

A general equilibrium analysis of Australia providing duty free access on goods imported from Least Developed Countries

Xiao-guang Zhang and George Verikios*

(Paper prepared for the 6th Annual Conference on Global Economic Analysis,
12-14 June 2003, the Hague, the Netherlands)

Abstract

The Doha ministerial declaration commits industrialised countries to liberalising access for least developed countries (LDCs) to their markets. Preferential trade policies have diverse impacts on the country that initiates them and on its trading partners, which include not only the LDCs but also other developed and developing countries that compete with LDCs in world export markets. To what extent such a policy may affect the initiating country and its trading partners is of concern to policy makers. This paper uses Australia as a case study to quantify the general equilibrium effects of providing tariff-free access to Australian markets on all parties concerned. The main sources of the projected effects are identified and discussed.

We use a disaggregated version of the GTAP model to minimise aggregation bias. We also develop a post-solution micro-simulation model and an extended database to derive results for those LDCs and some other trading partners that are not identified separately in the GTAP database.

Given the current patterns of trade and tariffs, removing tariffs on Australian imports from LDCs will primarily affect imports of clothing. Simulation results show that the overall effects on the Australian economy are likely to be small due to the small share of Australia's trade with LDCs and the small effect of tariff cuts on the domestic prices paid by consumers and producers. The policy change is projected to benefit mainly major LDC clothing exporters. To what extent other trading partners that already enjoy free access to Australia's domestic market, are affected depends on the degree of substitution between imports from these two sources. Based on the empirical evidence, the adverse effect on other exporters to Australia is modest.

1. Introduction

The Doha ministerial declaration commits industrialised countries to providing duty and quota free access to their markets for goods originating from developing countries and, especially, least developed countries (LDCs). Currently, 49 countries are designated by the United Nations as LDCs as their per capita incomes are among the lowest in the world (UNCTAD, 2001b). The improved access is intended to be non-reciprocal, that is, the initiative will not require beneficiary LDCs to respond by lowering their tariffs.

In response to the Doha declaration, some industrialised countries have already provided tariff and quota free access to their markets. The European Union introduced the "Everything but Arms" (EBA) initiative. Other industrialised countries including Australia have announced similar initiatives for LDCs' imports (UNCTAD, 2001a).

* Australian Productivity Commission. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Commission. Correspondence address: Productivity Commission, LB 2, Collins Street East, Melbourne, VIC 8003, Australia. Emails: xzhang@pc.gov.au; gverikios@pc.gov.au

Although increasing opportunities for trade alone is unlikely to resolve all the problems in LDCs, this policy is designed to provide an impetus for their economic development. From a donor country's point of view, therefore, it will be important to know, both qualitatively and quantitatively, what impact such an initiative may have on the LDCs and on other trading partners, as well as on its own economy. This paper uses Australia as a case study to quantify the economic impacts of removing tariffs on goods originating from LDCs on the LDCs' economies, on other developing country trading partners, and on the Australian economy itself.

Like many industrialised countries, Australia already has preferential agreements with selected developing countries. This includes duty-free access to Australian markets by some developing countries, including LDCs, under the South Pacific Regional Trade and Economic Co-operation Agreement (SPARTECA). One of the main policy concerns in regard to the new initiative is the possible impact this new policy may have on SPARTECA members.

As the assessment involves many countries and commodities, it is conducted in a general equilibrium (GE) framework based on the GTAP model (Hertel 1997). The simulation results from the GTAP model are decomposed using a post-solution simulation model which includes individual trading partners that are not separately identified in the GTAP database, but are important in their relevance to policy considerations.

The remainder of this paper is organised as follows. Section 2 highlights some key factors that may influence the outcomes of preferential trade agreements (PTA) by briefly reviewing the literature on PTAs. Section 3 outlines the main features of the GE model used in the simulations and the post-simulation analysis. Section 4 describes Australian trade with LDCs and the policy initiatives modelled. Section 5 presents and discusses the simulation results. The final section summarises the main findings and draws out policy implications.

2. The theory of preferential trade agreements

The traditional analysis of PTAs is based on the notion of "trade creation" and "trade diversion", introduced by Viner (1950). Since then, there has been an extensive literature on the effects of various PTAs such as customs unions and free trade areas.¹ Both partial and general equilibrium (GE) approaches have been used in analysing the impacts of PTAs on various parties. As trade usually involves multiple trading partners, the partial equilibrium (PE) approach is often unable to capture interactions between sectors and countries in consumption and production, and can produce misleading results.

Before turning to our simulation results, it is useful to highlight some of the effects that determine the outcomes of PTAs based on theoretical models. Imagine a simple and stylised GE model with three countries (A, B and C) trading three goods (1, 2 and 3) with each other, where each country is assumed to produce and export one good and import the other two goods from its trading partners. Consumers in all countries are assumed to have identical preferences for the three goods. This pattern of trade and consumption implies that goods produced in different countries are imperfect substitutes in consumption. Initially, all countries impose a tariff on the imported goods and tariff revenue is redistributed to the consumer in a lump-sum fashion.

It can be shown that if the country introducing a tariff preference for one of its trading partners is too small to affect the world prices of the goods it exports and imports, then this

¹ For a recent survey, see Panagariya (2000).

country will normally benefit from its preferential liberalisation. This case is effectively equivalent to a PE analysis of a small open economy, in which the terms of trade for the liberalising country are fixed and the response of the rest of the world's prices is ruled out by assumption.²

If the small country assumption is relaxed in a GE context, however, the above results will change. The feedback effects from the rest of the world alter the results for the liberalising country. As Bhagwati and Panagariya (1996) have shown in a similar analysis, the introduction of a tariff preference may benefit the preference receiver, and hurt the other partner and the liberalising country itself. This is because the liberalising country is no longer small relative to the rest of the world, implying that the tariff preference will lead to a deterioration of that country's terms of trade. As a result, the liberalising country may lose from its own preferential trade liberalisation.

The intuition behind this result can be explained by the concepts of trade creation and trade diversion first enunciated by Viner (1950). First, let country A produce and export good 1 and import goods 2 and 3. Then suppose that country A removes the tariff on good 2 imported from country B. The removal of tariffs expands the imports of good 2, which is beneficial trade creation. As good 2 and 3 are substitutes in consumption, it also leads a contraction of imports of good 3 from country C, which is harmful trade diversion. Country B benefits from trade creation while country C loses from trade diversion.

The net effect on country A depends on the relative magnitude of these two effects. As domestic good (good 1) and imported good (good 2) are net substitutes, when trade balance is fixed, the tariff removal expands the value of exports by country A at world prices. If the value of imports of good 2 expands more than the value of imports of good 3 contracts, the beneficial effect of trade creation dominates the harmful effect of trade diversion. To what extent this will occur depends on the substitutability between each pair of goods as well as the relative magnitudes of tariffs. As Panagariya and Duttagupta (1999) have pointed out, this analytical ambiguity assigns a critical role to parameters determining the degree of substitutability between domestic and imported composite on the one hand and between import sources on the other in GE models.

This analytical model, though simple, is useful for illustrating the complexity of PTA analysis. It shows that GE effects of non-reciprocal PTAs depend on whether other goods are net complements to or substitutes for the goods whose imports are being liberalised. In reality, however, other important factors may interact with the factors specified in the simple model, such as trade in and use of intermediate inputs in production and saving-investment decisions. A CGE model of world trade such as GTAP accounts for many of the features that may be relevant to analysing the effects of PTAs.³

Although the effects highlighted in the analytical model above are still present, they will be intertwined with and influenced by other factors that are incorporated into a CGE model. The net outcome will be more difficult to predict in an CGE model than in an analytical model. The results are dependent on the parameter settings, data and the model's structure.

² This is also the result of the Meade-Lipsey small-union model (Lipsey 1958).

³ For CGE analysis of non-reciprocal PTAs, see for example Brown (1988, 1989), Srinivasan, Whalley and Wooton (1993) and Robinson and Thierfelder (1999).

3. Models and databases

Two models are used in this study: a CGE model and a post-solution simulation model. The former is used to capture the effects on Australia and its major trading partners specified in the GTAP database. The latter is used to quantify the effects on exports by LDCs to Australia, and exports to Australia by other countries of interest that are not separately identified in the GTAP database.

3.1 The GTAP model and database

The CGE model used is the GTAP version 6.1.⁴ The model divides the world economy into geographical regions and each regional economy into industries. Goods produced by an industry in different regions are assumed to be imperfect substitutes for imports. Domestic and imported goods form constant elasticity of substitution (CES) composites which are used by the household, the government and firms in consumption, production and investment formation.

Within each region, a single household represents both consumers and factor owners. Consumers are assumed to have identical preferences over composite goods. The government collects taxes and spends them on public goods. Total regional income is allocated between private consumption, public consumption and savings. Consumers' demands for goods and services have constant difference of elasticities (CDE) functional forms.

Within each region, industries use composite intermediate inputs and primary factors of production to produce outputs. Production technologies exhibit constant returns to scale. Composite intermediate inputs are used in fixed proportion while primary factors of production are substitutable with each other. Among the five primary factors of production specified in the model, skilled, unskilled labour and capital are mobile across domestic industries, while land and natural resources are used, in fixed proportion, only in agricultural and mining industries. All primary factors are immobile internationally.

Returns to factors of production accrue to households in the form of income which, in turn, finances consumption demand and savings. Household savings can either finance domestic or foreign investment. Total world savings equals investment.

At the macroeconomic level, household consumption, government consumption and net (of depreciation) savings in each region are a variable share of regional income. These aggregates vary in response to changes in regional income and prices. It is assumed that net investment will be reallocated across regions to equalise the expected rate of return on regional investments. All changes are evaluated relative to a price index for the world endowment of factors, which serves as a numeraire.⁵

The model is comparative static: it compares two static equilibrium situations for regional and global economies under alternative policy scenarios with no reference to the time path from one equilibrium to another.

The database used in simulations is the GTAP database version 5 (Dimaranan and McDougall 2002), where 1997 is the base year. The original database divides the world into 66 regional economies, each of which consists of 57 industries. Trade data are combined with protection

⁴ The original model is documented in Hertel (1997). Version 6.1 is available at <http://www.agecon.purdue.edu/GTAP/>.

⁵ The experiment was implemented using the GEMPACK software suite (Harrison and Pearson 1996).

and transportation cost data to represent the fundamental international trade linkage across regions. Detailed input–output databases account for the inter-sectoral linkages and other economic relationships within each regional economy.

For the purposes of this study, the database is aggregated into 39 regional groups and 43 industries. Tables A1 and A2 of the appendix report the mapping from the 66 regions and 57 industries in the original GTAP 5 database to the aggregated database containing 39 regions and 43 industries.

Within the 39 aggregated regions, 13 regions include LDCs. Of these 13 regions, six are individual LDCs (Bangladesh, Malawi, Mozambique, United Republic of Tanzania, Uganda and Zambia) and seven are regional groups including some LDCs (Rest of South Asia, Central America and the Caribbean, Rest of Middle East, Rest of South African Customs Union, Rest of Southern Africa, Rest of Sub-Saharan Africa and the Rest of World).

As the focus of this study is on commodity trade, the services industries in the original database are aggregated into a single sector to reduce the size of the model (table A2).

3.2 The post-solution simulation model and database

A post-solution simulation model was developed to quantify the impacts of preferential liberalisation on Australian trading partners of interest, which are not identified separately in the GTAP database. This simulation is based on a model describing the Australian demand for imports originating from each of the countries included in the 7 aggregate LDC-inclusive regions in the database. The import demand functions are derived from the same CES functions used in the GTAP model. As in GTAP, the post-solution simulation model assumes that, for Australian users, imports of commodities from different countries are (imperfectly) substitutable with each other.

In percentage change form, the demand for an import from country i , which is included in an aggregated region can be expressed as

$$q_i = q - \sigma (p_i - p)$$

in which, q denotes the percentage change in the demand for the composite of imports from all countries in the region;⁶ p_i is the domestic price of the import from country i and p is the average price of imports from all countries weighted by the values of their imports; σ is the constant elasticity of substitution between any pair of imports from two source countries.

The domestic price of the imports from country i is defined as

$$p_i = p_{iw} + t_i$$

in which p_{iw} is the world (c.i.f.) price of import from country i and the t_i is the power of tariff rate for import from country i .

The elasticity of substitution σ is taken from the GTAP 5 database. The percentage changes in the world prices of imports p_{iw} and in the Australian demand for total imports of the commodity q specified are taken from the GTAP simulation results. It is assumed that all countries in a given regional group face the same world prices for their exports (the ‘small country assumption’). Considering the small size of most economies included in those regional groups, this assumption seems reasonable.

⁶ It may be interpreted as a shift in the income of the importing country.

For instance, the simulated response in the Australian demand for imports of clothing from Cambodia is a function of the projected change in the price and quantity of imports of clothing for the whole regional grouping, the rest of the world, which includes Cambodia. The Australian domestic market price of an import is therefore equal to the world prices for the region as a whole plus the tariff for the country concerned.

The policy scenarios simulated in the post-solution simulation are the same as that used in the GTAP simulation: the actual duties paid on LDC imports are removed completely. When LDC tariffs are removed, Australian consumers are expected to shift their demand for imports from other countries to those from LDCs.

The data on Australian imports used in the post-solution simulation model are obtained from the ABS and other sources.⁷ They include the values of imports from all sources at the HS 4-digit level and the values of duties paid on relevant imports. The HS trade data are aggregated into the 42 GTAP traded commodity groups. The ad valorem tariff rates are calculated as the value of duties paid divided by the cif value of imports. The policy scenario simulated in the post-solution simulation is the same as that in the CGE analysis. The 42 LDCs that exported to Australia in 1997 and are included in the post-simulation analysis are listed in the appendix, table A3.

4. Australia's trade with LDCs and tariff structure

Before turning to the simulation results, it will be useful to outline briefly Australia's trade with LDCs and existing tariffs on imports from LDCs.⁸ Australia currently provides preferential market access for developing countries under the Australian System of Tariff Preferences (ASTP) scheme and SPARTECA. The ASTP scheme reduces the tariff rate for imports from developing countries by 5 percentage points if MFN rates not zero or above 5 per cent, while SPARTECA allows duty-free entry for imports from beneficiary countries.

The ASTP scheme excludes some products from tariff preferences, including some that are important to LDCs, such as textiles, clothing and footwear (TCF). Non-SPARTECA LDCs still face high tariffs in some categories of TCF, particularly apparel and certain finished textiles. TCF is an important export to Australia for these LDCs.

Imports from LDCs were valued at A\$242 million in 2001-02, only 0.02 per cent of total imports to Australia, more than half of which were TCF. Australian imports from LDCs are primarily from Asian LDCs. Of these, Bangladesh accounts for around three quarters of Australia's imports of TCF from LDCs.

The original GTAP database contains 1997 import tariff rates on Australian commodity imports originating from LDCs. However, these rates do not account for the ASTP. The database was therefore updated and made consistent with the tariffs reported by the ABS trade statistics (2002).⁹ Since most tariffs on LDC imports are below 5 per cent, only the tariff rates for TCF imports are reported in table 1.

⁷ Data were extracted from a variety of sources, including ABS (2002) *International Trade, Australia*, Cat. No. 5465.0, the World Bank's *World Development Indicators 2001 database* and various UNCTAD, UN, WTO, World Bank and IMF publications. Australian production data was sourced from ABS (1998) *Manufacturing Production, Commodities Produced, Australia*, Cat. No. 8365.0.

⁸ A more detailed description of the Australian pattern of trade with LDCs and tariff structure can be found in PC (2002).

⁹ This was done using the ALTERTAX procedure outlined in Malcolm (1998).

Table 1 **Average tariff rates on TCF imports from LDCs, 1997 (per cent)**

<i>Country</i>	<i>Textiles</i>	<i>Clothing</i>	<i>Footwear</i>
Bangladesh	0.10	33.36	1.40
Tanzania	0	31.91	0
Uganda	0	34.16	0
Haiti	0	29.17	0
Cambodia	12.70	29.69	0
Laos PD Republic	0	29.20	0
Burma	9.88	18.40	0
Maldives	0	25.29	0
Nepal	0.96	8.87	0.46
Lesotho	0	33.74	0
Democratic Republic of Congo	0	34.19	0
Ethiopia	0	27.08	0
Gambia	13.64	0	0
Madagascar	0	8.71	0
Mali	0	18.97	0
Senegal	14.22	14.07	8.76

Note: (1) The average tariff rates are calculated using imports as weights. (2) The LDCs with no TCF exports to Australia or not subject to Australia TCF tariffs are not included in the table.

Source: ABS (2002).

The policy experiment consists of removing all remaining tariffs on Australian imports from LDCs in the adjusted database. For the 6 regions representing single LDCs the removal of all tariffs on imports into Australia is relatively straightforward: all tariffs are reduced to zero. For the 7 regional groupings that include only some LDCs, the regional tariffs are removed in proportion to the LDC duty shares. The duty shares are calculated from Australia's trade statistics (ABS, 2002). The total tariff revenue to be removed accounts only for 0.03 per cent of total tariff revenue. In the post-solution simulation, Australian tariffs are removed for the imports of all LDCs that are not specified individually in the GTAP simulation.

5. Simulation results and discussion

Table 2 shows the general effects of the Australian initiative on all LDCs and other regions in the world in terms of percentage changes in real gross domestic product (GDP) and trade. Almost all LDCs and LDC-inclusive regions are projected to benefit from the preferential access to Australian markets in terms of real GDP, with Bangladesh and other South Asian countries being the major beneficiaries. Some LDCs, projected to be slightly worse off, are among those with little or no trade with Australia, or trade in those commodities that attracted low or no tariffs prior to the liberalisation.

Australia is projected to be worse off, as expected in the analytical model in section 2. However, the loss is negligible due to the small size of the overall tariffs removed and the small share of imports from LDCs into Australia. Nonetheless, as Australian domestic goods are assumed to be substitutable for imports from LDCs, the Australian terms of trade are affected adversely. This effect contributes largely to the overall losses for Australia. The reverse is true for the beneficiary LDCs.

Most other trading partner countries are largely unaffected by the Australian LDC initiative. They may either benefit little or lose little, depending, among other things, on what extent their exports compete with LDC exports in the Australian market.

Previous discussion has shown that according to current trade patterns, the changes in tariff preference are likely to affect mainly trade in clothing, sourced from a few LDCs, such as

Bangladesh, Burma, Cambodia and Nepal. The parts of the clothing sector in Australia and other countries that compete directly with LDCs in the Australian market, such as Fiji and China, are also adversely affected.

Table 2 Simulated effects on LDCs' and other countries' real GDP and trade (per cent)

<i>Region</i>	<i>Real GDP</i>	<i>Export volume</i>	<i>Import volume</i>
<u><i>LDC regions</i></u>			
Bangladesh ^a	0.000662	0.020857	0.041132
Rest of South Asia ^b	0.000127	0.002262	0.002746
Rest of World ^b	0.000080	0.001326	0.003022
Uganda ^a	0.000061	0.002206	0.003443
Central America and the Caribbean ^b	0.000022	0.000108	0.000220
Rest of Sub-Saharan Africa ^b	0.000013	0.000108	0.000261
Mozambique ^a	0.000012	0.000125	0.000118
Rest of Southern Africa ^b	0.000010	0.000019	0.000155
Tanzania ^a	0.000009	0.000218	0.000249
Malawi ^a	0.000005	0.000089	0.000135
Rest of Middle East ^b	0.000002	-0.000013	-0.000007
Rest of South African Customs Union ^b	-0.000002	-0.000090	-0.000034
Zambia ^a	-0.000010	-0.000103	-0.000184
<u><i>Non-LDC regions</i></u>			
Australia	-0.000264	-0.001519	0.004301
New Zealand	-0.000046	-0.000791	-0.000976
China	0.000005	-0.000223	-0.000352
Hong Kong	0.000011	0.000067	0.000143
Japan	..	-0.000063	-0.000008
Korea	0.000001	-0.000021	0.000072
Taiwan	0.000001	-0.000056	0.000006
Indonesia	0.000002	-0.000087	-0.000056
Malaysia	0.000009	-0.000033	0.000028
Philippines	0.000011	-0.000027	0.000033
Singapore	0.000004	-0.000018	0.000020
Thailand	0.000007	-0.000034	0.000018
Vietnam	-0.000036	-0.000132	-0.000336
India	0.000006	0.000051	0.000063
Sri Lanka	0.000032	0.000082	0.000050
Canada	-0.000002	-0.000046	-0.000031
United States	-0.000001	-0.000041	-0.000095
Rest of Latin America	..	-0.000028	-0.000005
European Union	-0.000003	-0.000022	-0.000026
Rest of Western Europe	..	-0.000030	-0.000027
Eastern Europe	..	-0.000002	0.000023
Turkey	0.000003	0.000058	0.000136
Morocco	0.000018	0.000080	0.000219
Rest of North Africa	0.000008	0.000011	0.000099
Botswana	-0.000005	-0.000088	0.000014
Zimbabwe	0.000001	0.000010	0.000016
Total	-0.000002	0.000098	0.000098

^a Single LDC. ^b Region inclusive of LDCs. .. Less than 0.0000005 per cent.

Source: GTAP simulation.

Table 3 reports the simulated effects of the policy change on LDC exports to Australia. It shows that clothing exports to Australia from LDCs are projected to increase. Especially, clothing exports from Bangladesh to Australia increase 11-fold. Exports to Australia from

Cambodia, Burma and Nepal are also projected to increase by large proportions. Clothing exports account for almost the entire rise in LDC exports to Australia. Overall, total export volumes from LDCs to Australia are projected to increase by 12.48 per cent, which is driven mainly by a 423 per cent rise in exports of clothing.

Table 3 Simulated effects on LDCs' exports to Australia

<i>LDC</i>	<i>Total export volume</i>		<i>Clothing export volume</i>	
	%	A\$1,000 ^a	%	A\$1,000 ^a
<i>Asia</i>				
Afghanistan	-0.06	..	..	..
Bangladesh ^b	32.69	14,520	1,150.19	14,431
Bhutan	-0.02	..	..	..
Burma	14.62	1331	160.59	1,327
Cambodia	129.99	2,617	259.94	2,606
Laos People's Democratic Republic	126.46	141	255.67	141
Nepal	52.63	1,115	77.34	1,104
<i>Africa</i>				
Comoros, Republic	-0.02	..	..	..
Democratic Republic of Congo	0.53	2	313.15	2
Equatorial Guinea	-0.01	..	..	..
Eritrea	1.28	..	..	..
Ethiopia	1.73	31	250.54	2
Gambia	3.00	..	12.26	..
Guinea	-0.01	..	..	..
Lesotho	0.17	..	296.30	..
Liberia	0.46	..	..	..
Madagascar	8.56	75	88.91	75
Malawi ^b	-0.01	..	-0.58	..
Mali	7.86	27	179.16	1
Mauritania	-0.01	..	..	..
Mozambique ^b	1.25	1	-0.58	..
Senegal	7.54	3	136.11	..
Sierra Leone	-0.04	..	..	..
Tanzania ^b	..	..	0.72	..
Uganda ^b	0.29	18	1,219.06	19
Zambia ^b	..	..	-0.58	..
<i>Others</i>				
Haiti	5.32	2	256.05	1
Kiribati (SPARTECA)	3.83	21	..	..
Maldives	13.25	..	221.76	..
Samoa (SPARTECA)	-0.02	-12	..	..
Solomon Islands (SPARTECA)	0.02	1	..	..
Vanuatu (SPARTECA)	0.41	5	-1.29	..
Sum of LDCs	12.48	19,899	423.10	19,710

Notes: (1) ^a Based on 1997 Australian import values. (2) ^b Identified separately in GTAP. (3) The following 8 LDCs with no export to Australia in 1997 are excluded from the table: Tuvalu (SPARTECA), Cape Verde, Central Africa Republic, Chad, Benin, Djibouti, Guinea Bissau and Burkina Faso. (4) The following 9 LDCs with simulated change less than 0.005 per cent or A\$500 are excluded from the table: Yemen, Angola, Burundi, Niger, Rwanda, Sao Tome PR, Somalia, Sudan and Togo. (5) .. less than 0.005 per cent or A\$500.

Source: GTAP and post-solution simulations.

As Bangladesh is a separate region in the GTAP database, the effects on this LDC economy can be discussed in more detail. Table 4 reports the projected changes in some indicators of the Bangladesh economy. The table shows that a country benefiting from the tariff preference

increases its exports to Australia by diverting some of their traditional TCF exports from other destinations (in the case of Bangladesh, away from the US and the EU). Meanwhile, as its export market expands, it diverts resources away from other parts of the economy into its clothing sector. As a result, Bangladesh's clothing industry is projected to expand by 0.15 per cent.

Inputs into the clothing industry increase to accommodate increase in exports and production. This includes increases in inputs into Bangladesh's production (such as domestically produced cotton) and imported inputs. Other imports increase too in response to increased real consumption. Both effects are reflected in the increase in aggregate imports (table 4). Overall, there is a positive gain on real GDP and real consumption in Bangladesh. The same results can be expected for those LDCs that have a well developed domestic clothing industry and established clothing exports to the Australian market.

The effect of tariff preference on the trading partner countries that have been discriminated against depends on how substitutable their exports are for those from the beneficiary LDCs in the donor's market, and the size of their market share relative to that of LDCs. Given the parameters adopted in the GTAP database, the substitution between import sources are equal for all suppliers. As a result, it is the market size that determines the responsiveness of non-beneficiary trading partners.

Table 4 Simulated effects on Bangladesh

<i>Indicator</i>	<i>%</i>
<i>Clothing sector</i>	
Exports to Australia	1151
Exports to EU and USA	-0.58
Domestic clothing output	0.15
<i>Macro</i>	
Real GDP	0.001
Real consumption	0.005
Real aggregate exports	0.017
Real aggregate imports	0.041

Source: GTAP simulation.

For a large clothing exporter such as China (which contributes more than 30 per cent of Australian clothing imports), the effects of granting preferential access to LDC exports is very modest: a fall by about 0.57 per cent. As clothing is not dominant in Chinese exports, this fall has little overall impact on the Chinese economy, as seen in the change in real GDP in table 2.

Moreover, the pattern of Chinese exports of clothing and intermediate inputs into clothing production (textiles and semi-finished clothing products) may also contribute to the overall results for China. China is a supplier of intermediate inputs into the clothing production of LDCs and other countries. Although China's direct exports of clothing to Australia are projected to fall, the rise of LDC clothing exports encourages China's exports of textiles and semi-finished clothing to LDCs, which may compensate for the fall in clothing exports to Australia.

For small developing countries relying heavily on clothing exports to Australia, especially those under SPARTECA, the potential impact of LDC tariff preference can be comparatively greater. For instance, Australia accounts for more than one third of Fiji's exports. Exports of clothing account for around 25 per cent of all Fijian exports (UN 2000). Fiji's exports of clothing to Australia are projected to fall by about 1.3 per cent, or A\$1.8 million. Although

this is still small in percentage terms, this could nonetheless have some adverse effect on its domestic economy, larger than those projected for other clothing exporters, such as China.

The simulated effects on Australian industries are reported in table 5. As expected, the Australian clothing industry is affected the most among all industries. However the effect is still modest: the output of clothing is projected to fall by just 0.12 per cent and the imports of clothing to rise by about 0.44 per cent. This is because the imports from LDCs are very small. Australian demand for most imports falls except in parts of clothing (Wearing apparel), but overall import volume still increases slightly by 0.043 per cent. Foreign demand for most Australian exports increases, which drives up the output of most industries.

As discussed in section 2, the effects of PTAs depend, among other things, on the substitutability between domestic goods and the goods imported from various trading partners. In the case of the Australian LDC initiative, the simulation results are particularly sensitive to the substitution elasticities between Australian domestic clothing products and the imports of clothing products from LDCs and other trading partners. The results presented above are based on the standard parameters in the GTAP 5 database, in which the elasticity of substitution between Australia domestic clothing and the composite of imported clothing is 4.4 while that between any pair of import sources is 8.8, both of which are quite high, compared with that for other products. If clothing products from different countries are not so substitutable as implied in the GTAP database, the effects of the Australian LDC initiative might be smaller.¹⁰

6. Summary and concluding remarks

In this paper we use a global CGE model and an attached post-solution simulation model to quantify the economic effects of Australia providing duty free access for goods from LDCs on Australia and its trading partners. As shown above, the general effects are quite small. Nonetheless, the major effects from the model simulations are largely consistent with predictions from the analytical model.

Firstly, preference receivers (country B in the analytical model), especially those exporting to Australia, are projected to benefit, as the analytical model predicts. The gains tend to be concentrated in major LDC clothing exporters because clothing products used to attract high tariffs.

Secondly, extent to which other trading partners (country C in the analytical model) might benefit depends on several factors, which can be identified in analytical models: the substitutability between their exports and the levels of tariffs they attract. In the case of Australia, the overall effect depends also on the importance of clothing exports in their domestic economies.

Thirdly, for the preference giving country (country A in the analytical model), Australia, the general effect is negative, as expected. This reflects the dominance of trade diversion over trade creation effects and adverse terms of trade effect. However, the magnitude of the

¹⁰ This view may be supported by a similarity analysis conducted by PC (2002), which indicates possible low substitutability between Australian domestic clothing products and clothing imports and between clothing products imported from different countries.

adverse effects on Australian industries in general and the clothing industry in particular are small, due to the limited sized of LDC imports. ¹¹

Table 5 Simulated effects on Australian industries (per cent)

<i>Industry</i>	<i>Domestic output</i>	<i>Export volume</i>	<i>Import volume</i>
Wearing apparel	-0.1165	0.0167	0.4355
Textiles	-0.0231	0.0075	-0.0322
Wool, silk-worm cocoons ^a	-0.0038	0.0026	-0.0244
Petroleum, coal products	-0.0001	0.0010	..
Services	..	0.0075	-0.0039
Paper products, publishing	0.0002	0.0053	-0.0030
Fishing ^a	0.0004	0.0023	-0.0013
Coal	0.0004	0.0005	..
Meat products n.e.c. ^a	0.0005	0.0053	-0.0030
Oil	0.0005	0.0010	-0.0004
Forestry ^a	0.0008	0.0071	-0.0032
Gas	0.0009	0.0001	..
Beverages and tobacco products ^a	0.0010	0.0099	-0.0057
Wood products	0.0011	0.0072	-0.0035
Cereal grains n.e.c. ^a	0.0012	0.0020	-0.0025
Crops n.e.c. ^a	0.0015	0.0049	-0.0012
Food products n.e.c.	0.0015	0.0071	-0.0032
Animal products n.e.c.	0.0016	0.0061	-0.0027
Mineral products n.e.c.	0.0017	0.0089	-0.0031
Vegetables, fruit, nuts ^a	0.0018	0.0058	-0.0015
Raw milk ^a	0.0018	0.0057	-0.0027
Dairy products	0.0018	0.0054	-0.0020
Bovine cattle, sheep and goats, horses ^a	0.0020	0.0028	-0.0008
Metal products	0.0020	0.0100	-0.0034
Vegetable oils and fats ^a	0.0021	0.0057	-0.0011
Chemical, rubber, plastic products	0.0022	0.0055	-0.0013
Bovine cattle, sheep and goat meat	0.0024	0.0047	-0.0020
Sugar cane, sugar beet ^a	0.0024	0.0040	-0.0007
Sugar	0.0025	0.0044	0.0019
Wheat ^a	0.0025	0.0028	-0.0005
Oil seeds	0.0025	0.0048	0.0005
Paddy rice ^a	0.0027	0.0032	-0.0010
Plant-based fibers ^a	0.0027	0.0052	-0.0280
Processed rice	0.0027	0.0054	-0.0027
Minerals n.e.c.	0.0039	0.0037	0.0022
Machinery and equipment n.e.c.	0.0044	0.0091	-0.0018
Ferrous metals	0.0047	0.0088	-0.0012
Motor vehicles and parts	0.0047	0.0161	-0.0050
Electronic equipment	0.0048	0.0080	-0.0009
Manufactures n.e.c.	0.0048	0.0093	-0.0025
Transport equipment n.e.c.	0.0058	0.0148	-0.0052
Leather products	0.0063	0.0173	0.0001
Metals n.e.c.	0.0070	0.0078	-0.0004

Note: (1) ^a Agricultural products. (2) n.e.c.: not elsewhere classified. (3) .. less than 0.00005 per cent.

Source: GTAP simulation.

¹¹ These projections are closely in line with that obtained in other similar studies such as UNCTAD's analysis on Quad LDC initiatives (2001a).

Moreover, CGE model results also reveal some interactions and GE effects that simple analytical models are unable to capture. For instance, the model simulation shows that some countries competing with LDCs in Australian markets, such as China, may not necessarily lose from such a policy change, because they can benefit indirectly from increasing their exports of intermediate inputs to the exporting sectors in LDCs. These interactions captured by CGE model simulations help us understand more about the complexity of PTA analysis.

It should be noted that CGE models such as GTAP also have their limitations. For instance, these models still do not capture all the factors that may determine the outcome of preferential liberalisation. In the real world, to what extent a beneficiary trading partner can gain from such policy change depends, to a large extent, on the responsiveness of its domestic industries. Unfortunately, the responsiveness of production in most LDCs is limited. A favourable external opportunity may not be sufficiently strong enough to overcome all the domestic constraints in LDCs, such as underdeveloped infrastructure and shortage of some important factors of production. Efforts in capacity building in LDCs, for example, may improve their infrastructure. Some LDCs may then become attractive places for foreign investment or technology transfer, and offer opportunities for industrialised countries to reallocate more labour intensive sections of production those countries.

A model incorporating foreign investment would capture the effects of such globalisation of production. Moreover, a dynamic framework would be needed to illustrate the process of reallocating production facilities and movement of productive factors across countries.

References

- Australian Bureau of Statistics (ABS) 2002, *International Trade, Australia*, Cat. No. 5465.0.
- ABS, 1998, *Manufacturing Production, Commodities Produced, Australia*, Cat. No. 8365.0.
- Bhagwati, J and A. Panagariya, 1996. 'Preferential trading areas and multilateralism: Strangers, friends or foes?' in J. Bhagwati and A. Panagariya, eds., *The Economics of Preferential Trade Agreements*, AEI Press, Washington, D.C.
- Brown, D. 1988, 'Trade preferences for developing countries: a survey of results', *Journal of Development Studies*, 24, pp 335-63.
- Brown, D. 1989, 'A computational analysis of Japan's generalised system of preferences', *Journal of Development Economics*, 30, 103-28.
- Dimaranan, B.V. and McDougall, R.A. 2002, *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University.
- Harrison, J.W. and Pearson K.R. 1996, 'Computing solutions for large general equilibrium models using GEMPACK', *Computational Economics* 9(2) 83-127.
- Hertel, T. W. (ed.) 1997, *Global Trade Analysis: Modeling and Applications*, Cambridge University Press, Cambridge.
- Lipdey, R. 1958. *The Theory of Customs Unions: A General-Equilibrium Analysis*, University of London, Ph.D. thesis, published by Weidendelt and Nicolson, London, 1970.
- Malcolm, G., 1998, Adjusting tax rates in the GTAP data base, GTAP technical paper no. 12, Center for Global Trade Analysis, Purdue University, West Lafayette.
- Panagariya, A, 2000, 'Preferential trade liberalization: the traditional theory and new developments', *Journal of Economic Literature*, Vol. 38, June. pp.287-331.
- Panagariya, A, and R. Duttagupta, 1999, 'The "Gains" from preferential trade liberalization in CGEs: where from do the they come?' U. Maryland, mimeo. Forthcoming in S. Lahiri, ed., *Regionalism and Clobalization: Theory and Practice*. London: Routledge.
- PC (Productivity Commission), 2002, *Removing Tariffs on Goods Originating from Least Developed Countries*, Research Report, AusInfo, Canberra, October.
- Robinson, S. and Thierfelder, K., 1999, 'Trade liberalization and regional integration: the search for large numbers', International Food Policy Research Institute, Trade and Macroeconomics Division, Working Paper, No.34.
- Srinivasan, T.N., Whalley, J. and Wooton, I., 1993, 'Measuring the effects of regionalism on trade and welfare', in Anderson, K. and R. Blackhurst, eds. *Regional Integration and the Global Trading System*, New York: St. Martin's Press.
- UN (United Nations) 2000, *International Trade Statistics Yearbook*, New York.
- UNCTAD 2001a, *Duty and Quota Free Market Access for LDCs: An Analysis of Quad Initiatives*, Geneva and London.

- UNCTAD 2001b, *Statistical Profiles of the Least Developed Countries*, Geneva.
- Viner, Jacob, 1950. *The Customs Union Issue*, New York: Carnegie Endowment for International Peace.
- World Bank 2001, *World Bank Development Indicators 2001*, database accessed 22 April 2002, Washington.
- World Bank 2002, *Global Economic Prospects and the Developing Countries*, Washington.
- WTO (World Trade Organisation) 2000, *Participation of Developing Countries in World Trade: Recent Developments, and Trade of the Least-Developed Countries*, Note, Geneva, February.
- WTO 2001, *Market Access Conditions for Least Developed Countries*, Note, Geneva, April.

Appendix: Concordances and tables

This attachment includes details of the commodity and regional aggregations and mapping between the GTAP model and the models used in this study.

Table A1 Mapping of 66 regions in GTAP 5 database to 39 aggregated regions in this study

<i>GTAP 5 database region</i>	<i>Aggregated region and abbreviation</i>
1. Australia	1. Australia (AUS)
2. New Zealand	2. New Zealand (NZL)
3. China	3. China (CHN)
4. Hong Kong	4. Hong Kong (HKG)
5. Japan	5. Japan (JPN)
6. Korea	6. Korea (KOR)
7. Taiwan	7. Taiwan (TWN)
8. Indonesia	8. Indonesia (IDN)
9. Malaysia	9. Malaysia (MYS)
10. Philippines	10. Philippines (PHL)
11. Singapore	11. Singapore (SGP)
12. Thailand	12. Thailand (THA)
13. Vietnam	13. Vietnam (VNM)
14. Bangladesh	14. Bangladesh (BGD)
15. India	15. India (IND)
16. Sri Lanka	16. Sri Lanka (LKA)
17. Rest of South Asia	17. Rest of South Asia (XSA)
18. Canada	18. Canada (CAN)
19. United States	19. United States (USA)
20. Mexico	20. Rest of Latin America (OthLatAmer)
21. Central America and the Caribbean	21. Central America and the Caribbean (XCM)
22. Colombia	20. Rest of Latin America (OthLatAmer)
23. Peru	20. Rest of Latin America (OthLatAmer)
24. Venezuela	20. Rest of Latin America (OthLatAmer)
25. Rest of Andean Pact	20. Rest of Latin America (OthLatAmer)
26. Argentina	20. Rest of Latin America (OthLatAmer)
27. Brazil	20. Rest of Latin America (OthLatAmer)
28. Chile	20. Rest of Latin America (OthLatAmer)
29. Uruguay	20. Rest of Latin America (OthLatAmer)
30. Rest of South America	20. Rest of Latin America (OthLatAmer)
31. Austria	22. European Union (EUN)
32. Belgium	22. European Union (EUN)
33. Denmark	22. European Union (EUN)
34. Finland	22. European Union (EUN)
35. France	22. European Union (EUN)
36. Germany	22. European Union (EUN)
37. United Kingdom	22. European Union (EUN)
38. Greece	22. European Union (EUN)
39. Ireland	22. European Union (EUN)
40. Italy	22. European Union (EUN)
41. Luxembourg	22. European Union (EUN)
42. Netherlands	22. European Union (EUN)
43. Portugal	22. European Union (EUN)
44. Spain	22. European Union (EUN)
45. Sweden	22. European Union (EUN)
46. Switzerland	23. Rest of Western Europe (OthWestEur)
47. Rest of EFTA	23. Rest of Western Europe (OthWestEur)
48. Hungary	24. Eastern Europe (EastEur)
49. Poland	24. Eastern Europe (EastEur)
50. Rest of Central European Associates	24. Eastern Europe (EastEur)

(Continued next page)

Table A1 (continued)

<i>GTAP 5 database region</i>	<i>Aggregated region and abbreviation</i>
51. Former Soviet Union	24. Eastern Europe (EastEur)
52. Turkey	25. Turkey (TUR)
53. Rest of Middle East	26. Rest of Middle East (XME)
54. Morocco	27. Morocco (MAR)
55. Rest of North Africa	28. Rest of North Africa (XNF)
56. Botswana	29. Botswana (BWA)
57. Rest of South African Customs Union	30. Rest of South African Customs Union (XSC)
58. Malawi	31. Malawi (MWI)
59. Mozambique	32. Mozambique (MOZ)
60. Tanzania	33. Tanzania (TZA)
61. Zambia	34. Zambia (ZMB)
62. Zimbabwe	35. Zimbabwe (ZWE)
63. Other Southern Africa	36. Rest of Southern Africa (XSF)
64. Uganda	37. Uganda (UGA)
65. Rest of Sub-Saharan Africa	38. Rest of Sub-Saharan Africa (XSS)
66. Rest of World	39. Rest of World (XRW)

Table A2 Mapping of GTAP 5 database commodities to 43 aggregated commodities

<i>GTAP 5 database commodity</i>	<i>Aggregated commodity and abbreviation</i>
1. Paddy rice	1. Paddy rice (pdr)
2. Wheat	2. Wheat (wht)
3. Cereal grains n.e.c.	3. Cereal grains n.e.c. (gro)
4. Vegetables, fruit, nuts	4. Vegetables, fruit, nuts (v_f)
5. Oil seeds	5. Oil seeds (osd)
6. Sugar cane, sugar beet	6. Sugar cane, sugar beet (c_b)
7. Plant-based fibers	7. Plant-based fibers (pfb)
8. Crops n.e.c.	8. Crops n.e.c. (ocr)
9. Bovine cattle, sheep and goats, horses	9. Bovine cattle, sheep and goats, horses (ctl)
10. Animal products n.e.c.	10. Animal products n.e.c. (oap)
11. Raw milk	11. Raw milk (rmk)
12. Wool, silk-worm cocoons	12. Wool, silk-worm cocoons (wol)
13. Forestry	13. Forestry (for)
14. Fishing	14. Fishing (fsh)
15. Coal	15. Coal (col)
16. Oil	16. Oil (oil)
17. Gas	17. Gas (gas)
18. Minerals n.e.c.	18. Minerals n.e.c. (omn)
19. Bovine cattle, sheep and goat meat prods	19. Bovine cattle, sheep and goat meat (cmt)
20. Meat products n.e.c.	20. Meat products n.e.c. (omt)
21. Vegetable oils and fats	21. Vegetable oils and fats (vol)
22. Dairy products	22. Dairy products (mil)
23. Processed rice	23. Processed rice (pcr)
24. Sugar	24. Sugar (sgr)
25. Food products n.e.c.	25. Food products n.e.c. (ofd)
26. Beverages and tobacco products	26. Beverages and tobacco products (b_t)
27. Textiles	27. Textiles (tex)
28. Wearing apparel	28. Wearing apparel (wap)
29. Leather products	29. Leather products (lea)
30. Wood products	30. Wood products (lum)
31. Paper products, publishing	31. Paper products, publishing (ppp)
32. Petroleum, coal products	32. Petroleum, coal products (p_c)
33. Chemical, rubber, plastic products	33. Chemical, rubber, plastic products (crp)
34. Mineral products n.e.c.	34. Mineral products n.e.c. (nmm)
35. Ferrous metals	35. Ferrous metals (I_s)
36. Metals n.e.c.	36. Metals n.e.c. (nfm)
37. Metal products	37. Metal products (fmp)
38. Motor vehicles and parts	38. Motor vehicles and parts (mvh)
39. Transport equipment n.e.c.	39. Transport equipment n.e.c. (otn)
40. Electronic equipment	40. Electronic equipment (ele)
41. Machinery and equipment n.e.c.	41. Machinery and equipment n.e.c. (ome)
42. Manufactures n.e.c.	42. Manufactures n.e.c. (omf)
43. Electricity	43. Services (ser)
44. Gas manufacture, distribution	43. Services (ser)
45. Water	43. Services (ser)
46. Construction	43. Services (ser)
47. Trade	43. Services (ser)
48. Transport n.e.c.	43. Services (ser)
49. Water transport	43. Services (ser)
50. Air Transport	43. Services (ser)
51. Communication	43. Services (ser)
52. Financial services n.e.c.	43. Services (ser)
53. Insurance	43. Services (ser)
54. Business services n.e.c.	43. Services (ser)
55. Recreational and other services	43. Services (ser)
56. Public Admin., Defense, Education, Health	43. Services (ser)
57. Dwellings	43. Services (ser)

Note: n.e.c.: not elsewhere classified.

Table A3 LDCs included in the post-solution simulation model

<i>GTAP model region code</i>	<i>Post-solution simulation model country code</i>	<i>Description</i>
BGD	BADE	Bangladesh
MWI	MLWI	Malawi
MOZ	MOZA	Mozambique
TZA	TANZ	Tanzania
ZMB	ZMBA	Zambia
UGA	UGAN	Uganda
XCM	HAIT	Haiti
XME	YEMN	Yemen
XRW	AFGH	Afghanistan
XRW	CMBD	Cambodia
XRW	LAOS	Laos People's Democratic Republic
XRW	BURM	Burma
XRW	KIRI	Kiribati (SPARTECA)
XRW	WSAM	Samoa (SPARTECA)
XRW	SOLO	Solomon Islands (SPARTECA)
XRW	TUVA	Tuvalu (SPARTECA)
XRW	VANU	Vanuatu (SPARTECA)
XSA	BHUT	Bhutan
XSA	MLDV	Maldives
XSA	NEPA	Nepal
XSC	LESO	Lesotho
XSF	ANGO	Angola
XSS	BRND	Burundi
XSS	CVER	Cape Verde
XSS	CEAR	Central Africa Republic
XSS	CHAD	Chad
XSS	CMRO	Comoros, Republic
XSS	BENR	Benin
XSS	EGUI	Equatorial Guinea
XSS	ZAIR	Democratic Republic of Congo
XSS	ETHI	Ethiopia
XSS	DJIB	Djibouti
XSS	GAMB	Gambia
XSS	GUIN	Guinea
XSS	LIBE	Liberia
XSS	MASY	Madagascar
XSS	MALI	Mali
XSS	MRTN	Mauritania
XSS	NIGE	Niger
XSS	BGUI	Guinea Bissau
XSS	RWAN	Rwanda
XSS	SAOT	Sao Tome PR
XSS	SENE	Senegal
XSS	SLEO	Sierra Leone
XSS	SOML	Somalia
XSS	SUDA	Sudan
XSS	TOGO	Togo
XSS	BURK	Burkina Faso
XSS	ERIT	Eritrea