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Long-run Effects on China of APEC Trade Liberalisation

by

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General Paper No. G-130 October 1998

ISSN 1 031 9034

ISBN 0 7326 1509 7

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Abstract

Plans for APEC trade liberalisation include the elimination of all tariffs between member states. In this paper we use two computable general equilibrium models to examine the effects of these plans, focussing on China. Our modelling shows that liberalisation increases China's capital stock and real GDP. The implication for Chinese industries depend on the extent to which liberalisation exposes them to additional import competition. Industries strongly stimulated include Textiles and Communications Equipment. Transport Equipment is the most adversely affected. Chinese regional results follow from the industrial compositions of the regions, with Zhejiang the most favourably affected and Jilin the least.

JEL: C68 Computable General Equilibrium Models, F15 Economic Integration

1. Introduction

Increasingly, the perceived importance of regional trade pacts rivals that of the world-wide (GATT/WTO) system of trade regulation. APEC (Asia-Pacific Economic Co-operation Forum) is one of the most important of the regional trade groupings, taking in the US, Japan, Canada, and most of south-east Asia. Plans for trade liberalisation within APEC include the eventual elimination of all tariff barriers between member states. In this paper we model the effects of such a tariff reduction, paying particular attention to the effects within the People's Republic of China (PRC).

Tariff changes take effect through changes in the relative prices of imports and their domestic equivalents. Because some sectors are initially more highly protected than others, the removal of protection tends to affect some sectors more than others. For these reasons, computable general equilibrium (CGE) models are the tools of choice for simulating the effects of tariff changes. Such models have two distinctive features: they incorporate a number of distinct sectors, and the behavioural equations of the model deal with the response of industries and consumers to changes in relative prices.

The simulations reported in this paper make use of two CGE models. The first, GTAP[1], is a multi-country model, which distinguishes 37 commodity types and up to 20 regions of the world. The second, PRCGEM[2], is a single-country model of China, which distinguishes 118 commodity types and 30 regions within China. Compared to GTAP, PRCGEM has a far greater level of sectoral detail as well as a more recent data base. We use GTAP to compute the effect of the APEC trade liberalisation on the Chinese terms of trade; that is, on the import prices and the

[1] The GTAP model is named after its home, the Global Trade Analysis Project based in Purdue University. The model is documented in Hertel (1996).

[2] PRCGEM (PRC General Equilibrium Model) has been created by the Centre of Policy Studies, Monash University, in conjunction with the Institute of Quantitative and Technical Economics of the Chinese Academy of Social Sciences, Beijing. This co-operative project was made possible by a grant from the Australian Department of Foreign Affairs and Trade (East Asia Analytical Unit).

positions of export-demand schedules facing China.[3] PRCGEM is then used to compute the effects of the changed trade conditions on the Chinese economy. The technique by which GTAP informs a single-country model is explained in Adams *et al.* (1997) for the case of GTAP and a CGE model of Australia.

Past CGE analyses of the effects of trade liberalisation in a regional block on China have focussed solely on the effects of shocks to trade-policy instruments in China alone (see for example Lewis, Robinson and Wang, 1995 and Xu, 1996). This paper extends those analyses by including shocks to China's trade conditions (i.e. to China's terms of trade) brought about by liberalisation across other members of the block. As our results show, the terms-of-trade shocks have a mild impact on the Chinese economy, reinforcing the direct effects of the tariff cuts for some variables and offsetting the direct effects for other variables. This paper also extends earlier work by providing a detailed analysis for China of the structural and regional effects of trade liberalisation. Some industries win and others lose. The regional impacts depend on the industrial composition of each region. Generally, we find that the benefits of trade reforms are spread fairly evenly between regions.

The remainder of this paper is laid out as follows. In Section 2 we briefly describe the GTAP model and the simulation that was conducted with it. Section 3 describes the PRCGEM model and simulations. Conclusions are drawn in Section 4.

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[3] In PRCGEM, import prices are usually exogenous (a "small-country" assumption) but export-demand elasticities are assumed to be less than infinite.

2. The GTAP model and simulations

2.1 Overview

GTAP is a multi-region CGE model designed for comparative-static analysis of trade policy issues. Our version distinguishes the 14 regions shown in Table 1, and the 37 sectors shown in Table 2. In addition to a representative producer in each of the 37 sectors, there are three other agents in each region: a capital creator, a household and the government. In each region there is one type of labour and a single, homogenous capital good. Total supplies of labour and land are fixed for each region, but capital is mobile, crossing regional borders to equalise percentage changes in rates of return.

Table 1: Regional aggregation of GTAP used for this paper

Identifier	Region
1. AUS	Australia
2. NZL	New Zealand
3. JPN	Japan
4. KOR	Republic of Korea
5. IDN	Indonesia
6. MYS	Malaysia
7. PHL	Philippines
8. SGP	Singapore
9. THA	Thailand
10. CHN	China
11. HKG	Hong Kong
12. TWN	Taiwan
13. NAM	*North America* (United States, Canada and Mexico)
14. ROW	*Rest of the World* (Europe, India, rest of South Asia, Central America, Caribbean, South America and Africa)

2.2 Theory

The modelling of each regional economy in GTAP is based on ORANI, a single region model of Australia (Dixon, *et al.*, 1982). The basic theoretical assumptions made in GTAP are as follows.

Markets for commodities

Demand equals supply in all commodity markets, and each market is assumed to be competitive, implying equality between the price received by the producer and the producer's marginal cost. Regional governments intervene in their own markets by imposing taxes and subsidies on commodities, thus driving wedges between prices paid by purchasers and prices received by producers.

In markets for traded commodities, buyers differentiate between domestically produced products and imported products in the same commodity category.[4] Product differentiation is also allowed between imports by region of origin. This allows for two-way trade across regions in each tradable product.

Input demands for production of commodities

Two broad categories of inputs to production are recognised: intermediate inputs and primary factors. In every region, each sector is assumed to choose the mix of inputs to minimise total cost for a given level of output. Sectors are constrained in their choice of inputs by a three-level nested production technology. At the first level, intermediate-input bundles and primary-factor bundles are used in fixed proportions. At the second level, intermediate-input bundles are formed as combinations of imported bundles and domestic goods in the same commodity category, and primary-factor bundles are formed as combinations of labour, capital and land. In both cases the aggregator function has a Constant Elasticity of Substitution (CES) form. At the third level, imported bundles are formed as CES combinations of imports of the relevant commodity from the different regions of supply.

Household demands

Each region has a single representative household. Aggregate household expenditure is determined as a constant share of total regional income (household consumption plus government expenditure plus national savings). The household buys bundles of commodities to maximise utility subject to its expenditure constraint.[5] The bundles are CES combinations of domestic goods and import bundles, with the import bundles being CES aggregations of imports from each region.

Demands for inputs to capital creation and the determination of investment

The single cost-minimising capital creator in each region combines inputs to assemble units of capital, subject to a nested production technology similar to that facing each sector for current

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[4] Allowing for the possibility that imported products may not be perfectly substitutable for the corresponding domestic product is an idea used in Armington (1969).

[5] GTAP represents consumer demands using the Constant Difference Elasticity implicit expenditure function.

production. The only difference is that the capital creator does not use primary factors directly. The use of primary factors in capital creation is recognised indirectly through inputs of commodities to capital construction.

Investment in each region is financed from a global pool of savings. Each region contributes a fixed proportion of its income to the savings pool. In standard GTAP, there are two alternative ways that this pool is allocated to investment in each region. The first makes investment in each region a fixed proportion of the overall size of the pool. Thus if the pool increases by 10 per cent, investment in each region increases by 10 per cent. The second relates investment allocations to relative rates of return. Regions that experience increases in their rates of return relative to the global average will receive increased shares of the investment budget, whereas regions experiencing reductions in their rates of return relative to the global average will receive reduced shares

Government demands for commodities

The share of aggregate government expenditure in each region's income is held fixed. Government expenditure is allocated across commodities by a Cobb-Douglas distribution. The allocation of total expenditure on each commodity category to domestically produced and imported supplies is based on the same nesting scheme used to allocate other categories of demand.

2.3 Data base

The GTAP data base comprises: input/output data for each region, bilateral trade data derived from United Nations trade statistics; and support and protection data derived from a number of sources. The simulation reported in this study is based on version 3 of the data base, as described in McDougall (1997), modified to reflect a post-NAFTA pattern of trade and protection.

Table 2: Sectoral aggregation of GTAP used for this paper

Identifier	Sectors	Identifier	Sectors
1. pdr	Paddy Rice	20. lea	Leather, etc.
2. wht	Wheat	21. lum	Lumber
3. gro	Grains	22. ppp	Pulp, Paper, etc.
4. ngc	Non-Grains Crops	23. p_c	Petroleum and Coal
5. wol	Wool	24. crp	Chemicals, Rubbers, Plastics
6. olp	Other Livestock	25. nmm	Non-Metallic Minerals
7. for	Forestry	26. I_s	Primary Ferrous Metals
8. fsh	Fisheries	27. nfm	Non-Ferrous Metals
9. col	Coal	28. fmp	Fabricated Metal Products
10. oil	Oil	29. trn	Transport Industries
11. gas	Gas	30. ome	Machinery and Equipment
12. omn	Other Minerals	31. omf	Other Manufacturing
13. pcr	Processed Rice	32. egw	Electricity, Water and Gas
14. met	Meat Products	33. cns	Construction
15. mil	Milk Products	34. t_t	Trade and Transport
16. ofp	Other Food Products	35. osp	Other Services (Private)
17. b_t	Beverages and Tobacco	36. osg	Other Services (Govt)
18. tex	Textiles	37. dwe	Ownership of Dwellings
19. wap	Wearing Apparels		

The levels of import protection present in the post-NAFTA data base are summarised in Table 3. This table shows, for each commodity, trade-weighted averages of bilateral *ad valorem* tariffs (and tariff equivalents of bilateral non-tariff barriers) levied on imports from the APEC region.[6] Note that GTAP does not have protection data for services. The final column shows, for each commodity, the average *ad valorem* tariff rate across all APEC-regions on imports from APEC countries.

[6] From now on, whenever we use the term "tariff" we mean both tariffs and tariff equivalents of other trade barriers such as import quotas. The rates of protection in Table 3 are averages of bilateral rates in the post-NAFTA GTAP data base.

Table 3: Average tariff rates by commodity and levying country on imports from APEC (*ad valorem*, percentage rates)*

	Destination														
	AUS	NZL	JPN	KOR	IDN	MYS	PHL	SGP	THA	CHN	HKG	TWN	NAM	ROW	APEC
1. pdr	238.1	0.0	15.7	0.0	0.0	0.0	0.0	0.0	0.0	1.6	66.7	0.0	27.6	151.4	25.7
2. wht	2.8	0.0	0.1	20.0	54.0	24.4	8.3	65.3	42.1	13.4	0.0	0.0	1.6	62.3	11.9
3. gro	0.0	0.0	336.0	327.0	6.3	326.9	326.9	27.0	325.8	10.1	0.0	325.6	0.0	13.5	246.6
4. ngc	2.7	2.0	42.0	51.7	54.7	51.7	51.7	14.5	51.8	-9.0	0.0	72.9	3.1	40.7	20.6
5. wol	0.0	0.0	0.0	10.0	5.0	2.0	20.1	27.1	30.0	15.0	0.0	0.5	7.7	3.6	7.0
6. olp	0.0	0.0	1.1	117.7	5.6	118.0	117.9	27.0	117.8	-32.7	0.0	5.6	0.1	7.3	22.0
7. for	0.0	0.0	0.0	3.3	14.9	19.1	10.0	0.0	10.0	7.5	0.0	0.5	0.0	6.9	1.3
8. fsh	0.0	0.7	5.1	20.0	29.2	3.5	12.4	1.1	50.5	27.2	0.0	29.1	0.1	8.2	6.2
9. col	0.0	0.0	0.0	1.1	5.0	4.5	16.6	0.0	24.9	14.9	0.0	0.7	0.0	5.8	0.5
10. oil	0.0	0.0	3.3	5.0	0.0	0.0	10.0	0.0	25.0	2.0	0.0	9.3	0.1	6.0	2.2
11. gas	4.7	0.0	0.9	5.0	5.0	5.0	20.0	0.0	0.0	33.4	0.0	5.4	0.0	3.6	1.2
12. omn	0.1	0.5	0.0	3.0	2.2	3.4	10.7	0.0	11.7	1.5	0.0	0.7	0.6	2.6	1.0
13. pcr	1.0	0.2	36.5	78.0	0.0	78.0	77.7	27.0	78.9	-35.1	0.0	81.1	3.8	12.5	9.6
14. met	2.5	0.8	308.0	114.0	14.5	272.0	271.6	24.0	272.0	-32.7	0.0	27.7	4.2	48.8	143.8
15. mil	1.9	8.7	207.0	111.0	17.2	111.0	111.0	27.0	111.0	27.6	0.0	72.1	10.0	42.1	71.4
16. ofp	2.5	2.3	14.2	18.1	12.3	6.5	21.1	22.3	53.4	30.0	0.0	16.3	1.3	15.0	9.3
17. b_t	6.4	2.6	8.1	92.9	23.8	37.5	46.3	22.0	60.0	129.6	0.0	35.0	0.9	41.7	18.2
18, tex	28.8	5.1	6.0	19.3	32.6	24.0	38.3	0.1	62.0	65.4	0.0	6.8	6.2	29.9	24.2
19. wap	57.6	23.3	12.3	27.1	43.0	28.4	49.4	4.6	73.1	80.8	0.0	12.6	16.6	18.9	16.6
20. lea	21.5	21.9	14.9	20.2	5.6	26.0	32.3	0.8	43.0	36.3	0.0	2.4	8.1	11.0	11.6
21. lum	7.6	7.3	3.0	16.4	33.4	33.4	30.8	0.8	26.5	23.9	0.0	4.1	1.0	8.3	3.7
22. ppp	6.3	4.4	0.7	8.1	7.3	6.1	30.7	0.0	23.6	23.5	0.0	3.8	0.3	7.2	3.5
23. p_c	0.3	0.1	2.4	8.5	4.8	4.2	20.5	6.7	29.7	12.3	0.0	8.7	0.1	18.9	6.3
24. crp	9.6	3.7	3.9	17.3	6.7	9.1	19.3	2.1	36.0	25.9	0.0	3.9	5.6	19.3	9.3
25. nmm	13.9	4.9	2.3	21.2	15.0	19.0	32.2	0.0	37.3	34.9	0.0	6.5	3.6	16.0	7.8
26. I_s	9.2	4.7	3.4	11.7	8.1	6.6	15.1	0.0	18.7	13.4	0.0	8.2	2.6	15.5	6.8
27. nfm	3.4	1.2	1.2	15.3	9.9	5.5	17.9	0.0	17.7	18.1	0.0	2.8	0.5	7.6	4.1
28. fmp	17.2	8.4	3.2	20.6	23.2	13.7	31.6	0.0	32.9	42.4	0.0	9.6	2.8	14.7	7.5
29. trn	20.3	10.2	3.1	7.7	13.7	14.2	20.6	3.1	56.1	59.0	0.0	15.2	2.0	14.2	6.6
30. ome	10.6	6.4	0.9	17.7	14.2	9.1	21.8	0.0	35.6	27.8	0.0	5.4	11.1	13.6	11.1
31. omf	11.8	11.6	3.0	18.2	30.5	14.3	35.8	0.1	46.7	67.2	0.0	5.3	5.3	11.8	9.4
32. egw	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.8
33. cns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34. t_t	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35. osp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36. osg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37. dwe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All	11.1	5.1	17.6	20.6	14.4	14.4	24.6	2.0	35.9	33.1	0.0	10.9	5.8	12.6	11.2

Source: Post-NAFTA GTAP data base.

* The negative numbers in the column headed CHN point to the existence of import subsidies.

The outstanding feature in Table 3 is the very high tariffs levied on agricultural products (primary and manufactured) in East Asia. For example, tariffs in Japan on grains (3), meat products (14) and milk products (15) are above 200 per cent. In South Korea, the average tariff on grains (3) is 327 per cent, while tariffs of above 100 per cent are levied on other livestock (6), and on meat and milk products. The average tariff on APEC-produced grains in all APEC countries (column labelled APEC) is 247 per cent, while that on APEC-produced meat products is 144 per cent.

In countries outside of East Asia, average tariffs on manufactured non-food commodities are generally higher than those on agricultural products (primary and manufactured). The highest tariff in China, for example, is on beverages and tobacco (row 17), while Australia, New Zealand,

Thailand, Philippines and Indonesia impose relatively high rates of protection across a broad range of manufactured products.

Chinese merchandise trade patterns prior to the implementation of APEC are summarised in Tables 4 and 5. Table 4 shows exports (fob prices) by commodity and destination. Table 5 shows imports (c.i.f. prices) by commodity and source. The numbers in the body of each table are percentage shares, summing to 100 across the regions identified at the head of the table. Values of total exports (Table 4) and of total imports (Table 5) in 1992 US dollars are given in the final columns. Both tables have as their primary source the post-NAFTA GTAP database for 1992.

Two things stand out in Tables 4 and 5. The first is that North America, Japan and the ROW are the major trading partners of China. Other APEC countries are important trading partners in only a few commodities. For example, South Korea is an important destination for exports of grain (row 3), coal (9), non-metallic minerals (25) and primary ferrous metals (26), while Taiwan is an important source for imports of textiles (row 18), leather (20), paper products (22), chemicals, rubbers and plastics (24), fabricated metal products (28), and machinery and equipment (30). The second point is that trade with China occurs primarily in manufactured goods (see the final columns of both tables). More than half of all imports to China and exports from China are made up of textiles (row 18), wearing apparels (19), chemicals, etc. (24), and machinery and equipment (30).

Table 4: Chinese exports (fob prices) (percentage shares of destination-region in exports by commodity)*

	Destination														Total
	AUS	NZL	JPN	KOR	IDN	MYS	PHL	SGP	THA	CHN	HKG	TWN	NAM	ROW	($m)
1. pdr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	1
2. wht	0.0	0.0	0.0	13.4	0.0	2.1	0.0	0.0	68.9	0.0	14.4	0.0	0.0	1.2	2
3. gro	0.0	0.0	23.8	39.1	0.3	12.3	0.0	1.3	3.4	0.0	0.3	0.0	0.0	19.3	1274
4. ngc	0.5	0.2	24.3	4.5	4.7	2.7	0.5	5.8	1.5	0.0	13.9	2.8	3.5	35.0	2694
5. wol	0.0	0.0	1.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.3	94.8	11
6. olp	0.1	0.1	15.1	5.9	0.1	0.1	0.0	0.6	2.1	0.0	34.9	1.9	4.8	34.1	1448
7. for	0.0	0.0	85.4	2.9	0.0	0.0	0.0	0.1	0.0	0.0	3.4	5.4	0.7	2.0	62
8. fsh	0.2	0.0	49.4	2.3	0.0	0.0	0.0	0.3	0.1	0.0	13.1	3.1	25.7	5.6	1328
9. col	0.0	0.0	30.0	18.2	0.8	0.9	0.5	0.1	0.7	0.0	7.7	9.5	0.0	31.5	849
10. oil	0.0	0.0	60.1	6.7	0.0	0.0	0.4	8.8	0.0	0.0	0.0	0.0	17.4	6.6	2831
11. gas	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.7	0.0	21.1	42.3	0.0	22.0	6
12. omn	0.8	0.3	27.6	5.5	0.8	1.6	0.3	1.4	2.7	0.0	11.3	2.0	12.7	33.1	786
13. pcr	0.0	0.0	0.3	0.0	3.9	0.0	0.0	0.2	0.0	0.0	7.7	0.0	4.7	83.1	227
14. met	0.0	0.0	27.8	1.1	0.1	1.7	0.1	6.9	0.7	0.0	23.1	0.7	0.2	37.4	585
15. mil	0.0	0.0	0.3	0.1	0.5	0.0	0.0	0.6	0.1	0.0	56.5	0.2	0.5	41.2	21
16. ofp	0.7	0.1	28.7	4.4	0.5	1.1	0.7	2.6	2.3	0.0	12.7	0.8	5.0	40.4	3095
17. b_t	0.1	0.0	8.5	1.3	2.0	0.4	2.1	15.2	0.8	0.0	22.1	12.3	4.3	30.9	749
18, tex	1.8	0.3	11.8	5.7	0.6	0.9	1.1	3.5	1.2	0.0	28.1	1.2	10.8	33.0	7639
19. wap	2.3	0.3	22.6	0.6	0.0	0.1	0.1	0.7	0.0	0.0	11.6	0.5	21.9	39.2	16420
20. lea	1.7	0.2	8.1	1.0	0.1	0.1	0.1	0.8	0.3	0.0	6.8	1.1	47.7	32.1	9534
21. lum	1.4	0.2	22.7	1.8	0.1	0.2	0.1	1.3	0.2	0.0	19.1	2.8	27.5	22.7	1392
22. ppp	1.8	0.2	5.9	0.8	0.6	2.2	0.6	7.2	1.3	0.0	46.5	1.5	7.1	24.3	481
23. p_c	0.9	0.2	13.1	7.8	1.0	0.4	2.4	37.2	4.9	0.0	12.5	0.7	5.9	13.0	1028
24. crp	1.4	0.3	12.2	3.9	1.7	1.3	0.8	2.7	2.3	0.0	17.9	2.3	15.7	37.6	5702
25. nmm	3.0	0.1	11.4	10.8	0.7	0.8	0.9	2.1	0.8	0.0	19.1	2.3	16.4	31.5	1565
26. I_s	0.8	0.0	21.0	13.0	3.0	2.4	0.4	4.0	14.2	0.0	8.5	5.7	6.5	20.6	1376
27. nfm	0.3	0.1	14.7	5.6	0.7	0.9	0.2	11.0	1.4	0.0	27.6	5.6	10.1	21.6	718
28. fmp	1.6	0.2	6.1	0.9	1.7	1.3	1.1	3.8	1.1	0.0	12.3	1.5	21.9	46.3	2193
29. trn	0.3	0.1	2.9	0.5	0.5	1.1	0.2	3.4	3.3	0.0	18.1	0.4	25.0	44.2	1820
30. ome	1.1	0.1	6.2	1.7	1.2	1.2	0.7	2.7	1.3	0.0	35.5	3.2	17.4	27.9	13756
31. omf	1.5	0.2	9.1	1.1	0.4	0.5	0.5	2.1	0.4	0.0	1.4	1.2	42.8	38.7	7957
32. egw	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
33. cns	2.4	1.1	0.0	0.1	2.9	2.9	3.1	0.0	2.9	0.0	32.0	0.0	17.4	35.3	1
34. t_t	2.5	1.2	4.7	2.8	3.8	3.1	3.8	0.4	3.8	0.0	2.4	2.3	5.7	63.5	14
35. osp	0.6	0.2	10.4	1.3	0.1	0.1	0.0	1.6	0.1	0.0	1.9	0.8	19.4	63.5	13042
36. osg	5.2	3.0	1.3	10.7	0.4	1.3	0.0	1.5	0.1	0.0	2.7	1.7	2.7	69.5	39
37. dwe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
All	1.3	0.2	15.3	3.1	0.7	0.8	0.4	2.8	1.1	0.0	14.6	1.7	21.2	36.9	100646

Source: Post-NAFTA GTAP data base.

* The numbers in the main body of the table are shares which sum to 100 across the rows. The numbers in the final column are levels expressed in $US million, 1992 fob prices.

2.4 Setting up the GTAP simulation

The GTAP simulation involved complete removal of all import tariffs on APEC-sourced imports in each APEC country other than China[7]. Import protection between the Rest of the World and APEC is maintained.

Our modelling strategy, in which we use the GTAP results to drive the PRCGEM model, requires us to summarise the changes in China's trading environment as movements in the import supply and export demand schedules confronting China. This is done by turning off in GTAP the Chinese response to the APEC trade liberalisation and determining the percentage deviations in the foreign-currency prices of imports (c.i.f.) at the pre-APEC levels of Chinese imports, and in Chinese export volumes at the existing levels of foreign-currency prices (fob) of Chinese exports. To turn off the Chinese response we must also fix Chinese investment and savings. This is because in GTAP each region interacts with each other region not only via trade in goods and services, but also via contributions to global savings and calls on global savings for investment funds.

The deviations in Chinese import prices and export volumes are computed under the following assumptions about factor markets and macro behaviour in regions other than China:

- capital is mobile, moving across regions to equalise percentage changes in rates of return in the solution year;
- changes in the global rate of return ensure that the global stock of capital is unaffected by the tariff shocks;
- percentage changes in expected rates of return (i.e. rates of return expected in the post-solution year) are equalised at a rate which ensures that the weighted sum of percentage changes in each region's investment (i.e. in global investment) matches the percentage change in global savings; and
- aggregate employment of labour and of land is fixed in each region. [8]

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[7] The effects on China of removing China's trade barriers against the rest of APEC are accounted for in the PRCGEM simulation.

[8] GTAP allows other assumptions about factor markets and macro behaviour to those used here. Each set of assumptions describe a closure of the model. The standard GTAP closure is a short-run closure in which each region's endowments of capital, labour and land are held fixed.

Table 5: Chinese imports (c.i.f. prices)
(percentage shares of region of source in imports by commodity)*

	Source														Total
	AUS	NZL	JPN	KOR	IDN	MYS	PHL	SGP	THA	CHN	HKG	TWN	NAM	ROW	($m)
1. pdr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	0.0	0.0	86.2	0.0	1.5	0
2. wht	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.2	11.8	1368
3. gro	42.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	34.6	20.4	121
4. ngc	1.7	0.2	1.7	1.8	4.0	7.8	0.8	2.4	14.2	0.0	0.4	2.5	35.9	26.6	1250
5. wol	62.8	28.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	2.3	0.1	6.4	606
6. olp	13.4	4.4	2.0	1.3	4.1	0.4	0.8	1.6	1.3	0.0	1.2	1.5	26.0	41.8	278
7. for	0.3	9.8	0.1	0.0	2.7	36.1	0.0	0.1	1.1	0.0	0.3	0.2	30.9	18.3	563
8. fsh	3.0	2.1	9.1	0.3	1.7	0.7	1.1	4.4	8.7	0.0	0.3	2.8	12.6	53.2	384
9. col	33.0	18.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.7	43.6	45
10. oil	5.8	0.0	0.5	0.0	42.8	4.6	0.0	0.2	0.0	0.0	0.0	0.0	1.0	44.9	1682
11. gas	0.0	0.3	12.3	8.3	5.5	0.5	36.9	26.0	5.7	0.0	0.0	1.6	1.6	1.4	87
12. omn	35.8	0.0	0.6	0.6	1.9	0.8	1.4	0.1	0.3	0.0	0.1	0.6	4.6	53.1	1375
13. pcr	6.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	90.1	0.0	0.0	0.0	0.3	3.1	51
14. met	5.3	3.4	3.7	0.2	0.1	0.4	0.0	0.2	3.2	0.0	0.9	0.4	47.3	35.0	154
15. mil	12.2	8.7	1.3	0.1	0.9	3.9	0.0	3.8	1.9	0.0	2.9	1.6	8.7	53.9	119
16. ofp	5.0	1.0	5.2	1.4	2.1	12.1	1.0	4.5	2.4	0.0	4.0	2.3	7.0	52.0	1693
17. b_t	0.2	0.0	3.7	0.8	0.1	0.2	0.2	5.0	1.4	0.0	15.5	1.1	19.6	52.2	603
18, tex	1.3	0.1	19.7	17.5	1.2	0.7	0.1	0.3	1.1	0.0	9.5	30.5	4.9	13.1	11543
19. wap	0.3	0.0	13.2	2.3	0.3	0.3	0.4	0.4	1.0	0.0	54.9	4.4	1.7	20.9	807
20. lea	1.0	0.5	5.1	15.7	0.3	0.2	0.1	0.5	1.9	0.0	6.0	35.6	6.9	26.2	2127
21. lum	0.4	0.3	3.5	1.0	55.3	15.5	0.3	2.7	0.8	0.0	2.5	4.8	5.3	7.6	1354
22. ppp	1.2	0.9	15.8	6.0	2.5	0.6	0.1	1.1	0.5	0.0	16.8	12.4	24.5	17.7	2741
23. p_c	0.5	0.0	8.4	4.1	0.5	0.0	0.3	55.5	0.1	0.0	0.1	0.6	19.2	10.5	1633
24. crp	1.4	0.1	14.9	6.6	0.5	0.7	0.4	3.6	0.7	0.0	7.3	11.4	18.4	34.0	14768
25. nmm	0.9	0.1	38.2	2.7	0.5	0.4	0.6	1.1	0.7	0.0	5.6	9.3	9.6	30.2	584
26. I_s	0.5	0.1	43.5	14.0	0.2	0.2	0.2	0.4	0.2	0.0	1.0	2.9	4.4	32.3	5651
27. nfm	6.7	0.1	13.3	4.1	0.9	0.6	1.5	1.5	0.4	0.0	4.8	8.8	10.6	46.6	2603
28. fmp	1.4	0.2	14.9	4.0	0.3	0.7	0.2	2.4	0.4	0.0	22.2	17.6	14.3	21.4	1405
29. trn	0.6	0.0	28.2	0.2	0.1	0.0	0.0	0.5	0.1	0.0	0.0	2.5	22.8	44.9	7604
30. ome	0.3	0.0	30.9	2.6	0.0	1.1	0.2	2.8	0.6	0.0	10.5	11.5	12.9	26.5	31504
31. omf	0.2	0.1	37.6	4.2	0.2	0.4	0.1	2.6	0.4	0.0	33.1	9.2	5.6	6.4	2299
32. egw	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	283
33. cns	0.9	0.9	0.0	2.2	2.9	2.9	2.0	0.1	2.9	0.0	63.3	0.0	0.1	21.8	1
34. t_t	3.2	2.5	7.1	4.1	2.7	2.8	2.8	4.7	2.8	0.0	3.3	5.7	18.1	40.2	13
35. osp	0.5	0.3	4.7	0.9	0.0	0.0	0.1	2.1	0.1	0.0	5.3	0.6	18.0	67.4	5619
36. osg	1.8	0.3	0.1	1.7	0.0	0.0	0.0	0.9	0.0	0.0	1.9	0.3	7.7	85.1	28
37. dwe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
All	2.1	0.4	21.1	5.5	1.9	1.4	0.3	2.9	0.9	0.0	8.3	11.0	14.1	30.2	102947

Source: Post-NAFTA GTAP data base.

* The numbers in the main body of the table are shares which sum to 100 across the rows. The numbers in the final column are levels expressed in $US million, 1992 c.i.f. prices.

Because capital is mobile across each region, we describe our simulation as long-run (even though capital world-wide is held fixed), with all results expressed in terms of percentage changes from control in a year sufficiently far into the future to allow capital to be installed, and to allow old capital to depreciate in response to APEC-trade liberalisation.

2.5 Results of the GTAP simulation

Table 6 reports the effects of the APEC shocks on selected macroeconomic variables in regions other than China. Table 8 gives percentage deviations in prices (c.i.f.) for Chinese imports,

and in volumes of Chinese exports. Table 7 reports some data and intermediate calculations used to explain the main results. In the remainder of this section we give an overview of the projections in Table 6. A more detailed explanation is given in section 2.6. The China-specific results in Table 8 are discussed in section 2.7.

Overview of macro results

As shown in columns (6) and (7) of Table 6, the real-GDP gains from trade liberalisation tend to favour regions which are small and open.[9] Good examples are Thailand (row 9), where real GDP is projected to increase by nearly 40 per cent relative to base, Malaysia (6), the Philippines(7), and Singapore (8). Apart from being small and open, these regions also have high pre-APEC levels of protection, including against imports of investment goods. As explained below, removing protection on imports of investment goods increases GDP by stimulating capital formation. The regions that gain least in terms of real GDP are the ROW (row 14), which does not cut protection, and the large APEC regions, North America (13) and Japan (3).

Projections for the terms of trade are given in column (4) of Table 6. Here, the regional pattern favours Japan (row 2), the agricultural exporting regions (Australia (1) and New Zealand (2)), Singapore (8) and Hong Kong (11). Japan's terms of trade improve, in part, because of strong increases in North American demand for Japanese products. The terms-of-trade increases in Australia and New Zealand flow from the existence, before liberalisation, of large barriers to trade in agricultural and food commodities from these countries. The increases in Singapore and Hong Kong stem mainly from strong increases in demand from other APEC regions for other machinery and equipment (commodity 30). The regions which experience terms-of-trade decline do so mainly because they are agricultural importing regions, or because the ROW (where real activity falls because of liberalisation) is over represented as a destination for their exports.

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[9] There are two concepts of GDP in the GTAP model. Changes in real GDP at market prices are share-weighted sums of changes in the quantities of labour, capital and land, and of changes in real indirect taxes (net of subsidies). Changes in real GDP at factor cost exclude changes in indirect taxes (net of subsidies). We report results for both concepts.

Columns (8) and (9) of Table 6 show the trade-enhancing effects in each APEC-region of tariff reductions. All APEC regions are projected to experience increases in trade volumes, with the greatest increases occurring in regions with the highest initial levels of protection.

2.6 Macro effects in detail

We begin with projections for real factor prices, changes in which explain changes in capital/labour ratios. With employment fixed, an increase (decrease) in a region's capital/labour ratio implies an increase (decrease) in its real GDP. We then look at projections for the terms of trade and for trade volumes.

Real capital rentals

Projected changes in nominal capital rentals in each region are shown in column (1) of Table 6. A measure of changes in real capital rentals can be deduced by comparing the numbers in column (1) with the numbers in column (3) which show projected changes in the price of GDP (factor cost). In all regions other than Japan (row 3) and the ROW (14), rentals fall relative to the GDP deflator. The largest falls occur in the Philippines (11.6 per cent), Thailand (8.6 per cent), Singapore (7.1 per cent) and Malaysia (7.0 per cent).

To understand these projections, first note that the nominal rental is the numerator in the calculation of a region's rate of return, the denominator being the region-specific investment price index. In the GTAP simulation, rates of return across regions move together to prevent any change in global capital. Because the percentage change in the global rate of return turns out to be quite small (less than 1 per cent), rentals in each region are more or less indexed to the costs of creating capital.

Table 6: Effects of APEC trade liberalisation on macro variables in regions other than China

Region	(1) capital rental	(2) labour wage	(3) GDP deflator	(4) terms of trade	(5) aggregate capital stock	(6) real GDP (factor cost)	(7) real GDP (market prices)	(8) export volumes	(9) import volumes
1. AUS	-1.1	3.0	1.9	1.8	4.3	1.7	2.0	14.8	16.9
2. NZL	0.1	5.1	3.9	4.3	5.7	2.1	2.5	5.4	10.4
3. JPN	6.1	6.7	6.3	6.6	0.8	0.3	0.8	10.8	23.5
4. KOR	1.5	12.8	6.6	-1.9	13.0	5.7	7.9	27.3	31.2
5. IDN	-0.8	7.9	2.5	-0.7	11.1	6.4	7.2	19.8	22.7
6. MYS	-3.2	17.5	3.8	-4.0	26.9	16.9	19.9	28.4	29.4
7. PHL	-3.9	22.0	7.8	-4.3	28.0	13.5	17.2	54.4	46.0
8. SGP	1.1	14.6	8.2	2.5	19.3	8.6	9.0	11.0	14.9
9. THA	-10.6	23.6	-2.4	-6.9	54.2	35.2	38.4	63.7	56.3
10. CHN	na.	na.	na.	na.	na.	na.	na.	na.	na.
11. HKG	3.5	7.7	5.5	3.7	4.3	2.2	3.0	4.0	7.7
12. TWN	1.7	7.7	5.1	0.2	7.4	3.0	3.9	13.5	17.1
13. NAM	-2.4	-1.7	-1.9	-1.4	0.9	0.4	0.4	12.9	10.7
14. ROW	-0.8	-2.9	-2.0	-0.4	-2.4	-1.1	-1.1	-1.3	-2.3

There are two main mechanisms via which tariff cuts can reduce real capital costs (i.e. nominal capital costs relative to the GDP deflator) in a region. The first is via the direct effects of the tariff cuts on the duty-paid prices of imported inputs to investment. The second is via a terms-of-trade improvement which reduces the average c.i.f.-price of imported capital goods relative to the GDP deflator.[10]

The direct-tariff effect is strongest in regions where investment is intensive in imports which are subject, initially, to high tariffs. Column (1) of Table 7 shows the initial import intensity of capital creation in each region, and Table 3 (especially rows 25 to 31) shows the initial degree of tariff protection afforded capital imports. These data suggest that the tariff effect will be strongest in Thailand, where tariff rates on capital inputs are about twice those of any other region, and in Malaysia and the Philippines. However, it will have negligible effects in Japan (where imports account for a very small proportion of capital costs) and in the ROW (where tariffs are unchanged).

[10] A fall in the average c.i.f. price of imported capital goods relative to the price of output will, in most cases, be associated with a terms-of-trade improvement. A terms-of-trade improvement reduces the price of total domestic expenditure (which includes imports but not exports) relative to the price of output (which includes exports but not imports). However, since imports of capital goods are only a part of total imports, not all terms-of-trade improvements will lead to a fall in the price of imported capital goods relative to the GDP deflator.

In other regions, such as Australia (row 1), New Zealand (2) and North America (13), the change in real rentals reflects a more balanced combination of the two effects. In Australia and New Zealand the second effect reinforces the direct-tariff effect. By contrast, in North America the second effect is almost as large as the direct-tariff effect, but works in an opposite direction to produce little change in the real rental.

Real wage rates

Deducting column (3) from column (2) in Table 6 gives projections of changes in real wages. In all regions other than the ROW (row 14) real wages rise. The largest rises occur in Thailand (25.6) per cent), the Philippines (14.2 per cent) and Malaysia (13.6 per cent).

In CGE models like GTAP and PRCGEM there is a strong relationship between the real wage and real rental described by *Factor Price Frontier (FPF)*[11]. The *FPF* is a relationship between marginal products, showing the most efficient marginal product of one factor for any given level of the other. For region r, it can be expressed as:

$$(1) \qquad mp_L(r) = \left[-\frac{P_K(r)K(r)}{P_L(r)L(r)} \right] mp_K(r),$$

where $mp_L(r)$ and $mp_K(r)$ are percentage changes in the marginal products of labour and capital in region r, $P_K(r)K(r)$ is the capital component of nominal GDP, and $P_L(r)L(r)$ is the labour component. Equation (1) says that the elasticity of the marginal product of labour (capital) with respect to the marginal product of capital (labour) is minus the ratio of the capital (labour) component to the labour (capital) component. Under perfect competition, we can substitute in equation (1) the percentage changes in real factor payments for the percentage changes in marginal products to give:

$$(2) \qquad (p_L(r) - p_{GDP}(r)) = \left[-\frac{P_K(r)K(r)}{P_L(r)L(r)} \right] (p_K(r) - p_{GDP}(r)),$$

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[11] The *FPF* relates to constant-returns-to-scale, two-factor models. In GTAP there is a third factor, land. However, for most purposes it can be ignored due to its small share in each region's total value added.

where $p_L(r)$, $p_K(r)$ and $p_{GDP}(r)$ are percentage changes in the prices of labour, capital and output.

Initial values for the ratios of factor payments are given in column (2) of Table 7. These show that the responsiveness of real wages to a 1 per cent change in real rental will be greatest in the developing regions such as Thailand (row 9), Malaysia (6) and Indonesia (row 5). In these regions wages are low, and hence the ratios of capital payments to labour payments are high. In developed regions, the situation is reversed: comparatively high wages mean that the ratios are low.

Equation (2) and the data in Table 7 do not explain exactly our real-wage projections. This is due to two main complications: changes in real land rentals; and changes in elasticity values as the economies adjust to the cuts in tariffs. The effect of changes in real land rentals is especially important for agriculturally oriented regions like Australia and New Zealand. In these two countries, real land rentals are projected to rise by over 40 per cent. This means, given land's GDP-share in each country of about 2 per cent, that (2) will over-estimate the real wage change by nearly 1 percentage point.

Table 7: Initial data and the decomposition of terms-of-trade changes

Region	(1) *Share (%) of imports in cost of capital creation*	(2) *Ratio of absolute factor payments (K/L)*	(3) Average capital/ labour substitution elasticity	(4) Share (%) of capital in GDP	(5) world price effect	(6) export price effect	(7) import price effect	(8) =(5)+(6)-(7)
1. AUS	18.5	0.68	1.0	38.9	-0.2	2.3	0.3	1.8
2. NZL	25.5	0.67	1.1	38.4	-0.3	4.7	0.2	4.3
3. JPN	2.3	0.68	1.3	40.3	0.5	5.5	-0.6	6.6
4. KOR	14.1	0.94	1.1	45.0	-0.4	-0.7	0.8	-1.9
5. IDN	19.7	1.83	1.3	59.1	-0.6	0.2	0.4	-0.7
6. MYS	29.0	2.16	1.3	64.9	-0.3	-2.9	0.9	-4.0
7. PHL	35.9	1.23	1.1	51.3	-0.2	-3.7	0.5	-4.3
8. SGP	44.3	0.87	1.3	46.2	0.1	1.8	-0.6	2.5
9. THA	41.8	2.99	1.3	70.8	-0.3	-6.0	0.7	-6.9
10. CHN	17.4	0.67	1.2	36.4	na.	na.	na.	na.
11. HKG	25.0	1.09	1.1	52.2	0.0	4.4	0.7	3.7
12. TWN	25.4	0.70	1.2	40.5	-0.2	1.5	1.1	0.2
13. NAM	14.3	0.60	1.2	37.5	0.1	-1.7	-0.1	-1.4
14. ROW	11.9	0.80	1.1	43.9	0.0	-1.0	-0.6	-0.4

Source: (columns (1) to (4)) Post-NAFTA GTAP database for 1992.

Capital and real GDP

The CES specification for primary-factor demands in GTAP implies that:

$$p_K(r) - p_L(r) = (\lambda(r) - k(r)) / \sigma(r), \tag{3}$$

where $\lambda(r)$ and $k(r)$ are percentage changes in labour and capital, and $\sigma(r)$ is the average capital-labour substitution elasticity. In (3) the LHS is the percentage change in region r's ratio of capital rental to wage rate, while the RHS is the reciprocal of $\sigma(r)$ times the percentage change in region r's labour-capital ratio. In our simulations $\lambda(r) = 0$. Thus (3) reduces (after re-arrangement) to:

$$k(r) = \sigma(r)(p_L(r) - p_K(r)). \tag{4}$$

Initial values for $\sigma(r)$ are given in column (3) of Table 7. These were calculated as share-weighted sums of industry-specific elasticities taken directly from the GTAP database, with the shares being industry shares in total value added. By using these values, and setting $((p_L(r) - p_K(r))$ according to the values given in columns (1) and (2) of Table 6, we obtain changes in capital which agree closely with the projections in column (5). The approximation is due, once again, to movements away from the initial average elasticities as the economies adjust to the tariff cuts.

Having explained the changes in capital stocks via (4) we have also explained the changes in real GDP at factor cost, since

(5) $$gdp = S_L\lambda + S_K k + S_N n\,,$$

where: gdp is the percentage change in real factor-cost GDP; l, k and n are percentage changes in labour, capital and land; and the Ss are the respective shares in factor-cost GDP. For our long-run simulations we assume $l = n = 0$, thus (5) becomes

(6) $$gdp = S_K k\,.$$

Initial values for S_K are given in column (4) of Table 7.

In column (7) of Table 6 we report changes in real GDP at market prices. Changes in real GDP (market prices) are related to changes in real GDP (factor cost) by the addition of real indirect taxes net of subsidies. Thus comparing the numbers in column (7) with those in column (6) shows the contribution of real indirect taxes net of subsidies to the change in real GDP (market prices).

Terms of trade

To understand the terms-of-trade results in column (4) of Table 6 we adopt the approach suggested in McDougall (1993), and decompose the change in terms of trade in each region into three parts: the world price effect, the export price effect and the import price effect. The decomposition begins with an expression for the percentage change in region r's terms of trade:

(7) $$tot(r) = px(\bullet,r) - pm(\bullet,r),$$

where $px(\bullet,r)$ is the percentage change in the average price (fob) received for exports and $pm(\bullet,r)$ is the percentage change in the average price (c.i.f.) paid for imports. The two variables on the RHS of (7) are defined by:

(8) $$px(\bullet,r) = \sum_{i=1}^{37} SX(i,r)\,px(i,r)\,,$$

(9) $$pm(\bullet,r) = \sum_{i=1}^{37} SM(i,r)\,pm(i,r)\,,$$

where $SX(i,r)$ and $SM(i,r)$ are the shares of commodity i in region r's aggregate export receipts and import bill, and $px(i,r)$ and $pm(i,r)$ are percentage changes in the export (fob) and import (c.i.f.) prices of i in r. Substituting (9) and (8) into (7) and then manipulating yields:

$$(10) \qquad tot(r) = \sum_i \left\{ SX(i,r)(pw_{fob}(i) - pw) - SM(i,r)(pw_{cif}(i) - pw) \right\}$$

$$+ \sum_i SX(i,r)(px(i,r) - pw_{fob}(i))$$

$$- \sum_i SM(i,r)(pm(i,r) - pw_{cif}(i)),$$

where: pw is an index of average world prices, $pw_{fob}(i)$ is the average world fob price of i; and $pw_{cif}(i)$ is the average c.i.f. price of i. If $pw_{fob}(i) = pw_{cif}(i) = pw(i)$ for all i[12], then we obtain McDougall's decomposition:

$$(11) \qquad tot(r) = \sum_i (SX(i,r) - SM(i,r))(pw(i) - pw) \text{ (World price effect)}$$

$$+ \sum_i SX(i,r)(px(i,r) - pw(i)) \text{ (Export price effect)}$$

$$- \sum_i SM(i,r)(pm(i,r) - pw(i)) \text{ (Import price effect).}$$

The *world price effect* is the sum over all traded commodities of the product of region r's net trade share for commodity i and the change in world price of i relative to an average of world prices (pw). Thus, if on average region r is a net exporter of commodities for which trade-liberalisation means higher world prices, then the world price effect for r will be positive.

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[12] This assumes that the cost of transport, which is the difference between the fob and c.i.f. price of i, is a negligible share of the c.i.f. price. For some commodities this is not the case, thus the equation which follows is only an approximation.

The *export price effect* is an export-share weighted sum of changes in the ratio of region r's export price for commodity i to the average world price of i. The *import price effect* is an import-share weighted sum of changes in the ratio of the region-specific import price for i to the average world price. Both effects arise because of the assumption of imperfect substitutability between imports of the same good from different sources. Hence, they depend crucially on values assigned for the "Armington" elasticities of substitution between supplies of commodities from different regional sources.[13] If there was perfect substitution, then both effects would be zero.

The results of the decomposition for each region's terms of trade are shown in columns (5) to (8) of Table 7. In most cases the export-price effect dominates.

In this simulation, among the many factors determining the relative size of $SX(i,r)\,(px(i,r)-pw(i))$ across i and r, the most important appear to be: (a) the initial bilateral-structure of tariff rates; (b) the degree to which the ROW competes with region r on markets for commodity i; and (c) the extent to which the ROW is a destination for i from r. Take for example, r = JPN (Japan) and i = OME (machinery and equipment). According to the initial database, $SX(OME,JPN)$ = 0.12 (i.e. 12 per cent), with most of these exports destined for North America. Japan's major competitors on that market are the ROW and North America.[14] Imports from North America face zero tariffs in the post-NAFTA data base. Thus removing tariffs on APEC-sourced imports only, translates into strong increased demand for Japanese manufactured OME in North America, and hence to a relatively large positive value for $SX(OME,JPN)(px(OME,JPN)-pw(OME))$. Similar arguments apply to i = TRN, OMF and T_T for r = JPN, explaining why the export-price effect for Japan is so large.

Thailand provides a contrasting example. Its main exports are of light manufacturing (textiles, wearing apparels, etc.) sold, predominately to the ROW. As shown in column (6) of Table 6, activity in the ROW is suppressed by APEC liberalisation. This leads to negative outcomes for

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[13] The values of the Armington elasticities for substitution between domestic goods and aggregated imports vary across commodities but not regions. Their values lie mostly between 1.9 and 3.0. The values of the elasticities for substitution among imports from different sources are twice those of the domestic/import elasticities.

[14] Recall that North America is a grouping of the United States, Canada and Mexico.

$SX(i,r)(px(i,r)-pw(i))$, i = TEX, WAP, LEA, OME and r = THA and to a strongly negative export price effect for Thailand.

Trade volumes

The changes in import volumes shown in column (9) of Table 6 reflect three main factors: (a) the changes in relative domestic/import prices due to the direct effects of the tariff cuts; (b) changes in the import-intensive components of domestic demand; and (c) changes in each region's real exchange rate. The impact on imports of (a) is unambiguously positive. In most regions, the import-intensive components of demand are investment related. In these simulations real investment moves closely with the capital stock in each region (see column (5) of Table 6). Thus in most APEC regions the effects of (b) reinforce those of (a).

The final factor is changes in real exchange rates.[15] In these simulations, the change in real domestic absorption (C+I+G) in each APEC-region exceeds that of real GDP because C and G are tied to GDP, but I moves in line with capital. This means that the balance of trade for each APEC region must deteriorate in real terms. The stimuli to import volumes from effects (a) and (b) generate some of the deterioration in each economy. The residual adjustments occur via changes in real exchange rates.

2.7 Effects on Chinese exports and imports as measured by GTAP

Table 8 shows GTAP projections of the percentage changes in foreign demand for Chinese exports (column I) and in prices (c.i.f.) for Chinese imports (2) due to APEC trade liberalisation. The numbers in column (1) measure the percentage horizontal shifts in the demand schedules for Chinese exports. The numbers in column (2) measure the percentage vertical shifts in the supply schedules for Chinese imports.

Demand for Chinese exports

Turning first to column (1), we see, that of China's main export commodities,' large increases in foreign demand are projected for wearing apparel (row 19), chemicals, rubbers and

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[15] One definition of the real exchange rate for region r is the GDP deflator in r relative to a trade-weighted average of GDP deflators in r's major trading partners.

Table 8: Projected changes in China's trading environment due to APEC*

	(1) percentage change in foreign demand	(2) percentage change in import price (c.i.f.)		(1) percentage change in foreign demand	(2) percentage change in import price (c.i.f.)
1. pdr	-6.0	9.5	20. lea	-8.1	-2.9
2. wht	91.6	-0.4	21. lum	5.7	0.1
3. gro	50.3	1.4	22. ppp	8.1	0.7
4. ngc	54.4	3.6	23. p_c	20.7	-0.2
5. wol	9.8	4.2	24. crp	18.0	-0.4
6. olp	20.0	0.3	25. nmm	21.1	1.3
7. for	4.6	-1.3	26. I_s	33.6	1.2
8. fsh	13.7	-1.6	27. nfm	4.1	-0.6
9. col	3.5	-0.5	28. fmp	20.4	1.0
10. oil	7.7	-1.0	29. trn	13.1	-0.2
11. gas	-2.0	-0.3	30. ome	1.6	0.9
12. omn	9.5	-1.1	31. omf	11.0	1.9
13. pcr	14.6	18.7	32. egw	-3.3	4.0
14. met	90.2	-1.5	33. cns	0.2	1.0
15. mil	9.2	-1.1	34. t_t	-0.9	-0.3
16. ofp	-3.7	-3.9	35. osp	-4.2	-1.0
17. b_t	55.6	-1.1	36. osg	-3.5	-1.8
18, tex	17.1	-1.4	37. dwe	-0.5	-1.0
19. wap	25.4	1.2			

* All of the changes refer to the situation before Chinese export prices and import volumes respond to the new trading conditions.

plastics (24) and textiles (18). Contractions are expected for leather (20), and other private services (35).

In explaining the result for a specific commodity, we first trace the main sources of changes in demand for that commodity. Then, having identified the main regions, we examine changes in each region's demand for the Chinese product. By way of example, we discuss wearing apparel and leather. The largest contributions to the change in demand for Chinese wearing apparel come from Japan (which contributes 15.6 percentage points to the overall increase of 25.4 cent), North America (9.3 percentage points) and the ROW (-7.9 percentage points). The large positive contributions made by Japan and North America reflect their high initial market shares (see Table 4), and large increases in their demand for Chinese apparel. The negative contribution made by the ROW reflects its high initial share and a projected fall in demand of 20 per cent. For Chinese-produced leather, the ROW contributes -8.0 percentage points to the overall fall of 8.1 per cent. The contribution made by North America (the major market for Chinese leather) is negligible.

The following is a short qualitative description of the factors underlying the projected changes in demand for Chinese wearing apparel and leather in each of the major markets:

- *ROW*

(wearing apparel and leather) demand falls because of decline in overall activity in ROW (see column (6) of Table 6), and because of increased competition from the ROW where production costs in general have declined (see column (3) of Table 6).

- *North America*

(wearing apparel) demand rises in response to increased consumption demand for wearing apparel overall (favourable price changes induce substitution in consumption towards wearing apparel), but Chinese producers lose market share in North America to East Asian producers who face, in the initial situation, higher tariffs;

(leather) demand falls by 4 per cent because of increased competition from other Asian producers, particularly South Korea, in a market which increases in line with the general economy (i.e. by about 0.5 per cent, see column (7) of Table 6).

- *Japan*

(wearing apparel) (as in North America) demand rises in response to increased consumption demand, but Chinese producers lose market share.

Chinese import prices

China imports mainly textiles (commodity 18), chemicals, rubbers and plastics (24), iron and steel (26), transport equipment (29), other machinery and equipment (30) and private services (35). As column (2) of Table 8 shows, import prices (c.i.f.) increase for all these commodities, other than iron and steel and other machinery and equipment. However, the most remarkable feature of the numbers in column (2) is their evenness, with most percentage changes lying in the range of +/- 2 per cent. The reason for this is that in GTAP the final c.i.f. price of a commodity is a CES average of c.i.f. prices for that commodity from each source-region. The CES averaging across regions restricts the variability in the final c.i.f.-import prices.

3. The PRCGEM model and simulations

3.1 Theory

PRCGEM is a computable general equilibrium model of the Chinese economy. It distinguishes 118 sectors, 30 regions and 2 households. Its theoretical structure follows the Australian ORANI-F model (Horridge, Parmenter and Pearson, 1993). Its main characteristics are listed below.

Assumptions about producers

- single-product industries
- price takers
- cost minimises
- nested Leontief/CES production functions allow substitution between domestic and imported sources of produced inputs, and between labour, capital and land

Assumptions about investors

- create capital goods from domestic and imported commodities
- price takers
- cost minimises
- production functions allow substitution between sources (import/domestic)
- investment/capital ratios in each industry exogenous, or related to relative rates of return

Assumptions about households

- disaggregated into Peasant and Non-Peasant
- aggregate spending exogenous, or proportional to GDP
- utility functions allow substitution between commodities (LES) and between domestic and imported sources

International exports

- CET specification of imperfect transformation in production between two versions of each domestically-produced good: one version for domestic consumption, one for export.
- downward-sloping demand curves for individual exports

Government

- consumption exogenous
- variables and equations defining revenue from indirect taxation

Prices

- zero-pure-profits conditions and constant returns to scale imply basic values are functions just of input prices
- purchasers' prices are sums of basic values and sales taxes
- behaviour is money-neutral (i.e., depends only on relative prices), so one price (often the exchange rate) must be taken as an exogenous numeraire

Market clearing

- markets for commodities clear, but labour market need not clear

Regional disaggregation

- tops-down disaggregation to 30 provinces

Aggregated results for presentation

- Although computed at the 118-sector level, key sectoral results are also presented at an aggregated 33-sector level.

Flexible Choice of Exogenous Variables

- PRCGEM allows different variables to be chosen as exogenous. This allows the same basic model to be used in a variety of different ways. The different choices of exogenous variables (called closures) represent different assumptions about factor-market and macro behaviour. By altering the closure we can produce either long-run or short-run comparative-static simulations, or linked annual dynamic simulations in the style of the MONASH model (Adams *et al.* 1994; Dixon and Parmenter, 1994).

3.2 Data

The input-output database was compiled from the 118-sector Use Table of the 1992 Chinese Input-Output tables. That table does not distinguish between imported and domestic components of demand: it shows only net exports for each sector. To split demands into imported and domestic components, we supplemented the IO tables with a very disaggregated (6000-item)

listing of trade flows from Chinese Customs Statistics. Additional data were also used to derive the regional data-base, and to compute details of industry capital stocks and investment usage.

To date no program for econometric estimation of the elasticities required for the model has been undertaken. Elasticities for this first version of the model were assigned on the basis of literature reviews or guesstimation. "Armington" elasticities of substitution between domestically produced commodities and imports, the elasticity of substitution between primary factors, and the elasticities in the household demand system were all adapted from the ORANI-F data files. The CET elasticity of transformation between goods destined for the home or export market was set at 2. Export demand elasticities were set at -5.

3.3 Setting up the PRCGEM simulation

In setting up the PRCGEM simulation, we aimed to harmonise with the assumptions used in the GTAP experiment. As in the GTAP work, we chose a long-run comparative-static closure in which:

- the supply of capital in each industry is elastic and industry rates of return are fixed;
- labour supply is fixed in total, is mobile between industries and has fixed inter-industry wage relativities;
- aggregate real household spending and government consumption move with real GDP; and
- investment in each industry is proportional to capital stock in that industry.

The terms-of-trade and tariff-rate shocks for the PRCGEM simulation were generated by the GTAP model. Since in GTAP all trade prices and volumes are modelled bilaterally, the changes in, say, the prices of Chinese imports, were distinguished by country of origin as well as by commodity. PRCGEM does not support this distinction. We used the GTAP data about Chinese trade flows to compute the weighted average (over source country) change in import prices for each GTAP good. Likewise, Chinese export demand shifts were aggregated over destination. The GTAP scenario for changes in Chinese bilateral tariffs (-100 per cent for rates on imports from APEC countries, unchanged on imports from the ROW) were aggregated in the same way as the import price changes.

Initially, these changes in import prices, export demands and Chinese tariffs were all at the GTAP, 37-sector level of disaggregation. They were then mapped to the 118 PRCGEM sectors. Nearly all PRCGEM sectors corresponded to only one GTAP sector. We applied the percent change from each GTAP sector to all the corresponding PRCGEM sectors.

Table 9: Selected base data and summary of shocks*

No	Broad Sector	Original Base Levels of			Exogenous Shocks to		
		Output	Imports	Exports	Export Demand	Power of Tariffs	Import Prices
		(1)	(2)	(3)	(4)	(5)	(6)
1	Agriculture	9085	178	253	41.69	9.01	0.99
2	Coal Mining	726	2	43	3.53	-13.02	-0.45
3	Natural Gas & Crude	610	96	51	7.68	-2.02	-0.97
4	Metal Ores	230	63	19	9.51	-1.57	-1.14
5	Other Mining	639	31	21	8.44	-6.62	-1.25
6	Food Products	4063	125	328	40.08	-9.48	-2.76
7	Textiles	3799	459	826	17.11	-37.95	-1.41
8	Clothing & Shoes	1514	121	939	15.06	-32.76	-1.64
9	Wood Products	487	58	114	5.66	-19.89	0.08
10	Paper & Printing	1764	158	360	10.52	-22.56	0.93
11	Electricity	1178	16	0	1.00	-2.91	3.97
12	Petroleum Refining	830	84	48	20.69	-10.99	-0.19
13	Coal Prods (Coke/Gas)	179	1	7	20.68	-10.99	-0.19
14	Chemicals	4857	791	485	18.04	-17.87	-0.35
15	NonMetallic Mineral Prods	2536	44	151	21.06	-26.16	1.32
16	Basic Metals	3174	422	146	20.43	-11.50	0.52
17	Metal Products	1428	52	157	20.36	-28.51	1.00
18	Machinery	3789	1055	460	1.63	-20.60	0.92
19	Transport Equipment	1541	413	94	13.07	-36.18	-0.16
20	Electrical Machinery	1540	225	245	1.63	-20.60	0.92
21	Electronic/Comms Equip.	1036	408	333	1.63	-20.60	0.92
22	Meters and Instruments	202	65	19	1.63	-20.60	0.92
23	Maintenance of Machinery	307	0	0	-4.19	0.00	-1.02
24	Manufacturing NEC	786	49	13	13.08	-25.56	0.58
25	Construction	5203	0	0	0.19	0.00	1.03
26	Freight Transport	1987	0	120	-0.85	0.00	-0.32
27	Commerce	5870	0	67	-0.85	0.00	-0.32
28	Restaurants	826	0	0	-0.85	0.00	-0.32
29	Passenger Transport	679	0	76	-0.85	0.00	-0.32
30	Public Utilities	2053	0	69	-0.85	0.00	-0.55
31	Education, Health & Research	2273	0	8	-4.01	0.00	-1.80
32	Finance and Insurance	1713	0	10	-4.19	0.00	-1.02
33	Public Administration	1910	0	0	-3.51	0.00	-1.80

* Base data are drawn from the 1992 PRCGEM data base and is measured in units of 10,000 RMB. Shock values are percentage changes.

Although PRCGEM simulations are computed at the 118-sector level, we choose below, for brevity, to present sectoral results at an aggregated 33-sector level. The last three columns of Table 9 summarise the exogenous changes, derived from GTAP, at this level of detail. The first three columns show relevant extracts from the PRCGEM database. The impact of the trade and tariff shocks is mediated by these base data. For example, in percentage terms, the increase in world demand for Chinese agriculture is the largest shock (column 4). Exports, however, account for only

a small share of Chinese agriculture (column 3). Hence the impact on the Chinese industry is not, we shall see, especially marked. By contrast, the reduction in tariffs on transport equipment (row 19) turns out to have a decidedly negative effect on the local industry. This is because imports (column 2) are a substantial fraction of local production.

3.4 Results of the PRCGEM simulation

Table 10 shows the effects on selected macro-economic variables of the shocks to import prices, export demands and Chinese tariffs. For this table only, we have broken up the total effect of the shocks into parts. Thus, column (1) shows the effects of the import price changes alone, column (2) the effects of the changes in export demand, and column (4) the local effects of the Chinese tariff changes. The total effects are shown in column (5). Table 11 shows the sectoral effects of the complete package, corresponding to column (5) of Table 10.

Macro Results

Our results indicate that the APEC trade liberalisation would increase Chinese GDP (row 6 of Table 10). Since we held total employment fixed (row 14), any increase in real GDP must come about predominantly through an increase in capital usage. Table 10 shows that most of the increase in capital generated in our simulation is attributable directly to the Chinese tariff reductions (row 13, column (4)). One reason is that the tariff reform reduces the cost of constructing capital relative to the price of domestic output (compare rows 8 and 12 of Table 10). This is because imports subject to tariff reductions (especially imports in categories 17-22 and 24 in Table 9) are a large component of the cost of constructing capital. In our simulation, rates of return are held fixed, so that capital rentals are indexed to the costs of constructing capital. Hence, reducing the construction costs reduces capital rentals (row 15 of Table 10). Thus, the cost of using capital is reduced, which causes industries to increase their capital/labour ratios. With aggregate employment fixed (row 14), an increase in the economy's capital/labour ratio implies an increase in capital usage and a corresponding increase in output.

Table 10: Economy wide effects in China of APEC trade liberalisation*

No.	Variable Description	Effect of changes in: Import Prices (1)	Export Demands (2)	Total (1)+(2) (3)	Chinese Tariffs (4)	Total (3)+(4) (5)
1	Real Consumption	-0.02	0.01	-0.01	1.86	1.85
2	Aggregate Real Investment	-0.09	0.03	-0.06	3.89	3.84
3	Aggregate Real Government Demands	-0.02	0.01	-0.01	1.86	1.85
4	Export Volume	-0.01	2.45	2.44	18.37	20.80
5	CIF weighted Import Volume Index	-0.11	2.71	2.60	23.01	25.60
6	Real GDP from Expenditure Side	-0.02	0.01	-0.01	1.86	1.85
7	Consumer Price Index	0.01	2.22	2.23	-3.35	-1.12
8	Aggregate Investment Price Index	0.14	1.95	2.09	-6.19	-4.10
9	Government Demands Price Index	0.04	2.37	2.42	-2.58	-0.17
10	Exports Price Index	0.00	2.42	2.42	-3.67	-1.26
11	CIF Imports Price Index in RMB	0.13	0.00	0.13	0.00	0.13
12	GDP Price Index, Expenditure Side	0.03	2.58	2.62	-4.89	-2.28
13	Rental Weighted Aggregate Capital Stock	-0.06	0.07	0.01	3.87	3.88
14	Wage Weighted Aggregate Employment	0.00	0.00	0.00	0.00	0.00
15	Average Capital Rental	0.14	1.95	2.09	-6.19	-4.10
16	Average Money Wage (pre-tax)	-0.05	3.18	3.14	4.27	7.41
17	Ordinary Change in % (Balance of Trade)/GDP	-0.01	0.42	0.41	-1.15	-0.74
18	Exchange Rate, Yuan/$world	0.00	0.00	0.00	0.00	0.00
19	Terms of Trade	-0.13	2.42	2.28	-3.67	-1.39
20	Real Devaluation	0.10	-2.58	-2.48	4.89	2.41
21	Duty-paid Imports Price Index in RMB	0.13	0.00	0.13	-20.59	-20.46

* All results are percentage changes unless otherwise stated

Tariff reductions also generate a real depreciation (row 20 of Table 10) making exporters more competitive—export increases (row 4) are due much more to the local tariff change (column 4) than to outside movements in foreign demand curves (column 2).

Another feature of our closure is that we have held the investment/capital ratios fixed for each industry. The effect of this is that aggregate real investment (row 2) increases at a rate similar to the rate of increase of the aggregate capital stock (row 13)[16] and faster than real GDP (row 6). We linked real household and government consumption (rows 1 and 3) to real GDP. Hence, real GNE (the aggregate of real household and government consumption and real investment) increases more rapidly than real GDP, forcing the balance of trade to move towards deficit (row 17).

[16] The two do not move precisely together because the weights used to compute the change in aggregate investment are not the same as those used to compute the change in the aggregate capital stock.

Real wages rise by 8.5 per cent (row 16 *minus* row 7). Again, the bulk of this rise is due to the local tariff reform. Under alternative closure assumptions, some or all of this real wage increase could have been traded off for an increase in employment.

Sectoral Results

Results for sectoral outputs, exports and imports are shown in Table 11. A decomposition of the output results is given in Table 12. For each sector, it shows how the increase in the total output can be broken into three parts[17]:

(1) that part due to the increase in demand for the corresponding commodity, whether locally-produced or imported; (In computing this contribution we assume that import/domestic ratios of domestic users' purchases do not change.)

(2) that part due to the substitution of the locally-produced output for the imported equivalent; and

(3) that part due to the growth in the sector's exports.

Most sectors benefit from the proposed trade liberalisation. The sectors that benefit most are Clothing & Shoes (8), Textiles (7) and Electronic Equipment (21).

[17] It should be stressed that this decomposition is quite independent of the attribution, in Table 10, of results to the various shocks. In fact, as can be seen from row 4 of Table 10, the main force increasing exports is the not the increased world demand, but the real depreciation which follows from the Chinese tariff cuts.

Table 11: Sectoral impacts in China of APEC trade liberalisation*

No.	Broad Sector	Output (1)	Export (2)	Import (3)
1	Agriculture	1.36	9.92	-12.15
2	Coal Mining	0.77	3.53	28.11
3	Natural Gas & Crude	1.22	8.86	0.66
4	Metal Ores	-1.05	6.26	0.35
5	Other Mining	1.14	6.58	14.33
6	Food Products	2.87	22.99	26.99
7	Textiles	6.97	28.53	64.08
8	Clothing & Shoes	19.90	32.31	49.93
9	Wood Products	3.30	18.25	29.71
10	Paper & Printing	2.74	17.33	32.33
11	Electricity	0.95	5.81	-6.36
12	Petroleum Refining	1.29	13.99	16.57
13	Coal Prods (Coke/Gas)	0.11	11.02	16.75
14	Chemicals	0.11	19.57	22.88
15	NonMetallic Mineral Prods	2.50	16.40	40.51
16	Basic Metals	-0.96	12.60	13.18
17	Metal Products	2.66	20.29	47.80
18	Machinery	-3.23	12.81	22.23
19	Transport Equipment	-8.86	22.29	39.03
20	Electrical Machinery	-0.63	8.69	25.59
21	Electronic/Comms Equip.	6.47	24.66	18.20
22	Meters and Instruments	-6.24	3.87	23.84
23	Maintenance of Machinery	3.43	-4.19	0.00
24	Manufacturing NEC	2.79	13.57	2.28
25	Construction	3.76	0.19	0.00
26	Freight Transport	2.13	6.62	0.00
27	Commerce	2.33	2.14	0.00
28	Restaurants	1.41	-0.85	0.00
29	Passenger Transport	5.07	37.77	0.00
30	Public Utilities	1.99	4.51	0.00
31	Education, Health & Research	1.49	-0.45	1.81
32	Finance and Insurance	1.58	5.25	0.00
33	Public Administration	1.85	-3.51	0.00

* All results are percentage changes.

The output of Clothing and Shoes increases by nearly 20 per cent. This is largely the result of an increase in Chinese exports of 32.31 per cent (see Table 11). Exports account for 62 per cent of the total sales of this sector. Hence, the contribution of the export expansion to the change in the sector's output is 20 per cent (32.31×0.62). The local market for Clothing and Shoes expands strongly because the prices of the commodities fall as tariffs are removed. However, imports increase by nearly 50 per cent, offsetting the stimulus that the expansion of the domestic market would otherwise give to the output of the domestic sector (compare columns (1) and (2) of row 8 of Table 12).

Expansion of the Clothing-and-Shoes sector causes a sharp increase in the domestic demand for Textiles (column (1) of row 7 of Table 12). As in the case of Clothing and Shoes, the stimulus which this would give to the local Textiles sector is offset by a loss of market share to imports (column (2)). The proposed tariff cuts in both China and other countries in the region generate a 39.36 per cent fall in the price of imported Textiles, the largest among all sectors (see columns (5) and (6) of Table 9). The demand for imported Textiles is therefore expected to increase dramatically—by 64 per cent (column (3) of Table 11). As in the case of Clothing and Shoes, there is a net expansion in the output of the local Textiles sector, explained by an increase in exports. Exports of Textiles expand almost as strongly as exports of Clothing and Shoes (see column (2) of Table 11) but their share in the total sales of the local sector is only 22 per cent. Hence, their contribution to output growth is much smaller than was the case in the Clothing-and-Shoes sector.

The trade liberalisation leads to declines in output in six sectors. Of these six, Transport Equipment (sector 19) experiences the largest decline. Table 9 reveals that there is a significant cut in Chinese tariffs on Transport Equipment. Table 11 reveals that exports and imports both expand strongly. Exports account for only 6 per cent of the total sales of the domestic sector. Hence, the contribution of export expansion to the sector's output change, although positive, is rather small (see column (3) of row 19 of Table 12). Expansion of imports, which makes a large negative contribution (column (2)), is the fundamental reason for the decline in the sector's output. Column (1) of Table 12 suggests that the domestic market for Transport Equipment contracts marginally. To understand this, one must realise that the sector produces both finished vehicles and parts. The parts are used by the sector itself. This intra-sector usage accounts for about 50 per cent of the sector's total sales. The apparent decline in the domestic market just reflects the decline in the sector's demand for parts. The main domestic final use of Transport Equipment is as an input to capital formation. Investors expand their demand for Transport Equipment roughly in line with the overall expansion of investment.

As a final example of the mechanisms underlying the sectoral results, we will compare sectors 21 (Electronic and Communications Equipment) and 22 (Meters and Instruments). As can be seen from Table 9, these receive identical shocks in the trade-liberalisation simulation yet the

first has the third-largest output expansion[18] and the second has the second-largest output contraction. Imported inputs are a larger share of total inputs for Electronic and Communications Equipment than for Meters and Instruments. With import prices declining this explains why Electronic and Communications Equipment is better able to resist import competition than is Meters and Instruments (column (3) of Table 11) and is able to increase its exports more strongly (column (2)). Hence, in Table 12 the negative contribution of import competition (column (2)) is smaller for Electronic and Communications Equipment than for Meters and Instruments, and the positive contribution of exports (column (3)) is larger. The large size of the difference between the two export contributions is explained by the fact that exports account for a much larger share of the total sales of Electronic and Communications Equipment than of Meters and Instruments (32 per cent compared to 9 per cent). The final component of the explanation is that the domestic market for Electronic and Communications Equipment expands more strongly than that for Meters and Instruments (column (1) of Table 12). The strength of the domestic-market contribution for Electronic and Communications Equipment is explained mainly by the intra-sector component of its sales. The weakness of the contribution for Meters and Instruments arises from a bias of its intermediate sales towards other declining sectors (Transport Equipment, for example) and away from the most strongly expanding sectors (Textiles and Clothing and Shoes, for example).

[18] In recent years, the Electronic and Communication sector has been one of the most rapidly growing sectors in China. The simulation results suggest that the APEC trade liberalisation is likely to reinforce this trend.

Table 12 Decomposition of sectoral results*

No.	Broad Sector	Local Market	Import Competition	Export	Total
		(1)	(2)	(3)	(4)
1	Agriculture	0.83	0.24	0.29	1.36
2	Coal Mining	0.70	-0.10	0.18	0.77
3	Natural Gas & Crude	0.49	-0.01	0.74	1.22
4	Metal Ores	-1.36	-0.22	0.52	-1.05
5	Other Mining	1.67	-0.72	0.19	1.14
6	Food Products	2.29	-0.95	1.53	2.87
7	Textiles	6.87	-6.49	6.58	6.97
8	Clothing & Shoes	3.04	-3.42	20.28	19.90
9	Wood Products	2.24	-3.19	4.25	3.30
10	Paper & Printing	1.92	-2.68	3.49	2.74
11	Electricity	0.85	0.10	0.00	0.95
12	Petroleum Refining	1.95	-1.47	0.81	1.29
13	Coal Prods (Coke/Gas)	-0.28	-0.12	0.50	0.11
14	Chemicals	1.69	-3.38	1.80	0.11
15	NonMetallic Mineral Prods	2.16	-0.63	0.97	2.50
16	Basic Metals	0.14	-1.68	0.59	-0.96
17	Metal Products	2.02	-1.68	2.32	2.66
18	Machinery	1.04	-5.70	1.43	-3.23
19	Transport Equipment	-0.04	-10.30	1.48	-8.86
20	Electrical Machinery	1.64	-3.67	1.40	-0.63
21	Electronic/Comms Equip.	4.15	-5.55	7.87	6.47
22	Meters and Instruments	0.81	-7.41	0.36	-6.24
23	Maintenance of Machinery	3.44	0.00	0.00	3.43
24	Manufacturing NEC	2.60	0.00	0.19	2.79
25	Construction	3.76	0.00	0.00	3.76
26	Freight Transport	1.73	0.00	0.39	2.13
27	Commerce	2.30	0.00	0.03	2.33
28	Restaurants	1.41	0.00	0.00	1.41
29	Passenger Transport	1.85	0.00	3.22	5.07
30	Public Utilities	1.86	0.00	0.13	1.99
31	Education, Health & Research	1.49	0.00	0.00	1.49
32	Finance and Insurance	1.55	0.00	0.03	1.58
33	Public Administration	1.85	0.00	0.00	1.85

* All results are percentage changes.

Regional Results

Table 13 shows the effects of the trade liberalisation on real gross regional product (GRP) in each of 30 regions within China. These results are based on a tops-down disaggregation of the national-level results. The first step in the disaggregation to regions is to allocate each of the PRCGEM commodities to one of two groups: national and local. Commodities classed as national are traded extensively across region borders. Examples are the agricultural and mining commodities. Local commodities are those for which demand in each region is satisfied mainly from production in the region. Examples include perishable items such as bread, and services like retail

trade and repairs. For industries which produce national commodities, the same percentage change in production is assumed across regions. For industries producing local commodities we impose market clearing in each region. Hence, the percentage changes in output in each region for local industries are set equal to the percentage changes in demand for their products in each region. In calculating the region demand for the output of a local industry, the disaggregation takes account of: intermediate and investment demand by local industries and by the parts of the national industries located in the region; region household demands, which are a function of local factor incomes; and government demand. An attractive feature of our regional disaggregation is that its data requirements are modest. They are satisfied by having, for the base year, region shares in national-wide output of each industry and final demands by region for local commodities only.

As is shown in Table 13, the benefits of the trade reforms are spread fairly evenly between regions. Zhejiang, Guangdong and Fujian experience the strongest stimuli to GRP (all over 2.6 per cent), while Jilin lags behind (0.76 per cent).

In general, the benefits of the trade liberalisation will be greater for a region:

- the greater are the shares in the region's gross regional product of *national* industries which are relatively favoured by the trade liberalisation, or
- the smaller are the shares in the region's gross regional product of *national* industries which are relatively disadvantaged by the trade liberalisation.

Conversely, the benefits of the trade liberalisation will be smaller for a region:

- the smaller are the shares in the region's gross regional product of *national* industries which are relatively favoured by the trade liberalisation, or
- the greater are the shares in the region's gross regional product of *national* industries which are relatively disadvantaged by the trade liberalisation.

The treatment in PRCGEM of industries which produce local commodities magnifies the differences in regions' responses to the trade liberalisation. For these industries, the assumption that demand in each region must be met by supply in that region imposes regional multipliers deriving from the need for the outputs of *local* industries to expand relatively strongly in regions in which activity (and hence the demand for *local* commodities) is relatively strongly stimulated by the trade liberalisation.

Table 13: Regional impacts in China of APEC trade liberalisation: percentage changes in real gross regional products

	Region	Per cent change in real GRP
1	Beijing	1.66
2	Tianjin	1.69
3	Hebei	1.57
4	Shanxi	1.28
5	Mongolia	1.62
6	Liaoning	1.29
7	Jilin	0.76
8	Heilong	1.41
9	Shanghai	1.62
10	Jiangsu	2.16
11	Zhejiang	2.78
12	Anhui	1.70
13	Fujian	2.64
14	Jiangxi	1.62
15	Shandong	2.01
16	Henan	1.57
17	Hubei	1.52
18	Hunan	1.41
19	Guangdong	2.67
20	Guangxi	1.50
21	Hainan	2.07
22	Sichuan	1.30
23	Guizhou	1.25
24	Yunnan	1.40
25	Tibet	2.24
26	Shaanxi	1.52
27	Gansu	1.48
28	Qinghai	1.58
29	Ningxia	1.43
30	Xinjiang	1.80

Table 14 illustrates these mechanisms for a selection of regions. For each of the regions included, the last row of the table shows the difference between the percentage change in real gross regional product (at factor cost) induced by the trade liberalisation and the corresponding percentage change in real GDP. We have already noted, for example, that Jilin is the region stimulated least by the liberalisation. Table 14 shows that its real GRP increases 1.029 percentage points less than does real GDP (0.761 per cent compared to 1.79 per cent[19]). In rows 1-33 of the

[19] Note that this percentage change in real GDP differs a little from the 1.85 reported in Table 13. In that table, we report the change in real GDP at market prices, whereas for Table 14 a factor-cost measure is appropriate.

table are sectors' contributions to the deviations between the percentage changes in GRP and GDP. These are the terms in the sum on the right hand side of the formula:

$$(12) \qquad grp^r - gdp = \sum_i (S_i^r - S_i)(g_i - gdp) + S_i^r (g_i^r - g_i),$$

where grp^r is the percentage change in region r's real GRP;

gdp is the percentage change in real GDP;

S_i^r is the share of industry i in region r's real GRP;

S_i is the share of industry i in region real GDP;

g_i is the percentage change in the output of industry i at the national level; and

g_i^r is the percentage change in the output of industry i in region r.

The first term in the right hand side of (12) indicates that positive (negative) contributions to the increase in a region's GRP relative to GDP occur if the region has relatively large (small) shares of industries which, at the national level, are expanding relatively strongly or relatively small (large) shares of relatively weakly expanding industries. For *national* industries, only this term applies. The second term, indicates that an industry will make a positive (negative) contribution to a region's grp-gdp differential if it expands more (less) strongly in the region than it does nationally.

From Table 14, we can see that the main reasons for the relatively weak GRP increase in Jilin in our simulation is the negative contribution made by the Transport Equipment sector. This is a *national* sector which is adversely affected by the trade liberalisation. It accounts for 5.3 per cent of Jilin's GRP but only 1.4 per cent of GDP. Jilin also gets negative contributions from the Textiles, Clothing & Shoes, and Electronic & Communications Equipment sectors. As we have seen, all of these are strongly stimulated by the trade liberalisation. But their shares in Jilin's GRP are all below their shares in GDP (0.9, 0.6 and 0.3 per cent compared to 2.7, 1.2 and 0.9 per cent). *Local* sectors (23, 25-8, 30 and 31) also make negative contributions. The reason is that these sectors expand less strongly in Jilin than at the national level because demand for their output grows less rapidly.

Zhejiang is the region which is most strongly stimulated by the trade liberalisation. Its real GRP expands 0.985 percentage points more rapidly than GDP. Large positive contributions come

from Textiles and Clothing & Shoes, sectors which are strongly stimulated by the trade liberalisation and whose shares in Zhejiang's GRP are much larger than their shares in GDP (6.8 and 2.5 per cent compared to 2.7 and 1.2 per cent). Agriculture and Transport Equipment are examples of sectors whose outputs expand less strongly than GDP and which make positive contributions to the relatively strong expansion of Zhejiang's GRP because they have lower shares in the regions GRP than in GDP (19.3 and 0.8 per cent compared to 24 and 1.4 per cent). Local sectors all make positive contributions because they expand more rapidly in Zhejiang than nationally.

Beijing gains slightly less from the trade liberalisation than does China as a whole. The share of Clothing & Shoes in Beijing's GRP (1.5 per cent) is slightly larger than the corresponding GDP share. Hence, Clothing & Shoes makes a positive contribution. This is more than offset however by negative contributions from the adversely affected Transport Equipment sector (which accounts for 3.4 of Beijing's GRP but only 1.4 per cent of GDP) and the strongly stimulated Textiles sector (which accounts for 1.7 per cent of Beijing's GRP but 2.7 per cent of GDP).

Table 14:Sectoral contributions to deviations between percentage changes in GRP and GDP

		Beijing	Jilin	Shanghai	Zhejiang	Guangdong	Sichuan
1	Agriculture	0.067	-0.072	0.105	0.114	0.089	-0.102
2	Coal Mining	0.011	0.001	0.016	0.014	0.014	0.002
3	Natural Gas & Crude	0.009	-0.001	0.009	0.009	0.009	0.004
4	Metal Ores	0.004	0.008	0.01	0.007	0.004	-0.008
5	Other Mining	0.006	-0.025	0.006	0.005	0.005	-0.001
6	Food Products	-0.007	0.008	-0.012	0.002	-0.002	0.004
7	Textiles	-0.048	-0.088	0.078	0.205	-0.025	-0.053
8	Clothing & Shoes	0.124	-0.088	0.203	0.242	0.203	-0.143
9	Wood Products	0.017	-0.014	-0.004	-0.001	0.01	-0.003
10	Paper & Printing	0.024	-0.047	0.058	0.041	0.031	-0.032
11	Electricity	0.002	-0.005	0.000	0.004	0.000	0.004
12	Petroleum Refining	-0.005	0.001	0.000	0.001	0.000	0.003
13	Coal Prods (Coke/Gas)	-0.005	0.000	-0.002	0.001	0.002	0.001
14	Chemicals	-0.002	-0.078	-0.036	0.054	0.060	-0.008
15	Nonmetal mineral prods	-0.003	0.001	-0.008	0.004	0.004	-0.004
16	Basic Metals	-0.071	0.020	-0.153	0.051	0.059	-0.016
17	Metal Products	0.001	-0.003	0.008	0.005	0.003	-0.002
18	Machinery	-0.042	0.059	-0.178	-0.047	0.061	-0.011
19	Transport Equipment	-0.213	-0.410	-0.171	0.057	0.048	-0.008
20	Electrical Machinery	0.001	0.014	-0.021	-0.019	-0.035	0.011
21	Elec/Comms Equip.	0.040	-0.029	0.040	-0.004	0.071	-0.007
22	Meters and Instruments	-0.011	0.007	-0.035	-0.017	0.011	-0.003
23	Machinery maintenance	-0.001	-0.003	-0.001	0.004	0.002	-0.001
24	*Manufacturing NEC*	*0.001*	*0.000*	*0.001*	*0.001*	*0.000*	*0.000*
25	Construction	0.000	-0.063	-0.050	0.064	0.032	-0.008
26	Freight Transport	-0.001	-0.013	0.000	0.003	0.008	-0.007
27	*Commerce*	*-0.029*	*-0.166*	*-0.019*	*0.15*	*0.162*	*-0.080*
28	Restaurants	-0.001	-0.002	-0.002	0.002	0.002	-0.001
29	Passenger Transport	0.005	0.000	0.009	0.005	0.002	-0.003
30	Public Utilities	0.000	-0.029	-0.008	0.017	0.037	-0.013
31	Ed., Health, Research	-0.007	-0.012	-0.009	0.012	0.010	-0.005
32	*Finance and Insurance*	*-0.001*	*0.000*	*-0.001*	*-0.001*	*0.000*	*0.000*
33	Public Administration	0.000	0.000	0.000	0.000	0.000	0.000
	grp - gdp	*-0.135*	*-1.029*	*-0.167*	*0.985*	*0.877*	*-0.49*
	Gross Regional Product	1.657	0.761	1.623	2.779	2.668	1.302

4. Conclusion

This paper reports work in which an established multi-country computable general equilibrium model (GTAP) was combined with a newly constructed computable general equilibrium model of the Peoples Republic of China (PRCGEM) to estimate the effects on the industrial and regional structures of PRC economy of trade liberalisation proposed as part of the Asia-Pacific Economic Co-operation (APEC) Forum.

In simulating APEC trade liberalisation, we recognise that its effects on the PRC economy stem from changes which it generates in the world prices of Chinese imports and exports as well as from the direct effects of cuts in Chinese protection rates. We use the GTAP model to estimate the changes in world prices. We impose them on PRCGEM as changes in c.i.f. import prices and shifts in the model's foreign demand schedules for Chinese exports. Overall, they imply an improvement in China's terms of trade of approximately 2.5 per cent. In addition to these price shocks, we impose on PRCGEM cuts in Chinese protection rates.

In setting up PRCGEM to project the effects of the trade liberalisation we adopt long-run assumptions. The liberalisation is assumed not to affect aggregate employment or rates of return on capital. Aggregate real household and government consumption is forced to respond at the same percentage rate as real gross domestic product. Real investment in each industry is forced to respond at the same rate as the industry's capital stock.

We report results for Chinese macroeconomic variables, for output by industry and for gross regional product by province.

At the macroeconomic level, the trade liberalisation generates an increase in the capital stock and hence in real GDP. This is because it reduces the domestic prices of imported capital goods, reducing the overall costs of constructing capital. Domestic consumption is assumed to expand in line with GDP but investment expands with the capital stock, i.e., more rapidly than GDP. Hence, overall domestic spending expands more than GDP and the trade balance moves towards deficit. Imports expand sharply when protection is reduced. Exports are stimulated by a depreciation of the real exchange rate.

The implications for Chinese industries depend primarily on the extent to which the trade liberalisation exposes the industries to additional import competition and on industries' export orientation. Examples of industry sectors which are strongly stimulated by the liberalisation are *Textiles*, *Clothing & Shoes* and *Electronic & Communications Equipment*. *Transport Equipment* is the sector most adversely affected by the trade liberalisation. Regional results follow from the industrial compositions of the regions. Zhejiang and Guangdong are the provinces most favourably affected by the trade liberalisation. Jilin is the province which is stimulated least by the trade liberalisation.

An overall conclusion is that the effects of the terms-of-trade change taken from GTAP are rather small relative to the direct effects of cuts in Chinese protection rates.

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