necessarily meaningful to the conventional GDP contributions of households and government, who are not producers
- likely to overestimate GDP increases
- likely to overestimate efficiency gains for economies
- likely to overestimate terms of trade effects countervailing to increases of GDP and efficiency.

Acknowledging these shortcomings, the iceberg method is nevertheless a reasonable and computationally tractable approach for our purposes. This is because we are concerned with small changes in import costs at the border.

A.4 Interpreting our GTAP results

A.4.1 Armington structure of GTAP can influence terms of trade effects

Zhang (2006) describes how the Armington structure plays a crucial role in determining the response of trade flows and consumption patterns to changes in productivity parameters and trade costs.

The Armington specification of GTAP ensures that production of final commodities in each country uses both domestic and foreign intermediate inputs and that consumers consume both domestically produced and imported commodities.

Typically input-output data for domestic production cannot distinguish between countries of origin on an industry-use basis.

The Armington structure circumvents this problem by assuming aggregation of each good from all countries takes place at the border.

The Armington aggregator, which combines commodity exports from each source country into a single commodity aggregate, is a constant elasticity of substitution (CES) consumption function:

$$y_{ik} = \theta_{\rho_i} \left[\sum_{k=1}^{n} a_{ijk} y_{ijk}^{\rho_i} \right]^{1/\rho_i}$$

where,

y_{ik} is the aggregate demand for imported commodity i in country k.

y_{ijk} is the imports by country k of commodity i from country j

a_{ijk} are non-negative parameters that govern the relative shares for each commodity i for trade between j and k.

θ_{ρ_i} is the productivity effect of commodity i

$1/(1 - \rho_i)$ is the elasticity of this CES function, referred to as the Armington elasticity. It determines the degree of substitutability across origin countries for commodity i.

As noted by Zhang (2006) the choice of the Armington assumption is an important one as it impacts on the outcomes of policy shocks introduced to CGE models. This is due to both the Armington structure itself and the size of the substitution elasticities, which can have a large effect on the terms of trade.

Zhang (2006) describes how the Armington structure plays a crucial role in determining the response of trade flows and consumption patterns to changes in productivity parameters and trade costs.

Zhang (2006) observes that:

> *Two consequences of introducing the Armington assumption are that:*
>
> - *every country in a CGE model has market power in every market in which it buys and sells*
> - *comparative advantage in production does not exist.*
>
> *The first consequence means that when one country reduces its tariff rates, the model results tend to display large negative terms of trade effects. The second means that any resource reallocation across industries is small relative to what might occur in a non-Armington model. Both factors reduce the gains from trade liberalisation in simulations that use a CGE model. As a consequence, any benefits from reducing tariffs tend to be small, and occasionally negative. This is especially the case when the initial tariffs are small*. (Zhang 2006)

A.4.2 GDP effects via cost of capital effects

In this study we are concerned with removal of an NTM of the 'protection' type (above). A reduction of border clearance time lowers import costs. The impact on welfare is similar to the removal of a tariff and can be estimated as an ad valorem measure. Both removal of a tariff and removal of an NTM have similar effects in improving welfare and allocative efficiency, but not necessarily by the same amount to the same people. The removal of a tariff is a cost to some entities, such as a government and a benefit to others, such as a firm. To the extent that removal of a 'protection' NTM is similar to a tariff measure, because it increases welfare and allocative efficiency in an economy, we can draw lessons for GDP impacts of the removal of NTMs from the case for the removal of tariff measures.

Adams (2003) describes three main mechanisms through which tariff cuts can affect the real cost of capital (the nominal cost of capital adjusted for GDP price inflation).

> *The first is via a change in the global rate of return on capital – essentially the rate of return required on the global market for capital. The second is via the direct effects of the tariff cuts on the duty-paid prices of imported inputs to investment. The third is via changes in the terms-of-trade that affect the average c.i.f. price of imported capital goods relative to the GDP deflator.* (Adams 2003)

We can conclude that higher investment demand for production will raise the rate of return on capital, thereby tending to reduce GDP. The second will tend to reduce the costs of imported inputs to production, thereby tending to raise GDP. The third will tend to lower the costs of production, because imported inputs to production will be less expensive.

A.5 Consumer welfare

We measure welfare of households in terms of 'utility' – an economic term for satisfaction from consuming things. We assume that the more goods and services a household can purchase, the better off they are.

Changes in consumer welfare of households due to perturbations is explicitly modelled in the GTAP model. Consumer welfare is measured in terms of utility of households.

According to Hertel (2012), it is important to have a unique measure of regional welfare in the GTAP model because the GTAP model is designed to assess the inter-regional incidence of economic policies.

Hence, the GTAP model specifies 'regional households' that maximise welfare from current consumption, future consumption and the provision of public goods:

> *The GTAP model incorporates private consumption, government spending and savings directly into the regional household's utility function. Therefore, regional welfare might fall, even when private consumption rises, if government consumption and/or savings are adversely affected by a given policy. In short, in the standard closure, private spending, government spending and savings are all determined as part of a single utility maximization problem undertaken by the regional household.* (Hertel 2012)

Both prices and incomes affect our purchasing power. Both prices and household incomes change following a perturbation to global economies. We use equivalent variation as a measure of the combined impact of changes in prices and changes in incomes on utility.

Equivalent variation measures the income required to maintain the initial level of utility after a perturbation.

In the case of a price fall (rise) due to a perturbation, a household is better (worse) off. The change in utility is measured as the amount of income that would purchase the utility change prior to the shock occurring.

Applying the findings of Fugazza and Maur (2008) to the present MRA study, we should expect welfare effects (see below) to be unambiguously positive for all MRA economies. In the GTAP framework, efficiency shocks lower the price of imports, and this leads to an increase in demand for them at the expense of domestic goods:

> *Because in GTAP this efficiency gain applies nondiscriminatorily to all imports there are no trade diversion effects at work. This should thus result in unambiguous positive welfare effects for all countries.* (Fugazza and Maur 2008)

A.6 Sensitivity analysis

In most economic models, results are very dependent on the value of variables that are exogenous to the model. These exogenous variables can be either parameters of the model or shocks implemented for a specific experiment.

Sometimes the value of exogenous variables is not known precisely because they are econometrically estimated or involve errors for parameters or shocks, and we would like to know the variations of the model (CGE) results with respect to some changes on parameters or shocks.

Therefore, we usually test the model by imposing a range of change in exogenous parameters to find the sensitivity of the model to the value of parameters or shocks.

In this study, we used systematic sensitivity analysis (SSA) (Hertel et al. 2001), and we selected the change in the value of time in trade estimated (Minor and Hummels 2013) as the exogenous variable of interest to perform an SSA.

We follow the Gaussian 'quadratures' technique for the GTAP model to calculate means and standard deviations for the results, which give us an indication of the sensitivity of the model to shock value and the degree of confidence associated to any result. We use a triangular distribution in which central values are the time value for each commodity, with 10 percent minimum and maximum values for lower and upper levels respectively. Hertel (2012) describes this methodology:

> *…it is clear that we are unlikely to have access to a fully validated, global CGE model in the near future. A more modest goal is to provide sufficient robustness checks to assure policy makers that key findings are not simply a function of certain arbitrary (or worse yet, carefully selected) parameter settings. This leads to the topic of Systematic Sensitivity Analysis (SSA), a tool which has been widely employed in the GTAP community to explore the sensitivity of model results to parametric uncertainty. The basic idea is to sample from a set of parameter distributions, each time resolving the model and saving the results. After completion of the SSA, the user can compute standard statistics – most commonly the mean and variance of model results, thereupon providing model consumers with appropriately constructed confidence intervals. Thus, it should be possible to say, for example: "Given the overall structure of the GTAP model, we are 95% confident that this policy will improve regional welfare".* (Hertel 2012)

Hertel (2012) notes that a:

> *more common approach to SSA is to simply specify a uniform or a triangular distribution with a lower endpoint of zero (for nonnegative elasticity values). This reassures the reader that the author is being suitable conservative by specifying a generous variance in the underlying distribution.* (Hertel 2012)

However, Hertel (2012) concludes, that none of this is satisfactory and it would be far preferable to actually estimate the relevant parameters and the associated distributions and use these directly in the SSA.

In summary for this analysis, we have used a conservative approach in specifying a triangular distribution for sampling with central values being the value of time saving for each commodity time value with 10 percent upper and lower bounds. This accords with Hertel's description above. It is likely to be superior to assigning arbitrary error margins for time saving for each commodity.

Appendix B Import and Export impacts

This Appendix presents GTAP model results for MRA impacts on imports and exports. We regard these as merely illustrative. This is because the absolute values of the results are small. Hence the main assumption of the iceberg method, that a change in import cost can be modelled as a productivity change, is likely to have a sizeable influence on them.

B.1 Merchandise imports – change

Over the long term, New Zealand experiences percentage increases of 0.24 (0.59) percent for Scenario 2 (Scenario 1) in annual merchandise imports. Meanwhile Australia sees a 0.02 (0.04) percent increase for Scenario 2 (Scenario 1) in merchandise imports.

Import value increases are positive (or zero from rounding) for all nine economies, except Hong Kong, the USA and Canada for Scenario 1. Rises are consistent with the price substitution effect dominating the expansion effect in the iceberg model (above). (Appendix A.3.2).

Increases are relatively sizeable for New Zealand and Australia reflecting relatively high trade flows and mutual increased demand for imports of firms and consumer households from falls in import costs. Results for other MRA partners are at least an order of magnitude less.

Results for non-MRA regions (Table 13) show falls in import values. This is explained as a trade diversion away from non-MRA regions to MRA regions due to falls in prices of imports from MRA regions.

Table 5 Merchandise imports of MRA partners – change[1]

2018 US$ billion

Country	Imports	Change	
		Scenario 1	Scenario 2
New Zealand	44	0.26	0.10
Australia	236	0.08	0.05
Canada	469	-0.01	0.00
China	2,136	0.02	0.01
Hong Kong	628	-0.01	0.00
Japan	749	0.01	0.01
Korea	535	0.00	0.00
Singapore	371	0.00	0.01
United States	2,614	-0.01	0.01

1 Base year of change is 2018 for nominal imports. Change is expressed in terms of annual results and occurs over the long term.

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

Table 6 Merchandise imports of MRA partners – percentage change[1]

Percent

Country	Change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	0.587	0.236	0.009	0.004
Australia	0.035	0.020	0.002	0.001
Canada	-0.002	-0.000	0.000	0.000
China	0.001	0.001	0.000	0.000
Hong Kong	-0.001	-0.000	0.000	0.000
Japan	0.001	0.001	0.000	0.000
Korea	-0.000	0.001	0.000	0.000
Singapore	0.001	0.003	0.000	0.000
United States	-0.001	0.000	0.000	0.000

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: NZIER modelling

B.2 Merchandise exports of MRA partners – change

Over the long term, New Zealand experiences the greatest change in merchandise exports (Table 12 and Table 8) due to the New Zealand network of MRAs, rising US$0.02 billion (US$0.11 billion) for Scenario 2 (Scenario 1).

Merchandise export changes are generally positive for other MRA partners.

We can explain these in terms of the impact on each MRA partner due to:

- Greater demand for imports due to the substitution effect of the iceberg approach, thereby creating a demand for increased exports from other MRA partners.
- Increased competitiveness of exports due to lower costs of imported inputs together with a terms of trade effect (Appendix A.3.3), which raises exports of each partner.
- The expansion effect of the iceberg method that tends to lower demand for imports due to increased efficiency of importing firms (Appendix A.3.2).

The aggregate of these effects results in the net effect observed.

Non-MRA regions (Table 14) experience falls in export values. This can be explained, in part, as a substitution by MRA partners away from them in favour of MRA partners for lower priced imports.

Table 7 Merchandise exports – change[1]

2018 US$ billion

Country	Exports	Change	
		Scenario 1	Scenario 2
New Zealand	40	0.11	0.02
Australia	257	0.05	0.03
Canada	450	0.00	0.00
China	2,487	0.03	0.02
Hong Kong	569	0.00	0.00
Japan	738	0.00	0.01
Korea	605	0.00	0.00
Singapore	413	0.00	0.01
United States	1,664	0.01	0.02

1 Base year of change is 2018 for nominal exports. Change is expressed in terms of annual results and occurs over the long term.

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

Table 8 Merchandise exports – percentage change[1]

Percent

Country	Percentage change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	0.286	0.059	0.006	0.001
Australia	0.019	0.011	0.001	0.001
Canada	-0.001	0.000	0.000	0.000
China	0.001	0.001	0.000	0.000
Hong Kong	-0.001	-0.003	0.000	0.000
Japan	0.000	0.001	0.000	0.000
Korea	-0.000	0.001	0.000	0.000
Singapore	0.001	0.002	0.000	0.000
United States	0.001	0.001	0.000	0.000

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

B.3 Impact of MRAs on main imports and exports

We investigated changes in bilateral trade with New Zealand in the main commodity groups of each MRA partner arising from the MRAs.

The GTAP model calculates the impact of the MRA at the level of commodity group for each bilateral trade partner.

We investigated the change in value of trade produced by each MRA arrangement according to the top ten commodities traded by value. We derived the percentage (for the latest available data – June 2019 year) of the value of trade for the top ten that represents this impact.

We report these MRA percentage impacts for the top ten commodities. For illustration, we also provide the identity of the top four commodities that make up the trade impact for Scenario 2 in Table 9 and Table 10 below.

Table 9 Impact of MRAs on imports from New Zealand's MRA partners

Percent

Country	Value of MRA impact as percentage of top ten by value		Top four product categories of MRA impact for Scenario 2			
	Scenario 1	Scenario 2	1	2	3	4
Australia	1.99	1.59	Chemical, rubber, plastic products	Paper products, publishing	Mineral products nec	Food products nec
Canada	1.42	0.99	Machinery and equipment nec	Chemical, rubber, plastic products	Meat: cattle, sheep, goats, horse	Paper products, publishing
China	1.74	1.32	Machinery and equipment nec	Electronic equipment	Chemical, rubber, plastic products	Metal products
Hong Kong	0.74	0.19	Machinery and equipment nec	Chemical, rubber, plastic products	Electronic equipment	Food products nec
Japan	2.39	2.07	Motor vehicles and parts	Machinery and equipment nec	Transport equipment nec	Chemical, rubber, plastic products
Korea	1.63	1.41	Motor vehicles and parts	Petroleum, coal products	Chemical, rubber, plastic products	Machinery and equipment nec
Singapore	1.23	1.05	Petroleum, coal products	Chemical, rubber, plastic products	Manufactures nec	Food products nec
United States	0.95	0.67	Machinery and equipment nec	Transport equipment nec	Chemical, rubber, plastic products	Motor vehicles and parts

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

Table 10 Impact of MRAs on exports to New Zealand's MRA partners

Percent

Country	Value of MRA impact as percentage of top ten by value		Top four product categories of MRA impacts for Scenario 2			
	Scenario 1	Scenario 2	1	2	3	4
Australia	1.78	0.08	Dairy products	Food products nec	Wood products	Metal products
Canada	0.70	0.41	Dairy products	Machinery and equipment nec	Vegetables, fruit, nuts	Meat: cattle, sheep, goats, horse
China	1.73	0.44	Dairy products	Wood products	Vegetables, fruit, nuts	Food products nec
Hong Kong	1.99	0.08	Dairy products	Vegetables, fruit, nuts	Food products nec	Meat: cattle, sheep, goats, horse
Japan	1.74	0.92	Food products nec	Dairy products	Wood products	Vegetables, fruit, nuts
Korea	2.06	0.56	Dairy products	Food products nec	Wood products	Vegetables, fruit, nuts
Singapore	1.17	-0.01	Dairy products	Vegetables, fruit, nuts	Food products nec	Oil
United States	1.08	0.41	Dairy products	Wood products	Chemical, rubber, plastic products nec	Machinery and equipment nec

Source: World Bank national accounts data, OECD national accounts data files and NZIER modelling

Based on the aggregate value (not percentage) for Scenario 2 for the top ten imports (in the HS6 trade classification), key countries for imports affected are Australia, China, Japan and United States.

The commodities making up the top four for various nations are:

- chemical, rubber and plastic products for all MRA partners
- machinery and equipment nec for Canada, China, Hong Kong, Korea, Japan and the United States
- motor vehicles and parts for Japan, Korea and the United States
- petroleum, coal products for Singapore and Korea
- transport equipment nec for the United States and Japan
- electronic equipment for China and Hong Kong
- paper products and publishing for Australia and Canada.

Based on the aggregate value (not percentage) for Scenario 2 for the top ten exports (in the HS6 trade classification), key countries for exports affected are Australia, China, Japan and Korea.

The commodities making up the top four for various nations are:

- dairy products for all MRA partners
- wood products for Australia, China, Japan, Korea and the United States
- machinery and equipment nec for Canada and the United States
- vegetables, fruit, nuts for Canada, China, Hong Kong, Japan, Korea and Singapore
- food products nec for Australia, China, Hong Kong, Japan, Korea and Singapore
- metal products for Australia
- meat: cattle, sheep, goats, horse for Canada and Hong Kong
- oil for Singapore
- chemical, rubber, plastic products for the United States.

Appendix C Detailed GTAP modelling results

Table 11 GDP price index – change[1]

Percent

Country	Change	
	Scenario 1	Scenario 2
New Zealand	0.288	0.0487
Australia	0.0135	0.0117
Canada	-0.0019	-0.0005
China	-0.0017	-0.0004
Hong Kong	-0.0013	-0.0004
Japan	-0.0005	0
Korea	-0.0012	-0.0005
Singapore	-0.0004	0.0006
United States	-0.0011	-0.0003
Oceania	-0.0293	-0.0036
United Kingdom	-0.0016	-0.0012
East Asia	-0.0018	-0.0012
Southeast Asia	-0.0031	-0.0021
South Asia	-0.0013	-0.0009
North America	-0.0018	-0.0008
Latin America	-0.0019	-0.0009
European Union	-0.0016	-0.001
Non-EU	-0.0016	-0.0009
East Block	-0.0021	-0.001
Middle East and North Africa	-0.0016	-0.0011
Sub-Saharan Africa	-0.0018	-0.0008
Rest of World	-0.0016	-0.0009

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: NZIER modelling

Table 12 GDP volume index – change[1]

Percent

Country	Change	
	Scenario 1	Scenario 2
New Zealand	0.1091	0.0994
Australia	0.0039	0.0008
Canada	0.0002	0.0001
China	0.0005	0.0001
Hong Kong	0.0009	0.0003
Japan	0.0004	0.0002
Korea	0.0011	0.0004
Singapore	0.0011	0.0004
United States	0.0001	0.0001
Oceania	-0.0063	-0.0011
United Kingdom	-0.0002	-0.0001
East Asia	-0.0001	0
Southeast Asia	-0.0001	-0.0001
South Asia	-0.0001	0
North America	-0.0001	0
Latin America	-0.0001	0
European Union	-0.0001	0
Non-EU	0	0
East Block	-0.0001	0
Middle East and North Africa	-0.0001	0
Sub-Saharan Africa	-0.0001	0
Rest of World	0	0

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: NZIER modelling

Table 13 Merchandise imports – change[1]

Percent

Country	Change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	0.587	0.236	0.009	0.004
Australia	0.035	0.020	0.002	0.001
Canada	-0.002	-0.000	0.000	0.000
China	0.001	0.001	0.000	0.000
Hong Kong	-0.001	-0.000	0.000	0.000
Japan	0.001	0.001	0.000	0.000
Korea	-0.000	0.001	0.000	0.000
Singapore	0.001	0.003	0.000	0.000
United States	-0.001	0.000	0.000	0.000
Oceania	-0.037	-0.006	0.001	0.000
United Kingdom	-0.003	-0.001	0.000	0.000
East Asia	-0.004	-0.003	0.000	0.000
Southeast Asia	-0.004	-0.002	0.000	0.000
South Asia	-0.003	-0.001	0.000	0.000
North America	-0.002	-0.001	0.000	0.000
Latin America	-0.003	-0.001	0.000	0.000
European Union	-0.002	-0.001	0.000	0.000
Non-EU	-0.002	-0.001	0.000	0.000
East Block	-0.003	-0.001	0.000	0.000
Middle East and North Africa	-0.003	-0.002	0.000	0.000
Sub-Saharan Africa	-0.003	-0.001	0.000	0.000
Rest of World	-0.002	-0.001	0.000	0.000

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: NZIER modelling

Table 14 Merchandise exports – change[1]

Percent

Country	Change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	0.286	0.059	0.006	0.001
Australia	0.019	0.012	0.001	0.001
Canada	-0.001	0.000	0.000	0.000
China	0.001	0.001	0.000	0.000
Hong Kong	-0.001	-0.000	0.000	0.000
Japan	0.000	0.001	0.000	0.000
Korea	-0.000	0.001	0.000	0.000
Singapore	0.001	0.002	0.000	0.000
United States	0.001	0.001	0.000	0.000
Oceania	0.001	-0.001	0.000	0.000
United Kingdom	-0.002	-0.001	0.000	0.000
East Asia	-0.003	-0.002	0.000	0.000
Southeast Asia	-0.003	-0.002	0.000	0.000
South Asia	-0.002	-0.001	0.000	0.000
North America	-0.001	-0.001	0.000	0.000
Latin America	-0.001	-0.000	0.000	0.000
European Union	-0.001	-0.001	0.000	0.000
Non-EU	-0.002	-0.001	0.000	0.000
East Block	-0.002	-0.001	0.000	0.000
Middle East and North Africa	-0.002	-0.001	0.000	0.000
Sub-Saharan Africa	-0.002	-0.001	0.000	0.000
Rest of World	-0.002	-0.001	0.000	0.000

1 Percentages are derived from the GTAP model. Change is expressed in terms of total change in annual results occurring over the long term.

Source: NZIER modelling

Table 15 Consumer welfare – change

Equivalent variation in 2007 U$S million

Country	Change		Standard deviation	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
New Zealand	284.81	185.68	3.73	2.91
Australia	59.06	27.55	2.62	1.89
Canada	0.10	2.02	0.26	0.18
China	19.62	6.88	1.68	1.04
Hong Kong	1.54	0.53	0.09	0.02
Japan	24.33	16.87	1.45	0.91
Korea	9.98	4.98	0.73	0.43
Singapore	3.44	2.14	0.22	0.16
United States	16.42	13.46	1.29	1.09
Oceania	-9.05	-1.47	0.24	0.03
United Kingdom	-12.01	-6.15	0.18	0.09
East Asia	-3.75	-2.45	0.06	0.05
Southeast Asia	-19.87	-12.26	0.28	0.18
South Asia	-4.81	-2.67	0.10	0.08
North America	-3.32	-1.70	0.06	0.03
Latin America	-9.78	-3.85	0.20	0.14
European Union	-29.39	-17.09	0.43	0.29
Non-EU	-1.94	-0.90	0.04	0.02
East Block	-4.00	-1.75	0.11	0.10
Middle East and North Africa	-15.80	-9.95	0.22	0.18
Sub-Saharan Africa	-5.06	-1.88	0.09	0.06
Rest of World	-0.80	-0.52	0.02	0.02

Source: NZIER modelling