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Modelling international developments

***GTAP simulations of PMV
and other tariff changes***

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Contents

1	Introduction	1
	This report	1
	Some key results	1
	Key features of the modelling design	3
2	PMV tariffs	6
	Reducing Australia's PMV tariffs	6
	Reducing Australian and APEC PMV tariffs	8
3	Manufacturing tariffs	11
	Australian and APEC manufacturing tariffs reduced to 5 per cent	11
	Australian and APEC manufacturing tariffs removed	13
4	Manufacturing tariffs and agricultural protection	16
	APEC tariffs and agricultural protection reduced to 5 per cent	16
	Removing Australian and APEC protection	18
	Removing world manufacturing tariffs and agricultural protection	20
5	Sensitivity analysis	23
	Changes in parameter groups	23
	Alternate closure	25
A	Appendix: technical simulation details	27
	Model aggregation	27
	Database adjustments	28
	Solution method	29
	References	30
	Boxes, charts and tables	
1.1	Simulations undertaken	1

1.2	Summary welfare results Percentage change in income	2
1.3	GTAP regions and sectors used in this report	3
2.1	Welfare effects of reducing Australia's PMV tariffs Changes in equivalent variation and components	6
2.2	Reducing Australia's PMV tariffs to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline	7
2.3	Welfare effects of reducing Australian and APEC PMV tariffs to 5 per cent Changes in equivalent variation and components	8
2.4	Reducing Australian and APEC PMV tariffs to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline	9
3.1	Welfare effects of reducing Australian and APEC manufacturing tariffs to 5 per cent Changes in equivalent variation and components	11
3.2	Reducing Australian and APEC manufacturing tariffs to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline	12
3.3	Welfare effects of removing Australian and APEC manufacturing tariffs Changes in equivalent variation and components	13
3.4	Removing Australian and APEC manufacturing tariffs: macroeconomic and sectoral results by region Per cent change from baseline	14
4.1	Welfare effects of reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 percent Changes in equivalent variation and components	16
4.2	Reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline	17
4.3	Welfare effects of removing Australian and APEC manufacturing tariffs and agricultural protection Changes in equivalent variation and components	18
4.4	Removing Australian and APEC manufacturing tariffs and agricultural protection: macroeconomic and sectoral results by region Per cent change from baseline	19
4.5	Welfare effects of removing world manufacturing tariffs and agricultural protection Changes in equivalent variation and components	20

4.6	Removing world manufacturing tariffs and agricultural protection: macroeconomic and sectoral results by region Per cent change from baseline	21
5.1	Sensitivity analysis: confidence interval expressed as a percentage^a	24
5.2	Welfare effects of reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 percent: alternate closure Changes in equivalent variation and components	25
5.3	Reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 per cent: macroeconomic and sectoral results by region: alternative closure Per cent change from baseline	26

1

Introduction

This report

This report presents the results of a number of simulations using the GTAP model of the world economy. These simulations are designed to capture some of the potential implications of Australian, APEC, and global liberalisation of motor vehicles, manufacturing and agricultural protection.

Table 1.1 summarises the simulations and indicates their presentation in chapters 2 to 4. Chapter 5 of the report undertakes some sensitivity analysis of the results while the appendix summarises some technical details of the simulations.

1.1 Simulations undertaken

<i>Simulation</i>	<i>Reported in</i>
1. Unilateral reduction in Australia's PMV tariffs to 5 per cent	Chapter 2
2. Reduction in Australian and other APEC PMV tariffs to 5 per cent	Chapter 2
3. Reduction in Australian and other APEC manufacturing tariffs to 5 per cent	Chapter 3
4. Removal of Australian and other APEC manufacturing tariffs	Chapter 3
5. Reduction in Australian and other APEC manufacturing tariffs and agricultural protection to 5 per cent	Chapter 4
6. Removal of Australian and other APEC manufacturing tariffs and agricultural protection	Chapter 4
7. Removal of Australian and rest of world manufacturing tariffs and agricultural protection	Chapter 4

Some key results

Broad sources of welfare change

There are two broad sources of welfare change captured in the simulations presented here. The first is changes in allocative efficiency. Removing tariffs reduces activity in the previously protected sector and increases activity in other sectors in the economy. Typically, the expanding sectors

are export oriented, as import protection tends to tax exporters. This change in activity involves the reallocation of resources to uses that do not require any protection and so leads to an overall welfare gain.

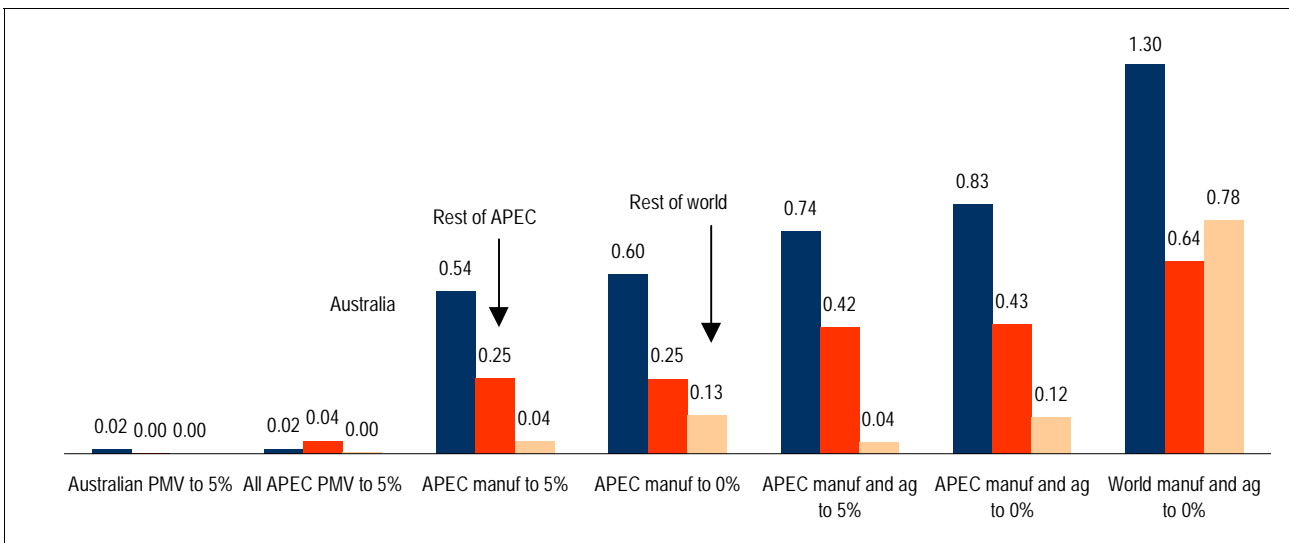
The second source of welfare change is changes in a country’s terms of trade — which can change because of changes in export prices, or import prices, or both. Typically, when a country removes its own import protection, this leads to an increase in exports. Depending on the demand conditions facing these exports, this increase in the quantity of exports may result in a decline in their price. Thus, a country removing its own tariffs may experience a terms of trade loss.

But when a foreign country reduces its protection against products from the home country, then the increase in demand for the home country’s products will increase the price of those products, resulting in an improvement in the home country’s terms of trade. Thus, while removing protection at home may be associated with a terms of trade loss, protection removed overseas will result in a terms of trade gain.

Welfare results for each simulation

Chart 1.2 summarises the welfare effects (measured as the percentage change in real income) that emerge in each simulation. Except in the first two simulations (involving reductions in motor vehicle tariffs only), Australia’s percentage gains are very high compared with the other aggregate regions.

1.2 Summary welfare results Percentage change in income



Data source: GTAP model simulations

In the first two simulations, Australia's gains come through improvements in resource allocation (allocative efficiency), as removal of its own tariffs leads to a reallocation of resources (away from motor vehicles, towards export sectors). This increase in exports is associated with a small terms of trade loss, but there is nevertheless a net gain in welfare.

For the other simulations, most of Australia's welfare gains come through net terms of trade *improvements*, with relatively small gains from improvements in domestic resource allocation. The terms of trade gains arise through the increased demand by other regions for Australia's products as those regions remove their tariffs. In the case of world agricultural and manufacturing protection removal, around 92 per cent of Australia's gains come about through terms of trade improvements.

Key features of the modelling design

The GTAP model

GTAP is a global general equilibrium model and database. Its origins lie in work originally undertaken at the (then) Industry Commission. Since the publication of the first GTAP book (Hertel et al, 1997) the GTAP project (based at Purdue University) has become a global network of developers, contributors and users.

The full GTAP database covers 66 regions and 57 sectors, and the latest version of the database is calibrated around 1997 as a base year. For the simulations presented here we aggregated the database to 14 regions and 16 sectors. These are set out in table 1.3, and the mapping of these aggregates to the full GTAP database is summarised in the appendix.

1.3 GTAP regions and sectors used in this report

Regions	Sectors
Australia	Crops
NZ	Livestock
US	Forestry & mining
Canada	Food processing
Mexico	TCF
EU	Paper products
Chinas	Chemicals etc
Korea	Ferrous metals
Other Asian APEC	Motor vehicles
Malaysia	Transport nec
Singapore	Other equipment
Thailand	Electrical
Japan	Other manufacturing
ROW	Utilities and construction
	Trade & transport
	Services

We have chosen this aggregation to make simulation with the model manageable while not losing the essence of the kinds of interactions the simulations outlined above are designed to capture.

Trade-offs in using a global model

GTAP is a globally consistent database of production, consumption and trade. It provides an invaluable tool for analysing global interactions, particularly the effects of other countries' trade reforms on a particular country such as Australia.

There are, however, two important trade-offs with such a global database. First, the database will not necessarily reflect the full details of a particular sector in a particular region. For example, the export and import share for the Australian motor vehicles industry represented in the model are not the same as what is observed from recent Australian data. Second, and related, the database is inevitably aggregated. In the current version of the GTAP model, motor vehicles and parts are a single sector. So, for example, the tariffs in that sector are an average of the tariffs on both motor vehicles and parts.

These trade-offs mean that some care should be used in interpreting the model results. It is important to keep in mind that for the simulations presented here (most of which are concerned with the effects on Australia of the actions of other regions), it is the relativities between different simulations that are most important.

The model closure

The main closure used in this report treats all endowments (land, labour and capital) as fixed. That is, the quantities of each of these used within a region do not vary as a result of the policy under consideration. This closure choice has both advantages and disadvantages. The advantage is that it allows the simulations to focus on the resource allocation effects of the change under consideration. The potential source of gain in this case is that resources can be used more efficiently following trade liberalisation, for example.

The disadvantage is that the simulations do not show the capital cumulation effects that might result from trade reform. That is, the simulations focus on the static rather than the dynamic effects of liberalisation. To some extent this is inevitable, as GTAP is a comparative static model. However, in the sensitivity analysis presented in chapter 5 we

show the effects of an alternative closure that allows capital to vary in each region.

Key parameter choices

We have used the standard GTAP parameters file with one exception: the trade parameters. There are two sets of these parameters:

- those determining the substitution between domestic and composite imported goods in each region; and
- those determining the substitution between imports from different sources.

For both of these sets, we have used double the standard values. This follows common practice with the GTAP model. It is essentially based on the observation that the standard parameter set often generates unreasonably large terms of trade effects and that with the standard parameters it is difficult to replicate observed trade flows.

The values of the elasticity of substitution between imports from different sources range from 8 to 20 in the doubled-the-standard parameter set (the value for motor vehicles is 20). In GTAP, the export demand elasticities facing each region are implicitly determined by the import-import substitution elasticities in the countries that the region exports to. It turns out that the value of these import substitution elasticities (which are the same for all regions but differ by sector) sets an upper bound to the (absolute) value of the export demand elasticity for each commodity facing each region. Thus the upper (absolute) value of the export demand elasticities vary from 8 to 20.

In chapter 5 we present sensitivity analysis of groups of model parameters to give an indication of the importance of parameter choices for the simulations presented here.

The welfare measure

In the simulations presented here we use equivalent variation (EV, the change in real income measured at the prices prevailing before the simulated change) as our welfare measure. GTAP has one single representative household per region, so EV can easily be measured. When presented in dollar terms, the change in EV refers to 1997 US dollars.

2

*PMV tariffs***Reducing Australia's PMV tariffs**

Tables 2.1 and 2.2 report key model results from reducing Australia's PMV tariffs to 5 per cent. Table 2.1 presents welfare effects and table 2.2 presents the macroeconomic and sectoral effects.

Table 2.1 presents three components of the welfare effects: an allocative efficiency effect (resulting from the reallocation of activity from subsidised to non subsidised sectors); a terms of trade effect (resulting from changes in export or import prices) and an effect related to the relative price of capital and savings. This last effect is itself a kind of terms of trade effect.

Australia's tariff removal leads to an improvement in allocative efficiency (\$142 million) some of which is offset by a worsening in the terms of trade. Table 2.2 indicates that this is a result of a decline in Australia's prices received (export prices) relative to prices paid (import prices).

Australia's tariff removal has some flow on effects to the regions that export cars to Australia (EU, Korea and Japan).

2.1 Welfare effects of reducing Australia's PMV tariffs Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	53	142	-84	-4
NZ	-2	-4	2	0
US	0	-1	-1	2
Canada	-2	-1	-2	0
Mexico	-1	-0	-0	0
EU	23	-8	30	1
Chinas	-6	-4	-3	1
Korea	76	41	35	-0
Other Asian APEC	-3	-1	-2	-0
Malaysia	2	1	1	0
Singapore	1	0	0	0
Thailand	-1	-1	-0	0
Japan	43	10	35	-2
ROW	-15	-5	-12	1
Total APEC	161	182	-18	-2
World	169	169	-0	-0

Source: GTAP simulation

2.2 Reducing Australia's PMV tariffs to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.04	-0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Income	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.34	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Exports	1.17	0.01	0.01	0.00	0.00	0.01	0.00	0.05	0.01	0.01	0.01	0.00	0.02	0.00
Imports	1.32	0.03	0.00	0.00	0.00	0.01	0.00	0.06	0.00	0.01	0.01	0.00	0.02	0.00
GDP deflator	-0.22	-0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.00
Terms of trade	-0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00
Prices received	-0.11	-0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00
Prices paid	0.00	-0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sectoral output														
Crops	0.14	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	-0.01	0.00
Livestock	0.24	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	-0.01	-0.01	0.00
Forestry & mining	0.24	0.01	0.00	0.00	0.00	-0.01	0.00	-0.04	0.00	-0.01	-0.01	-0.01	-0.02	0.00
Food processing	0.23	0.03	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	-0.01	-0.03	-0.01	-0.01	0.00
TCF	0.63	0.02	0.00	0.01	0.00	-0.01	0.01	-0.15	0.01	0.00	0.00	0.00	-0.01	0.00
Paper products	0.08	-0.02	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	-0.01	-0.01	0.00	0.00	0.00
Chemicals etc	0.11	-0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.01	0.00	0.00	0.00	0.00	0.00
Ferrous metals	-0.30	-0.06	0.00	0.01	0.00	0.00	0.00	-0.02	-0.01	0.00	-0.01	0.00	0.00	0.00
Motor vehicles	-10.51	-1.31	0.01	-0.02	0.00	0.10	-0.03	0.91	-0.10	0.29	-0.05	-0.03	0.14	0.01
Transport nec	0.94	-0.11	0.00	0.01	0.00	-0.01	0.01	-0.28	0.01	-0.02	0.00	0.02	-0.04	0.02
Other equipment	0.83	0.06	0.00	0.01	0.01	0.00	0.01	-0.07	0.02	0.00	0.01	0.01	-0.02	0.01
Electrical	0.87	0.09	0.01	0.02	0.02	0.01	0.02	-0.12	0.02	0.01	0.02	0.02	-0.01	0.01
Other manufact	0.66	-0.08	-0.01	0.00	0.00	-0.01	-0.01	-0.07	-0.02	-0.03	-0.03	-0.01	-0.01	0.00
Utilities and constr	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Trade & transport	0.10	0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
Services	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00

Source: GTAP simulation

For these countries, the positive effect is mostly due to an improvement in their terms of trade, arising from increased Australian demand for motor vehicles.

For Australia, the sectoral results show a predictable pattern. The output of motor vehicles (and ferrous metals) declines, while the output of other industries increases.

Reducing Australian and APEC PMV tariffs

Tables 2.3 and 2.4 show the model results of reducing Australian and other APEC motor vehicle tariffs to 5 per cent. The welfare effects for Australia are almost identical to the previous simulation — an increase in allocative efficiency, partly offset with a terms of trade decline.

There are large differences for the other regions, however, most of which gain from a better allocation of resources. Some also have partially offsetting losses in their terms of trade. Compared with the previous simulation, Australia's total gains are 8 per cent higher. APEC gains are some 37 times higher, and world gains are 39 times higher.

In absolute terms, the largest gains are to Other Asian APEC, followed by Japan and Korea. For Japan, the gains are mostly terms of trade, whereas for Korea and other Asian APEC there is a large component of allocative gains. The EU also gains from of a terms of trade effect.

2.3 Welfare effects of reducing Australian and APEC PMV tariffs to 5 per cent

Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	57	142	-83	-2
NZ	38	34	-0	4
US	-142	-53	-82	-7
Canada	56	52	-2	7
Mexico	362	363	-5	4
EU	459	67	364	27
Chinas	260	1 143	-956	73
Korea	1 005	626	381	-2
Other Asian APEC	1 755	2 124	-188	-181
Malaysia	716	817	-208	106
Singapore	49	10	38	1
Thailand	772	1 156	-448	64
Japan	1 186	120	1 191	-125
ROW	-25	-48	-9	32
Total APEC	6 114	6 534	-363	-57
World	6 547	6 554	-8	1

Source: GTAP simulation

2.4 Reducing Australian and APEC PMV tariffs to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.04	0.05	0.00	0.01	0.09	0.00	0.09	0.14	0.69	0.77	0.01	0.73	0.00	0.00
Income	0.02	0.06	0.00	0.01	0.11	0.01	0.02	0.26	0.63	0.76	0.07	0.56	0.03	0.00
Investment	0.28	0.71	-0.05	-0.03	0.30	-0.05	0.11	0.12	2.27	0.97	0.03	1.91	0.02	-0.07
Exports	1.17	0.34	-0.01	0.02	0.97	0.06	1.89	1.04	2.61	3.11	0.11	6.38	0.57	0.04
Imports	1.25	0.78	-0.08	0.00	1.23	0.05	1.77	1.22	3.01	3.59	0.13	6.83	0.93	-0.02
GDP deflator	-0.27	-0.15	-0.07	-0.04	0.04	-0.01	-0.39	0.31	-0.38	-1.46	0.00	-1.92	0.19	-0.03
Terms of trade	-0.11	0.00	-0.01	0.00	0.00	0.01	-0.22	0.23	-0.17	-0.21	0.03	-0.60	0.24	0.00
Prices received	-0.15	-0.05	-0.06	-0.05	-0.05	-0.01	-0.24	0.21	-0.19	-0.24	-0.06	-0.63	0.17	-0.03
Prices paid	-0.04	-0.05	-0.05	-0.05	-0.05	-0.03	-0.02	-0.02	-0.02	-0.03	-0.09	-0.03	-0.07	-0.03
Sectoral output														
Crops	0.24	0.09	0.06	0.07	-0.08	0.00	0.14	-0.08	-0.21	0.04	-0.02	0.13	-0.14	0.01
Livestock	0.31	0.00	0.03	0.00	-0.05	-0.01	0.14	-0.13	0.03	0.19	0.05	0.59	-0.13	0.00
Forestry & mining	0.31	0.08	0.04	0.01	-0.21	-0.02	0.32	-0.48	-0.73	0.28	-0.01	1.39	-0.30	0.01
Food processing	0.31	0.06	0.03	0.00	-0.04	-0.01	0.20	-0.10	-0.31	0.14	-0.07	1.01	-0.11	0.01
TCF	0.57	-0.26	0.01	-0.10	-0.81	-0.16	1.13	-2.43	-4.33	0.88	-0.24	4.14	-0.69	-0.05
Paper products	0.11	-0.01	0.04	0.00	-0.05	-0.02	0.45	-0.54	-1.17	0.66	0.03	1.40	-0.12	0.01
Chemicals etc	0.12	-0.01	0.03	0.00	-0.11	-0.01	0.24	-0.31	-0.82	-0.06	-0.15	1.46	-0.05	0.02
Ferrous metals	-0.33	0.00	-0.09	-0.06	0.00	0.00	-0.05	-0.18	-0.26	-0.50	-0.14	2.52	-0.26	-0.01
Motor vehicles	-11.81	-25.50	-1.21	-0.25	4.53	0.70	-36.54	12.91	-37.90	-31.34	-17.74	-61.72	6.02	-0.14
Transport nec	0.13	8.54	0.32	0.20	-0.17	-0.06	1.52	-3.78	2.00	5.14	0.00	8.96	-1.91	0.22
Other equipment	1.07	0.32	0.15	0.09	-0.97	-0.03	0.84	-1.01	-0.04	1.59	0.39	4.83	-0.96	0.03
Electrical	0.89	0.16	0.01	-0.49	-1.16	-0.32	0.95	-2.16	18.35	1.18	0.50	4.89	-0.78	-0.18
Other manufact	0.75	-0.05	0.01	-0.14	-0.40	-0.09	0.46	-0.81	-1.53	1.17	-0.09	3.52	-0.28	-0.04
Utilities and constr	0.22	0.35	-0.02	-0.02	0.22	-0.02	0.10	0.09	1.75	0.84	0.03	1.83	0.00	-0.04
Trade & transport	0.10	0.08	-0.01	0.01	0.03	0.00	0.35	-0.16	0.19	0.67	0.02	1.32	-0.04	0.00
Services	0.04	0.02	0.01	0.02	0.00	0.00	0.05	-0.05	-0.57	0.42	0.10	2.01	-0.02	0.01

Source: GTAP simulation

The percentage change in the welfare (or income gains) can be seen from the income row of table 2.4. In percentage terms the largest gain is for Malaysia, followed by Thailand and other Asian APEC. Allocative efficiency gains dominated for Thailand and Malaysia.

Comparing the Australian sectoral results with the previous simulation shows a larger decline in motor vehicle production and a slightly larger expansion in most other sectors (particularly agriculture). This indicates that while the removal of other APEC motor vehicle tariffs benefits the Australian economy as a whole, it does not improve the fortunes of the motor vehicle sector. The liberalising APEC regions tend to increase their motor vehicle imports from the EU, Mexico, Korea and Japan rather than Australia. But because their income has increase, they demand more agricultural and related products from Australia.

An interesting result in both tables 2.3 and 2.4 is the loss of welfare to the United States caused by a combination of allocative and terms of trade losses. The allocative loss is a puzzle, because normally we would expect that the decline in motor vehicle production would be a benefit to the economy (given that it is a protected sector). However, the welfare effects are more directly related to the imports of the protected commodity. The US primarily imports motor vehicles from Japan, Korea and the EU. But the increase in demand for motor vehicles from these regions has led to an increase in the price of their vehicles. This combined with the fact that the weighted US tariffs are initially close to 5 per cent (and so in fact are not reduced in this simulation) means that the US reduces its imports of this protected sector. This in turn leads to an allocative loss.

Table 2.4 illustrates the change in the global composition of automotive production following the tariff removal. Production increases in Mexico, Korea and Japan (and to a small extent the EU), but declines elsewhere.

3

Manufacturing tariffs

Australian and APEC manufacturing tariffs reduced to 5 per cent

Tables 3.1 and 3.2 show the model effects of reducing Australian and APEC manufacturing tariffs to 5 per cent. For these simulations we include food processing as a manufacturing activity, even though it contains some very early stage processing.

This simulation leads to gains for all regions, although the composition of the gain varies. For regions removing tariffs (APEC), the main source of gain is an improvement in allocative efficiency, which is offset to some degree by a worsening in the terms of trade in some cases.

For the EU (which is not liberalising) the gain comes from an improvement in its terms of trade as other regions demand more of its products. The same is true for Australia. For this simulation, most of Australia's welfare gain is a result of an improvement in its terms of trade.

3.1 Welfare effects of reducing Australian and APEC manufacturing tariffs to 5 per cent Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	1 886	357	1 511	18
NZ	3 139	373	2 803	-37
US	1 335	2 792	-888	-569
Canada	1 381	2 316	-1 024	90
Mexico	1 154	1 973	-963	144
EU	2 006	-563	2 723	-154
Chinas	8 352	10 455	-2 158	56
Korea	2 707	2 068	655	-16
Other Asian APEC	4 176	4 726	-387	-164
Malaysia	1 314	1 439	-238	114
Singapore	474	4	463	7
Thailand	3 578	3 605	-121	94
Japan	7 309	11 091	-4 123	341
ROW	2 626	1 028	1 517	81
Total APEC	36 807	41 199	-4 471	79
World	41 439	41 665	-231	6

Source: GTAP simulation

3.2 Reducing Australian and APEC manufacturing tariffs to 5 per cent: macroeconomic and sectoral results by region Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.09	0.56	0.04	0.37	0.51	-0.01	0.81	0.46	1.53	1.36	0.01	2.29	0.26	0.02
Income	0.54	5.38	0.02	0.24	0.34	0.03	0.71	0.69	1.49	1.39	0.69	2.60	0.20	0.06
Investment	1.49	11.21	-0.29	-0.54	0.43	-0.15	1.53	1.24	4.29	1.73	0.69	6.03	-0.23	-0.31
Exports	6.00	19.01	3.24	3.96	7.15	0.04	17.43	9.68	13.89	6.32	-0.40	21.12	13.29	0.56
Imports	9.22	44.36	2.24	3.58	7.42	0.04	18.51	11.14	13.71	7.22	0.02	24.22	14.85	0.35
GDP deflator	1.89	16.20	-0.58	-1.30	-1.56	0.11	-0.98	-0.07	-0.17	-1.84	0.68	-3.58	-1.27	0.13
Terms of trade	2.04	15.47	-0.14	-0.41	-0.78	0.11	-0.45	0.39	-0.33	-0.24	0.35	-0.17	-0.80	0.14
Prices received	2.03	15.52	-0.50	-0.74	-1.13	0.07	-0.73	0.21	-0.44	-0.38	0.06	-0.38	-0.57	0.07
Prices paid	-0.01	0.04	-0.36	-0.33	-0.35	-0.03	-0.28	-0.18	-0.11	-0.14	-0.29	-0.21	0.23	-0.07
Sectoral output														
Crops	-2.75	-11.95	0.03	0.67	0.23	1.49	-1.30	-1.14	-1.15	0.13	-0.39	0.54	-7.39	0.32
Livestock	15.49	32.81	1.62	-6.10	-3.40	3.50	0.76	-10.03	1.32	3.19	0.71	7.87	-17.17	0.95
Forestry & mining	-2.71	-16.16	0.49	1.09	0.83	-0.20	-0.10	-2.22	-2.90	-0.52	-1.41	0.97	-1.48	-0.12
Food processing	44.24	96.50	1.67	-12.66	-5.31	4.02	-8.26	-14.08	-3.59	4.74	20.98	14.84	-23.83	2.04
TCF	-32.74	-70.62	-16.14	-23.32	-20.29	-3.69	11.20	23.96	46.23	19.99	12.26	-4.83	5.35	-1.14
Paper products	2.23	-11.25	0.35	0.17	0.84	0.09	-0.79	0.91	-5.50	-1.72	1.13	-2.11	-0.93	-0.12
Chemicals etc	-0.74	-14.94	-0.18	0.79	0.17	-0.44	0.46	1.31	-5.09	-2.91	3.68	-5.05	1.69	-0.33
Ferrous metals	-3.99	-23.39	0.44	1.52	2.32	-0.51	-2.84	-1.82	-8.27	-2.99	7.61	-6.17	2.52	-1.07
Motor vehicles	-22.70	-62.35	-0.67	1.86	12.31	-1.02	-38.19	9.23	-51.84	-30.27	-20.37	-59.78	9.92	-1.04
Transport nec	-10.59	-33.89	-0.82	2.59	-5.38	-7.70	5.47	-8.89	44.35	5.20	-11.84	115.17	10.58	-2.36
Other equipment	-7.44	-45.43	0.65	1.95	5.17	-1.02	-1.85	-5.25	5.80	3.11	-2.60	1.61	3.11	-1.02
Electrical	-9.98	-37.00	-0.73	0.04	7.04	-2.37	1.22	-0.19	11.51	0.26	-2.82	4.72	2.13	-1.36
Other manufact	-10.50	-38.87	0.98	2.68	0.78	-0.49	1.07	-3.77	-6.51	-0.46	-3.03	-1.41	2.30	-0.99
Utilities and constr	0.75	6.30	-0.12	-0.12	0.26	-0.14	1.21	1.04	3.53	1.57	0.64	4.38	-0.10	-0.23
Trade & transport	-0.42	-6.26	0.21	0.62	0.52	0.30	0.31	0.11	-0.05	0.87	0.29	0.90	0.26	0.24
Services	-0.38	-0.62	0.09	0.61	0.53	-0.04	-0.19	-0.31	-2.03	-0.38	-0.96	1.49	0.03	0.01

Source: GTAP simulations

In percentage terms, the largest income gains are to New Zealand, followed by Thailand, Other Asia and Malaysia. The sectoral composition of these gains differs considerably between regions. For New Zealand, the large gain is from an increase in food processing output.

Australian and APEC manufacturing tariffs removed

Tables 3.3 and 3.4 show the model effects of removing Australian and APEC manufacturing tariffs. The results are similar to the previous simulation, although generally larger in magnitude.

One exception is that for the US, the combination of terms of trade loss and loss due to the relative price of capital and savings now dominates its allocative efficiency gain, resulting in a net loss in welfare. The sensitivity analysis presented in chapter 5 indicates that this net result for the US is very sensitive to the choice of import substitution parameters, and could in fact be reversed with higher parameter values.

World gains in this simulation are 24 per cent higher than the previous simulation (where the tariffs were only reduced to 5 per cent), while Australia's gains are 10 per cent higher. Australia's higher gains are composed of a 20 per cent increase in allocative efficiency gains and an 8 per cent increase in terms of trade gains.

3.3 Welfare effects of removing Australian and APEC manufacturing tariffs
Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	2 088	429	1 633	25
NZ	3 380	305	3 090	-15
US	-2 588	3 920	-4 975	-1 534
Canada	751	2 613	-2 137	275
Mexico	469	2 208	-2 101	361
EU	7 747	972	6 924	-150
Chinas	9 096	13 040	-4 165	221
Korea	3 572	3 252	280	40
Other Asian APEC	4 335	5 405	-821	-249
Malaysia	1 409	1 739	-521	191
Singapore	1 097	-2	1 070	29
Thailand	3 891	3 843	-57	106
Japan	9 296	11 215	-2 234	314
ROW	6 755	2 680	3 687	388
Total APEC	36 795	47 968	-10 937	-235
World	51 297	51 620	-326	3

Source: GTAP simulation

3.4 Removing Australian and APEC manufacturing tariffs: macroeconomic and sectoral results by region Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.11	0.46	0.05	0.41	0.57	0.01	1.01	0.73	1.75	1.64	0.00	2.44	0.26	0.05
Income	0.60	5.79	-0.04	0.13	0.14	0.11	0.78	0.91	1.55	1.49	1.60	2.83	0.26	0.16
Investment	2.93	13.86	-0.38	-0.57	0.74	-0.54	3.65	3.51	7.04	4.25	1.65	9.87	-0.43	-0.68
Exports	12.68	24.06	9.60	4.97	11.11	0.53	34.37	22.11	25.75	13.01	-0.14	28.53	20.03	1.45
Imports	17.28	53.44	6.98	4.24	11.12	0.43	37.24	25.31	25.20	15.38	0.85	34.06	22.91	1.02
GDP deflator	1.31	16.55	-1.53	-2.51	-3.18	0.29	-1.57	-0.27	-0.27	-2.78	1.47	-4.96	-1.19	0.28
Terms of trade	2.09	16.54	-0.61	-0.84	-1.66	0.27	-0.82	0.17	-0.67	-0.50	0.81	-0.10	-0.40	0.33
Prices received	1.80	16.24	-1.33	-1.71	-2.52	0.20	-1.34	-0.21	-0.96	-0.86	0.13	-0.49	-0.43	0.18
Prices paid	-0.29	-0.26	-0.72	-0.87	-0.87	-0.07	-0.53	-0.37	-0.28	-0.36	-0.67	-0.39	-0.02	-0.16
Sectoral output														
Crops	-2.75	-11.95	0.03	0.67	0.23	1.49	-1.30	-1.14	-1.15	0.13	-0.39	0.54	-7.39	0.32
Livestock	15.49	32.81	1.62	-6.10	-3.40	3.50	0.76	-10.03	1.32	3.19	0.71	7.87	-17.17	0.95
Forestry & mining	-2.71	-16.16	0.49	1.09	0.83	-0.20	-0.10	-2.22	-2.90	-0.52	-1.41	0.97	-1.48	-0.12
Food processing	44.24	96.50	1.67	-12.66	-5.31	4.02	-8.26	-14.08	-3.59	4.74	20.98	14.84	-23.83	2.04
TCF	-32.74	-70.62	-16.14	-23.32	-20.29	-3.69	11.20	23.96	46.23	19.99	12.26	-4.83	5.35	-1.14
Paper products	2.23	-11.25	0.35	0.17	0.84	0.09	-0.79	0.91	-5.50	-1.72	1.13	-2.11	-0.93	-0.12
Chemicals etc	-0.74	-14.94	-0.18	0.79	0.17	-0.44	0.46	1.31	-5.09	-2.91	3.68	-5.05	1.69	-0.33
Ferrous metals	-3.99	-23.39	0.44	1.52	2.32	-0.51	-2.84	-1.82	-8.27	-2.99	7.61	-6.17	2.52	-1.07
Motor vehicles	-22.70	-62.35	-0.67	1.86	12.31	-1.02	-38.19	9.23	-51.84	-30.27	-20.37	-59.78	9.92	-1.04
Transport nec	-10.59	-33.89	-0.82	2.59	-5.38	-7.70	5.47	-8.89	44.35	5.20	-11.84	115.17	10.58	-2.36
Other equipment	-7.44	-45.43	0.65	1.95	5.17	-1.02	-1.85	-5.25	5.80	3.11	-2.60	1.61	3.11	-1.02
Electrical	-9.98	-37.00	-0.73	0.04	7.04	-2.37	1.22	-0.19	11.51	0.26	-2.82	4.72	2.13	-1.36
Other manufact	-10.50	-38.87	0.98	2.68	0.78	-0.49	1.07	-3.77	-6.51	-0.46	-3.03	-1.41	2.30	-0.99
Utilities and constr	0.75	6.30	-0.12	-0.12	0.26	-0.14	1.21	1.04	3.53	1.57	0.64	4.38	-0.10	-0.23
Trade & transport	-0.42	-6.26	0.21	0.62	0.52	0.30	0.31	0.11	-0.05	0.87	0.29	0.90	0.26	0.24
Services	-0.38	-0.62	0.09	0.61	0.53	-0.04	-0.19	-0.31	-2.03	-0.38	-0.96	1.49	0.03	0.01

Source: GTAP simulation

The largest percentage gainers in this simulation are Thailand, Other Asia and Malaysia, each of which experience large changes in their overall trade.

4

Manufacturing tariffs and agricultural protection

APEC tariffs and agricultural protection reduced to 5 per cent

Tables 4.1 and 4.2 show the model effects of reducing APEC tariffs and agricultural protection to 5 per cent. In this context, agricultural protection refers to tariffs as well as output and export subsidies on raw agricultural products.

All regions gain under this simulation, although the composition of the gains varies. For Australia, 87 per cent of the gains are improvements in its terms of trade. For countries such as China and Korea, however, allocative efficiency gains dominate.

Including agricultural tariff reductions increase the world gains by 58 per cent (compared with only removing manufacturing tariffs to 5 per cent), increases APEC gains by 66 per cent, and increases Australia's gains by 37 per cent.

4.1 Welfare effects of reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 per cent Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	2 584	327	2 248	9
NZ	2 771	346	2 460	-36
US	1 966	3 444	-929	-549
Canada	4 439	2 705	1 683	51
Mexico	1 114	2 142	-1 175	146
EU	2 240	-137	2 524	-147
Chinas	10 371	13 014	-2 688	45
Korea	11 436	11 898	-421	-41
Other Asian APEC	4 315	4 884	-402	-167
Malaysia	1 775	2 380	-749	144
Singapore	672	-38	700	9
Thailand	3 630	3 823	-280	87
Japan	16 090	20 203	-4 501	388
ROW	2 001	612	1 323	65
Total APEC	61 163	65 130	-4 055	89
World	65 404	65 605	-208	7

Source: GTAP simulation

4.2 Reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 per cent: macroeconomic and sectoral results by region

Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.08	0.53	0.04	0.43	0.55	0.00	1.01	2.69	1.58	2.25	-0.05	2.43	0.48	0.01
Income	0.74	4.75	0.03	0.78	0.32	0.03	0.89	2.91	1.54	1.87	0.98	2.64	0.44	0.05
Investment	0.90	9.96	-0.36	-0.21	0.57	-0.25	1.64	3.10	3.93	3.98	0.71	6.32	-0.12	-0.46
Exports	5.38	17.32	3.73	4.21	8.13	0.06	19.80	14.66	15.55	9.03	-0.46	22.03	15.20	0.60
Imports	8.81	39.42	2.57	5.06	8.48	-0.01	20.96	17.00	14.86	10.39	0.11	25.27	17.31	0.25
GDP deflator	1.88	14.22	-0.53	-0.45	-1.79	0.15	-1.13	-1.95	-0.04	-2.63	1.02	-3.94	-1.64	0.17
Terms of trade	3.04	13.60	-0.14	0.71	-0.96	0.10	-0.56	-0.21	-0.35	-0.74	0.53	-0.36	-0.84	0.12
Prices received	3.04	13.59	-0.40	0.44	-1.15	0.12	-0.73	-0.36	-0.38	-0.72	0.25	-0.64	-0.63	0.11
Prices paid	0.00	-0.01	-0.26	-0.27	-0.19	0.02	-0.17	-0.15	-0.03	0.02	-0.28	-0.28	0.21	-0.01
Sectoral output														
Crops	23.93	-9.61	0.32	37.07	-2.17	1.76	-1.69	-32.69	-0.15	-5.04	19.57	-1.07	-38.58	0.79
Livestock	-1.34	29.72	2.43	-27.07	-1.71	2.69	0.43	63.83	-0.40	21.24	-11.53	7.90	-15.91	0.41
Forestry & mining	-1.98	-14.55	0.49	0.50	0.71	-0.11	-0.10	-0.88	-2.73	-1.54	3.30	0.47	-0.12	-0.09
Food processing	23.31	89.11	0.77	-24.08	-4.10	2.78	-9.28	65.39	-6.65	41.02	11.76	16.91	-19.61	0.81
TCF	-33.80	-67.96	-16.72	-23.50	-20.49	-4.27	12.45	25.22	46.83	15.97	10.97	-0.52	6.72	-1.57
Paper products	1.16	-10.13	0.36	-0.86	1.04	0.04	-0.58	2.70	-5.05	-2.05	1.18	-2.05	-0.73	-0.13
Chemicals etc	-0.88	-13.59	-0.26	1.39	0.14	-0.58	0.37	0.83	-4.96	19.73	2.76	-4.12	1.48	-0.40
Ferrous metals	-3.86	-21.45	0.53	0.09	2.65	-0.37	-2.84	-6.76	-7.48	-5.68	7.27	-6.95	3.22	-0.85
Motor vehicles	-19.90	-59.39	-0.59	0.25	12.77	-0.73	-38.34	1.66	-51.89	-35.40	-20.45	-60.65	10.73	-0.65
Transport nec	-8.29	-30.51	-0.40	0.72	-5.20	-6.94	5.29	-23.67	45.84	-2.99	-11.75	111.26	11.91	-1.50
Other equipment	-5.45	-41.93	0.78	0.70	5.54	-0.81	-1.98	-12.63	6.17	-2.66	-2.47	0.05	3.68	-0.76
Electrical	-7.34	-33.65	-0.23	-0.15	8.28	-1.86	1.22	-8.47	12.22	-2.26	-3.06	3.24	2.86	-0.96
Other manufact	-8.88	-36.05	1.01	1.07	0.99	-0.46	1.02	-7.75	-5.72	-2.90	-3.62	-1.89	2.94	-0.85
Utilities and constr	0.36	5.62	-0.15	0.05	0.38	-0.20	1.30	2.72	3.26	3.39	0.62	4.65	0.06	-0.32
Trade & transport	-0.35	-5.64	0.22	0.73	0.54	0.42	0.39	0.47	0.03	0.53	0.85	1.22	0.54	0.33
Services	-0.10	-0.57	0.10	0.81	0.49	-0.02	-0.19	0.22	-1.71	-2.24	-0.94	1.31	0.15	0.03

Source: GTAP simulation

Removing Australian and APEC protection

Tables 4.3 and 4.4 show the effect of removing manufacturing tariffs and agricultural protection in Australia and the rest of APEC.

Compared with the previous simulation, removing the remaining agricultural and manufacturing protection in APEC increases the gains to Australia by 12 per cent (made up of an increase the terms of trade gain of 10 per cent and an increase in the allocative gain of 24 per cent). Gains to the world as a whole increase by 17 per cent.

As seen in the previous complete removal simulations, terms of trade and capital cost effects now dominate the allocative efficiency effects for the US. The sensitivity analysis in chapter 5 indicates that the magnitude and sign of the net effect is sensitive to the choice of import substitution parameters.

4.3 Welfare effects of removing Australian and APEC manufacturing tariffs and agricultural protection

Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	2 904	408	2 480	15
NZ	3 007	281	2 742	-15
US	-1 525	4 906	-4 815	-1 616
Canada	4 201	3 061	882	258
Mexico	304	2 388	-2 453	369
EU	7 739	1 084	6 780	-125
Chinas	11 015	15 883	-5 081	213
Korea	12 767	13 700	-972	39
Other Asian APEC	4 739	5 574	-604	-231
Malaysia	1 940	2 714	-990	217
Singapore	1 378	-20	1 367	31
Thailand	3 975	4 102	-222	96
Japan	18 196	20 697	-2 890	389
ROW	6 012	2 160	3 488	364
Total APEC	62 901	73 693	-10 557	-235
World	76 653	76 937	-289	4

Source: GTAP simulation

4.4 Removing Australian and APEC manufacturing tariffs and agricultural protection: macroeconomic and sectoral results by region Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.10	0.43	0.06	0.49	0.62	0.01	1.23	3.10	1.81	2.57	-0.02	2.61	0.49	0.04
Income	0.83	5.15	-0.02	0.74	0.09	0.11	0.94	3.25	1.69	2.05	2.01	2.89	0.50	0.14
Investment	2.28	12.66	-0.49	-0.35	0.90	-0.63	3.93	5.95	6.78	6.90	1.64	10.26	-0.36	-0.86
Exports	12.23	22.81	10.59	5.44	12.78	0.53	37.95	28.14	28.53	16.56	-0.47	29.97	22.28	1.51
Imports	17.13	48.96	7.68	6.03	12.83	0.37	41.02	32.53	27.60	19.65	0.68	35.72	25.61	0.89
GDP deflator	1.28	14.59	-1.52	-1.67	-3.40	0.35	-1.79	-2.00	0.03	-3.46	2.10	-5.33	-1.57	0.39
Terms of trade	3.19	14.67	-0.59	0.39	-1.95	0.27	-0.98	-0.48	-0.49	-0.93	1.03	-0.30	-0.50	0.32
Prices received	2.92	14.30	-1.20	-0.42	-2.56	0.27	-1.36	-0.79	-0.67	-1.10	0.37	-0.74	-0.50	0.25
Prices paid	-0.26	-0.32	-0.61	-0.81	-0.63	0.00	-0.39	-0.32	-0.18	-0.16	-0.65	-0.45	0.01	-0.07
Sectoral output														
Crops	25.44	-10.25	-1.57	39.62	-1.55	2.78	-2.62	-35.23	-0.75	-6.21	20.85	-1.11	-42.85	1.40
Livestock	0.78	32.85	2.41	-30.17	-1.83	3.61	0.24	71.78	-1.09	25.61	-12.42	9.05	-18.67	0.61
Forestry & mining	-1.22	-14.26	1.06	1.39	1.26	-0.16	-1.40	-4.21	-3.63	-2.17	6.21	0.04	0.10	-0.41
Food processing	26.62	96.25	0.23	-25.18	-3.63	3.67	-12.04	73.64	-8.96	51.59	18.69	20.93	-22.71	1.27
TCF	-37.49	-74.03	-23.56	-31.25	-27.93	-5.37	19.71	32.77	72.84	28.69	12.70	-0.77	3.03	-2.24
Paper products	0.21	-12.73	0.76	0.01	1.37	0.11	-3.38	2.13	-7.25	-8.40	1.31	-3.70	-0.95	-0.27
Chemicals etc	-2.45	-15.97	-0.69	-0.78	-0.44	-0.32	-1.02	3.38	-9.19	20.10	7.83	-6.74	1.83	0.01
Ferrous metals	-6.51	-25.80	-0.83	-4.22	1.48	-0.04	-4.08	-8.55	-13.80	-10.73	9.69	-9.46	5.00	-0.42
Motor vehicles	-28.28	-68.72	-2.99	-2.56	17.62	-0.55	-46.89	0.73	-49.15	-25.15	-22.79	-63.90	16.88	-1.40
Transport nec	-8.39	-32.11	1.32	1.09	-10.33	-11.15	12.14	-25.86	112.98	-0.89	-5.51	104.05	9.48	-3.70
Other equipment	-10.40	-50.71	1.23	-1.84	2.94	-1.02	-3.29	-17.77	23.82	-3.28	-1.18	2.50	6.05	-1.18
Electrical	-8.10	-37.94	-0.06	-0.17	11.47	-4.59	9.94	-3.34	21.79	4.23	-5.63	3.99	1.80	-2.44
Other manufact	-10.16	-41.26	1.12	-2.16	-0.62	0.22	0.09	-8.97	-8.56	-5.80	-2.98	1.32	3.73	-1.39
Utilities and constr	1.26	6.91	-0.22	0.07	0.54	-0.45	3.05	4.90	5.56	5.72	1.39	7.24	-0.10	-0.58
Trade & transport	-0.11	-5.52	0.49	1.35	0.98	0.69	0.08	0.65	-0.58	0.13	0.78	0.47	0.53	0.55
Services	-0.13	-0.63	0.21	1.46	0.78	-0.09	-0.93	-0.53	-3.88	-5.32	-2.48	0.29	0.05	0.00

Source: GTAP simulation

Removing world manufacturing tariffs and agricultural protection

Tables 4.5 and 4.6 show the model effects of removing world manufacturing and agricultural protection.

The addition of the rest of the world into the liberalising group significantly increases the gains (compared with the previous simulation where only APEC was liberalising). Total world gains increase by 137 per cent, mostly due to improved allocative efficiency.

Total APEC gains increase by 49 per cent, mostly due to a turn around in the terms of trade effect. Gains to Australia increase by 56 per cent, resulting from a significant improvement in the terms of trade as the EU is included in liberalising regions.

4.5 Welfare effects of removing world manufacturing tariffs and agricultural protection

Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>
	US\$ million	US\$ million	US\$ million	US\$ million
Australia	4 536	320	4 167	50
NZ	5 364	470	4 917	-24
US	8 701	5 475	3 266	-39
Canada	5 426	3 031	2 233	163
Mexico	768	2 544	-2 070	294
EU	26 312	32 014	-7 478	1 776
Chinas	15 461	15 997	-767	231
Korea	16 577	15 147	1 382	47
Other Asian APEC	5 997	5 840	152	4
Malaysia	2 991	2 927	-48	112
Singapore	2 283	157	2 047	79
Thailand	5 335	4 323	891	122
Japan	20 298	19 076	1 742	-521
ROW	61 824	75 209	-11 091	-2 294
Total APEC	93 738	75 308	17 912	517
World	181 874	182 531	-657	-1

Source: GTAP simulation

4.6 Removing world manufacturing tariffs and agricultural protection: macroeconomic and sectoral results by region Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.08	0.71	0.07	0.48	0.66	0.40	1.24	3.42	1.89	2.76	0.20	2.74	0.45	1.52
Income	1.30	9.19	0.12	0.96	0.22	0.38	1.32	4.22	2.14	3.15	3.33	3.88	0.56	1.42
Investment	1.75	18.03	-1.65	-1.69	-0.35	-2.31	3.40	6.12	6.12	6.53	2.10	9.66	-1.66	7.17
Exports	15.28	35.09	15.90	6.45	15.49	7.55	41.64	33.21	32.10	19.99	2.13	32.90	27.61	47.86
Imports	21.60	81.65	11.49	6.88	15.03	6.01	44.93	38.79	30.87	23.77	3.66	39.48	29.03	48.86
GDP deflator	3.00	26.11	-0.91	-1.17	-2.74	-1.99	-0.32	0.06	1.60	-1.69	3.66	-3.83	-0.67	-2.71
Terms of trade	5.34	26.03	0.32	0.90	-1.69	-0.28	-0.15	0.82	0.23	-0.10	1.55	1.01	0.24	-0.79
Prices received	4.92	25.55	-0.57	0.19	-2.20	-1.34	-0.33	0.44	0.24	-0.08	0.99	0.65	0.24	-1.44
Prices paid	-0.40	-0.38	-0.88	-0.71	-0.52	-1.06	-0.18	-0.38	0.01	0.02	-0.56	-0.35	0.00	-0.65
Sectoral output														
Crops	23.73	-16.16	1.35	44.11	0.11	-6.74	-0.88	-34.52	-0.10	-5.44	20.89	0.21	-39.24	-0.34
Livestock	11.37	45.94	8.98	-25.41	-0.53	-9.22	0.88	83.64	-0.48	31.36	-9.92	12.01	-10.44	-1.11
Forestry & mining	-3.15	-21.57	0.51	0.85	0.42	3.77	-2.29	-5.53	-4.33	-1.46	10.29	-0.74	-0.98	-1.07
Food processing	47.13	126.40	5.55	-17.99	-2.42	-11.42	-11.06	87.71	-8.26	67.89	32.76	27.51	-19.82	0.81
TCF	-43.12	-85.02	-18.28	-31.52	-29.63	-13.90	23.65	30.92	87.87	29.60	19.66	4.93	3.39	-2.06
Paper products	1.20	-18.75	1.18	0.53	1.83	1.28	-3.64	1.85	-6.80	-8.64	2.38	-3.84	-0.89	-3.36
Chemicals etc	-2.25	-23.24	-0.56	-1.28	-0.69	-0.54	-0.94	4.24	-9.66	13.43	14.23	-7.04	2.01	-0.21
Ferrous metals	-7.42	-35.05	-0.87	-4.56	2.86	2.21	-4.41	-6.85	-16.03	-14.51	12.62	-5.16	5.51	-5.43
Motor vehicles	-35.72	-78.76	-3.67	-2.87	25.46	-11.22	-51.39	4.53	-52.56	1.68	-28.68	-50.41	21.59	19.08
Transport nec	-16.25	-50.29	-5.48	-7.57	-13.04	-1.37	11.65	-38.92	132.59	-17.73	-0.90	106.28	48.22	-16.50
Other equipment	-15.26	-64.92	0.82	-2.51	1.14	5.65	-4.89	-21.14	24.38	-7.26	0.12	0.25	3.61	-8.87
Electrical	-10.86	-50.87	0.57	3.83	13.60	-5.00	9.02	-6.01	23.46	7.25	-2.11	1.17	0.88	1.89
Other manufact	-15.84	-54.02	0.56	-5.22	-2.04	2.42	0.80	-11.36	-9.65	-7.32	-3.85	-4.64	2.82	-3.49
Utilities and constr	0.76	9.81	-0.73	-0.80	-0.57	-1.16	2.53	5.06	5.00	5.36	1.74	6.68	-1.21	4.20
Trade & transport	-0.41	-8.19	0.43	1.54	0.69	2.73	-0.59	1.95	-1.19	-0.62	0.83	-1.02	0.40	1.78
Services	-0.38	-0.73	0.05	1.10	0.45	0.64	-1.16	-1.05	-5.09	-7.44	-6.02	-1.37	-0.13	-0.45

Source: GTAP simulations

The largest gainers from this simulation are the Asian economies, New Zealand and Australia. For the former, the gains largely come about through increased manufacturing activity, while for Australia and New Zealand, agriculture and food processing gains are the most significant.

5

Sensitivity analysis

Changes in parameter groups

There are three key parameter groups in the GTAP model:

- ***trade parameters*** which include the elasticity of substitution between domestic and imported goods in aggregate, and the elasticity of substitution between imported goods from different sources;
- ***supply parameters*** including the elasticity of substitution between primary factors, the elasticity of substitution between intermediate inputs (in composite) and value added and the elasticity of transformation between endowment commodities; and
- ***demand parameters*** which include the substitution and income parameters.

We undertake sensitivity analysis for each of these parameter groups using the sensitivity facilities built into the GEMPACK implementation of GTAP. This essentially involves simulating a variation in the parameters according to some distribution, and then observing the mean and standard deviation of the corresponding results. A 50 per cent variation in a set of parameters will result in a particular standard deviation for the model results. This standard deviation provides information about the sensitivity of the model results to the parameter group.

For the sensitivity analysis here we conduct our variations around the third simulation (Australia and other APEC regions reducing tariffs on all manufacturing activities to 5 per cent). We have assumed a 50 per cent variation in each of the parameter groups and this variation is assumed to have a triangular distribution.

Results are presented in table 5.1. To summarise what would otherwise be a large number of results, we have reported the sensitivity of changes in EV, and the allocative and terms of trade components of EV only. Further, we have converted the standard deviation to a 95 per cent confidence interval and expressed this confidence interval as a single percentage of the mean value. Thus, for example, a value of 50 per cent implies that the 95

per cent confidence interval involves a 50 per cent variation above or below the mean. A value of greater than 100 per cent implies that the confidence interval includes a change in sign of the base value.

5.1 Sensitivity analysis: confidence interval expressed as a percentage^a

Region	Trade parameters			Supply parameters			Demand parameters		
	EV	Allocative component	Terms of trade component	EV	Allocative component	Terms of trade component	EV	Allocative component	Terms of trade component
Australia	42	24	46	1	4	1	1	2	2
NZ	52	40	53	0	1	0	1	2	1
US	108	42	34	2	0	4	3	1	3
Canada	76	50	11	2	1	1	2	1	1
Mexico	83	51	6	1	0	0	1	0	0
EU	26	14	18	10	25	2	1	4	0
Chinas	51	45	23	0	0	0	2	2	1
Korea	10	27	41	2	3	2	8	10	1
Other Asian APEC	37	35	27	0	0	1	1	2	4
Malaysia	51	40	40	1	0	4	1	1	2
Singapore	0	449	4	1	60	1	0	4	0
Thailand	49	45	115	0	0	2	2	2	1
Japan	45	49	54	5	3	0	9	7	3
ROW	11	37	4	3	1	5	2	2	2

^a Analysis is for simulation 3 (APEC manufacturing tariffs to 5 per cent). Results refer to the effect of a 50 per cent variation in the underlying parameter group. Parameters within the group are assumed to move together according to a triangular distribution.

Source: GTAP model simulations

Several points are evident from these results.

- EV results are very sensitive to the choice of trade parameters. For Australia, the overall EV results vary by 42 per cent as a result in of the 50 per cent variation in the trade parameters. Most of this is due to variation in the terms of trade component.
- For the US, the sign of the welfare results could be reversed by a change in the values of the import substitution parameters (the confidence interval involves and change relative to the mean of 108 per cent). This result is applicable to other simulations as well as simulation 3, and indicates that the net losses to the US in some of the simulations could be reversed with higher import substitution parameters.
- All country results are very sensitive to the trade parameters, but the US is the most sensitive.
- Trade parameters affect both the allocative and the terms of trade components of EV.
- The supply and demand parameters generally have a very small effect on the EV results. An important exception is the EU, whose supply parameters do influence the allocative component of the EV.

This pattern of sensitivity is not surprising as the underlying simulation involves trade related shocks that have the initial effect of changes relative

import prices. For other kinds of simulations, the results may be less sensitive to changes in trade parameters.

Alternate closure

In tables 5.2 and 5.3 we present the results of simulation 5 using an alternate model closure. This closure (initially suggested by Francois et al, 1996) assumes a fixed savings rate in each region, but allows the capital stock to vary according to investment allocated to each region.

5.2 Welfare effects of reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 percent: alternate closure

Changes in equivalent variation and components

	<i>Total</i>	<i>Allocative efficiency</i>	<i>Terms of trade</i>	<i>Price of capital</i>	<i>Endowment effect</i>
	US\$ million	US\$ million	US\$ million	US\$ million	US\$ million
Australia	3 889	463	2 328	6	1 092
NZ	4 933	622	2 427	-58	1 942
US	-8 940	3 526	218	-490	-12 195
Canada	3 889	2 618	1 809	42	-580
Mexico	1 945	2 280	-1 260	153	771
EU	-6 783	-1 171	3 368	-196	-8 783
Chinas	20 561	14 797	-3 081	61	8 783
Korea	18 092	12 933	-926	-46	6 130
Other Asian APEC	13 065	5 518	-800	-258	8 605
Malaysia	6 103	2 867	-1 165	165	4 236
Singapore	1 548	98	955	8	487
Thailand	35 820	7 359	-2 408	154	30 715
Japan	13 916	19 729	-4 029	339	-2 123
ROW	-6 679	-250	2 311	130	-8 869
Total APEC	114 819	72 810	-5 930	76	47 863
World	101 357	71 388	-251	10	30 211

Source: GTAP simulation

As table 5.2 indicates, there is now an additional component to the change in EV: the endowment effect, which is the contribution to changed income of the change in capital in place in each region. The endowment effect may either add or subtract from the overall welfare results.

Allowing capital to vary generally tends to exaggerate effects that were already present in the standard closure. For example, with the standard closure, the US and EU experienced decreases in investment. Under this closure, this decline in investment translates into a decline in the capital stock and with it a large welfare loss from the endowment effect.

5.3 Reducing Australian and APEC manufacturing tariffs and agricultural protection to 5 per cent: macroeconomic and sectoral results by region: alternative closure Per cent change from baseline

	<i>Australia</i>	<i>NZ</i>	<i>US</i>	<i>Canada</i>	<i>Mexico</i>	<i>EU</i>	<i>Chinas</i>	<i>Korea</i>	<i>Other Asia</i>	<i>Malaysia</i>	<i>Singapore</i>	<i>Thailand</i>	<i>Japan</i>	<i>ROW</i>
Macroeconomic results														
GDP	0.50	4.96	-0.16	0.28	0.84	-0.17	2.09	4.93	5.31	7.79	1.02	28.70	0.38	-0.26
Income	1.11	8.45	-0.12	0.68	0.57	-0.10	1.76	4.60	4.67	6.44	2.26	26.08	0.38	-0.15
Investment	0.94	10.73	-0.54	-0.38	0.44	-0.40	2.73	5.17	7.72	9.95	2.09	33.73	-0.25	-0.63
Capital	0.94	10.73	-0.54	-0.38	0.44	-0.40	2.73	5.17	7.72	9.95	2.09	33.73	-0.25	-0.63
Exports	6.36	23.56	3.57	3.95	8.50	-0.15	21.36	17.65	20.93	14.67	1.53	54.19	15.48	0.23
Imports	9.16	40.35	2.75	4.87	8.41	-0.10	22.04	18.80	18.73	15.62	2.22	53.20	17.82	0.22
GDP deflator	1.79	12.51	-0.50	-0.43	-1.90	0.18	-1.24	-2.28	-0.62	-3.27	1.30	-5.95	-1.62	0.24
Terms of trade	3.13	12.92	-0.02	0.76	-1.03	0.13	-0.64	-0.49	-0.68	-1.11	0.71	-2.65	-0.75	0.21
Prices received	3.03	12.84	-0.38	0.46	-1.24	0.12	-0.90	-0.66	-0.82	-1.23	0.11	-2.97	-0.63	0.18
Prices paid	-0.10	-0.07	-0.36	-0.30	-0.21	-0.01	-0.26	-0.17	-0.14	-0.12	-0.59	-0.34	0.12	-0.03
Sectoral output														
Crops	24.24	-8.19	0.61	37.51	-1.96	1.99	-1.27	-32.49	-0.07	-5.02	20.14	-1.66	-38.26	0.85
Livestock	-0.89	33.59	2.39	-27.13	-1.51	2.77	0.98	66.43	1.29	22.83	-11.48	7.55	-15.74	0.29
Forestry & mining	-1.39	-9.12	0.40	0.53	1.05	-0.09	0.74	1.14	0.03	2.97	4.32	17.81	-0.09	-0.17
Food processing	23.70	95.69	0.64	-24.15	-3.88	2.81	-8.78	67.84	-5.00	41.38	12.81	17.80	-19.62	0.70
TCF	-33.86	-67.56	-17.37	-24.08	-20.48	-4.98	13.02	27.18	55.94	19.15	8.98	33.38	6.21	-2.62
Paper products	1.61	-4.92	0.17	-0.94	1.48	-0.10	0.62	4.97	0.43	3.79	2.25	24.80	-0.82	-0.48
Chemicals etc	-0.21	-8.28	-0.45	1.25	0.51	-0.73	1.65	3.65	-0.88	25.23	4.78	19.03	1.53	-0.79
Ferrous metals	-3.37	-16.94	0.30	-0.22	3.07	-0.60	-1.28	-3.36	-1.23	2.45	10.35	31.72	3.32	-1.31
Motor vehicles	-19.26	-55.44	-0.80	-0.05	13.91	-1.01	-36.85	4.57	-42.67	-23.86	-20.48	-33.86	10.98	-1.20
Transport nec	-7.94	-24.84	-0.63	0.39	-4.83	-7.18	7.19	-21.84	63.10	13.82	-12.74	198.04	11.07	-2.27
Other equipment	-4.97	-36.25	0.45	0.16	5.99	-1.02	-0.28	-9.29	11.84	9.44	-0.32	46.61	3.76	-1.39
Electrical	-7.25	-29.58	-1.33	-2.01	6.65	-2.87	2.41	-6.78	16.02	2.46	0.04	52.93	2.05	-1.90
Other manufact	-8.11	-30.41	0.62	0.49	1.42	-0.75	2.50	-5.11	1.15	5.30	-2.71	29.65	2.83	-1.46
Utilities and constr	0.53	8.30	-0.32	-0.10	0.32	-0.35	2.40	4.85	7.19	9.30	1.96	31.27	-0.06	-0.54
Trade & transport	0.05	-1.17	0.04	0.62	0.85	0.25	1.59	2.73	4.56	6.85	1.25	26.75	0.46	0.02
Services	0.33	4.05	-0.09	0.68	0.82	-0.18	0.96	2.24	3.21	3.71	-0.49	22.31	0.05	-0.23

Source: GTAP simulation

A

Appendix: technical simulation details

Model aggregation

Tables A.1 and A.2 summarise the sectoral and regional aggregation used in this report.

A.1 Sectoral aggregation

Code	Old sector	New sector	Code	Old sector	New sector
pdr	Paddy rice	Crops	lum	Wood products	ForfishMin
wht	Wheat	Crops	ppp	Paper products, publishing	Paperprods
gro	Cereal grains nec	Crops	p_c	Petroleum, coal products	Chempetrol
v_f	Vegetables, fruit, nuts	Crops	crp	Chemical,rubber,plastic prods	Chempetrol
osd	Oil seeds	Crops	nmm	Mineral products nec	Othermanuf
c_b	Sugar cane, sugar beet	Crops	i_s	Ferrous metals	Ferrousmeta
pfb	Plant-based fibers	Crops	nfm	Metals nec	Othermanuf
ocr	Crops nec	Crops	fmp	Metal products	Ferrousmeta
ctl	Cattle,sheep,goats,horses	Livestock	mvh	Motor vehicles and parts	MVandparts
oap	Animal products nec	Livestock	otn	Transport equipment nec	Transnex
rmk	Raw milk	Livestock	ele	Electronic equipment	Electrical
wol	Wool, silk-worm cocoons	Livestock	ome	Machinery and equipment nec	Othequip
for	Forestry	ForfishMin	omf	Manufactures nec	Othermanuf
fsh	Fishing	ForfishMin	ely	Electricity	Elegswtrcon
col	Coal	ForfishMin	gdt	Gas manufacture, distribution	Elegswtrcon
oil	Oil	ForfishMin	wtr	Water	Elegswtrcon
gas	Gas	ForfishMin	cns	Construction	Elegswtrcon
omn	Minerals nec	ForfishMin	trd	Trade	Tradetrans
cmt	Meat: cattle,sheep,goats,horse	Foodproces	otp	Transport nec	Tradetrans
omt	Meat products nec	Foodproces	wtp	Sea transport	Tradetrans
vol	Vegetable oils and fats	Foodproces	atp	Air transport	Tradetrans
mil	Dairy products	Foodproces	cmn	Communication	CommServ
pcr	Processed rice	Foodproces	ofi	Financial services nec	CommServ
sgr	Sugar	Foodproces	isr	Insurance	CommServ
ofd	Food products nec	Foodproces	obs	Business services nec	CommServ
b_t	Beverages and tobacco products	Foodproces	ros	Recreation and other services	CommServ
tex	Textiles	Texgarmlea	osg	PubAdmin/Defence/Health/Educat	CommServ
wap	Wearing apparel	Texgarmlea	dwe	Dwellings	CommServ
lea	Leather products	Texgarmlea			

A.2 Regional aggregation

Code	Old region	New region	Code	Old region	New region
aus	Australia	Australia	fin	Finland	EU
nzl	New Zealand	NZ	fra	France	EU
chn	China	Chinas	deu	Germany	EU
hkg	Hong Kong	Chinas	gbr	United Kingdo	EU
jpn	Japan	Japan	grc	Greece	EU
kor	Korea	Korea	irl	Ireland	EU
twm	Taiwan	Chinas	ita	Italy	EU
idn	Indonesia	OthASAPPEC	lux	Luxembourg	EU
mys	Malaysia	Malaysia	nld	Netherlands	EU
phl	Philippines	OthASAPPEC	prt	Portugal	EU
sgp	Singapore	Singapore	esp	Spain	EU
tha	Thailand	Thailand	swe	Sweden	EU
vnm	Vietnam	OthASAPPEC	che	Switzerland	ROW
bgd	Bangladesh	ROW	xef	Rest of EFTA	ROW
ind	India	ROW	hun	Hungary	ROW
lka	Sri Lanka	ROW	pol	Poland	ROW
xsa	Rest of South	ROW	xce	Rest of Centr	ROW
can	Canada	Canada	xsu	Former Soviet	ROW
usa	United States	US	tur	Turkey	ROW
mex	Mexico	Mexico	xme	Rest of Middl	ROW
xcm	Central Ameri	ROW	mar	Morocco	ROW
col	Colombia	ROW	xnf	Rest of North	ROW
per	Peru	ROW	bwa	Botswana	ROW
ven	Venezuela	ROW	xsc	Rest of SACU	ROW
xap	Rest of Andea	ROW	mwi	Malawi	ROW
arg	Argentina	ROW	moz	Mozambique	ROW
bra	Brazil	ROW	tza	Tanzania	ROW
chl	Chile	ROW	zmb	Zambia	ROW
ury	Uruguay	ROW	zwe	Zimbabwe	ROW
xsm	Rest of South	ROW	xsf	Other Souther	ROW
aut	Austria	EU	uga	Uganda	ROW
bel	Belgium	EU	xss	Rest of Sub-S	ROW
dnk	Denmark	EU	xrw	Rest of World	ROW

Database adjustments

As identified on the GTAP website, the current release of the database contains some incorrect export taxes and subsidies for some regions. We have used the ALTERNATIVE closure and parameter set to remove these values.

Solution method

For all simulations we used GEMPACK's automatic accuracy facility. The base set up is a 4, 6, 8 step Gragg with 4 subintervals. Automatic accuracy was set to achieve 80 percent of results with accuracy of 4 figures (using both data and solution as criteria). The minimum subinterval size was set at 10^{n-6} .

References

- Francois, J., McDonald, B. and Nordstrom, H. 1996, *Liberalisation and Capital Accumulation in the GTAP Model*, GTAP Technical Paper No. 7, Global Trade Analysis Project, Purdue.
- Hertel, Thomas (editor) 1997 *Global Trade Analysis: Modelling and Applications*, Cambridge University Press, New York and Melbourne.