



Australian Government
Productivity Commission

Modelling
Supporting the
Productivity Commission
Annual Report 2008-09

Technical Note

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Publications Inquiries:

Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: maps@pc.gov.au

General Inquiries:

Tel: (03) 9653 2100 or (02) 6240 3200

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The Productivity Commission

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The theme chapter (Chapter 1) of the Productivity Commission's *Annual Report 2008-09* considered, among other things, the possible risks to economic growth of higher trade protection and overly burdensome regulation of the financial sector. To support its analysis, the Commission used a computable general equilibrium (CGE) model of the world economy — the Global Trade Analysis Project (GTAP) model — to provide an indication of the potential impacts and costs of illustrative increases in trade protection and overly burdensome financial market regulation.

This note provides supporting technical detail on the modelling framework used, the illustrative scenarios (or model 'shocks') considered and the model results. The focus of the modelling is on the longer-run effects of possible changes. That is, it is based on the assumption of full adjustment to the effects of the postulated increases in border protection and overly burdensome regulation. The results are exploratory and should therefore be viewed as illustrative of the potential effects of the policies assumed. *The estimates are not forecasts of how protection or regulation may evolve or the impacts of change.*

The analysis was finalised after comments were received on a work-in-progress version of the modelling from Dr Antoine Bouet (Senior Research Fellow, International Food Policy Research Institute, Washington), Mr Ken Heydon (former Deputy Director, Trade Directorate, Organisation for Economic Co-operation and Development, Paris), and Mr David Pearce (Executive Director, Centre for International Economics, Canberra). The referees' comments were supportive of the study in the context of the current situation. The referees referred to the need to consider a longer-run perspective to fully assess the impacts of policy changes. There was also a recognition of the evolving nature of national and international policies as the financial crisis and associated economic downturn unfold, all of which, add to the task of designing and presenting meaningful scenarios. In the area of border protection, it was suggested that the modelling could be interpreted as being broadly illustrative of the potential effect of other protectionist measures such as anti-dumping and government procurement policies. In the area of excessive regulatory burden, referees noted the difficulty defining an appropriate scenario and the potential for different regulatory responses across jurisdictions. The comments have been recognised in the final design and presentation of the modelling scenarios. In particular, it is emphasised that the scenarios are intended to indicate the sensitivity of economic outcomes to possible responses to the crisis that might impede economic efficiency and raise costs to industry and consumers.

This technical note is organised as follows. Section 1 provides the background to this study and the approach used, while sections 2 to 4 provide an overview of the GTAP model, the model closure and model database, respectively. Section 5

outlines two scenarios that explore the effects of hypothetical increases in border protection represented by higher tariffs, while section 6 explores the sensitivity of economic output to the costs associated with ‘excessive regulation’ of financial markets. The appendixes provide supporting detail. Appendix A details the GTAP country and industry aggregations. Appendix B outlines the modifications made to the GTAP model to meet the requirements of this study. Appendix C provides detail on the shocks used in modelling the hypothetical increases in border protection. Appendix D presents additional detail relating to sensitivity tests on alternative model closure assumptions.¹

1 Background and approach used

Governments and central banks worldwide have taken aggressive action to arrest the severe downturn in the global economy. Most governments have responded by lowering interest rates and providing cash transfers, tax cuts, a variety of subsidies, and direct investments in infrastructure. Many governments have also provided substantial support to the financial sector with the intention of stabilising financial markets. Such measures aim to bolster financial markets and aid economic recovery.

Nonetheless, there are concerns that some responses to the financial crisis could give rise to measures that would ultimately lower output and income growth potential. For this study, two areas are considered to align broadly with concerns raised about possible responses to the global financial crisis and its aftermath.

The first area considered is the longer-term effects of a hypothetical widespread resort to trade protectionism. While such an outbreak has not occurred, some countries have selectively increased border protection through tariffs and other protective measures (such as industry subsidies and local procurement programs). Although some trade and investment liberalising measures have been introduced since the start of the global financial crisis, available information suggests that new trade restricting measures have been more common.

The second area considered is the potential effects of excessive regulation of financial markets; that is, regulatory settings that impose additional costs on industry over the minimum necessary to efficiently regulate financial markets in the post-global financial crisis environment. While a range of changes are being considered at the national and international level to address deficiencies in financial market regulations, there is a risk that some changes might unduly restrict

¹ The model closure and shocks files are available from the Commission on request.

competition, innovation and productivity in these markets. The hypothetical simulation is intended to illustrate, in a stylised manner, the sensitivity of global output to the case of excessive regulation.

These scenarios are developed in more detail in sections 5 and 6.

2 The GTAP model

The model used in this study is the GTAP model, a widely-used multi-country, multi-sector general equilibrium model of the global economy (Hertel 1997).^{2,3} The main features of the model are outlined in box 1.

Its multi-country nature and its rich sectoral detail make the GTAP model ideally suited to quantifying the potential effects of changes in tariffs and other economic factors across countries. The detail of the model makes it particularly useful for the analysis of policies that have different effects across activities and countries. The model has been used widely to examine the effects of changes in tariffs, trade barriers and industry assistance arrangements across countries.

In a similar vein to Walmsley (1998) and Verikios and Hanslow (2009), international capital mobility has been introduced into the standard GTAP model through some minor modifications to the model theory and closure to better reflect the longer-term focus adopted in this study. These modifications allow capital stocks to move between regions in response to differences in expected rates of return. The modifications made are summarised in box 2 and outlined in full in appendix B.

² The model is available at <https://www.gtap.agecon.purdue.edu/models/current.asp>.

³ The terms ‘region’, ‘country’ and ‘economy’ are used interchangeably in this note to designate a regional entity appearing in the model, which can be a country or a group of countries (for example, the United States of America, the European Union and the Rest of Africa).

Box 1 Main features of the GTAP model

- A representative household in each region maximises a Cobb-Douglas utility function by allocating disposable income between private consumption, public consumption and savings. The shares of private consumption, government consumption and savings in regional income are fixed in nominal terms. Households allocate income based on static expectations.
- Private consumption is modelled using a constant difference in elasticities (CDE) function, which has the property that the price and income elasticities of demand vary in response to changes in prices and aggregate expenditure. The allocation of public consumption is governed by a Cobb-Douglas function. In each case, the relevant function determines the demand for each commodity. Commodity differentiation is then expressed through nested structures with constant elasticity of substitution (CES) between imported and domestically produced goods and CES substitution between imports from different countries (the 'Armington' assumption). The demand for commodities at each level in the nesting depends on relative prices and the relevant elasticity of substitution (the elasticities of substitution between imported goods originating from different countries are twice those between domestic and aggregated imported commodities).
- Producers in each region are divided into sectors (industries) and are assumed to minimise costs subject to a constant returns to scale production technology. They combine intermediate inputs and a primary factor bundle in fixed proportions to produce their output. Skilled and unskilled labour, capital and land are combined using a CES function to form a primary factor bundle. Goods and factor markets are assumed to be competitive and clear in equilibrium. Returns to factors and tax revenue within each country are assumed to accrue as income to households in that country.
- Non-labour primary factors of production are assumed to be domestically owned. That is, GTAP does not explicitly account for foreign direct investment and the repatriation of profits earned offshore. Consequently, changes in real GDP may not provide an accurate indicator of changes in national income and welfare.
- Households are assumed to save a fixed proportion of regional income (that is, their average propensity to save is fixed). Savings, net of depreciation, from each country are pooled together in a 'global bank' and distributed across countries to equalise the percentage changes in the expected rate of return across industries. While this implies changes in foreign ownership of the domestic capital stock, and hence a claim to part of domestic production by non-residents, net savings used by foreign countries in this version of GTAP do not generate returns to investing countries. Whether a country is a net saver or borrower in GTAP depends on the relative magnitude of changes in net savings (due to changes in household income) and the net inflow of (foreign) investment (due to changes in expected rates of return).
- Owing to the incomplete coverage of regional tax instruments, government expenditure in each region is not linked to tax revenue and the fiscal balance has no impact on model results. Government budgets are not explicitly modelled, but tax revenue is assumed to form part of household income in each region.

Box 2 **Modifications made to the GTAP model**

Modifications were made to the standard GTAP model to enable a broader range of capital market responses than would otherwise be possible. These modifications are consistent with the longer-term focus of this study. The modifications allow for the possibility of:

1. capital stocks moving between countries in response to differences in the expected rate of return; and
2. holding the ratio of investment to capital stock fixed to enable capital to move with the investment allocation.

Some variables were also added to the model for presentational purposes.

Appendix B provides a full list of the modifications made to the standard GTAP model and closure.

One of the sectors in the GTAP database pertinent to this study is ‘financial services nec’. It includes banking, non-bank financial services, security broking and services to finance and investment. It does not include insurance, insurance-related services such as insurance broking, or related business services such as legal and accounting services. Like other industries in GTAP, the financial services industry uses intermediate inputs and a primary factor bundle consisting of labour and physical capital and pays the owners of these factors for their use (in the form of wages and returns to capital).⁴ In keeping with the 1993 United Nations System of National Accounts that underpin the international standards for compiling the country-based input-output tables on which the GTAP database is based, the output of the financial services industry represents the value of ‘financial intermediation services indirectly measured’ (FISIM) plus direct service charges.⁵ The FISIM component of output represents the difference between the income received and interest payable on financial intermediation services (broadly, the margins to financial intermediation between lenders and borrowers).⁶

The production-based nature of the GTAP model enables the modelling of policies such as financial regulation that impact on the productivity and price of financial services delivery and returns on investment. The model, however, does not explain

⁴ The *financial services nec* industry in GTAP does not use land as a factor of production.

⁵ The 1993 edition of United Nations System of National Accounts can be found at <http://unstats.un.org/unsd/sna1993/toctop.asp>. The methodology used by national statistical agencies to measure the financial services industry varies from country to country.

⁶ GTAP does not model the sector as a ‘margin’ industry that links the flow of funds between domestic and foreign savers and investors.

the source of productivity and price changes in the financial sector. It also does not incorporate the financial market ‘flow of funds’ mechanisms applicable to passing through the assumed changes to the cost of finance that could arise from excessive financial market regulation. Such information needs to be estimated outside of the GTAP model and applied as ‘model shocks’ to ‘real sector’ variables included in the model.

Although GTAP provides insights into the possible mechanisms and effects of border protection and excessive financial regulation, the model, as a stylised representation of the global economy, does not provide an ‘ideal’ treatment of all factors that may influence economic outcomes. Some of the simplifying assumptions adopted in the model are outlined in box 3.

Box 3 Some simplifying assumptions adopted in GTAP

While a strength of the GTAP model is its country and sectoral detail and the associated real resource flows, the standard model does not explicitly account for:

- economies of scale and scope in production;
- heterogeneity within the products in the GTAP database (such as, but not limited to, the range of financial products offered by financial institutions);
- the turnover-based nature of many transactions (including one-off financial intermediation services and transaction fees);
- financial flows and financial instruments;
- consumer and investor confidence; and
- risk and uncertainty.

Where these factors (or others) are considered important to an analysis of economic change, they would need to be assessed outside of the standard model and, where appropriate and feasible, introduced as part of the modelling scenarios or as explicit extensions to the basic model theory.

3 Model closure (economic environment)⁷

The variant of the GTAP model used in this study is a comparative-static model that compares the regional economies modelled with and without the changes applied, allowing for a period of adjustment. As the model is comparative-static, it does not

⁷ The term ‘model closure’ is used to refer to the assignment of the model’s variables between those determined outside the model (that is, the exogenous variables) and those determined by the model (that is, the endogenous variables).

trace out the path through time by which adjustment occurs or the length of the adjustment period.

Within this comparative-static framework, the modelling describes the potential longer-term effects of policies, that is, after the initial effects of a policy have had time to work through the global economy. The estimated effects reflect those that might occur after there has been full adjustment of capital and labour markets (generally taken to be in the order of ten or more years).

The longer-run economic environment for the GTAP model involves:

- The world price index of capital goods is the model numeraire. That is, all product and factor price changes are expressed relative to a world price index of capital goods.
- The supply of labour and land⁸ is assumed to be fixed in each country. Within each country, labour is allowed to move between industries in response to differences in wages and land is assumed to be mobile across designated land using (that is, agricultural and mining) industries.
- Factor prices (wages and rates of return on physical capital and land) in each economy adjust to ensure that there is no change in the utilisation levels implied in the model database for labour, capital and land.⁹
- All tax rates are held fixed with tax revenue and the ratio of tax revenue to regional income adjusting in each country.

Reflecting the longer-run focus of the study, capital stocks in each region adjust in order to equilibrate the expected and actual rate of return on regional capital. Regional demands for investment goods are linked to changes in capital stocks by a fixed investment-to-capital ratio. Capital is assumed to be mobile between sectors in each region in response to differences in expected rates of return.

An alternative closure frequently adopted in GTAP simulations involves maintaining the global capital stock at initial levels. This ‘medium-run’ closure does not allow the impact of policy changes to affect the global capital stock and provides a means of evaluating the effects of successive stages of the adaptation process. To illustrate the sensitivity of results to alternative closure assumptions, this study re-estimated the impact of the changes in border protection using a

⁸ ‘Land’ represents agricultural land in agricultural industries and natural resources in mining and forestry industries. For other sectors, industrial land is accounted for in capital.

⁹ It is assumed that the microeconomic policy changes do not affect the distribution of labour between countries. Aggregate labour supply in each country (aggregate employment) is therefore assumed to be determined by factors beyond the scope of the modelling.

closure in which global capital stocks are assumed fixed while allowing capital to move between regions to equate expected returns and to allow investment to respond to changes in actual rates of return (see appendix D).

4 The model database

The database used is the latest available for the GTAP model (version 7). It represents the 2004 base year, a reference year that pre-dates the global financial crisis and economic downturn.¹⁰ The standard database is comprised of 113 regional economies and 57 industry sectors. It is composed of:

- a set of detailed ‘input–output tables’ representing the industrial structure in each country;
- bilateral trade data for each of the 57 sectors; and
- measures of international transport costs (transport margins) to account for the difference between the border price of products in the source country (free on board or fob) and at the border in the country of use (cost including insurance and freight or cif).

Prevailing levels of border protection on items of merchandise trade are included in the model in terms of tariff-rate equivalents measured at the border of the importing country.

For the purpose of this study:

- 20 economies in the original GTAP database are retained with the remaining economies aggregated into five regional groupings to facilitate the computation process (see appendix table A.1); and
- all 57 of the sectors in the original GTAP database are retained (appendix table A.2).

The GTAP database is expressed in US dollars, with country-specific data converted using market exchange rates.

With one exception, the parameter values used in this study are the standard parameter values contained in the GTAP model (Hertel et al. 2008).¹¹

¹⁰ The GTAP database is documented in Narayanan and Walmsley (2008) and on the GTAP website: <https://www.gtap.agecon.purdue.edu/databases/v7/default.asp>.

¹¹ The one exception relates to the parameter governing the flexibility of the expected net rate of return on the capital stock in each country with respect to investment, RORFLEX. This parameter was adjusted from an arbitrary default value of 10 to 16 for all scenarios to make

5 Hypothetical increases in border protection

To examine the potential impacts of an increase in border protection, two scenarios were considered. In each scenario, changes in border protection are represented by hypothetical increases in tariff rates.¹²

Scenario 1: Increasing tariffs to bound rates

The first scenario models the potential effects of increasing trade protection within the rules of the international trading system.

For this scenario, it is recognised that, while tariffs on merchandise trade are levied at ‘applied’ rates, World Trade Organization (WTO) commitments are defined in terms of ‘bound’ rates. The application of this scenario involves increasing applied tariff rates on all agricultural, mining and manufacturing items of merchandise trade in all countries to bound rates — the maximum level permissible under the rules of the international trading system administered by the WTO. The trade-weighted average applied and bound tariff rates for each of the 25 countries in the model are reported in table 1. The calculation of the tariff shocks uses detailed trade and border protection information from the Tariff Analytical and Simulation Tool for Economists (TASTE) program (see box 4).¹³

Table 1 and appendix table C.1 indicate that the applied tariff rates in the United States, the European Union, China and Taiwan are generally close to their bound rates for most tariff lines. Consequently, there is less scope for these countries to increase their applied rates within the rules of the international trading system administered by the WTO. As a result, the shocks are generally small for these countries.

computation of a model solution more tractable under the longer-term closure assumption adopted.

¹² Centre for International Economics (2009) and Bouet and Laborde (2009) have also undertaken analyses of increases in border protection. Both studies showed such an increase would lower global trade and global income. Because of different scenarios and modelling assumptions, the detailed results and distributional effects are not strictly comparable between studies.

¹³ As the TASTE database is for 2004, the applied rates reported here do not incorporate any change in tariff rates since then. The increases needed to lift Australian applied rates to bound rates, for example, may be higher than indicated here as statutory tariff rates were reduced in January 2005. On the other hand, the use of trade weights in aggregating tariff rates may lead to lower average applied rates than the use of reference-country weights, as no weight is placed on tariffs that result in no trade flows.

Table 1 Trade-weighted average applied and bound tariff rates, 2004

Per cent

<i>Country/region</i>	<i>Average tariff rate^a</i>		<i>Average change in the power of the tariff^b</i>
	<i>Applied rate</i>	<i>Bound rate</i>	
Australia	4.0	10.8	5.3
New Zealand	3.2	12.8	7.2
China	6.4	6.4	0.5
Hong Kong ^c	0.0	23.5	0.0
Japan	4.4	10.8	6.8
Korea	6.5	18.7	11.4
Taiwan	4.0	4.8	1.0
Indonesia	4.6	36.4	25.2
Malaysia	6.0	14.2	7.1
Philippines	3.5	22.8	18.7
Singapore ^c	0.0	18.1	0.0
Thailand	9.9	28.4	17.1
Bangladesh	17.6	77.8	47.4
India	15.9	43.1	21.9
Rest of Asia & Oceania	8.8	30.7	17.2
Canada	1.5	5.9	4.1
United States	1.8	2.9	0.9
Mexico	3.3	36.6	29.7
Brazil	8.1	30.3	17.5
Rest of America	8.4	38.2	23.5
European Union	1.0	1.7	0.5
Russia	10.1	50.0	28.8
Rest of Europe	3.8	24.5	17.9
South Africa	6.5	23.3	16.8
Rest of Africa	14.0	48.9	25.9

^a Expressed as a share of all merchandise and other imports. ^b To allow for the possibility that tariffs might be re-imposed on commodities that currently do not attract tariffs, tariffs in the GTAP model are expressed in terms of the 'power of the tariff' rather than in terms of the simple tariff rate. The power of the tariff is defined as one plus the applied tariff rate. The percentage change in the power of the tariff presented here is the average of the commodity and source-specific increases required to raise one plus the applied rate to one plus the bound rate. ^c No change assumed.

Source: Productivity Commission estimates.

Box 4 Calculation of tariff rates and model shocks

Tariff rates

The 'applied' and 'bound' tariff rates used to calculate the shocks are derived using the TASTE program (Horridge and Laborde 2008). TASTE incorporates a large database of bilateral trade flows and tariff revenues for around 5000 HS6 goods — goods classified at the 6 digit level of the Harmonised System of Tariff Classification — from around 200 regions for the year 2004. Each country's tariff rate by GTAP commodity represents the average of the corresponding HS6 tariff rates weighted up using the corresponding HS6 trade flows. The applied rates are estimated in TASTE by dividing tariff revenue by import values cif. The imputed applied rates may therefore differ from rates calculated from national customs duty schedules.¹⁴ For example, they take into account the effect of preferential trading arrangements that may result in differential tariff rates on imports from different countries and other tariff concession arrangements. Imputed rates would also typically include any anti-dumping duties levied. On the other hand, the resulting average ad valorem rate equivalents do not include the full effect of tariff rate quotas or prohibitive tariffs that prevent trade from occurring.

The bound rates by GTAP commodity are the bound rates for each HS6 item weighted up using the trade flows in TASTE. For countries such as Russia that are not members of the WTO and therefore do not have bound tariff rates, the TASTE default is used which is the higher of the most favoured nation (MFN) rate or 50 per cent.

Model shocks

The increases in the 'power of tariff' (see the footnote to table 1) calculated from the imputed applied and bound rates on each GTAP commodity in each GTAP region are summarised in appendix table C.1. These increases are applied as shocks to the source-specific tax on imports (the variable *tms* within GTAP).

The commodity and source-specific shocks are applied regardless of whether preferential trading agreements (PTAs) exist.¹⁵ Reflecting its status as a customs union, it is assumed that the increases in tariffs for the European Union apply to trade with non-member countries only.¹⁶ Reflecting their status as 'entrepot economies' that re-export a large share of their imports, Hong Kong and Singapore are assumed not to increase their tariffs to bound rates.

¹⁴ This may especially be the case for Australia, as the customs schedules are expressed in terms of fob values.

¹⁵ The effects of such agreements on import competition, and thus whether the tariff increases should also be applied to partner countries, would depend on the extent to which the partner country's industry undercuts the (tariff-inflated) price of rival imports. To the extent that they do not undercut the tariff-inflated price of goods from competing domestic and foreign suppliers, the duty concessions embodied in these PTAs would effectively transfer tariff revenue from the government of the importing country to producers with facilities located in the partner countries and correspondingly inflate the import price, and not significantly benefit local consumers through price reductions in the local market. In this case, the price of imports from the partner country may be similar to the increase in tariffs levied on non-partner countries.

In contrast, many other WTO members, including Australia, New Zealand, India and numerous developing countries, have large gaps between their applied and bound rates. Such countries could unilaterally increase their applied tariff rates without breaching their WTO commitments.¹⁷ The shocks for these countries therefore are generally much higher than for those countries where the applied rates are close to the bound rates.

As indicated above under the GTAP model theory, additional revenue raised through higher tariffs is assumed to be passed back to households in the form of higher regional income.

Results

Increasing tariffs from applied to bound rates is projected to reduce real world GDP by 1.8 per cent, over the longer term (table 2).¹⁸ Based on world GDP in 2007 before the onset of the global financial crisis, this would equate to around A\$1 trillion. The volume of world trade is projected to fall by 8 per cent from levels that would otherwise apply.

¹⁶ Given the difficulty in exempting particular bilateral trade flows between member countries within the aggregated GTAP database used, trade within the other customs unions (such as the Gulf Cooperation Council, MERCOSUR and the Southern African Customs Union) are not separately analysed. Given the small shares of world trade involved, this treatment will have negligible impact on the aggregate results presented.

¹⁷ Messerlin (2008), Achard, Rupp and Jomini (2008) and Bouet and Laborde (2009) provide discussions of the potential cost of increasing applied rates within bound rates, including some implications of differences between applied and bound rates across countries and commodities.

¹⁸ The changes in real GDP presented here are based on market exchange rates, as the GTAP model and database are based on market exchange rates. To adjust for differences in price levels across countries, some international comparisons are instead based on relative purchasing power. The use of 2004 purchasing power parity would involve placing relatively higher weights on, among other countries, India, China, Brazil and Russia and lower weights on Japan and the European Union (IMF 2009b). Overall, world real GDP is approximately 25 per cent higher in purchasing power parity terms. The projected losses in world real GDP reported here for scenarios 1 and 2 are 70 per cent and 30 per cent higher, respectively, and 25 per cent lower for scenario 3 in purchasing power parity terms.

Table 2 Potential effects of increasing tariffs from applied to bound rates

Per cent

<i>Country/region</i>	<i>Import volumes</i>	<i>Export volumes</i>	<i>Real GDP</i>
Australia	-7.1	-8.0	-0.7
New Zealand	-12.1	-10.2	-3.6
China	-2.0	-1.6	0.4
Hong Kong	-0.4	0.1	0.1
Japan	-2.6	-1.9	-0.4
Korea	-10.9	-9.3	-5.0
Taiwan	-0.5	-0.4	0.2
Indonesia	-32.4	-30.5	-8.9
Malaysia	-12.9	-10.6	-6.9
Philippines	-28.5	-29.8	-17.2
Singapore	-5.8	-4.4	-3.2
Thailand	-33.7	-34.3	-23.6
Bangladesh	-39.5	-45.7	-10.0
India	-22.3	-25.2	-6.6
Rest of Asia & Oceania	-22.6	-21.1	-11.6
Canada	-8.1	-7.7	-0.9
United States	-5.4	-6.2	0.0
Mexico	-39.2	-39.6	-19.6
Brazil	-28.2	-21.0	-3.7
Rest of America	-30.5	-28.9	-8.0
European Union	-1.1	-0.9	0.3
Russia	-32.7	-22.5	-8.8
Rest of Europe	-28.9	-28.7	-8.3
South Africa	-23.4	-22.1	-6.3
Rest of Africa	-27.0	-27.3	-11.9
World	-8.5	-8.5	-1.8

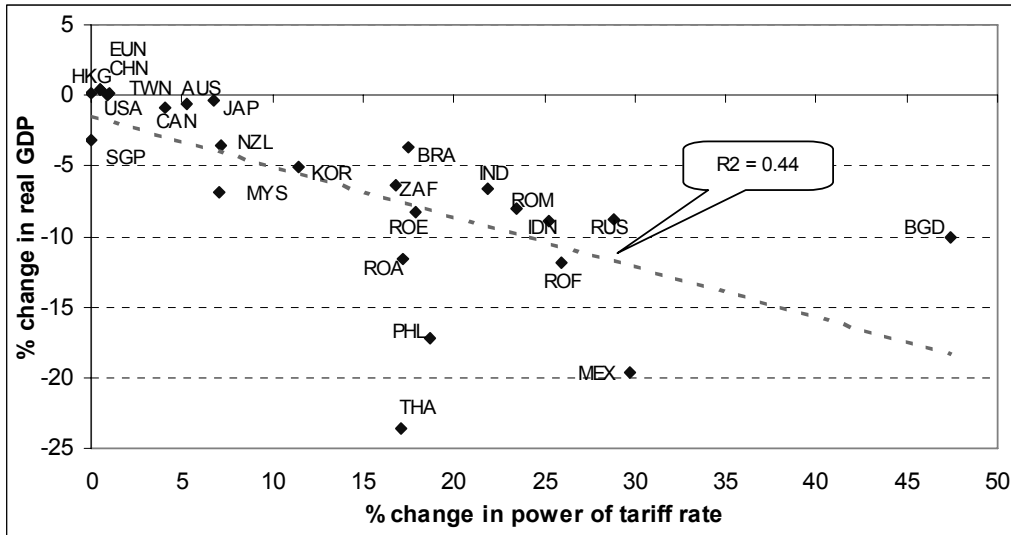
Source: GTAP model simulation.

The modelling indicates that increasing border protection reduces real GDP (figure 1) and trade volumes (figure 2) for most countries. These projected changes reflect the additional costs imposed on local industries, investors and consumers of higher border protection. Protection afforded by tariff increases would favour the higher cost domestic activities, with sectors receiving the largest tariff increases being, on average, advantaged. While the pattern and extent of the tariff increases implied under this scenario vary across products and countries, the largest and most widespread increases generally occur on the raw and processed forms of agricultural staples such as wheat, cereals, rice and sugar. Consequently, traditional exporters of these products such as Thailand experience some of the highest projected longer-term losses in real GDP (table 2). As their bound rates are generally much higher than their applied rates, countries such as Mexico and the Philippines are also

projected to experience larger longer-term declines in GDP as production becomes more domestically focused. Countries with more modest increases in tariffs are projected to gain a competitive advantage over their rivals and, consequently, fair relatively better — a factor that moderates the loss in competitiveness relative to other trading nations.

As applied rates in Australia are generally closer to their bound rate than many of the countries outside the United States, the European Union, China and Taiwan, the projected 0.7 per cent reduction in Australian real GDP is smaller than the reduction in the world economy and for many of the countries considered.¹⁹

Figure 1 Effects of increasing tariffs from applied to bound rates on real GDP (scenario 1)^a

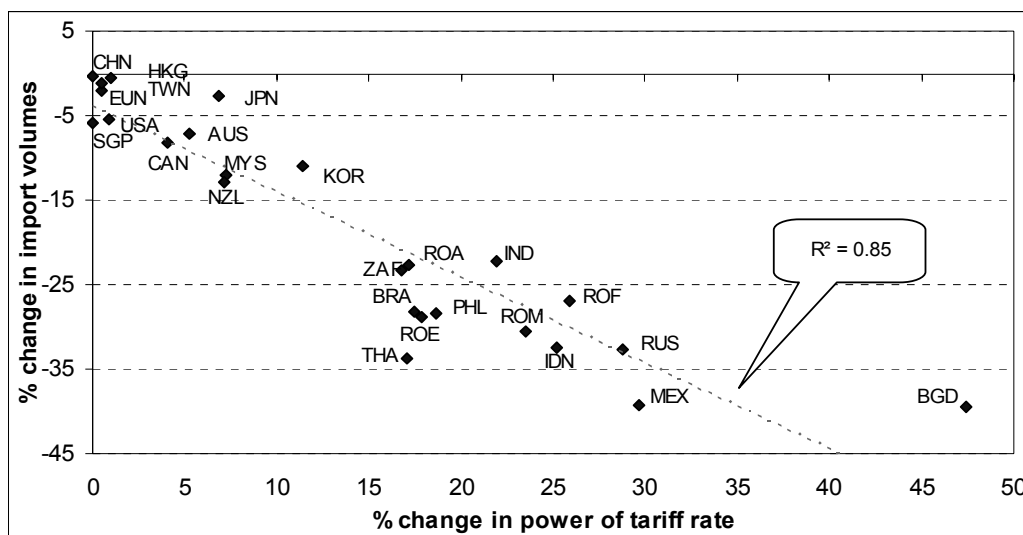


^a The diamonds indicate the percentage change in real GDP. The trend line is derived from an ordinary linear regression ($R^2 = 0.44$).

Source: Productivity Commission estimates.

¹⁹ The largest gaps between applied and bound tariff rates for Australia relate to imports of sugar, motor vehicles, textiles and wearing apparel.

Figure 2 **Effects of increasing tariffs from applied to bound rates on import volumes (scenario 1)^a**



^a The dots indicate percentage changes in import volumes. The trend line is derived from an ordinary linear regression ($R^2 = 0.85$).

Source: Productivity Commission estimates.

Scenario 2: Increasing average tariffs to 20 per cent

This scenario models the potential effect of increases in trade protection that are unconstrained by the rules of the international trading system administered by the WTO. It involves increasing the average tariff rate in each country to 20 per cent (based on initial trade flows) through proportionate increases in tariffs on selected ‘sensitive’ products such as dairy, iron and steel, copper, aluminium, motor vehicles and parts, chemicals and plastics, and textiles, clothing and footwear.

Items of merchandised trade treated as ‘sensitive’ are listed in appendix table C.2. The list is based on those products identified by the WTO as being subject to new protectionist measures since the start of the global financial crisis (WTO 2009). Sensitive products form part of 16 products in the GTAP database.

The average tariff rate of 20 per cent is loosely based on the tariff averages reached by key economies during the Great Depression (Crucini and Kahn 1996, 2003). The tariff changes considered, if they were to eventuate, would represent a departure from the disciplines currently prevailing in the global trading system administered by the WTO. It is, therefore, strictly hypothetical and illustrative of the potential impacts and costs of a widespread departure from the current rules-based trading system.

The methodology used to calculate the model shocks for this scenario is set out in box 5. The methodology can result in very large increases in particular tariffs, especially where the initial applied rate is low. The methodology used means that there will be no change in tariffs on imports of sensitive products for which there is no initial tariff in the GTAP database.²⁰

The resulting percentage changes in the power of the tariff for each GTAP good are summarised in table 3 and listed by GTAP product in appendix table C.5. Because the level of tariff protection is relatively low by historical standards for most countries, a shift towards higher border protection of the magnitude considered in this scenario would result in substantial increases in the average cost of imports to industrial and household users of those imports. However, for countries such as India and Bangladesh, which are recorded as having higher average applied rates, the increases are substantially less than the global average.

Results

Increasing average tariffs in all regions to 20 per cent by increasing tariffs on a range of sensitive products is projected to reduce real world GDP by 2.8 per cent, or over A\$1.5 trillion (table 4). Because of the targeted nature of the scenario, a general switch between trade in sensitive products and domestic production is projected.

The implications for individual countries will depend on the industry and trade structures of countries and on the level and distribution of changes in border protection in the domestic and export markets. For example, reflecting their relatively low exposure to international trade, notwithstanding substantial increases in their own tariffs the European Union and United States are projected to experience among the lowest declines in real GDP. On the other hand, the combination of their own large tariff increases and the tariff increases imposed by trading partners means that trade-exposed economies such as Thailand, the Philippines and Malaysia are projected to experience some of the largest declines in output (figure 3). In contrast, Bangladesh and Mexico, which are recorded as having a higher relative incidence of sensitive products attracting zero tariffs on bilateral trade flows, are projected to experience output increases.²¹

²⁰ This scenario differs in this respect from scenario 1, in which it was assumed that, after the policy change, all tariff rates on sensitive products rose to bound rates.

²¹ This result is sensitive to the modelling assumption that zero tariffs on sensitive products are not increased (see the discussion on page 16).

Box 5 Calculation of the shocks for scenario 2

This scenario involves increasing the average tariff rate in each GTAP country to 20 per cent of the total value of merchandise and other imports by increasing tariffs on imports of sensitive products only. The procedure can be explained in the following five steps.

Step 1

The total tariff revenue in region r to be raised from all tariffs after the increase in tariffs on sensitive products is: $TTR_r = 0.2 \times M_r$

where M_r is the cif value of all imports (ie merchandise and other imports) in region r .

Step 2

Tariff revenue in region r currently collected from imports of sensitive product i from region s is calculated as: $STR_{isr} = S_{ir} \times TR_{isr}$

where S_{ir} is the share of revenue from tariffs on product i in region r accounted for by sensitive products. This is calculated using TASTE data by aggregating the tariff revenue from each HS6 level product within those HS2 level products forming part of each GTAP sensitive product and dividing by the aggregate tariff revenue from each GTAP product. As a result, the sensitive products revenue shares vary by product and country (appendix table C.3); and TR_{isr} is the tariff revenue in region r currently collected from imports of product i from region s .

Step 3

The target sensitive product tariff revenue to be raised from tariffs on GTAP product i from region s imported into region r is calculated as: $TSTR_{isr} = RS_{isr} \times TTR_r$

where RS_{isr} is the share of each sensitive import i in total tariff revenue in region r and is defined as $RS_{isr} = STR_{isr} / \sum_i \sum_s STR_{isr}$.

Step 4

The implied new tariff rate for each imported product is: $NEWTR_{isr} = (TSTR_{isr} + TR_{isr}) / M_{isr}$

where M_{isr} is the cif value of imports of product i from region s into region r .

The average implied tariff rate for each sensitive product is set out in appendix table C.4.

To remove the effect of very large percentage changes in tariff rates for some sensitive imports, the implied new tariff rates are capped at 300 per cent. This involves several rounds of reallocating the excess tariff revenue from those products with an implied tariff rate above 300 per cent proportionately across the remaining sensitive products in that region, until no product has a new tariff rate above 300 per cent.

Step 5

The last step involves calculating the required power of the tariff for each product, and then the percentage change in the power of the tariff required for each GTAP product.

Table 3 Trade-weighted average tariff rates under scenario 2, 2004
Per cent

<i>Country/region</i>	<i>Average tariff rate^a</i>		<i>Share of tariff revenue from sensitive products</i>	<i>Required tariff increase for sensitive products^b</i>
	<i>Applied rate</i>	<i>Trade-weighted target rate</i>		
Australia	3.2	20	53.6	971
New Zealand	2.5	20	49.1	1 433
China	5.6	20	21.4	1 199
Hong Kong ^c	0	0	0	0
Japan	3.2	20	20.3	2 557
Korea	5.3	20	11.4	2 402
Taiwan	3.8	20	29.0	1 469
Indonesia	3.4	20	32.5	1 499
Malaysia	5.2	20	40.5	698
Philippines	3.3	20	23.2	2 194
Singapore ^c	0	0	0	0
Thailand	8.0	20	27.4	548
Bangladesh	16.8	20	11.0	171
India	12.8	20	8.8	640
Rest of Asia & Oceania	7.1	20	27.9	656
Canada	1.3	20	50.1	2 829
United States	1.5	20	53.8	2 307
Mexico	2.7	20	31.6	2 004
Brazil	6.2	20	16.6	1 334
Rest of America	6.9	20	25.6	736
European Union	0.8	20	30.3	8 044
Russia	7.5	20	27.8	594
Rest of Europe	3.1	20	22.8	2 433
South Africa	5.0	20	62.9	471
Rest of Africa	11.3	20	26.3	293

^a Average applied tariff rate in the GTAP database expressed as a share of all merchandise and other imports. ^b The required percentage increase in the average tariff on sensitive products for the average tariff to be 20 per cent. ^c No change assumed.

Source: Productivity Commission estimates.

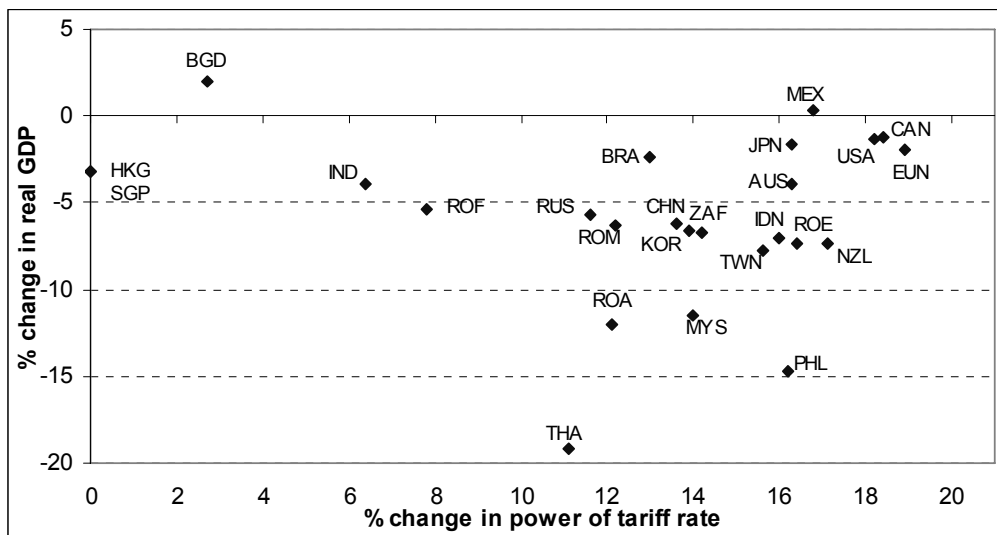
Table 4 Potential effects of increasing average tariff rates to 20 per cent by increasing tariffs on sensitive products

Per cent

<i>Country/region</i>	<i>Import volumes</i>	<i>Export volumes</i>	<i>Real GDP</i>
Australia	-11.2	-11.3	-3.9
New Zealand	-7.2	-5.3	-7.4
China	-18.8	-15.3	-6.2
Hong Kong	-7.8	-5.4	-3.2
Japan	-15.5	-10.1	-1.6
Korea	-15.7	-12.6	-6.6
Taiwan	-14.2	-12.1	-7.7
Indonesia	-15.7	-13.8	-7.1
Malaysia	-14.2	-12.8	-11.5
Philippines	-21.6	-23.3	-14.7
Singapore	-4.8	-4.1	-3.2
Thailand	-23.5	-23.5	-19.1
Bangladesh	18.4	9.0	2.0
India	-12.8	-11.3	-3.9
Rest of Asia & Oceania	-19.0	-16.6	-12.0
Canada	6.3	4.0	-1.2
United States	-7.1	-9.8	-1.3
Mexico	10.4	5.7	0.3
Brazil	-11.9	-8.4	-2.4
Rest of America	-14.4	-12.1	-6.3
European Union	-2.5	-3.2	-1.9
Russia	-17.4	-9.7	-5.7
Rest of Europe	-18.8	-17.5	-7.4
South Africa	-13.4	-13.7	-6.8
Rest of Africa	-7.5	-7.2	-5.4
World	-7.8	-7.8	-2.8

Source: GTAP model simulation.

Figure 3 Effects of increasing average tariff rates to 20 per cent on real GDP (scenario 2)



Source: Productivity Commission estimates.

Australian tariffs on sensitive products are projected to rise significantly under this scenario. In the context of other changes modelled though, the relative loss of competitiveness of other trading nations outweigh the loss of competitiveness of Australia. As a result, Australian production of sensitive products, especially motor vehicles, textiles, wearing apparel and metals nec, is projected to expand at the expense of traditional export-orientated industries, most notably agricultural commodities such as wheat, meat and milk products.²²

Sensitivity testing

The benchmark analysis in this study assumes physical capital stocks adjust to equilibrate expected (and actual) rates of return on capital employed within each GTAP region. The analysis therefore focuses on the question ‘what are the total output effects expected in the longer-run from an increase in tariffs?’.

To illustrate the sensitivity of results to the effects of successive stages of the capital adaptation process, this study also adopts a medium-run closure in which global capital stocks are assumed fixed. In this environment, capital is projected to move between regions according to relative rates of return. However, the resulting outcome would not represent a long-term equilibrium, as the adjustment process is

²² Australian commodity exports such as coal are also adversely affected, but by less than many agricultural exports as they are generally inputs into the expanding sectors such as metal manufacturing.

incomplete — the decline in per unit returns to capital would provide a signal for global investment (and ultimately the global capital stock) to fall.

With the partial adjustment implied by the alternative modelling assumptions, global output is projected to decline by around 1 per cent in both scenarios 1 and 2 (appendix tables D.1 and D.2). This is in comparison with the larger declines (1.8 and 2.8 per cent, respectively) projected in the scenarios with full adjustment of capital to the higher tariff environment (tables 2 and 4).

6 Regulatory burden on financial services

There is currently widespread debate about the appropriate regulatory responses needed to address the underlying causes of the global financial crisis and to ensure the longer-term viability, efficiency and sustainability of the financial sector. In canvassing the priority areas for policy reform in response to the crisis, the International Monetary Fund cautioned that:

The appropriate policy response to the crisis is not just “more” or “tougher” regulation, but smarter requirements combined with better-funded supervisors, independent of industry and political pressures. Banking is already heavily regulated and yet proved vulnerable to a systemic shock in some significant jurisdictions because supervisors had limited information and resources, while regulation itself created incentives to transfer risk outside the regulatory boundary while diluting the need for creditors and shareholders to monitor risk-taking. ... The appropriate combination of [policy] measures may vary by country or region, and authorities — both in mature and emerging markets — should recognize the potential trade-offs between them to achieve an optimal policy mix. (IMF 2009a, p. 38)

Regulatory changes that serve to inhibit competition and innovation without yielding cost advantages in terms of increased stability or consumer protection reduce productivity and raise costs. This scenario illustrates the possible longer-run impacts of ‘excessive regulation’ on the level of economic activity.

Applied general equilibrium modelling techniques have been used previously to quantify the real resource implications of domestic regulation, including financial market regulation. One stream of studies models the effect of excessive regulation as cost escalating (for example, Hertel et al. 1999, Hertel 2000). Another stream of studies models the effect of excessive regulation as tax equivalents on the basis that they give rise to economic rents — mark-ups of price over cost (for example, see Dee, Hanslow and Phamduc 2000).

In this study, the *sensitivity* of economic activity to excessive economic regulation of financial markets is examined through the lens of potential increases in:

-
- the cost of providing financial intermediation services above costs that would otherwise have been; and
 - the cost of funds to users of capital above levels that would otherwise have been.

With respect to the cost of financial service provision, excessive regulation is modelled in this study as requiring more resources (materials, other services, labour and capital) than otherwise to produce the same level of output. This may occur, for example, if inappropriate regulation increases the regulatory burden through excessive paperwork or regulation of ways of working.

Excessive regulation might also impede the transfer of funds between transactors in the economy, thereby raising the cost of funds to users of capital. This could occur on account of restrictions on borrowers in their sourcing funds from financial markets (that is, the demand for funds) or on lenders providing credit (that is, the supply of funds). In this framework, regulations that constrain the mix of available financial products, or the innovation or application of new products, are likely to impose additional financing costs on borrowers over that which would otherwise prevail.

Excessive regulation that impedes the flow of funds between borrowers and lenders is depicted in this study as *raising* the cost of finance per unit of capital employed. As GTAP does not directly model financial markets or explicitly link those markets to the real economy, the shift is effected via a reduction in capital productivity of the capital-using industries — that is, as noted, as an exogenous *increase* in the cost to industries of employing a unit of capital. The higher cost of capital would flow through to raise the price of the output of capital-using industries while the implied cost-inflated returns are modelled as primary factor income accruing to the GTAP national household (box 1).

Because of the central role of OECD economies in the operation and regulation of global financial markets, this study focuses on the potential impacts of excessive regulation in that region. To reflect the inter-connectedness of global financial markets, it considers, as a sensitivity test, flow-on effects of higher capital costs to non-OECD economies.

Calculation of shocks

The scenario modelled involves the application of two shocks to OECD economies.^{23,24}

²³ Given the country aggregation in the GTAP database used, the OECD is proxied in this study as consisting of Australia, New Zealand, Japan, Korea, Canada, the United States, Mexico and the

-
- An increase in the cost of providing financial intermediation services equivalent to a hypothetical 1 per cent decline in the productivity of all inputs used by the *financial sector nec* industry in OECD countries (such a decline in productivity, if it were to eventuate, would require more of all factors to be used per unit of output). To implement the declines in total factor productivity, uniform shocks were applied to the all intermediate input augmenting technical change variable within GTAP, *afall*, and to the value added augmenting technical change variable, *avaall*.
 - A hypothetical 1 per cent increase in the cost of a unit of physical capital.²⁵ The cost of capital shock was applied to the capital augmenting technical change component of the GTAP variable, *afeall*.

Results

The potential effects of a hypothetical excessive regulatory burden on financial services in OECD economies are presented in table 5.

Excessive regulatory burden on financial services in OECD countries affects the productivity of financial services in member countries and cost of doing business in these economies relative to non-OECD economies. The rise in the cost of capital raises the cost structure of capital-using industries and encourages firms to substitute labour for capital, resulting in a loss in competitiveness and those activities and a decline in the demand for capital. In the longer term, higher cost structures and associated lower returns translate into the decommissioning of capital and lower investment. Reflecting these longer-run processes, the global use of capital is projected to decline, reducing output by 0.5 per cent, or around A\$300 billion (table 5). This is comprised of around a 0.1 per cent decline in real GDP attributable to higher costs of providing financial intermediation services and a decline arising from the higher cost of funds to users of capital of nearly 0.5 per cent.

European Union. Six non-OECD countries (Cyprus, Estonia, Latvia, Lithuania, Malta and Slovenia) are included in this scenario because they are included in the European Union, which is treated as a member of the OECD. Conversely, two OECD countries (Switzerland and Turkey) are excluded as they are included in the Rest of Europe region in the model database.

²⁴ Each simulation can be interpreted as producing an ‘elasticity’ with respect to excessive financial market regulation. However, the sum of the two simulations does not product such an ‘elasticity’ result, but is rather interpreted as the effect on the economy of an arbitrary small increase in regulatory burden through two different pathways.

²⁵ That is, the increased cost of funds for investment from excessive regulation is modelled as an exogenous increase in the returns required per unit of physical capital (that is, a productivity decline due to ‘organisational’ and other changes).

Table 5 Potential effects of excessive regulatory burden of financial services in OECD countries

Per cent

<i>Country/region</i>	<i>Cost of providing financial services</i>	<i>Cost of funds to users of capital</i>	<i>Scenario total</i>
Australia ^a	-0.1	-0.6	-0.6
New Zealand ^a	-0.1	-0.9	-1.0
China	...	0.1	0.1
Hong Kong	...	0.1	0.1
Japan ^a	-0.1	-0.6	-0.7
Korea ^a	-0.1	-0.9	-0.9
Taiwan	...	0.1	0.1
Indonesia	...	0.1	0.1
Malaysia	...	...	...
Philippines	...	0.1	0.2
Singapore	...	0.1	0.1
Thailand	...	0.1	0.1
Bangladesh	...	0.1	0.1
India	...	0.1	0.1
Rest of Asia & Oceania	...	...	...
Canada ^a	-0.1	-0.5	-0.6
United States ^a	-0.2	-0.4	-0.5
Mexico ^a	...	-1.2	-1.2
Brazil	...	0.1	0.1
Rest of America	...	0.1	0.1
European Union ^a	-0.1	-0.8	-0.9
Russia	...	...	...
Rest of Europe	...	...	0.1
South Africa	...	0.1	0.1
Rest of Africa	...	...	...
World	-0.1	-0.5	-0.5

... less than 0.05 per cent. ^a Countries used here to proxy the OECD.

Source: GTAP model simulation.

As expected, the projected decline in output is concentrated in OECD economies in which higher costs have been assumed. Because the cost structure of non-OECD economies have been assumed not to increase in this scenario, the competitiveness of these economies increases relative to OECD economies and output is projected to rise. However, this projected increase is not sufficient to offset the projected decline in OECD economies, and world output as a whole is projected to decline.

Reflecting the focus of this scenario on OECD economies, Australian GDP is projected to decline. The projected decline in output of around 0.6 per cent is around the average for the OECD, with countries that have lower impacts also tending to have a higher share of more labour-intensive service industries.

Sensitivity testing

As would be expected, if the increased cost of funds for capital investment were to extend from the OECD economies modelled in the base case to other economies, the potential decrease in costs and associated output declines would be commensurably larger. In this study, the output declines are projected to increase from 0.5 per cent to 0.8 per cent (appendix table D.3). Output in all GTAP regions is projected to decline.

A Aggregations and mappings used

Table A.1 Country/region mapping adopted

<i>Region in GTAP database used</i>	<i>GTAP country/GTAP region</i>
Australia	Australia
New Zealand	New Zealand
China	China
Hong Kong	Hong Kong
Japan	Japan
Korea	Korea
Taiwan	Taiwan
Indonesia	Indonesia
Malaysia	Malaysia
Philippines	Philippines
Singapore	Singapore
Thailand	Thailand
Bangladesh	Bangladesh
India	India
Rest of Asia & Oceania	Cambodia; Iran; Kazakhstan; Kyrgyzstan; Laos; Myanmar; Pakistan; Sri Lanka; Vietnam; Rest of East Asia; Rest of Oceania; Rest of South Asia; Rest of Southeast Asia; Rest of Western Asia
Canada	Canada
United States	United States of America
Mexico	Mexico
Brazil	Brazil
Rest of America	Argentina; Bolivia; Caribbean; Chile; Colombia; Costa Rica; Ecuador; Guatemala; Nicaragua; Panama; Paraguay; Peru; Uruguay; Venezuela; Rest of Central America; Rest of North America; Rest of South America
European Union (27)	Austria; Belgium; Bulgaria; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden; United Kingdom

(Continued next page)

Table A.1 (continued)

<i>Region in GTAP database used</i>	<i>GTAP country/GTAP region</i>
Russia	Russian Federation
Rest of Europe	Albania; Armenia; Azerbaijan; Belarus; Croatia; Georgia; Norway; Switzerland; Turkey; Ukraine; Rest of EFTA; Rest of Eastern Europe; Rest of Europe; Rest of Former Soviet Union
South Africa	South Africa
Rest of Africa	Botswana; Egypt; Ethiopia; Madagascar; Malawi; Mauritius; Morocco; Mozambique; Nigeria; Senegal; Tanzania; Tunisia; Uganda; Zambia; Zimbabwe; Rest of Central Africa; Rest of Eastern Africa; Rest of North Africa; Rest of South African Customs; Rest of South Central Africa; Rest of Western Africa

Table A.2 GTAP sector and industry concordance

<i>GTAP sector</i>	<i>Code</i>	<i>Industry grouping</i>
Paddy rice	PDR	Agriculture/Food products
Wheat	WHT	Agriculture/Food products
Cereal grains nec	GRO	Agriculture/Food products
Vegetables, fruit, nuts	V_F	Agriculture/Food products
Oil seeds	OSD	Agriculture/Food products
Sugar cane, sugar beet	C_B	Agriculture/Food products
Plant-based fibers	PFB	Agriculture/Food products
Crops nec	OCR	Agriculture/Food products
Bovine cattle, sheep, goats, horses	CTL	Agriculture/Food products
Animal products nec	OAP	Agriculture/Food products
Raw milk	RMK	Agriculture/Food products
Wool, silk-worm cocoons	WOL	Agriculture/Food products
Forestry	FRS	Agriculture/Food products
Fishing	FSH	Agriculture/Food products
Coal	COA	Mining
Oil	OIL	Mining
Gas	GAS	Mining
Minerals nec	OMN	Mining
Bovine meat products	CMT	Agriculture/Food products
Meat products nec	OMT	Agriculture/Food products
Vegetable oils and fats	VOL	Agriculture/Food products
Dairy products	MIL	Agriculture/Food products
Processed rice	PCR	Agriculture/Food products
Sugar	SGR	Agriculture/Food products
Food products nec	OFD	Agriculture/Food products
Beverages and tobacco products	B_T	Agriculture/Food products
Textiles	TEX	Manufacturing
Wearing apparel	WAP	Manufacturing
Leather products	LEA	Manufacturing
Wood products	LUM	Manufacturing
Paper products, publishing	PPP	Manufacturing
Petroleum, coal products	P_C	Manufacturing
Chemical, rubber, plastic prods	CRP	Manufacturing
Mineral products nec	NMM	Manufacturing
Ferrous metals	I_S	Manufacturing
Metals nec	NFM	Manufacturing
Metal products	FMP	Manufacturing
Motor vehicles and parts	MVH	Manufacturing
Transport equipment nec	OTN	Manufacturing
Electronic equipment	ELE	Manufacturing
Machinery and equipment nec	OME	Manufacturing
Manufactures nec	OMF	Manufacturing

(Continued next page)

Table A.2 (continued)

<i>GTAP sector</i>	<i>Code</i>	<i>Industry grouping</i>
Electricity	ELY	Services
Gas manufacture, distribution	GDT	Services
Water	WTR	Services
Construction	CNS	Services
Trade	TRD	Services
Transport nec	OTP	Services
Water transport	WTP	Services
Air transport	ATP	Services
Communication	CMN	Services
Financial services nec	OFI	Services
Insurance	ISR	Services
Business services nec	OBS	Services
Recreation and other services	ROS	Services
Public administration, defence, education, health	OSG	Services
Dwellings	DWE	Services

B Modifications made to the GTAP model

This appendix outlines the modifications made to the GTAP model for this study.

B.1 Changes to the model theory

To enable international capital mobility

! Equalise actual rate of return (rorc) to allow capital mobility !

Variable

capital # Global capital stock: VKB weighted # ;

Equation E_capital

capital = $\text{sum}\{r, \text{reg}, \text{VKB}(r) / \text{sum}\{s, \text{reg}, \text{VKB}(s)\} * \text{qo}(\text{"capital"}, r)\}$;

Variable (all, r, reg)

f_rorc(r) # Shifter for E_rorc2 # ;

Variable

rorc_r # World average actual rate of return on capital # ;

Equation E_rorc2 (all, r, reg)

rorc(r) = rorc_r + f_rorc(r) ;

Reporting variable

! World real GDP !

Variable

qgdpwld # Real gdp for the world # ;

Equation E_qgdpwld

$\text{sum}\{r, \text{reg}, \text{GDP}(r)\} * \text{qgdpwld} = \text{sum}\{r, \text{reg}, \text{GDP}(r) * \text{qgdp}(r)\}$;

B.2 Changes to the standard GTAP model closure

Scenarios 1, 2 and 3

The following closure change to fix the investment-to-capital ratio gives this study a longer-run focus by enabling international capital mobility.

```
Swap qo("capital",reg) = EXPAND(endwc_comm,reg) ;
```

Sensitivity test for scenarios 1 and 2

The following closure changes were made to fix the global stock of capital and to allow investment to respond to actual rates of return.

```
Swap qo("capital",reg) = f_rorc(reg) ;
```

```
Swap rorc_r = capital ;
```

C Shocks and input data used

This appendix outlines the shocks applied in scenarios 1 and 2 and the detailed data used in their calculation.

Table C.1 Average increase in the power of the tariff to lift applied rates to bound rates (scenario 1)^a
Per cent

Country/region	PDR	WHT	GRO	V_F	OSD	C_B	PFB	OCR	CTL	OAP	RMK	WOL	FRS	FSH
Australia	1.0	0	0.8	1.2	1.0	0	0.2	4.9	1.0	0.7	0	1.8	0.6	0.7
New Zealand	0	0	0.6	1.0	0	0	0	1.5	0	0.1	0	0	0.2	1.8
China	62.3	67.8	1.7	0	0.6	0	38.4	0	0	0.2	0	0	1.0	0
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	85.8	133.6	6.9	9.7	8.8	0	0	1.8	9.4	0.1	0	4.9	39.3	0.4
Korea	0	1.0	407.7	24.7	145.9	1.8	1.0	12.9	9.7	4.9	0	3.6	38.1	15.6
Taiwan	8.6	0	0	2.9	0	0	0	0.5	15.0	0.1	0	0	0	5.6
Indonesia	126.1	24.9	39.7	40.0	27.5	33.6	27.0	35.5	37.7	35.3	0	33.3	38.1	33.8
Malaysia	40.0	0.5	2.9	7.6	8.0	1.7	0.1	14.0	4.7	11.5	0	4.7	16.1	39.8
Philippines	0	23.8	33.0	22.1	13.8	35.5	7.3	36.6	17.1	13.2	0	11.1	15.5	34.8
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	0	0	0	9.1	32.2	6.2	0.5	5.7	19.2	21.8	0	12.4	5.2	36.6
Bangladesh	112.0	7.0	199.3	112.2	97.1	160.9	196.5	133.0	194.1	129.3	0	8.9	55.4	42.2
India	1.1	1.7	44.5	35.8	35.7	74.6	77.2	40.6	63.8	34.6	0	10.2	22.3	41.2
Rest of Asia & Oceania	26.9	46.8	17.7	23.7	38.9	30.7	62.3	36.3	24.3	21.2	0	21.5	14.0	21.2
Canada	0	63.5	3.0	3.7	0	0	0	1.3	0.1	8.8	0	1.3	0.1	0.2
United States	0.5	2.4	0.3	3.0	0.8	1.6	6.3	1.9	0.2	0.2	0	0	0.3	0.3
Mexico	10.4	66.4	75.8	42.0	29.0	16.5	44.5	16.7	19.8	19.1	0	17.3	28.6	23.1
Brazil	53.6	55.0	45.3	26.8	34.6	23.4	45.4	19.2	20.2	20.3	0	19.2	18.7	22.4
Rest of America	44.0	56.5	68.9	37.0	52.3	31.6	36.8	30.6	21.1	35.4	0	30.5	34.7	25.7
European Union	11.6	15.8	9.3	5.4	0	49.9	0	2.0	1.1	0.6	0	0	0.1	1.8
Russia	37.7	49.6	46.5	40.5	43.9	43.4	49.9	40.5	47.2	41.4	0	37.4	41.4	36.7
Rest of Europe	40.5	58.7	78.5	27.0	30.1	30.7	8.1	17.8	45.3	38.9	0	6.5	11.0	10.8
South Africa	0	66.1	44.6	12.8	44.6	21.1	56.3	37.1	0	1.9	0	3.2	3.1	39.5
Rest of Africa	72.2	43.7	31.5	31.7	36.5	61.6	61.1	38.0	43.6	32.7	0	40.7	23.9	13.4

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Table C.1 (continued)

Country/region	COA	OIL	GAS	OMN	CMT	OMT	VOL	MIL	PCR	SGR	OFD	B_T	TEX	WAP
Australia	0.7	0	2.0	0.8	0.2	1.3	1.3	5.9	1.0	16.5	3.3	4.9	13.0	21.3
New Zealand	0	0	0	0.8	0.5	8.1	3.8	7.8	0	0	8.0	15.9	13.2	20.9
China	0	0	0	0	0	0.7	19.2	0	65.0	55.1	0.1	0	0	0
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	0	49.9	0	0.7	0.1	2.7	1.2	62.1	103.0	14.8	3.3	3.5	1.1	0.6
Korea	2.9	42.6	4.0	3.9	0.9	1.2	8.8	3.9	0	14.2	10.6	8.9	9.3	13.3
Taiwan	0	0.3	49.9	0	21.4	0	0.3	0.2	3.9	0	1.3	0	0.7	0
Indonesia	33.4	40.0	33.3	37.2	40.0	38.9	31.4	151.7	120.8	44.1	33.1	25.6	25.3	22.8
Malaysia	5.9	2.5	50.0	29.0	14.4	44.4	7.9	1.7	39.2	14.9	13.5	2.6	4.9	6.2
Philippines	44.3	45.6	40.2	42.1	23.4	5.5	12.5	18.5	0	36.9	28.7	33.5	19.1	14.5
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	25.5	50.0	0	41.2	0.2	7.9	73.9	82.6	0	17.3	5.8	0.1	8.4	4.2
Bangladesh	30.7	13.3	39.5	35.5	111.9	182.0	147.4	78.8	144.9	133.6	146.1	126.6	19.8	13.5
India	4.1	36.4	36.4	23.4	45.9	42.8	80.8	18.2	2.5	31.2	51.0	12.5	20.4	26.4
Rest of Asia & Oceania	22.7	40.3	40.3	14.0	27.3	20.0	25.4	19.2	16.7	22.0	23.1	43.7	12.5	16.0
Canada	0	49.9	0.8	0.5	20.6	12.7	4.2	50.8	0.8	7.3	7.3	3.4	7.2	4.0
United States	0	0.2	0	0.2	8.1	0.9	1.3	0.4	4.0	44.1	1.3	0.7	2.0	2.1
Mexico	29.9	27.2	35.0	30.4	42.2	100.4	32.6	33.0	40.6	154.4	44.4	44.0	30.6	21.5
Brazil	16.0	35.0	35.0	28.3	49.8	26.8	25.8	35.2	49.1	15.1	23.9	19.9	18.0	13.1
Rest of America	23.6	27.0	27.8	32.4	35.1	48.7	51.5	47.4	33.2	52.0	34.9	38.0	24.5	20.0
European Union	0	0	0.6	0	5.8	0.3	0.2	0.5	5.0	9.0	2.6	0.4	2.2	3.4
Russia	49.8	49.9	50.0	48.0	34.6	26.6	39.7	40.5	39.2	19.3	35.1	35.0	35.1	26.3
Rest of Europe	39.4	41.0	45.9	21.9	46.9	42.0	24.6	40.6	32.7	46.6	32.6	30.0	25.1	18.2
South Africa	50.0	50.0	50.0	0.3	72.0	44.7	46.5	17.0	0	81.5	35.7	98.4	8.7	11.7
Rest of Africa	9.9	34.6	49.3	22.5	27.6	38.0	43.5	44.0	41.3	60.5	40.0	37.9	19.3	15.5

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Table C.1 (continued)

Country/region	LEA	LUM	PPP	P_C	CRP	NMM	I_S	NFM	FMP	MVH	OTN	ELE	OME	OMF
Australia	10.2	5.9	4.2	0.3	4.6	9.7	3.5	0.3	9.4	13.3	5.1	1.8	6.1	8.8
New Zealand	17.3	11.1	0	3.2	7.9	11.4	10.6	7.6	14.4	13.8	2.9	5.4	11.2	17.5
China	0.1	0.4	0	0.2	0	0.3	0	0	0	0	0	0	0	0.1
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	1.4	8.0	0	0.5	0.5	0.5	0.4	0.3	0.4	0	0	0	0.1	0.8
Korea	4.3	17.0	0	5.3	2.2	12.2	0.2	9.0	5.8	17.6	6.3	1.8	6.3	4.0
Taiwan	0.7	0	4.4	17.1	0.4	0.3	1.9	0	0.6	1.4	0.3	0.1	0.1	0.5
Indonesia	34.3	34.1	32.1	37.2	33.0	33.2	31.1	33.5	29.1	25.7	38.3	8.2	31.7	29.2
Malaysia	15.1	13.6	20.8	10.1	17.2	10.8	29.6	12.0	17.3	5.3	13.0	0.3	8.9	8.2
Philippines	33.7	30.5	30.8	45.4	25.9	31.4	38.5	30.3	37.1	31.7	18.9	1.1	19.7	37.1
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	20.9	7.4	15.0	47.5	22.7	20.8	21.9	14.3	20.1	18.6	20.1	1.9	16.1	10.6
Bangladesh	32.3	17.8	22.5	15.6	35.4	18.1	31.1	22.8	21.5	22.5	27.5	32.4	37.1	15.9
India	16.9	25.9	18.8	32.2	23.1	21.8	20.3	22.6	25.9	17.7	10.5	2.1	13.2	24.2
Rest of Asia & Oceania	13.4	18.4	21.0	25.4	18.3	21.3	23.3	20.1	18.5	24.5	17.7	14.2	20.3	13.9
Canada	4.1	3.4	0	8.3	3.8	2.8	0.4	1.2	4.5	4.5	2.2	0.5	3.1	2.6
United States	0.5	0.4	0	0.7	0.9	1.1	0.1	1.2	0.8	2.7	0.1	0.2	0.6	0.7
Mexico	21.8	30.2	30.5	32.1	32.2	27.7	29.9	33.0	31.0	33.1	25.8	32.9	30.5	22.2
Brazil	19.4	11.7	17.5	34.5	14.5	21.2	20.8	14.9	14.8	17.1	29.1	21.8	15.8	13.7
Rest of America	19.8	29.6	26.5	25.7	23.8	26.9	28.0	29.5	26.5	23.1	30.6	23.0	26.1	23.4
European Union	1.4	0.3	0	0.8	0.4	0.5	0.1	0.6	0.3	0.3	0.3	0.2	0.2	0.3
Russia	31.7	30.3	38.9	46.5	37.3	34.2	45.7	40.8	33.7	30.9	35.7	39.9	40.0	29.9
Rest of Europe	20.9	13.8	18.9	25.3	16.0	20.0	26.4	16.3	19.4	18.6	13.3	8.5	16.0	8.8
South Africa	2.7	9.8	5.0	39.8	11.2	7.8	8.0	5.2	12.5	19.9	1.7	9.8	11.3	13.6
Rest of Africa	17.0	18.4	26.0	30.0	30.9	28.0	28.6	32.4	24.9	27.1	41.3	27.6	29.3	20.0

^a The shocks applied also vary by source region and are available from the Commission on request. ^b No change assumed.

Table C.2 Sensitive products on which tariff rates are raised to increase the average tariff rate to 20 per cent (scenario 2)

Code	GTAP sector	HS ^a	HS description
OAP	Animal products nec	04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
OMN	Minerals nec	31	Fertilisers
MIL	Dairy products	04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
OFD	Food products nec	04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
		19	Preparations of cereals, flour, starch or milk; pastrycooks' products
TEX	Textiles	61	Articles of apparel and clothing accessories, knitted or crocheted
		63	Other made up textile articles; sets; worn clothing and worn textile articles; rags
WAP	Wearing apparel	61	Articles of apparel and clothing accessories, knitted or crocheted
		62	Articles of apparel and clothing accessories, not knitted or crocheted
LEA	Leather products	64	Footwear, gaiters and the like; parts of such articles
CRP	Chemical, rubber, plastic products	31	Fertilisers
NMM	Mineral products	6810	Cement, concrete or artificial stone; whether or not reinforced, articles thereof
I_S	Ferrous metals	72	Iron and steel
		73	Articles of iron or steel
NFM	Metals nec	74	Copper and articles thereof
		76	Aluminium and articles thereof
FMP	Metal products	73	Articles of iron or steel
		74	Copper and articles thereof
		76	Aluminium and articles thereof
MVH	Motor vehicles and parts	87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof
OTN	Transport equipment nec	87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof
OME	Machinery and equipment nec	63	Other made up textile articles; sets; worn clothing and worn textile articles; rags
		73	Articles of iron or steel
		74	Copper and articles thereof
		87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof
OMF	Manufactures nec	63	Other made up textile articles; sets; worn clothing and worn textile articles; rags

^a The mapping of each HS6 good within the HS2 categories listed to the GTAP products listed is based on the default mapping in TASTE. The list of sensitive products is based on those products identified by the WTO as being subject to new protectionist measures since the start of the global financial crisis (WTO 2009).

Table C.3 Share of GTAP product tariff revenue accounted for by sensitive products (scenario 2)^a

Per cent

Country/region	PDR	WHT	GRO	V_F	OSD	C_B	PFB	OCR	CTL	OAP	RMK	WOL	FRS	FSH
Australia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Zealand	0	0	0	0	0	0	0	0	0	82	0	0	0	0
China	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	0	0	0	0	0	0	0	0	0	92	0	0	0	0
Korea	0	0	0	0	0	0	0	0	0	18	0	0	0	0
Taiwan	0	0	0	0	0	0	0	0	0	7	0	0	0	0
Indonesia	0	0	0	0	0	0	0	0	0	13	0	0	0	0
Malaysia	0	0	0	0	0	0	0	0	0	96	0	0	0	0
Philippines	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	0	0	0	0	0	0	0	0	0	14	0	0	0	0
Bangladesh	0	0	0	0	0	0	0	0	0	5	0	0	0	0
India	0	0	0	0	0	0	0	0	0	17	0	0	0	0
Rest of Asia & Oceania	0	0	0	0	0	0	0	0	0	79	0	0	0	0
Canada	0	0	0	0	0	0	0	0	0	73	0	0	0	0
United States	0	0	0	0	0	0	0	0	0	67	0	0	0	0
Mexico	0	0	0	0	0	0	0	0	0	9	0	0	0	0
Brazil	0	0	0	0	0	0	0	0	0	8	0	0	0	0
Rest of America	0	0	0	0	0	0	0	0	0	58	0	0	0	0
European Union	0	0	0	0	0	0	0	0	0	97	0	0	0	0
Russia	0	0	0	0	0	0	0	0	0	16	0	0	0	0
Rest of Europe	0	0	0	0	0	0	0	0	0	39	0	0	0	0
South Africa	0	0	0	0	0	0	0	0	0	93	0	0	0	0
Rest of Africa	0	0	0	0	0	0	0	0	0	37	0	0	0	0

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Table C.3 (continued)

Country/region	COA	OIL	GAS	OMN	CMT	OMT	VOL	MIL	PCR	SGR	OFD	B_T	TEX	WAP
Australia	0	0	0	0	0	0	0	97	0	0	15	0	61	98
New Zealand	0	0	0	0	0	0	0	2	0	0	7	0	64	95
China	0	0	0	0	0	0	0	93	0	0	6	0	3	89
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	0	0	0	0	0	0	0	94	0	0	18	0	72	94
Korea	0	0	0	0	0	0	0	95	0	0	2	0	3	93
Taiwan	0	0	0	0	0	0	0	93	0	0	12	0	37	97
Indonesia	0	0	0	0	0	0	0	97	0	0	6	0	4	93
Malaysia	0	0	0	0	0	0	0	91	0	0	15	0	16	96
Philippines	0	0	0	0	0	0	0	96	0	0	15	0	9	97
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	0	0	0	3	0	0	0	93	0	0	4	0	5	95
Bangladesh	0	0	0	0	0	0	0	98	0	0	35	0	1	92
India	0	0	0	1	0	0	0	78	0	0	12	0	2	86
Rest of Asia & Oceania	0	0	0	1	0	0	0	97	0	0	17	0	13	93
Canada	0	0	0	0	0	0	0	98	0	0	19	0	67	95
United States	0	0	0	0	0	0	0	98	0	0	11	0	75	96
Mexico	0	0	0	0	0	0	0	96	0	0	16	0	3	94
Brazil	0	0	0	0	0	0	0	72	0	0	7	0	6	94
Rest of America	0	0	0	0	0	0	0	97	0	0	16	0	24	96
European Union	0	0	0	0	0	0	0	96	0	0	5	0	59	96
Russia	0	0	0	0	0	0	0	98	0	0	8	0	49	7
Rest of Europe	0	0	0	0	0	0	0	92	0	0	16	0	19	95
South Africa	0	0	0	0	0	0	0	99	0	0	21	0	3	93
Rest of Africa	0	0	0	0	0	0	0	97	0	0	14	0	13	97

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Table C.3 (continued)

Country/region	LEA	LUM	PPP	P_C	CRP	NMM	I_S	NFM	FMP	MVH	OTN	ELE	OME	OMF
Australia	81	0	0	0	0	4	1	1	58	96	27	0	6	0
New Zealand	86	0	0	0	0	1	1	1	51	99	29	0	3	9
China	27	0	0	0	11	1	1	61	53	93	2	0	0	1
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	66	0	0	0	0	0	1	35	67	0	0	0	3	4
Korea	54	0	0	0	1	0	1	61	52	78	21	0	0	1
Taiwan	43	0	0	0	1	1	1	85	56	95	66	0	1	2
Indonesia	66	0	0	0	0	1	1	82	64	93	1	0	11	4
Malaysia	94	0	0	0	2	0	1	99	7	97	53	0	2	0
Philippines	69	0	0	0	3	1	1	77	72	96	7	0	2	18
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	37	0	0	0	4	2	1	74	64	89	48	0	1	2
Bangladesh	7	0	0	0	1	1	1	57	57	91	2	0	2	4
India	19	0	0	0	6	1	1	9	53	82	2	0	0	3
Rest of Asia & Oceania	67	0	0	0	2	1	1	73	62	92	37	0	4	4
Canada	85	0	0	0	0	1	1	81	5	96	11	0	7	6
United States	84	0	0	0	0	0	1	66	38	95	83	0	0	2
Mexico	53	0	0	0	1	0	1	83	49	94	59	0	1	2
Brazil	47	0	0	0	6	1	1	65	51	73	3	0	1	3
Rest of America	7	0	0	0	3	2	1	72	59	95	7	0	3	4
European Union	81	0	0	0	3	0	1	78	5	97	51	0	1	1
Russia	79	0	0	0	0	2	1	69	5	99	7	0	2	3
Rest of Europe	79	0	0	0	5	2	1	84	5	97	32	0	5	8
South Africa	8	0	0	0	0	0	1	95	33	97	44	0	5	15
Rest of Africa	69	0	0	0	1	1	1	77	64	96	48	0	5	32

^a Rounded to no decimal places for presentational purposes. ^b No change assumed.

Table C.4 Average tariff rate on GTAP products required to increase the average tariff rate to 20 per cent (scenario 2)^a
Per cent

Country/region	OAP	OMN	MIL	OFD	TEX	WAP	LEA	CRP	NMM	L_S	NFM	FMP	MVH	OTN	OME	OMF
Australia	0	0.1	35.5	4.1	86.1	215.4	80.8	2.8	5.6	33.8	9.1	35.2	87.0	2.9	5.3	2.9
New Zealand	0	0	17.7	6.5	52.2	179.5	110.5	1.7	3.2	22.7	16.7	24.9	111.3	3.0	3.7	17.5
China	11.6	0.6	152.0	21.2	16.7	211.0	35.0	22.4	12.1	62.9	34.4	67.7	278.9	12.5	7.3	16.2
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	82.7	0.1	291.7	62.4	141.6	255.8	242.1	0.9	0.6	24.9	5.2	8.2	0	0	0.1	2.4
Korea	31.8	1.4	298.4	46.9	80.6	289.9	118.7	8.1	8.5	44.9	64.7	110.5	168.3	12.5	6.8	10.4
Taiwan	9.4	0.2	216.9	79.0	71.1	295.1	52.9	3.6	9.0	60.3	33.2	90.2	293.9	35.2	3.3	3.8
Indonesia	10.1	1.7	64.3	12.8	13.0	153.8	42.2	4.4	5.5	76.9	43.7	88.8	197.2	63.2	8.8	13.8
Malaysia	11.7	0.2	7.7	11.7	38.6	196.2	113.3	5.3	11.0	91.6	47.3	88.8	269.2	27.2	5.2	7.0
Philippines	23.8	3.0	77.2	23.5	19.3	284.5	165.8	8.0	8.1	68.1	51.9	118.8	224.9	107.0	4.1	37.6
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	6.9	1.7	50.0	44.6	25.5	217.8	26.2	13.7	14.2	54.0	21.4	78.3	167.7	17.7	7.9	7.4
Bangladesh	15.9	10.6	85.8	27.8	27.5	82.4	29.5	12.6	27.6	38.9	23.2	40.4	57.4	20.1	9.4	31.6
India	14.2	13.7	208.8	67.6	18.5	80.2	27.9	19.9	15.1	139.8	23.7	64.8	152.6	11.4	14.5	17.9
Rest of Asia & Oceania	54.0	1.3	59.7	23.1	26.6	89.7	71.4	7.9	10.9	50.4	17.5	46.9	91.2	21.0	8.5	5.5
Canada	243.1	0	299.7	107.3	141.3	243.3	236.5	0.6	1.1	5.9	2.4	23.4	42.8	7.1	1.6	3.9
United States	3.4	0.1	297.2	14.8	136.4	218.3	241.3	1.4	3.6	5.2	10.1	19.6	28.8	10.1	1.1	1.5
Mexico	3.1	3.4	146.4	19.5	32.1	127.6	106.6	2.7	6.1	108.3	23.5	45.7	72.9	84.7	4.0	16.0
Brazil	10.2	1.9	66.4	12.6	25.2	260.9	96.7	13.4	11.3	151.3	57.2	127.0	140.4	17.3	14.4	25.0
Rest of America	40.1	2.3	117.6	20.6	28.3	123.4	68.4	7.4	9.6	39.2	24.3	46.4	106.5	16.7	7.7	19.7
European Union	79.1	0	15.9	52.6	88.7	145.1	128.4	7.1	1.2	22.8	77.5	50.6	38.3	122.3	2.9	2.8
Russia	12.1	1.3	46.5	16.6	43.1	97.7	79.7	9.3	13.5	20.6	33.2	48.4	100.6	14.9	8.0	18.7
Rest of Europe	59.2	0.5	299.3	80.8	33.0	176.6	99.5	3.6	6.1	88.1	14.3	35.5	65.0	8.6	3.5	5.6
South Africa	3.6	0.1	259.6	13.8	37.9	155.6	103.0	3.0	6.5	9.6	1.5	16.1	100.4	0.3	2.8	8.5
Rest of Africa	28.2	5.4	51.7	24.5	31.4	115.6	76.6	11.0	15.8	47.7	29.2	51.6	64.5	10.5	12.0	43.8

^a The tariff rates used to calculate the model shocks also vary by source region and are available from the Commission on request. ^b No change assumed.

Table C.5 Average increase in the power of tariff to increase the average tariff rate to 20 per cent (scenario 2)^a
Per cent

Country/region	OAP	OMN	MIL	OFD	TEX	WAP	LEA	CRP	NMM	L_S	NFM	FMP	MVH	OTN	OME	OMF
Australia	0	0	31.1	2.4	65.5	161.5	65.6	0	1.4	29.7	8.2	28.4	72.4	2	2	0
New Zealand	0	0	3.9	3.2	44.8	148.9	94.4	0	0.5	20.9	15.5	21.3	96.9	2.4	1	9.3
China	1.8	0	124.1	7.8	3.7	163.2	24.8	11.6	0.6	55.4	29.1	53.5	208	8.5	0.2	1.2
Hong Kong ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Japan	77.1	0	203	47	125.9	224.7	203.2	0	0	23.8	4.7	7.7	0	0	0.1	1.2
Korea	24.7	0	172.9	10.2	65.2	249.1	102.5	1.6	0.8	42.5	58.6	95.6	148.5	10.4	0.7	1.4
Taiwan	5.7	0	188.7	49.3	59.9	252.3	46.1	0.5	1.6	56.6	31.2	79.3	199.7	32.5	0.6	1
Indonesia	6.5	0	58	5.8	4.9	130.5	37	0	0.5	69	39.2	74.6	161.7	57.1	5.4	5.1
Malaysia	10.6	0	6.9	7.2	22.3	154.9	94.6	1.1	0.5	78.5	41.9	72	150.5	22.5	0.9	0.2
Philippines	10	0	71.4	17.1	12.3	237.2	141.7	3.1	1.7	63.4	47.8	104.8	194.2	94.6	1	28.2
Singapore ^b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	2.9	0.2	38.6	5.3	4.8	135.1	16.1	2.3	1	42.1	16.5	51.8	108.1	12.2	0.4	0.6
Bangladesh	1	0	40.6	8.8	0.5	38.2	14.2	0.2	0.5	21.5	10.2	16.5	28.5	4.4	0.2	1.7
India	6.9	0.6	128.9	21.6	1.8	60.4	13.7	4.9	0.4	101.7	7.6	43.5	102.7	1.3	0.4	2.7
Rest of Asia & Oceania	35.9	0.1	47.5	10.9	10.7	68.5	51.5	0.8	0.8	41	14.1	34.5	69.3	14	1.6	1.2
Canada	193.6	0	93.7	87.2	128.9	205.2	210.5	0	0.3	5.7	2.3	22.3	41.5	5.9	1.2	2.9
United States	3.2	0	216.1	10.2	120.3	191.2	205.9	0	0.2	5	9.4	17.3	27.2	9.5	0.1	0.4
Mexico	2.2	0	110.5	15.4	27.8	104.4	87.4	0.6	0.2	100.3	22.3	41.4	67	75.2	0.8	5
Brazil	5.1	0	56.7	5.7	9.5	202.5	73.7	5.4	0.8	127.3	48.5	95.2	112.7	13.3	1.5	5.9
Rest of America	30.1	0	90.1	10.1	16.5	93.8	51.5	1.3	1.1	33	19.7	34.8	82.1	5.3	1.3	4.3
European Union	77.7	0	13.5	49.3	85.4	137.8	121.8	6.7	0.6	22.8	76.8	49.9	37.1	120.9	2.5	2.2
Russia	5.6	0	37.1	4.9	28.9	66.3	57.7	0.1	1.5	17.2	25.1	32.2	74.9	3.9	0.8	2.6
Rest of Europe	50.9	0	218.8	56	26	158.5	90.5	1.9	1.6	82	13.6	32	61	7.6	1.8	3.7
South Africa	2.9	0	136.5	6.4	19.2	98.5	66.9	0	0	7.8	1.2	9.2	70	0.2	0.5	3.3
Rest of Africa	13	0	33.8	6.1	6.9	65.7	40.8	0.3	0.5	31.7	18.5	28.6	40.7	5.8	1.4	17.1

^a The shocks applied also vary by source region and are available from the Commission on request. ^b No change assumed.

D Sensitivity tests

Hypothetical increases in border protection

The basic model closure adopted in this study adopts a longer-run economic environment in which the level of physical capital adjusts to equilibrate expected and actual returns on capital in each region, such that the growth (decline) in regional investment is equal to the change in the stock of physical capital. To illustrate the sensitivity of results to this capital market closure, this appendix reports results for simulations in which the global capital stock is assumed fixed. In this environment, capital moves between regions according to relative expected rates of return. Investment in each region is assumed to respond to changes in the actual rate of return.

Scenario 1: Increasing tariffs to bound rates

Table D.1 Sensitivity test: global capital stock assumed fixed (scenario 1)
Per cent

<i>Country/region</i>	<i>Import volumes</i>	<i>Export volumes</i>	<i>Real GDP</i>
Australia	-5.8	-7.4	0.3
New Zealand	-10.5	-8.9	-1.8
China	...	-0.8	1.8
Hong Kong	1.8	2.5	2.6
Japan	-1.7	-0.4	0.5
Korea	-9.3	-8.0	-3.4
Taiwan	1.3	1.1	1.6
Indonesia	-31.2	-29.5	-7.4
Malaysia	-11.6	-9.3	-5.6
Philippines	-26.4	-27.5	-15.0
Singapore	-3.7	-2.2	-1.2
Thailand	-32.5	-32.7	-22.4
Bangladesh	-38.8	-44.9	-8.8
India	-20.9	-24.3	-5.2
Rest of Asia & Oceania	-21.0	-19.7	-9.6
Canada	-7.2	-6.9	-0.0
United States	-4.6	-5.4	0.6
Mexico	-38.2	-38.4	-18.2
Brazil	-27.1	-19.6	-2.3
Rest of America	-29.3	-27.9	-6.4
European Union	0.3	0.7	1.7
Russia	-31.1	-21.4	-7.0
Rest of Europe	-27.9	-27.7	-7.1
South Africa	-22.0	-20.2	-4.6
Rest of Africa	-25.9	-26.1	-10.5
World	-7.2	-7.2	-0.7

Source: GTAP model simulation.

Scenario 2: Increasing average tariffs to 20 per cent

Table D.2 Sensitivity test: global capital stock assumed fixed (scenario 2)
Per cent

<i>Country/region</i>	<i>Import volumes</i>	<i>Export volumes</i>	<i>Real GDP</i>
Australia	-8.9	-10.2	-2.3
New Zealand	-4.4	-2.9	-4.7
China	-16.0	-14.2	-4.0
Hong Kong	-4.4	-1.5	0.9
Japan	-14.2	-7.8	-0.1
Korea	-13.2	-10.5	-4.0
Taiwan	-11.7	-9.9	-5.7
Indonesia	-13.0	-11.4	-4.5
Malaysia	-12.1	-10.6	-9.4
Philippines	-17.5	-18.9	-10.7
Singapore	-1.2	-0.5	0.1
Thailand	-21.1	-20.3	-16.8
Bangladesh	20.8	11.6	4.5
India	-10.0	-9.4	-1.5
Rest of Asia & Oceania	-16.1	-14.0	-8.6
Canada	7.9	5.4	0.3
United States	-5.7	-8.5	-0.4
Mexico	12.8	8.5	2.8
Brazil	-9.6	-5.7	-0.1
Rest of America	-12.0	-10.0	-3.6
European Union	-0.2	-0.7	0.3
Russia	-14.3	-7.8	-2.6
Rest of Europe	-16.9	-15.3	-5.4
South Africa	-10.9	-10.3	-4.0
Rest of Africa	-5.0	-4.7	-2.9
World	-5.6	-5.6	-1.0

Source: GTAP model simulation.

Regulatory burden on financial services

Given their central role in the operation and regulation of global financial markets, this study focused on the potential impact of excessive regulation in OECD economies. To reflect the inter-connectedness of global financial markets, this study considers, as a sensitivity test, flow-on effects of higher capital costs to non-OECD economies.

Table D.3 **Sensitivity test: higher capital costs in all countries**

Per cent

<i>Country/region</i>	<i>Cost of providing financial services</i>	<i>Cost of funds to users of capital</i>	<i>Scenario total</i>
Australia ^a	-0.1	-0.6	-0.7
New Zealand ^a	-0.1	-1.0	-1.1
China	...	-0.7	-0.7
Hong Kong	...	-1.4	-1.3
Japan ^a	-0.1	-0.7	-0.8
Korea ^a	-0.1	-1.0	-1.1
Taiwan	...	-0.7	-0.7
Indonesia	...	-0.9	-0.8
Malaysia	...	-0.8	-0.8
Philippines	...	-1.4	-1.4
Singapore	...	-1.2	-1.1
Thailand	...	-1.6	-1.5
Bangladesh	...	-0.7	-0.7
India	...	-0.7	-0.7
Rest of Asia & Oceania	...	-1.2	-1.2
Canada ^a	-0.1	-0.6	-0.7
United States ^a	-0.2	-0.4	-0.5
Mexico ^a	...	-1.3	-1.3
Brazil	...	-0.9	-0.9
Rest of America	...	-1.0	-1.0
European Union ^a	-0.1	-0.9	-1.0
Russia	...	-0.9	-0.9
Rest of Europe	...	-0.8	-0.8
South Africa	...	-1.2	-1.1
Rest of Africa	...	-0.9	-0.9
World	-0.1	-0.7	-0.8

^a Countries used here to proxy the OECD.

Source: GTAP model simulation.

References

- Achard, P., Rupp, J. and Jomini, P. 2008, The cost of water in manufacturing tariffs: A 30 products, 33 billion dollars cost story, Policy Brief, Groupe d'Économie Mondiale, Paris, December.
- Bouet A. and Laborde, D. 2009, The potential costs of a failed Doha Round, Issue Briefs 56, International Food Policy Research Institute, Washington, D.C.
- Centre for International Economics 2009, Benefits of trade and trade liberalisation, Paper prepared for the Department of Foreign Affairs and Trade, Canberra, May.
- Crucini, M.J. and Kahn, J. 1996, 'Tariffs and aggregate economic activity: Lessons from the Great Depression', *Journal of Monetary Economics*, vol. 38, no. 3, pp. 427-67.
- 2003, Tariffs and the Great Depression revisited, Staff Report no. 172, Federal Reserve Bank of New York, New York, September.
- Dee, P., Hanlson, K. and Phamduc, T. 2000, 'Modelling the liberalisation of services', Chapter 15 in Productivity Commission and Australian National University 2000, *Achieving Better Regulation of Services*, Conference Proceedings, Ausinfo, Canberra, November, pp. 379-410.
- Hertel, T.W. (ed.) 1997, *Global Trade Analysis: Modelling and Applications*, Cambridge University Press.
- 2000, 'Potential gains from reducing trade barriers in manufacturing, services and agriculture', *Federal Reserve Bank of St. Louis Review*, vol. 82, no. 4, pp. 78-99.
- , Anderson, K., Francois, J.F., Hoekman, B. and Martin, W. 1999, Agriculture and non-agricultural liberalization in the Millennium Round, Paper presented at the Global Conference on Agriculture and the New Trade Agenda from a Development Perspective, Interests and Options in the WTO 2000 Negotiations, Sponsored by the World Bank and WTO, Geneva, 1-2 October.
- , McDougall, R.A., Narayanan, B.G. and Aguiar, A.H. 2008, 'Behavioral parameters', Chapter 14 in Narayanan, B.G. and Walmsley, T.L. (eds), *Global Trade, Assistance, and Production: The GTAP 7 Data Base*, Center for Global Trade Analysis, Purdue University.

-
- Horridge, J.M. and Laborde, D. 2008, TASTE: A program to adapt detailed trade and tariff data to GTAP-related purposes, GTAP Technical Paper, Centre for Global Trade Analysis, Purdue University, June.
- IMF (International Monetary Fund) 2009a, *Global Financial Satiability Report: Navigating the Financial Challenges Ahead*, IMF, Washington, D.C., October.
- 2009b, *World Economic Outlook Database*, IMF, Washington, D.C., October, <http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/index.aspx>.
- Messerlin, P. 2008, Walking a tightrope: world trade in manufacturing and the benefits of binding, GMF-GEM Policy Brief, Groupe d'Économie Mondiale, Paris, June.
- Narayanan, B.G. and Walmsley, T.L. (eds) 2008, *Global Trade, Assistance, and Production: The GTAP 7 Data Base*, Center for Global Trade Analysis, Purdue University.
- Verikios, G. and Hanslow, K. 2009, The long-run effects of structural change and the treatment of international capital accumulation, mobility and ownership, General Paper no. G-179, Centre of Policy Studies, Monash University, January.
- Walmsley, T.L. 1998, Long-run simulations with GTAP: Illustrative results from APEC trade liberalisation, GTAP Technical Paper no. 9, Center for Global Trade Analysis, Purdue University, March.
- WTO (World Trade Organization) 2009, *Report to the TPRB from the Director-General on the Financial and Economic Crisis and Trade-Related Developments*, WT/TPR/OV/W/2, Geneva, 15 July.