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Jiao Wang, David Mayes and Guanghua Wan

Effects of WTO membership on income distribution and labour movement in China —

A CGE analysis

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Effects of WTO membership on income distribution and labour movement in China – A CGE analysis*

Tiivistelmä

Tutkimuksessa selvitetään WTO-jäsenyyden vaikutuksia 31 alueella sekä 41:llä eri teollisuusalalla Kiinassa vuosina 2002–2007 laskettavan yleisen tasapainon mallin (CGE) avulla. Jos otetaan huomioon työvoiman liikkuminen Kiinan eri alueiden välillä, WTO-jäsenyyden suora vaikutus on varsin pieni. Reaalinen BKT kasvaisi 6,5 % lyhyellä ja 5,6 % pitkällä aikavälillä. On kuitenkin huomattava, että rakenteellisten uudistusten ja WTO-jäsenyyden vaikutus tuotantoon näyttäisi olevan varsin suuri varsinkin Kiinan rannikkoalueilla. Työvoiman liikkuvuus kasvaisi 69 % rakenneuudistusten toteuttamisen jälkeen. Lisäksi tulojakauman odotettaisiin tulevan tasaisemmaksi.

Asiasanat: laskettavat yleisen tasapainon mallit, Kiina , WTO, työvoiman liikkuvuus, tulonjako

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Jiao Wang, David Mayes and Guanghua Wan

Effects of WTO membership on income distribution and labour movement in China – A CGE analysis

Abstract

Using a CGE model (PRCGEM) updated to 2002, the paper explores how WTO membership could affect earnings in 40 industries across 31 regions (and 8 regional blocks) of China during the period 2002–2007. Taking into account labour movement between regions within China, the direct contribution of WTO membership to overall economic growth and development is predicted to be small, with a rise in real GDP of only 6.48% short term and 5.6% long term. However, structural economic change and the WTO shock should increase regional output, especially in the established coastal economies. Regional labour movement is found to increase 69.2% at the completion of economic structural reforms. A slight decrease in the Gini coefficient for income inequality is also anticipated.

Keywords: Applied CGE modelling, China, WTO, labour movement, inequality
JEL classification: C68, O18, R12, R23

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1 Introduction: China's WTO entry framework

Any discussion of events since China's formal accession to the WTO in December 2001 should be prefaced with a mention that the country was also a founding GATT member in 1947.[4] China's WTO membership is essentially the outcome of negotiations launched in 1982 to revive a lapsed trade status.

Our paper examines the obligations and reciprocal benefits taken on by China as a result of its WTO membership. However, these WTO-inspired changes are occurring in the context of a lasting dynamic imparted to the Chinese economy by decades of expansion and liberalisation of trade. Indeed, even if WTO negotiations had failed, many of China's trade barriers would have come down as numerous other agreements, particularly at the regional level, would have supplanted a stalled WTO membership process.

From 1949 to 1978, China's planned approach to foreign trade was closely managed through 10–16 foreign trade corporations (Lardy, 1992). Conventional trade barriers such as tariffs, quotas and licences played little role in this administered regime (Huang and Chen, 1999a). China announced its "Open Door Policy" in 1978. By 1984, there was wide access to foreign exchange earnings from exports and the planned aspect of trade had been substantially reduced. In the 1990s, the Chinese gained broad opportunities to trade and invest in China on an open basis (Table 1 and Table 4). By the start of WTO accession in 2002, Chinese trade had developed to the point where it become possible to classify China's trade barriers and incentives in conventional terms (even if a good proportion of imports was still coming from "privileged" sources).

Our simulations assume China has five years to implement its WTO commitments[5] and will meet most of its accession conditions by 2007 (foreign ownership and income payments have extended deadlines). Sectoral reforms include reductions in tariffs, commitments not to raise tariffs across commodities and manufactures, and improved access for services. Average manufacture tariffs are presumed to fall from some 17% in 2002 to about 9% in 2005. Tariffs on automobiles and auto parts decline from 80%–100% before 2001 to 25% in 2006. Quotas on other industrial products are eliminated by 2006, while tariffs on information technology equipment are progressively phased out. In the services

[4] China's membership was suspended in 1950.
[5] Upon joining the WTO in 2001, China is supposed to implement all the required WTO protocol by 2010. Most will be finished by 2007, especially the cutting of trade barriers. We assume the transition period for China's WTO membership is 2002–2007.

sector,[6] the permitted foreign ownership share of China's information technology and telecommunication companies rises to at least 49%. Reforms are generally taken to boost FDI inflows in the short term.

The first challenge here is distinguishing short-run shock adjustments from WTO accession effects – a non-trivial problem given that in the run-up to WTO accession, China floundered (although not as badly as other Asia economies, e.g. South Korea and Thailand) in the churn of the East Asia financial crisis throughout 1998 and the first half of 1999. China's real GDP growth slowed a bit from 8.8% in 1997 to 7.1% in 1999. Chinese exports, after soaring 20.9% in 1997, rose only 0.5% in 1998. Export growth bounced back, hitting 22.3% in 2002, 34.6% in 2003 and 35.4% in 2004.[7] Foreign direct investment declined 10% during 1997–2000. Chinese FDI inflows in 2002 increased 33.5% and contractual foreign investment 48% over the previous year. FDI inflows reached US$60.6 billion in 2003, making China the world's top FDI destination.

A start perhaps is to choose a plausible baseline with sustainable growth rates. China took a quarter of a century to establish itself as a major trading power. Between 1979 and 2003 Chinese exports grew from $13.7 billion to $438.2 billion, while imports grew from $15.7 billion to $412.8 billion. In 2003, however, the growth in trade was steeper than the trend – exports were up 34.6% and imports 39.8% on year. During the period 1990–2003, China's share of world exports increased from 1.8% to 5.84%, making it the world's fourth largest exporter (after Germany, Japan and the US) and third largest importer (after the US and Germany). China also ran trade surpluses in the six years preceding 2003, when the trade surplus was $25.47 billion. Merchandise trade surpluses and large-scale foreign investment have enabled China to accumulate massive foreign exchange reserves ($286.4 billion in 2002 and $403.2 billion in 2003). Somewhat to the astonishment of China's critics, China's accession to the WTO has proceeded quite smoothly. A recent World Bank report[8] estimates that if the trend continues China's share of world trade would increase from 3.0% in 1992 to 9.8% in 2020, making China the world's second largest trading economy after the US.

[6] Under the General Agreement on Trade and Services (GATS), trade in services as the supply of a service can be treated with four models: Cross-Border Supply, Consumption Abroad, Commercial Presence (FDI), and Movement of Individuals (Mattoo, 2002).
[7] China's imports increased at a fairly steady rate in the years up to 2004, when the trade surplus hit US$32 billion, an increase of 25.3% from 2003 (China Statistical Yearbook, various volumes).
[8] *China Engaged: Integration with the Global Economy* (1997), World Bank, p. 31.

The paper is organised as follows. In section 2, we discuss trade liberalisation and sectoral/regional inequality. Section 3 surveys recent CGE studies on the impacts of WTO membership on income inequality in China. Section 4 provides a rough description of the CGE model of China (PRCGEM). Section 5 presents our database, baseline and simulation scenarios. Section 6 describes the simulation results at macro, sectoral and regional levels. Section 7 deals with policy implications suggested by the analysis.

2 Trade liberalisation with sectoral/regional inequality

2.1 Trade patterns

China's agricultural sector employs a large share of the workforce, yet its per capita output has remained modest.[9] China's trade pattern in agricultural commodities generally follows its comparative advantage: China tends to import land-intensive commodities (e.g. grains, especially in the 1990s) and export labour-intensive agricultural commodities (e.g. fish, fruits, vegetables and processed agricultural goods).

Trade within the agricultural sector is managed by a complex institutional and policy regime, with non-tariff barriers (NTBs)[10] playing an important role in China's agricultural trade policies. Among its non-tariff barrier commitments, China has promised to reduce or eliminate the monopoly of state trading companies, as well as replace the current import quota and licensing system with a tariff-rate quota system. Trade in major grains, however, continues to be handled exclusively by state-owned trading organisations.

Domestic demand is satisfied by the allocation of import quotas. This is a major issue for the Chinese, since accession has seen the increase of agricultural imports at undistorted market prices[11] and reductions in government import quotas. WTO membership is expected to facilitate imports of resource-intensive products such as wheat, rice, cotton and soybeans, as well as the export of more labour-intensive products such as fruits, vegetables, livestock and aquaculture products.

[9] The agricultural sector accounted for over 55% of total employment in 1997, yet its overall contribution to value-added was only about 22% (Table 2 in Hertel et al., 2002).
[10] The most important non-tariff barriers in agriculture are quotas, import licences and the use of state trading companies.
[11] The share of agricultural goods sold at state-fixed prices declined from 94% in 1978 to around 17% in 1995 (Ianchovichina *et al*., 2000b, Table 1).

In recent years, China has vigorously built on its comparative advantage in light manufacturing (e.g. textiles and garments, toys, consumer electrical appliances and consumer electronic products). The share of manufacturing in total employment in 1997 was still relatively small (only about 18%), but already then it made a disproportionately large value-added contribution (33%). Textiles and clothing, electronics and chemicals led the way.

The global market continues to provide China with opportunities to diversify exports. During the period 1994–2000, the share of the exports coming from the Electrical Machinery, Consumer Electrical and Electronic Products categories rose from 16.3% to 29.3%, while share of exports from the Textiles and Garments category fell from 28.3% to 19.8% (Table 2). The phase-out of textile quotas has also helped boost exports of textiles and garments dramatically. Much of the significant growth in manufacturing has apparently been driven by exports and tariff exemptions for imported intermediate inputs used in the production of export goods.

China's effective tariff collection rate in 1995 was 5.6%, a figure well below the trade-weighted average tariff of 32% (World Bank, 1994). By 1997, the effective collection rate for Agriculture and Manufacturing Sectors was 3.48%, compared to an unweighted average tariff of 13.72% (China I/O Data, 1997).

An abundance of cheap labour has made China internationally competitive in low-cost, labour-intensive manufactures. Not surprisingly, manufactured products comprise an increasingly large share of China's trade. The share of Chinese manufactured exports to total exports rose from 50% in 1980 to 92% in 2000, while manufactured imports as a share of total imports rose from 65% to 82%. A large share of China's manufactured imports are intermediates (e.g., chemicals, electronic components and textile machinery) used in manufacturing products in China.

In 2000, the leading Chinese imports were:

- electrical machinery, equipment and related products,
- mineral fuels and related materials,
- base metals and related products,
- chemicals and related products,
- textile materials and products, and
- plastics and related products.

The leading exports in 2000 were:

- electrical machinery, equipment and parts,
- textile materials and products,
- base metals and related products,
- footwear and related products,
- chemicals and related products, and
- mineral fuels and related products.

Intra- and inter-industry trade have developed since China's WTO accession. China is a net importer of skilled- labour-intensive and capital-intensive manufacturing products and a net exporter of unskilled-labour-intensive manufacturing products.

Liberalisation of imports and the opening up of the service sector in China is expected to pressure the economy to rationalise and restructure, particularly in the case of state-owned enterprises (SOEs).[12] The share of services in total employment in 1997 was around 27% and its contribution to economy-wide value-added was about 45%.

As China's economy has shifted from an economy based on import substitution to an export-oriented economy, it has also developed a highly competitive labour-intensive, export-oriented manufacturing sector dominated by foreign-funded enterprises (FFEs).[13] Simultaneously, China maintains a fairly traditional capital-intensive industrial sector dominated by SOEs, as well as an agricultural sector that enjoys a relatively high degree of government support and tariff/non-tariff protection (UNCTAD, 2002).

The penetration of imported goods and services in the form of FDI is expected to increase competition on domestic markets and the use of modern technology. This trend should encourage local industries to improve efficiency and productivity, even if it involves extensive restructuring, labour-shedding and adjustment problems. Chinese con-

[12] SOEs, generally recognised for their low productivity, inefficient production with outdated facilities and technology, employment excesses and high inventory levels, account for about half of China's exports. Even so, most sales are, on balance, directed at domestic markets. SOEs still dominate heavy industries such as power, steel, chemicals and armaments and services such as banking, telecommunications, wholesale distribution and certain transport activities. SOEs accounted for 12% of total employment and 47% of manufacturing-sector employment in the late 1990s (China Statistical Yearbook 2000).

[13] FFEs (mostly owned by investors from East Asia) include equity joint ventures, contractual joint ventures, wholly foreign-owned enterprises and joint exploration companies for certain extractive industries. FFEs already dominate several light industries, including footwear, garments and toys.

sumers, in turn, expect a transparent, market-driven economic system will deliver an abundant variety of affordable goods.

2.2 Lowering barriers

China cut tariffs seven times between 1992 and 2001, lowering the unweighted import tariff level from 43.2% to around 15.3%.[14] In 2002, China further lowered tariff rates on 53,000 items, about 73% of all items subject to tariffs. This cut the unweighted average tariff to 12% at the end of 2002. The average tariff in 2004 was 10.4%.

Many non-tariff measures such as import and export licensing, price controls, subsidies, quotas and tendering have been modified. Between 1992 and 1997, China reduced the number of products subject to import quotas, licences administration and import controls fell from 1,247 to 385.[15]

China introduced in 1996 tariff-rate quotas (TRQs) on certain products and tariff rates applicable to imports both in and out of quota. TRQs have been widely applied to agricultural goods. Liberalisation of agricultural products in accordance with its WTO commitments is expected to a major impact key agricultural exporters such as the US, Argentina and Canada. The country has also made considerable progress in freeing agricultural commodities from state pricing and in guiding farmers to adjust the structure of agricultural production based on the demands of the market. Under its WTO protocol, China agreed to establish an efficient TRQ system for imports of agricultural bulk commodities (e.g. wheat, corn, cotton, barley and rice) during 2002–2004, whereby imports up to a specified quota level would be assessed a low tariff (1–3%) and imports above a certain level would be subject to a high tariff.

While China officially abolished direct subsidies for exports on January 1, 1991, many manufactured exports in China still receive indirect subsidies through guaranteed provision of energy, raw materials or labour supplies, or in the form of not-to-be-repaid or long-term bank loans at low interest rates. The value-added tax (VAT), introduced in the early 1990s, has recently been put to use as a quasi-subsidy tool. Tax rebates and duty exemptions on imported inputs for export production are provided to exporters, while com-

[14] Xinhua, Dec. 29, 2000, (http://www.china.org.cn/english/2000/Dec/5896.htm)
[15] Deregulation Report 1997 – China (APEC)

modities (imported or domestic produced) bound for the domestic market are subject to a high VAT rate.

Due to the limited and unreliable data sources and methodology, quantitative estimates of the impact of non-trade barriers in China are rarely attempted. According to the Pacific Economic Co-Operation Council (1995), NTB equivalents during 1984–1987, 1988–1990 and 1991–1993, were 10.6% (17.8% for primary products and 7.9% for manufactured goods), 23.2% (27.2 for primary products and 21.9% for manufactured goods) and 11.3% (11.5% for primary products and 11.3% for manufactured goods), respectively. Zhang et al. (1998) put the total average 1994 tariff equivalents of China's NTBs at 22.1%, with 30% of all imports enjoying highest protection. Li and Zhai (2000) decompose the difference between the domestic price and world undistorted price into the tariff rate and non-tariff barrier equivalent. Their calculated unweighted NTB equivalents for manufactured products are 13.03% for 1995. Li and Lejour (2000) estimate the NTB equivalent as suggested by Hoekman (1995) averaged 3.3% in 1997. Wang (2001b) calculates the NTB equivalents for China at 9.6% in total trade average for 1997 using the difference between import protection rate in the version-five GTAP database and China's tariff after adjustment for duty exemptions. Given the wide range of estimates to draw on, any quantitative analysis of China's NTBs should be approached with great caution. We use the last two sets of estimates.

China's service sector remains heavily regulated and sheltered from competition. It remains relatively underdeveloped and foreign participation has been minimal until quite recently. NTBs still abound in the service sector, and many service industries (e.g. basic telecommunications, banking and insurance) remain government monopolies.[16]

When China joined the WTO, banking and finance, foreign financial institutions were prohibited from doing local-currency business with Chinese enterprises and stringent geographic restrictions were imposed on the establishment of foreign banks. By 2007, all geographic and customer restrictions should be lifted.

China has actively awarded licences to foreign insurers in both the life and non-life sectors in recent years. Although all geographic and ownership restrictions should be lifted by 2007, we prudently assume that only half of NTBs will actually be gone by then.

[16] China earlier prohibited all foreign ownership in telecoms, but at WTO accession, foreign-held stakes of up to 25-30% were allowed in some cities. Foreigners presently may own up to 49% of a telecom.

2.3 Regional industry structures

The economic reforms introduced in 1978 were designed to correct the structural imbalance that resulted from the 1949 policy of rapid, state-directed industrialisation that emphasised development of steel and defence-related industries. During 1979–2001, reforms radically altered the output structure across regions.

China's manufacturing base is located mostly in seven regions. The North-Eastern Region (which includes the Liaoning province) is China's oldest and most industrialised region. Its diversified resource base supports petroleum refining, coal mining, iron and steel, chemical and timber industries. The Northern Region (Inner Mongolia) is a relatively new industrial region. The Beijing-Tianjin industrial belt is a coal-mining district producing iron and steel, machinery, chemicals and textiles. The Eastern Region is an old industrial region centred in Shanghai. The South-Central Region has well-developed food-processing and handicraft industries. The North-Western Region (Shananxi and Gansu provinces), the newest industrial region, is heavily involved in petroleum refining, as well as the petrochemical, iron and steel, and cotton textile industries. The South-Western Region (Sichuang, Yunnan, and Chongqing provinces) is the country's principal producer of non-ferrous metals.

The Guangdong province by itself accounts for more than a third of total trade, followed by Beijing, Shanghai and Jiangsu. The output of the regions along the sea is dominated by secondary industry (more than 50%) and tertiary industry (over 30%) (see Table 3).

This diversity suggests that implementation of China's WTO commitments will have different impacts across regions. Indeed, the uneven impacts of WTO membership are already manifested in rapid growth rates in some regions facilitated by restraints on spill-over to other regions and industries. Where possible we try to take such distortionary effects into account in our simulations.

Assessing the impact of trade liberalisation is highly problematic. There appears to be a considerable discrepancy between the restrictions nominally in place and the effective level of trade restrictions. In computing the impact of liberalisation, we must therefore tackle both the traditional problem of determining the tariff equivalent of quantitative restrictions (Li and Lejour, 2000) and the task of defining an appropriate level for actual barriers. China's Customs reported that 40% of imports in 1995 were ordinary imports with-

out duty exemptions/drawbacks.[17] Further, the GTAP Database 4 for 1995 (McDougall et al., 1998), shows 14% of imports were for final consumption. From these figures, we deduce that about 26% of imports were used as intermediates. The GTAP Database 4 puts China's exports at around 10% of its output, which implies that around 3% of imports are used for the production of ordinary exports (Ianchovichina and Martin, 2002). Lejour (2000), for example, finds a considerable effect from modelling duty exemptions explicitly. Failure to account for duty exemptions/drawbacks in the case of China's WTO membership overstates impacts for exports, welfare, output, etc. (Ianchovichina and Martin, 2001). Without full liberalisation, deep duty exemptions for imported intermediate inputs and high trade barriers (tariff/non-tariff) may disadvantage industries that rely on domestic value-added rather than imported intermediate inputs.

3 CGE models of China

We draw on a number of studies of trade liberalisation with China. Most employ computable general equilibrium (CGE) models[18] such as GTAP (Yang, 1996 and Hertel, 1997), MEGABARE (Mai et al., 1998), G-CUBED World Model (McKibbin and Tang, 1998), PRCGEM (Fan and Zheng, 2000, Mai et al., 2003, Mayes and Wang, 2003) or other purpose-built models (Wang and Li, 1998 and Zhai and Li, 2000).[19] In the main, these models are used to get an idea of longer-term impacts rather than establish a year-to-year trajectory. Almost all simulation results suggest China and its major trading partners (the US, EU, Japan, Taiwan and Hong Kong) gain from China's accession (McKibbin and Tang, 1998, Ianchovichina et al., 2000a and Wang, 2001). Not surprisingly, the results also suggest that China (including Hong Kong, Taiwan) will be the biggest beneficiary. Wang and

[17] Duty exemption/drawback is used as means of providing exporters with imported inputs at world prices or with a very low tariff. The host country, in turn, can increase its competitiveness in the world market while shielding its own producers against competition from the rest of the world.

[18] CGE models are widely used for policy analysis. They have an advantage over other models (e.g. partial equilibrium models) in policy analysis when there is a need to consider links between producing sectors, links between macro and micro levels, and the disaggregated impact of changes in policies and exogenous shocks (tariff reductions, technological progress, etc.) on sectoral structure, household welfare (equivalent variation), investment allocation and income distribution.

[19] For more China's trade liberalisation, see Gilbert and Wahl (2002). For single-country recursive dynamic CGE models, see Adams et al. (1994) and Dixon and Rimmer (2001) with respect to the MONASH model and Hertel et al. (2002) for the DRC-CGE Model. For multi-region recursive dynamic CGE models, see Ian-

Schuh (1998), for example, predict a net welfare gain of about $47.5 billion, or 5.3% of GDP in 1997 prices in the steady-state with capital market adjustment. Gilbert and Wahl (2002) show accession has no impact on the overall level of employment in China, but rather induces inter-sectoral shifts in employment and output in their CGE models (and particularly GTAP).

Table A summarises some the macro-economic estimates of the impact of China's WTO membership from a range of studies using CGE models. Due to different simulations under different assumptions and policy alternatives, the results are largely different. Results in multi-country CGE models tend to be larger than those in single-country models (possibly due to a consideration of feedback from the rest of the world). In any case, under the same framework (single- or multi-country CGE), there remain large differences in outcomes caused by different considerations of CGE structure under diverse labour-market assumptions with different baselines. These analyses find that China's WTO accession is welfare-enhancing and good for economic growth and trade, adding about 1.2% to GDP growth. Tariff reductions are also expected to lower import prices. As China's investment goods are import-intensive, the price of capital creation falls. This results in a higher rate of return on capital in China, so investment and capital increase.

A notable outcome is that growth of real investment outstrips consumption growth. This could be partly explained by the uneven income distribution effects from trade liberalisation. Savings are channelled into investment, adding to employment and income.[20] However, since this process involves both trade and financial liberalisation, the terms of trade deteriorate. Export growth thus results in an asymmetric growth of imports.

chovichina et al. (2000b). See Bovenberg and Goulder (1991) and Baldwin and Forslid (1999) for discussions of growth features in CGE models.

[20] While the evidence suggests Chinese savings have risen over time, there is no clear picture of how Chinese savers will behave once the country's WTO commitments are fully met. A flexible exchange-rate regime, for example, could help minimise disruptions from changes in the savings rate so as to achieve the transformation from current account surplus and capital inflow to current account deficit and capital inflow. On July 21, 2005, Chinese monetary authorities abandoned their long-standing US dollar peg for a sliding peg that allows the renminbi to fluctuate within a band of ± 0.3% against a basket of currencies.

Table A. Selected macro effects of China's WTO membership (cumulative effects from baseline), %

	GDP	Welfare[a]	Household consumption	Investment	Exports	Imports	Term of trade	Real exchange rate
Single-Country Model								
Wang and Li (1998)	1.53	1.24[b]	0.58	1.75	26.93	25.79	-1.57	1.85
Fan and Zheng (2000) [c]	0.06(0.62)		0.06(0.62)	0.00(1.59)	5.73(5.54)	7.26(9.05)	-1.84(-1.78)	3.34(2.79)
Li and Lejour (2000)	0.8	4.0	0.3	2.4	1.7	1.9		0.5
Li and Zhai (2000)	1.53	1.24[b]	0.58	1.75	26.93	25.79	-1.57	1.85
Zhai and Li (2000)	1.1	0.86[d]	1.05	0.81	17.13	16.75	-1.07	-0.27
Zhai and Wang (2002) [d]	1.09(2.45)	0.97(2.27)[d]	0.95(1.28)	1.27(4.31)	10.73(13.32)	10.94(13.56)	-0.73(-0.90)	
Diao et al. (2003)	0.73		0.81					4.79
Jiang (2003) [e]	0.56(0.54)	63.69(48.04)[f]	1.04(0.67)[g]	-1.22(3.84)			-0.46(-0.47)	0.00(5.45)[h]
Mai (2003) [i]	1.95(0.96)		1.95(0.96)	2.31(1.98)	8.94(6.31)	10.47(8.86)		1.13(1.66)
Mai et al. (2003)	10.7		10.7	11.6	11.2	12.0		
Multi-Country Model								
Yang (1996)	7.7				81.2	119.1	-12.2	
Wang (2001)	2.85	188.1			54.05	31.12	-5.66	
Francois and Spinanger (2002)	5.80				23.08			
Hertel et al. (2002)	0.64	0.69[j]	1.17	0.32	15.32	14.55		
Rees and Tyers (2004) [k]	0.42(0.28)		0.12(-1.37)	0.98(0.97)			-0.85(-1.12)	-1.03(-1.59)
Walmsley et al. (2004) [l]	4.26(1.57)	10.52(3.91)		6.08(0.72)[m]	17.59(13.73)	16.72(13.41)		

Note: [a] US$ billion.
[b] % of GDP.
[c] Results outside the parenthesis are static short-run gains associated with factor reallocation efficiency; those in parenthesis include both static and growth effects.
[d] Results in parenthesis consider a complete labour market reform.
[e] Results in parenthesis were not controlled for trade balance.
[f] RMB billion.
[g] Average household consumption of rural and urban households.
[h] Nominal exchange rate.
[i] Results in parenthesis do not consider endogenous productivity improvement.
[j] % in equivalent variation (EV).
[k] The results outside (inside) the parenthesis are short-run results under fiscal policy with no tax revenue switch (with tax revenue switch via an increase in the direct tax rate), when capital controls are ineffective.
[l] The results outside the parenthesis are China's accession with lump-sum replacement; those inside are tax revenue replacement.
[m] Capital stock.

The diverging trend in regional development is the result of profound structural changes in China's economy. Empirical studies addressing the issue of regional disparity and its determinants in China (Jian et al., 1996, Naughton, 1999, Kanbur and Zhang, 2004) suggest that the evolution of inequality coincides with political and economic events in China and globalisation processes (particularly since WTO membership). However, the existing literature provides no clear evidence as to how foreign trade expansion has affected regional development since WTO accession. Moreover, CGE research to date on China's WTO membership demonstrates overall welfare gains by sectors without considering how such gains might be distributed.

In addition to considering the complexity of China's economic structure and adjustments from WTO membership, it could also be worthwhile to distinguish regional impacts within China to get a fuller picture of the impact of China's accession. Data problems,[21] of course, have long dampened the enthusiasm of researchers to attempt CGE studies of the regional situation, but several brave efforts deserve mention (Yang and Huang, 1997, Fan and Zheng,[22] 2000, Diao et al., 2002, 2003, Jiang,[23] 2003).

Estimating the response of investment and its impact on location of an activity is a non-trivial problem. Moreover, as the new economic geography (Fujita *et al*., 1999) indicates, the attractions of agglomeration and the sheer size of China's markets tend to encourage expansion of foreign firms in the direction of local production.

We note several successes in tackling these problems. Walmsley et al. (2004) use a GTAP-Dynamic Model[24] to analyse the impact of China's WTO accession on foreign investment. They find that accession doubles the extent of foreign ownership of China's assets in 2020 relative to a non-accession baseline. Not surprisingly, this has a substantial impact, increasing the total welfare of China by as much as $125 billion in 2020. Using a dynamic approach enables an assessment of the costs of adjustment. The authors suggest that the short-term costs of trade liberalisation for highly protected goods industries will be

[21] It is difficult to get detailed regional I/O table, income, consumption and trade data for China. Moreover, inter-regional flows of products and factors are treated differently than in a global model as there are no customs data that might be used to track imports/exports between regions within China.
[22] In their top-down PRCGEM, sectors are classified into local and national sectors. Local sectors produce products that are not tradable between regions, while national sectors can produce tradable products. It is further assumed that the same percentage change in sectoral output applies to all regions within China. Hence, the differences in regional responses to the WTO accession are similar to structural changes.
[23] This model uses the "bottom-up" approach to model each region (28 provinces in total) within China as an open economy with its own agents and behavioural functions. Labour mobility across regions is allowed, while assuming perfect mobility of capital cross domestic region sand sectors.

significant both in terms of lost domestic output and lost jobs, while the long-term benefits of trade liberalisation will be sufficient to make up for any short-term losses (Zhang et al., 1998).

CGE models with micro-simulations have been applied to study income distribution.[25] Wage inequality between skilled and low-skilled workers is the outcome of the interaction of supply of skills (education), demand of skills (e.g. skill-biased technology which can come from the effect of FDI) and wage-setting factors (e.g. labour-market institutions, union coverage) (Te Velde and Morrissey, 2002). In China's case, institutional segmentation in the labour market (the Hukou household system[26]) and high labour mobility costs force foreign investors to pay a higher wage to attract the skilled labour from Chinese employers (SOEs). Thus, the costs of skilled labour push up the total average wage even without bringing in skill-biased technology.

CGE models can quantify income distribution effects in two ways. The first approach (Ricardian) describes them in terms of returns to factors of production. The second way is to model more than one household explicitly (e.g. peasant and non-peasant households in PRCGEM) as performed by Yang and Huang[27] (1997a), Wang and Zhai[28] (1998) and Li and Zhai (2000).

[24] Ianchovichina and McDougall (2001).

[25] See e.g. the CGE study of Tongeren (1994) on Dutch firms, Cogneau (1999) on a city of Antananarivo, and Cogneau and Robillard (2000) on a national model of Madagascar. They find that the neglect of general equilibrium effects in standard micro-simulations under the assumption of a fixed intra-group income distribution can strongly bias results.

[26] The Hukou system was established in cities in 1951 and extended to the rural areas in 1955. It establishes a tight relationship between place of residence and access to consumer goods, employment opportunities and social benefits. It consists of agricultural registration by rural residents and non-agricultural registration by urban residents. Social welfare for non-agricultural Hukou-holders is much better than for rural residents, and urban sectors must consider non-agricultural Hukou-holders first. This discourages rural-urban labour movement in the labour market. Despite significant modifications since the early 1980s, the Hukou system remains firmly in place today. For details, see Chan and Zhang (1999).

[27] Yang and Huang (1997a) tackle the income distribution of China systematically with a single country CGE comparative-static model. They consider a 30% reduction in the overall tariff and a similar reduction in the agricultural tariff only. Their results show that comprehensive trade liberalisation leads to a Pareto improvement in China. Consequently, income inequality in both rural-urban and rural income distribution diminishes. If only agricultural liberalisation is undertaken, poorer rural households are worse off, while the overall economic situation improves. If only industrial liberalisation is undertaken, both rural-urban equality and rural income distribution narrow, while urban income distribution becomes more inequitable. The paper only considers trade liberalisation (not investment liberalisation) and results are solely focused on the national level. Moreover, the model does not account for tax replacement.

[28] Tax replacement is introduced in the seminal paper of Wang and Zhai (1998). Their simulations assume the level of government revenue is maintained by endogenous adjustment of various taxes. Their results indicate both increased economic efficiency and improved income equality as a result of trade liberalisation, both in terms of factor payments and household incomes. They emphasise that increases in income disparity are not a necessary outcome of China's trade liberalisation and can be avoided by appropriate adjustment of the domestic tax structure.

4 Basic model structure

We study the effects of trade policies in China after accession using an updated PRCGEM model[29] with an updated database (2002 Regional/National I/O Table). PRCGEM is a conventional single-country comparative static model that assumes perfectly competitive constant-returns-to-scale production.[30] The model distinguishes 40 sectors, 31 provinces, 2 occupations and 2 household types. Its theoretical structure follows the Australian ORANI-F model (Horridge et al., 1993), and is solved using GEMPACK (Harrison and Pearson, 1996). We apply the PRCGEM model first to tariff liberalisation, and then, after minor modifications, use it to capture the major features and impacts of non-tariff equivalent liberalisation in China's current economy. Finally, the original PRCGEM is again adjusted to separate China's trade regimes into an ordinary trade regime and a processing trade regime.[31] A small duty exemption mechanism is introduced.

This section summarises the PRCGEM's main features. A more detailed description is found in Appendix I.

An important feature of this single-country multi-regional CGE model is the explicit treatment of two trading regimes (EOPEs[32] and DOPEs[33]). EOPEs grew rapidly in the 1990s, eventually accounting for more than half of total trade. Considering the different characters and behaviour of trade between EOPEs and DOPEs, it is critical to give an explicit treatment to this dual trade regime in the CGE model.

PRCGEM considers 31 regions, each with a demand structure and foreign trade in commodities and services. The inter-regional input/output (I/O) is also embedded. Produc-

[29] This updated PRCGEM is an extension of the original PRCGEM used in China's WTO accession study (Fan and Zheng, 2000). Some significant modifications are introduced to capture major features of foreign trade/investment with regional extension. For simplicity, we keep the name PRCGEM.
[30] Some of the available dynamic features were not used in these simulations.
[31] China had developed two trading regimes by 1987. The new regime, export processing, was extremely open. Most foreign-invested firms and some domestic firms participated in it. The second was the traditional trade regime. Export processing expanded rapidly; by 1995, it accounted for over 50% of all Chinese exports (Naughton, 1996).
[32] Export-Oriented Processing Enterprises (EOPEs) produce exclusively for export markets using imported intermediates that are either exempt from duties or eligible for a refund on the import tax paid. "Ordinary" exports outside the EOPEs are produced exclusively with domestic inputs. In actuality, complex administrative rules strongly discourage EOPEs from selling domestically. Ianchovichina (2004) shows that in 1995 approximately less than 3% of intermediate imports were used for the production of ordinary exports.
[33] Domestic-Oriented Processing Enterprises (DOPEs) produce no exports and exclusively supply China's domestic market.

tion is modelled using nested CES functions that assume constant returns to scale (CRS). Household demand is modelled by the Linear Expenditure System (LES). Trade is modelled by the Armington assumption for import demand (i.e. intermediate, investment, household, government import demand), and a CET for export supply. The small country assumption holds for imports, meaning that import prices are exogenously determined in the model. All demand and supply functions are assumed to be homogeneous of degree zero in prices (or money-neutral behaviour). All commodity and factor markets are assumed to clear by prices. Labour (with movement determined by the relative real income across sectors/regions and the CES) is assumed to be perfectly mobile within sectors/regions in a short/long-run closure. This assures a single region-wide equilibrating wage rate for both skilled and unskilled labour. Land is assumed to be fixed and used solely for agricultural activity. Capital (with its movement driven by relative rental rates across sectors/regions and the CES) is assumed to be partially mobile, reflecting differences in the marketability of capital goods across sectors/regions. It is assumed capital is immobile in a short-run closure, and perfectly mobile in a long-run closure.

The current PRGEM used for this research has a simple recursive dynamic structure. Dynamics in the PRCGEM originate from accumulation of the productive factors and productivity changes, taking into account changes in industrial structure, factor composition and comparative advantage. The base year is 1997. The model is solved directly for subsequent years to 2002. Then, using the resulting 2002 baseline, the model is solved for 2007, when most requirements in the WTO protocol are deemed to be implemented. Growth rates are exogenous for population, tariff/non-tariff barriers, duty exemption, capital, land, labour force and labour productivity.

5 Database, baseline and scenario design

China's WTO accession includes a complex package of trade and investment liberalisation. Based on the final commitments made for market accession, this paper quantifies the impacts of the following:

- tariff reductions on agricultural and industrial products;
- elimination of duty exemption by 2007; and
- non-tariff barrier cuts in agriculture and industrial commodities.

At best, this analysis only captures a fraction of the impacts of China's WTO membership. It necessarily avoids such obviously important issues as the dismantling of barriers in services, FDI and enforcement of WTO commitments.

In view of the high, unpredictable tariff exemption and other aspects of China's imports,[34] we use MFN tariff rates to represent the effective tariff rate rather than the nominal tariff rate. Welfare and other effects from cutting this tariff are fairly modest, given the low share of government tariff revenue since the early 1990s. China's government tariff revenue share of total tax revenue drifted in the range of 3.38–6.45% between 1990 and 2003, i.e. tariff revenue accounted for only a sliver of total government revenue. Thus, it is unlikely that trade liberalisation (tariff cuts) will have much impact on government policy or expenditure decisions. Reducing tariff duties could generally reduce government revenues, or, in the case of high import tariff rates, increase tariff revenues where there is incentive to bypass tariff payments through smuggling, illegally eliciting the support from customs officials to reduce the declared value of the imports or similar grey-market behaviour (i.e. lowering the import duty reduces incentives to cheat and results in more goods trading through official import channels). We must omit such speculation from our empirical model, of course, and note simply that the government is free to offset any declines in tariff revenue with increases in other sources of revenue such as the income tax. The tariff rates projected in Table 5 fall gradually from 1997 to 2002. The change after 2007 is negligible, even if China does not complete full implementation of its promised tariff cuts until 2010. We thus take 2007 as the "final year" for China's tariff cuts under its WTO accession commitments.

5.1 Data and special considerations [35]

The base case projection over a five-year period (2002–2007) is established with 2002 Regional/National I/O Table (derived from the 1997/2000 National I/O Table and 2000 Re-

[34] It is well recognised that China's tariff collections are significantly below the nominal tariff level due to the large volume of processed trade, extensive import duty exemptions and widespread smuggling (World Bank, 1994 and Bach, et al., 1996).
[35] Appendix I provides detailed summary of database.

gional I/O Table using the RAS method[36] supported with data from various China Statistical Yearbooks).

The data in the Trade, Tariff and Production dataset are grouped and simplified for ease of presentation. An exchange rate of 829 renminbi per 100 US dollars (1995–2003 average) is used. Again, we do not take into account several major aspects of WTO accession, including the reduction of barriers in service trade (sectors 24-40), foreign investment (FDI), the MFA phase-out for textiles and apparel, protection of intellectual property rights, securing market access and cooperation in dispute settlement.

Using W to represent factor prices, K as capital and P as output prices, our focus here is on $\frac{\partial W}{\partial P}$ and $\frac{\partial W}{\partial K}$, i.e. the effects on factor prices (W) of changing prices due to free trade and impacts on factor prices of changing capital stocks due to foreign investment.

Most CGE models aggregate household categories, which limits their usefulness for poverty and income distribution analysis.

5.2 Baseline scenario

In order to simulate the impact of China's WTO accession, we select one baseline scenario (in 2002) and two main simulations of the period 2002–2007. For the baseline scenario, we assume no trade reform (tariff/non-tariff or duty exemption cut) takes place during the period 2002–2007 (Table 5). We also assume economic development without WTO membership in 2002–2007 follows the same path as in 1997–2002.[37] "Short-run" and "long-run" simulations beyond the baseline simulation are considered to isolate and quantify the impacts of "tariff" and "tariff & non-tariff" reductions and duty exemption cut for China's WTO accession. There are two macro-closures[38] for the short/long-run simulations. In both cases, CIF foreign currency import prices, exchange rate, number of households, power of tariffs/non-tariffs, use of land, most technical change and shift variables are treated as exogenous, such that:

[36] We apply a "biproportional" row-and-column operation; from Bacharach (1970).
[37] While it is a strong assumption that economic structural change and development are the same in 1997–2002 and 2002–2007, it could conceivably occur if the business cycle period was five years.
[38] Closure rules are applied to classify model variables as endogenous (i.e. values are determined by the model) or exogenous (values are pre-determined or shocks external to the model). The number of endogenous variables must equal the number of equations.

- *In the closure of short-run simulations*, aggregate use of capital and aggregate real investment expenditure are fixed and allocated among industries according to the changes in the investment capital ratio; the labour supply between regions/sectors is mobile, but the total labour supply is exogenous.
- *In the closure of long-run simulations*, the supply of capital is elastic across sectors and regions, capital stocks are determined by the exogenous rate of return, the investment capital ratio is fixed, and the labour supply (e.g. aggregate employment with wage bill weights) is fixed and mobile between 40 sectors. The total labour supply is again exogenous.

We use equivalent variation (EV) as a measure of the welfare impacts of China's trade liberalisation.[39] PRCGEM's lack of an inter-temporal utility function complicates the determination of the total welfare effect of China's accession, so we take EV as a measure of the change in the consumer surplus, i.e. the social welfare impact of China's trade liberalisation. Thus, EV takes the pre-policy equilibrium income and consumer price index as given and measures the changes in income required to obtain the post-policy utility level at pre-policy consumer price index as:

$$EV = CPI\,(\sum_i CA_i - \sum_i CB_i) = \sum_i CB_i(1 + c_i\%) - \sum_i CB_i = \sum_i CB_i c_i\%$$

where *CPI* is the pre-policy (baseline) consumer price index, which is assumed unity; CA_i is sectoral post-policy (simulation) consumption; CB_i is sectoral pre-policy (baseline) household consumption; and *c* is the percentage change in consumption. A positive EV value means improved welfare (gain); a negative EV means reduced welfare (loss).

Movement of labour[40] has become a prominent feature of China's economic development, reflecting ongoing changes in the internal division of work. Early rural reforms

[39] The most direct way to measure the welfare effects of a price change is to assess how it affects the maximum utility level a consumer can achieve. Two expenditure-based measures are widely used:

- Equivalent Variation (EV), the minimum (maximum) amount of money which would have to be given to (taken away from) an individual to make them as well off as they would have been after the price fall (rise); and
- Compensating Variation (CV), the amount of money that leaves a person as well off as they were before a change, measuring the amount of money required to maintain a person's satisfaction, or economic welfare, at the level it was before the change.

[40] In view of the short-term characteristics of labour movement between regions and other difficulties of tracking such mobility, we prefer to talk about "movement" rather than "migration" to avoid confusion.

(i.e. development of Township and Village Enterprises)[41] led to an initial increase in rural incomes. With the success of the agricultural reforms under Deng Xiaoping in the late 1970s and early 1980s, food supply in China's cities increased dramatically, making it possible for people to come in from rural areas and survive without food rationing. As rural incomes began to level off, farmers started to look for alternative sources of income. In the mid-1980s, regulations concerning the movement of labour were revised to at least temporarily relax enforcement of labour-movement restrictions. Since 1986, and especially since 1998, inequality (mainly rural-urban inequality) has widened as the effects of other reform policies (non-state sector growth) have started to be felt.

Transition to a market-oriented economy creates a high disparity in economic development among regions. Movement of labour in China mainly consists of surplus labour moving from rural areas to rapidly developing urban areas.[42] While the majority of rural residents moving to cities have only high school or primary school educations, they have generally made positive contributions to the rapid growth of coastal areas. Not only have they helped build China's new urban infrastructure, they have been crucial in keeping labour-intensive sectors in coastal regions internationally competitive. Movers also transfer resources (remittances, investments, information, etc.) back to their home villages, contributing to rural economic development and helping reduce income disparities.

This study focuses on inter-regional movement of labour and resulting impacts on regional income inequality, and leaves open opportunities for further research on rural-urban and intra-regional labour movement. We assume simply that a wage difference across regions results in movement of labour,[43] which likely over-estimates actual labour movement.[44]

$$L_{e,r}^{move} = \alpha_{e,r} \cdot (W_e - W_r) \qquad \text{e,r = 1,2,3…….31}$$

[41] Township and Village Enterprises (TVEs), initially established in late 1950s, were responsible for establishing and promoting rural industry. TVEs today are the single largest source of employment for industrial workers. See Fu and Balasubramanyam (2003) for details.
[42] Further discussion of movement of labour and migration in China can be found in Huang and Pieke (2003) and Wan et al. (2005).
[43] When the wage in the destination region is relatively high, labour moves to pursue the higher wage. In reality, the movement of labour is influenced by many factors beyond the wage rate differences such as differences in regional unemployment rates, population size or density, agricultural contribution to GDP (surplus rural labour accounts for a good deal of labour movement) and distance from home. For details, see Wan et al. (2005).
[44] Beyond regional wage differences, other factors (distances, culture shock, etc.) may militate against labour movement/migration. Again, see Wan et al. (2005) for details.

$L_{e,r}^{move}$ = Labour movement from Region *e* (origin) to Region *r* (destination)

$\alpha_{e,r}$ = Coefficient

W_i = Wage rate ($i = e, r$)

The purpose of introducing labour movement between regions is to re-measure regional inequality, which traditionally has been calculated without considering massive movements of labour. We thus hypothesise that potential regional inequality will be lower when net labour movement is considered in the calculation of per capita income across regions.

We quantify the impact from tariff and non-tariff liberalisation with removal of duty exemption on agricultural and manufactured sectors under China's November 2001 WTO accession protocol in our short- and long-run simulations. Using gravity equation estimates, Francois and Spinanger (2002) solve for tariff equivalents of non-tariff barriers in the service sectors before and after China's accession.[45] We focus here on the agriculture and manufacturing sectors as there are no import tariffs in the service sector, only trade barriers such as quotas and licences. We thus leave service-sector liberalisation for further research[46] with the acknowledgement that service-sector trade liberalisation will directly affects the service production and trade and have significant implications for other sectors in the economy through the channel of international transportation margins and forward-linkages through inter-industry input-output relations (Robinson et al., 2002). Thus, our findings should likely underestimate impacts on social welfare, and export and import growth.

China enjoys reciprocal benefits from WTO membership. We use a single-country model here, so we only consider a single rest-of-the-world input and omit feedback effects. The effects of reciprocal benefits from WTO in PRCGEM show up when we shock export demand.

In the policy simulations, we analyse the effects of trade liberalisation on GDP, household, export and stocks demands, supply of domestic and imported goods, price of

[45] Service sectors include wholesale and retail trade, transportation services (land, water and air), telecommunications, construction, finance, insurance and real estate services, other commercial services and other services (health care, etc.).

exports, capital, land and labour, employment and investment. Sensitivity analysis follows to check how sensible the simulation results are on the key parameters (export elasticity, Armington index, etc.).

6 Simulation results for trade liberalisation

As mentioned, we consider just two closures:

(i) The closure of a unilateral tariff/tariff&non-tariff[47] cut with removal of duty exemption[48] in non-service sectors as required by WTO accession.[49]

(ii) The closure of full economic structural and development besides closure (i).[50] Gradual liberalisation, which allows domestic firms to adjust and transform their productive structure gradually to face competition with foreign products on the domestic market, is considered.

Base Case: 2002 I/O Table (40 sectors, 2 households, 31 regions)

2002 Regional I/O Table (31 regions, 40 sectors)

- Short-Run, Only WTO (tariff/non-tariff and duty exemption);
- Long-Run, Only WTO (tariff/non-tariff and duty exemption);
- Short-Run, Full Economic Structural and Development (tariff/non-tariff and duty exemption plus normal economic development with same trend as 1997–2002[51]);[52]
- Long-Run, Full Economic Structural and Development (tariff/non-tariff and duty

[46] In a separate exercise, we introduce the tariff equivalent tariff cut on services from Francois and Spinagner (2002) and associated sector-specific productivity impacts from Mai et al. (2003) to study China's service liberalisation due to WTO membership.
[47] We assume a 90% decrease from 1997 to 2005. This reaches zero in 2006, when the non-tariff barrier in agriculture and manufacturing sectors should have fallen by 90%.
[48] The duty exemption is assumed to be reduced to zero gradually during 2002–2007.
[49] Actually, this is the limited WTO effect. For simplicity, we use "Only WTO" to represent this effect throughout this paper.
[50] In this research, the reaction of other WTO member countries is ignored in this single-country CGE model. More detailed research on treating the response of the rest of the world requires a multi-country CGE model, which is beyond this paper.
[51] The baseline is the published 1997 I/O Regional/National Table which is calibrated according to the economic growth with liberalisation for the period of 1997–2002, to produce an updated 2002 I/O Regional/National Table. It is assumed that if the WTO liberalisation were not involved, China's economy would just change as in 1997–2002 till 2007.
[52] Including closure (**i**).

exemption plus normal economic development with same trend as 1997–2002).[53]

Our CGE model has the advantage of indicating adjustment costs involved, especially in the short-run, due to the incomplete movement of certain factors. This can be detected in part through comparison of short-run and long-run simulations. The principle routes of impact from China's WTO accession within the model are straightforward. Chinese consumers benefit from lower prices as trade barriers are reduced (they also likely benefit from increased choice, although this is not picked up in our calculations). Some industries (e.g. heavy industries and agriculture) are hurt by reduced protection, while other industries (especially export-oriented industries such as textiles and clothing) benefit considerably from improved access to overseas markets and reduced costs of intermediate imports. Aggregate output expands by 43.26% and real GDP 31.72% in the long-run full closure – both from larger markets (domestic and overseas) and because of more efficient resource allocation across sectors and regions. Liberalisation with economic structural change may well play an important role throughout the economy, but we have not attempted here to model changes in responsiveness or any growth-rate effect from a less restricted economy. The expectation that labour movement should be stronger in the short run than in the long run is confirmed by our results. Total regional labour movement under the full short-run closure is 5.8% higher than the full long-run closure. The regional picture confirms that regional inequality is still significant, especially for the full closure.[54]

6.1 Macro results

Table 6 presents key efficiency indicators and other macroeconomic indicators under the short/long-run scenarios for China's WTO accession, measuring deviations from the 2002 baseline. Due to the low real tariff collection rate and tariff exemptions granted to EOPEs, the gains arising from the only WTO scenario are relatively small. The results show China benefits from its WTO accession in terms of real GDP, household consumption and trade. In 2007, China's real GDP would be 6.48% (5.60%) higher than in the baseline of 2002 under the pure short-run (long-run) WTO shock[55] and 22.46% (31.72%) higher under the short-run (long-run) full economic structural and development shock. Real investment

[53] Including closure (ii).
[54] Regions along the coast are much better off than inland regions in China.

would be 2.2% higher than in the base scenario in the long-run simulation for only WTO and 14.94% for full economic structural and development. Real household consumption would be 6.48% (5.60%) higher in the pure short-run (long-run) WTO shock, indicating the benefits to consumers from trade liberalisation are small. In the short-run (long-run) full shock, real household consumption rises to 22.46% (31.72%).

China's trade (exports and imports) grows rapidly, especially in the full closure. The pure WTO effect is only 5.96% (10.1%) for real imports (exports) in the long-run, which may be due to considering the 100% duty exemption tariff cut for EOPEs with already low real tariff rate.[56] The contribution of pure WTO effect on exports (imports) is US$35.01 (US$6.67) billion in the short-run closure, while it is US$29.43 (US$16.33) in the long-run closure. The real exchange rate depreciates in the pure WTO, while it appreciates in the full closure because of the relatively strong increase in imports, originating from the reduction in import protection for import intermediates used in EOPEs. Trade (exports and imports) increases approximately 50% in the full closure. This may be partly the result of relatively low growth of real investment, which is only 2.2% (14.94%) in the long-run pure WTO closure (full closure). The Sectoral Gross Allocation Effect (GAE)[57] is 1.38% (1.44%) higher than the baseline in short-run (long-run) pure WTO closure, confirming that labour movement plays a role in labour productivity. The GAE increases to 6.29% (6.2%) in short-run (long-run) full closure.

The factors interact. Generally, the gains in GDP and welfare result from the enhanced efficiency of resource allocation arising from increased specialisation with comparative advantage. Removing tariff/non-tariff protection rates encourages cheap imports of intermediates used in EOPEs, especially in the short-run simulation of only WTO, which in turn induces real appreciation of the Chinese currency. Trade in EOPEs accounts for more than 50% of China's total trade (exports plus imports). Moreover, exports in EOPEs have high import content due to policy orientation and factors such as the nature of FDI. Thus, growth of exports is expected to result in a corresponding growth of imports, which in turn increases pressure for real depreciation of the currency. Relatively strong growth of exports, on the other hand, results in real currency appreciation that contributes

[55] This result confirms the literature in Table A to some extent.
[56] Consequently, the results are trivial because most of the barriers do not exist significantly.
[57] GAE is used to measure the growth in aggregate labour productivity when employment shifts among sectors, given relative labour productivities (Syrquin, 1986). For simplicity, the baseline GAE is assumed to be one.

to further growth of imports. This real exchange factor has contributed to the rapid increase in China's trade dependence and FDI inflows during the past two decades. With processing trade (from EOPEs) accounting for over 50% of China's total trade, higher exports will result in a corresponding growth of imports. The only WTO shock shows slightly worse terms of trade, while the terms of trade are better with full economic structural and development, especially in the short-run closure. There is no significant difference for demand on both non-peasant and peasant labour at around 13.5%. In the full economic structural and development closure, there is significant labour movement from rural to non-rural jobs, given the exogenous aggregate labour growth rate.

6.2 Sectoral results

Macro-level efficiency gains are not evenly distributed across sectors due to differences in industry structure across sectors. Table 7 reports the percentage change in real output, employment, trade, etc., induced by China's WTO accession and full economic structural and development. The agriculture sector imports less and exports more under the pure WTO shock, mainly due to a significant increase of real output.[58] However, full economic structural and development produces a totally opposite picture of higher real imports with decreasing real exports of agriculture in short/long-run closure. Real imports increase by 102.41% (102.59%), while real exports decrease by 10.16% (4.58%) in the short-run (long-run) closure. Furthermore, WTO membership pushes up the relative position of both labour-intensive sectors (clothing and textiles, etc.) and capital-intensive sectors (electric equipment and machinery, etc.) significantly, especially in the closure of long-run full economic structural and development. In the long-run full closure, the imports growth in textiles and clothings industries is much stronger than their exports growth rate.

In the light of natural average employment growth of 13.82% in the simulation period, the only WTO shock has little impact on employment movement between sectors, while the full economic structural and development significantly transfers labour from land-intensive agriculture to labour-intensive industry (clothing and textiles, etc.) in the long-run. However, the sectoral employment growth rate result shows that employment growth rate in the clothing industry is 1.4 (2.8) times higher than the national rate in the

short-run (long-run) full closure, while the opposite is true for the textile industry. Construction employment grows at a rate more than 2.5 times the national rate. The electronics and telecommunications sector leads both export growth and manufacturing development. Average total output growth in manufacturing sectors is over 40% in the long-run full closure, under 27% in agriculture, 68% in construction sector and over 38% in the service sectors.

The difference between short-run and long-run simulation is significant across sectors, especially in the full closure, which implies some significant industry reconstruction adjustment upon further reform and liberalisation besides WTO membership. Manufacturing industries lead China's economic development.

6.3 Provincial/regional results

Economy-wide efficiency gains are also not distributed uniformly across regions within China. Provinces in China have different factor endowments, industrial structures, basic infrastructure and comparative advantages. Consequently, it is necessary to investigate the details of regional output, employment and trade (exports and imports) induced by China's WTO membership and full economic structural and development. The larger the share of industries in provincial/regional output or trade relatively advantaged by full economic structural and development (WTO membership), the greater the benefits conferred on that particular province/region. According to economic geography and regional I/O table, we organise China's 31 provinces into eight regional blocks.[59]

Table 8 and Table 9 show the uneven distribution of gains/losses from China's WTO and full economic structural and development simulations. We see little impact in the only WTO simulation (around 1.1% annual real GDP growth), except in real imports and exports (where China made huge efforts to liberalise before accession). Expansion of foreign trade becomes significant, especially in the long-run simulation. The foreign trade of NMR, NCR and SCR is greater than in the rest of China. This may be due to the rela-

[58] Uniform technology improvement is assumed across sectors. Given the small contribution of the only WTO shock, real output can significantly improve only when the sectoral output share is sufficiently large. With full liberalisation, the story could well change.

[59] The regional blocks are: North-Eastern Region = NER (Liaoning, Jilin, Heilongjiang); North Municipalities Region = NMR (Beijing, Tianjin); North Coastal Region = NCR (Hebei, Shandong); Central Coastal Region = CCR (Shanghai, Jiangsu, Zhejiang); South Coastal Regions = SCR (Fujian, Guangdong, Hainan); Central Region = CR (Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan); North-Western Region = NWR (Mon-

tively large share of intermediate imports (used in EOPEs) in total imports and a relatively high dependence on exports. Higher economic growth in NMR, NCR and SCR increase the demand for labour, so rising wages in these regions attract labour from the rest of China. For example, employment in NMR and SCR increases by 25.13% (24.17%) and 15.12% (16.88%) in the short-run (long-run) full economic structural and development closure. The contribution from the only WTO shock, however, is not significant; the national average labour force grows around 13.82%. The welfare gain mostly comes from coastal regions. As expected, everyone is better off upon liberalisation. But because some regions develop faster than others, regional inequalities persist.

Studies of China's regional income inequality traditionally have relied on per capita income derived from household registration. This may bias the true picture when extensive labour movement is involved. Certainly, the notion of significant inter-regional labour movement is not challenged. In 2002, 35.51% of total labour movement was to Guangdong province, 22.07% to the CCR and 6.91% to the NWR (Figure 3). Due to wage inequality and the economic development gap across regions, labour tends to move from poor western regions (especially the South-Western Region) to the rich coastal regions (especially the South-Coastal and Central Region). Figure 6 and Figure 7 find that total inter-regional labour movement increases from 42.42 million people in 2002 to 75.94 (71.78) million in the short-run (long-run) full closure, while the contribution of pure WTO closure is slightly negative for labour movement.[60] This may be due to the decreasing regional wage difference under pure WTO closure. The distribution of inter-regional labour movement is still biased to coastal regions (Figure 4).[61] The situation under the long-run WTO closure is more or less the same (Figure 5). Major labour movement indicates regional income inequality. As labour sources, the SWR (particularly, Sichuan province) and CR dominate at 22.86% (21.62%) and 36.96% (37.78%) in the short-run (long-run) full closure, respectively (Figure 6 and Figure 7). The same is true for the WTO shock (Figure 4 and Figure 5). The result generally shows that the distribution of labour movement leads to slightly

golia, Shaanxi, Gansu, Qinghai, Ningxia, Xingjiang); South-Western Region = SWR (Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet).

[60] Detailed results of inter-regional labour movement for 31 regions are available upon request.

[61] For example, for the North Municipalities Region, Central Coastal Region and South Coastal Region (i.e. Guangdong province) – 35.5% (22.34%) of total moving labour goes to the Guangdong province (SCR) in the short-run WTO shock and only 6.83% moves to the NWR, where economic development lags far behind coastal regions.

greater equality across regions with full economic structural change and development. The amount of labour movement increases dramatically to 70%.

Thus, China's regional income inequality is slightly over-estimated when we ignore the issue of labour movement and its contribution to economic development (Table 11). The Gini coefficient for the 2002 baseline is 0.281 (0.311) with (without) consideration of inter-regional labour movement. The coefficient rises to 0.311 (0.317) in the short-run closure and 0.309 (0.312) in long-run closure of only WTO (full economic structural and development) when regional labour movement is ignored. It becomes 0.285 (0.269) in short-run closure and 0.281 (0.268) in long-run closure of only WTO (full economic structural and development). The same is true for the eight regional blocks: Gini coefficients decrease when labour movement is considered (Table 11). The regions where the greatest labour movement is involved see relatively substantial changes in the Gini coefficients, i.e. coastal regions (top destinations for labour movement) and central regions (top origins of labour movement) play an important role. In the short-run (long-run) WTO shock, the income inequality in the CCR is over-estimated by 18.54% (19.49%) when inter-regional labour movement is ignored in calculating the Gini coefficient. It becomes larger in the full economic development simulation – GINI coefficients at the CCR are overestimated by 31.26% (29.11%) in the short-run (long-run) closure. In the CR, the Gini coefficient decrease by around 6% (21%) in the WTO (full economic development) short/long-run simulation.

7 Major policy implications and limitations

This paper analysed the impact of China's WTO accession using a multi-region multi-sectoral single country CGE model (PRCGEM). Here, only tariff/non-tariff liberalisation and duty exemption cuts in agricultural and manufacturing sectors were considered. Yet, even with these changes, China was shown to gain considerably in terms of economic efficiency. When China implements its required commitments for market access in agricultural and manufacturing sectors in 2007, real GDP and welfare (measured in Hicks EV) beyond normal economic development was found to increase 6.48% (5.60%), or RMB 7,615.15 billion (RMB 6,585.69 billion) in the short-run (long-run) WTO closure. The pure WTO shock was found to contribute approximately 1.1% in additional real GDP

growth rate annually. Thus, the larger gains in real GDP were mainly due to enhanced efficiency of resource allocation brought about by a rapid trade growth and real output in accordance with regional/sectoral comparative advantage in China. When full economic structural and development with recursive closure was considered, China's efficiency gains (in particular, from technology improvement in production factor of capital, land and labour) were even larger. However, gains were not evenly distributed either across sectors or across regions due to the different industry features and regional economic differences. This suggested several ways in which globalisation might play a role in increasing regional inequality in China:

- Regions with location advantages (i.e. coastal regions) are better positioned to exploit benefits of trade and investment (Lin, 2002).
- Industrial infrastructure under government policy preferences may place some regions in better positions to attract investment and trade (Demurger, 2001 and Wan et al., 2003).[62]
- Despite a uniform national policy of opening up, different customs and traditions across regions result in different abilities to accept foreign capital with technologies.
- China's affluent east regions enjoy disproportionally generous fiscal transfers.

The results for China's WTO membership with full economic structural and development may imply some sort of dramatic economic structural adjustment with large adjustment costs. One direct impact could be on structural unemployment upon liberalisation. The model assumes full employment, with labour moving across sectors and regions to clear the labour market. When the inter-regional difference in wages was considered alone, huge labour movements occurred under the full closure. Labour movement's share of total employment increased from 5.75% in 2002 to 9.93% (9.14%) in the short-run (long-run) full closure, while it decreased slightly to 4.45% (4.61%) in the pure WTO closure.[63]

[62] Wan et al. (2003) find that domestic capital plays a dominant role in rising regional inequality after the mid-1980s. Infrastructure is also found to contribute to regional inequality, while privatisation apparently helps equalise incomes across regions.

[63] In terms of people, total labour movement will increase from 42.42 million to 75.94 million (71.78 million) in the short-run (long-run) full closure, while it decreases to 37.43 million (38.52 million) in the short-run (long-run) WTO shock.

Labour movement in China mostly involves millions of farmers moving from the agricultural sector (regions dominated by agriculture) to the non-agricultural sector (regions with high growth in the manufacturing and service sectors), with internal reform (or liberalisation) and foreign trade/investment liberalisation appearing to play significant roles. Thus, labour-intensive sectors (i.e. textile and clothing) are the main beneficiaries.

These results have several important implications for policy makers. Although total welfare was found to improve considerably, substantial adjustment costs (e.g. changes in industrial structure as a result of liberalisation and reform) may also be involved. With the structural adjustment added to the economy-wide benefits, the role of both central and local governments becomes crucial.

Due to the low degree of regional integration resulting mainly from local protection in China, regional disparities could well emerge as significant issues as liberalisation proceeds. Indeed, labour movement between regions to some extent is a reflection of regional inequality. Yet, while removing the limitations of labour movement could help reduce regional disparities, their removal could also harm regional economic development and stability. Massive labour movement between regions in China has thus become an important economic issue and a major social problem. A healthy and complete social security system is thus urgently needed to facilitate labour movement. Governments (both central and local) should encourage regional integration by investing more in infrastructure, education and transport not only in faster growing coastal provinces but also inland, so that the economic efficiency benefits of liberalisation are widely spread.

Finally, the factors (factor endowment, geography, basic infrastructure, etc.) underlying economic gaps among regions constitute potential obstacles to further economic growth. Rapid economic expansion does not automatically improve the welfare of all individuals in a society. Our results suggest that inequality across regions is falling, although some regions continue to benefit more than others. By joining the WTO, China is expected to eventually develop an open economy that is strong enough to deal head on with pressures from global competition and domestic disparity. Hence, while income inequality may worsen in the short run, it is expected to improve after transition as adjustment policies take effect.

Of course, simple calculation of gains and losses does not indicate whether gainers will actually be willing to share their gains with losers. Public sector investment, financed mainly through taxation of gainers, as well as inter-regional and inter-household transfers,

will be required in development of an equitable Chinese society. The extent of that taxation in itself will affect the incentives for investment by the successful and profits available for reinvestment. This complex set of concerns will ultimately need to be addressed in future simulations.

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Appendix I

Data

Input-Output (IO) Tables

Input-Output (IO) accounts provide detailed information on the flows of goods and services that make up the production process of industries. They are presented in the form of Use, Make, Direct Requirements and Total Requirements tables. The source used in this PRCGEM model is the updated 2002 Regional/National I/O table based on "Input-Output Table of China in 1997" (from China's State Statistical Bureau, which includes 124 sectors, 2 households and 31 regions), "Intermediate Use Part of 2000 Input-Output Table[1] (from China's Statistical Yearbook 2003) and "Multi-Regional Input-Output Model for China 2000" (from the Institute of Developing Economics, Japan External Trade Organization). Here, we aggregate to 40 sectors.[2] Of the 40 sectors, there is one for agriculture (sector 1), 25 for manufactures (sectors 2-26), one for construction (sector 27) and 13 for services (sectors 24-40 in Table 5). The intermediate input matrix (commodity-by-commodity matrix) refers to the sum of domestic and imported intermediate transactions. Household consumption, government consumption, capital formation, exports and change in inventories are the final demand categories. Exports are valued FOB. The unit of measurement of the 2002 IO Table is 10,000 renminbi, while PRCGEM is expressed in RMB 100 million.

Tariff Data

To take some account of tariff exemptions, we use the MFN tariff rate for the agriculture and manufacturing sectors rather than the nominal tariff rate. Between 1997 and 2000, the tariff rate (MFN) changed little compared to the period 1992–1997. Due to the lack of complete tariff information between 1997 and 2000, we assume initially there was no tariff change between 1997 and 2000. In 1997, the unweighted average effective tariff rate for agriculture and manufacturing sectors was 5.50% (Table 5), while the unweighted average MFN counterpart was 13.72%. According to the tariff revenue data for 1997, the effective tariff rate was much

[1] In this Input-Output table, only 17 sectors are considered.

[2] Due to the data limitations, we choose 40 sectors for our model to sufficiently constrain the results. This narrowing also helps in comparison with other studies, which typically use about the same number of sectors.

smaller than the MFN tariff rate (Table 5).[3] The sectoral reduction rates of import tariffs are aggregated from the Harmonized Commodity Description and Coding System (HS) tariff schedules for the period 2002–2007 in China's WTO accession final offer. The MFN tariff data after 2002 are from China's WTO protocol and the percentage change in MFN tariff from 2002 to 2007 is used to shock the effective tariff change after 1997/2002. The unweighted average MFN tariff rate for agriculture and manufacturing sectors is anticipated to fall from 12.06% upon accession to 7.51% in 2007. Table 3 shows that imports are dominated by manufactured goods (more than 80%) compared with agricultural commodities (less than 8.4%). The effective tariff rate is very low, especially for manufactured imports (0.32% in 1997).

Appendix II

31-Region, 40-Sector PRCGEM

1. Price block

Despite its name, the "small country" assumption[4] is appropriate here, given China's role in world trade and the fact it is a price-taker. Thus, world import prices are treated as exogenous in terms of foreign currency. Purchaser prices are sums of basic values and sales taxes. All demand and supply functions in PRCGEM are assumed homogeneous of degree zero in prices, so behaviour is money-neutral, i.e. only relative price matters in determining quantities of commodities. Normally, the exchange rate (the price of a dollar in Chinese currency) is taken as an exogenous numeraire. Zero pure-profit conditions (e.g. zero pure profit in importing, whereby the import price is equal to foreign currency import price times exchange rate and tariff) and constant returns to scale are assumed, implying basic values are solely functions of input prices. Users minimise their costs by consuming the composite commodities from imported and domestic sources. Producers maximise their profits by selling commodities to the domestic market and the rest of the world.

[3] The share of tariff revenue in China's government tax revenue is less than 6% on average in the period 1990–2003. Therefore, we expect tariff liberalisation will have little direct impact on government tax revenues.

[4] We assume China can export or import any desired quantity at international prices fixed in foreign currency.

2. Production block

There are 40 sectors in the PRCGEM model. All sectors operate at constant returns to scale in production. Each industry can only produce one product, which means there are 40 commodities. Each producer uses domestic and imported intermediates and primary goods (such as labour, capital and land) for production under nested Leontief/CES[5] production functions, and then supplies the domestic absorption and exports on a CET basis to maximise profits and pay wages to labour factor and rentals to owners of land and capital. All foreign producers and consumers are treated as "rest of the world" under the assumption of "same tastes."

3. Demand block (household, government and investor)

The household sector is disaggregated into peasant and non-peasant households, with aggregate spending exogenous and proportional to GDP. The utility functions allow substitution between commodities through a Linear Expenditure System (LES)[6] (Philips, 1974) and between domestic and imported sources. Government consumption demand is exogenous, and revenue derives from indirect taxation (taxes on basic flows plus the tariff revenue).

Following the 1994 taxation reform in China, import tariff revenue declined due to trade liberalisation and the value-added tax (based on the value-added of industries) gradually assumed prominence as the government's most important source of domestic tax revenue.

Investors create capital goods from domestic and imported commodities on a CES basis. Investment is bound by exogenous investment/capital ratios or related to relative rates of return.

4. Trade block

Most CGE models incorporate imperfect competition in all markets, imperfect substitution in all markets and imperfect substitution between foreign and domestic goods and between alternative sources of imports (as in the Armington model of

[5] CES functions are used in CGE modelling because they are well-behaved, reasonably flexible and consistent with assumptions commonly used in economic models, particularly linear homogeneity and homotheticity. Cobb-Douglas and Leontief functions are essentially special cases of CES functions.
[6] Expenditure on each good in an LES is a linear function of prices and total expenditure.

trade).[7] Here, we adopt the Armington specification to model foreign trade as a CES aggregation of imported and domestically produced commodities from the viewpoint of domestic producers and consumers. CET export transformation functions are used to describe how production can be transformed into domestic and foreign parts. In sectors lacking any imports, the CES function is dropped, i.e. composite good demand equals domestic sales. In sectors without exports, the CET function is also dropped, resulting in equality between domestic output and domestic sales.

5. Market-clearing block

In the product market, equilibrium is reached when total supply of each composite commodity (goods and factors) is equal to all domestic demand in the same category and each sector earns zero profit. The labour market is not cleared.

In the short-run comparative-static capital market, capital is sector-fixed (shocked for forecasting, un-shocked for short-run simulation) and investment/capital ratios are linked to capital rental rates (deflated by new capital prices) in the endogenous investment industries.

In the long-run comparative-static capital market, capital stocks are determined by rates of return, because capital is assumed to be inter-sectorally mobile. Capital stock in the PRCGEM model is defined as the last period's capital stock plus net investment deflated by the depreciation rate. In the long run, gross investment is endogenously specified for allocation among industries according to a fixed investment/capital ratio or relative rate of return in each sector, while the gross rate of return on new capital (investment) is exogenous.

6. Closure

PRCGEM has the flexibility to designate different variables as exogenous (closure). By altering closure rules, it is easy to switch for comparative-static long/short-run simulations or dynamic long/short-run forecasts (similar to the MONASH Model),[8]

[7] This approach has been criticised. Senhadji (1997) points out two common problems with the use of the Armington (1969) aggregator in CGE analysis. First, it fixes the weight coefficients in the CES function based on the factor shares, which is incorrect because those coefficient weights correspond to the input shares only in the Cobb-Douglas case. Second, by requiring that the calibrated model must replicate the given benchmark data, it entails that the variation in the elasticity of substitution must not affect the initial benchmark expenditure shares. This criticism was subsequently refuted by Willenbockel (1999); see Tongzon (2001).

[8] MONASH is a dynamic model of the Australian economy (Adams et al., 1994; Dixon and Rimmer, 2001).

since different closures represent different assumptions about factor/good markets and macro behaviour. Comparative-static simulations describe the deviation of the economy with a policy change (e.g. tariff cut) from the baseline where there is no policy change. We might ask, for example, "If tariffs are reduced by 5% on a range of goods, how far and in what direction would the overall economy diverge over one year from the baseline (i.e. what it would otherwise have been)?"

Dynamic simulations, on the other hand, replicate known development patterns and forecast the possible future development patterns by incorporating technical changes and adjustment costs. For forecasting, it is necessary to consider all the exogenous shocks to the model over time to check the changes in the endogenous variables in a specified time (e.g. five years). While the dynamic model is closer to the real world, it is also far more complex and unpredictable (and sometimes more misleading) than its comparative-static counterpart. Figure 1 shows the comparative-static interpretation of exports under the tariff liberalisation. The AC (Baseline) represents the state of the economy as it would be without tariff change over time. AB (post-simulation line) represents the state of the economy as it would be with only tariff liberalisation over time. Thus, the result from GEMPACK is the percentage change from A to D.

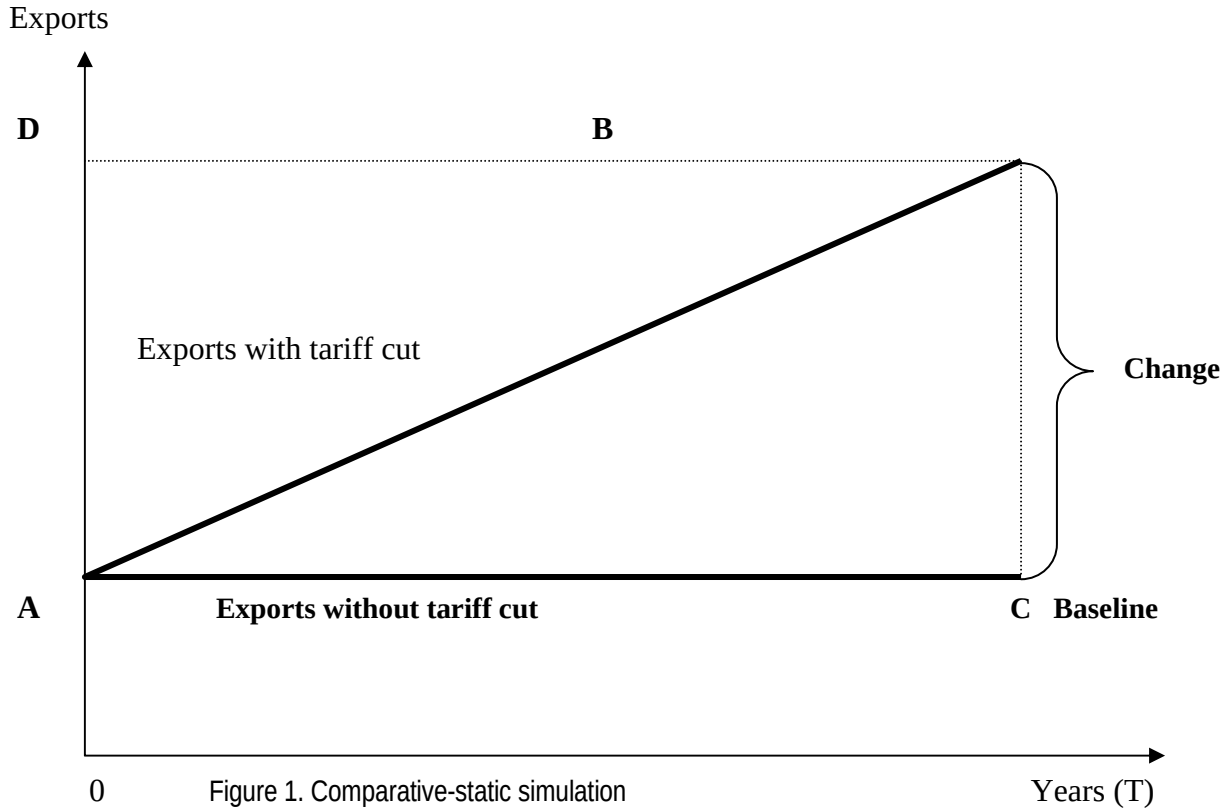


Figure 1. Comparative-static simulation

7. Equation system

Following the structure described above, PRCGEM equations can be grouped under the following classifications:

- Producers' demands for produced/intermediate inputs and primary factors;
- Demands for inputs to capital creation/investment goods (no primary factors are used directly as inputs to capital formation, and the use of primary factors in capital creation is recognised through inputs of the construction commodity/service);
- Household demands;
- Export demands (traditional and non-traditional exports);
- Government demands;
- Demands for margins (wholesale and retail trade, transport);
- Prices: output, exports, imports, labour, capital and land (zero pure profits in production, capital creating and importing; zero pure profits in distribution; the price received by the producer is uniform across all customers);
- Market-clearing conditions for commodities and primary factors (demand equals supply for domestically produced margin and non-margin commodities and imported commodities);
- Indirect taxes; and
- Regional and national macroeconomic variables and price indices.

8. Solution methods[9]

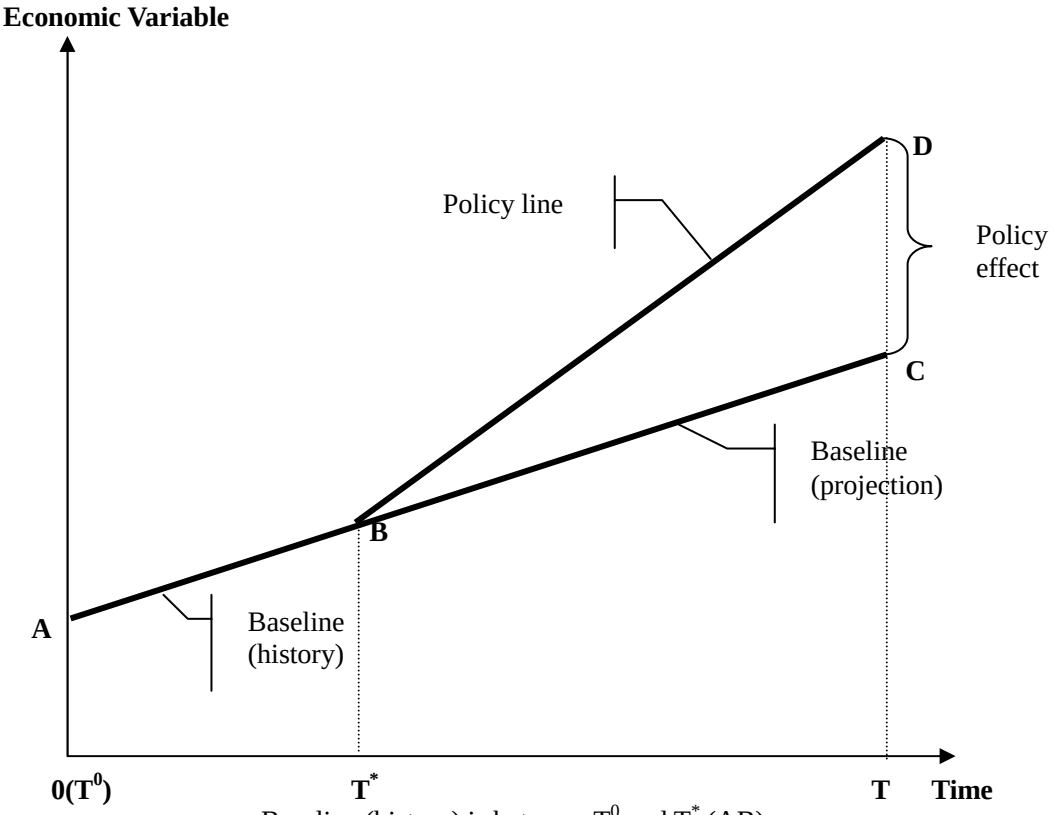
Four solution methods for multi-step simulations[10] are used in PRCGEM: Johansen (one step), Euler, Gragg and Midpoint. The Johansen solution is more inaccurate for larger shocks. Using subtotals, we divide up the effects of the shocks in PRCGEM. Johansen solutions are defined to be solutions obtained by solving the linearised equations of the model once, with inaccuracy increasing with the size of the shock. In Euler's method, the direction to move under the shock at each step is essentially that of the tangent to the curve at the appropriate point. Gragg's and the midpoint method

[9] Detailed information is provided in GEMPACK User Documentation – GPD-3 (release 7.0) (http://www.monash.edu.au/policy/gpdoc.htm).

[10] The idea of a multi-step simulation is to break up each shock (from closure) into smaller pieces. In each step, linearised equations are solved for these smaller shocks and the data, shares and elasticities are recomputed to take into account the changes from the previous step. The more steps involved for the shocks, the more accurate the simulation.

are similar to Euler's method, following the tangent along the curve from the initial solution. The difference here is that Euler's method follows the tangent from the current point, while Gragg's and the midpoint method follow the tangent from the previous point. Gragg's method also uses a more accurate method than Euler's method for calculating the direction in which to move at each step. Gragg's method and the midpoint method are otherwise identical, except that Gragg's method does an extra pass. In order to get better simulation results, we need to have as many solution steps as possible. The idea behind the multi-step simulation is to divide the exogenous shocks into at least two pieces. In each step, the linearised equations are then calculated with these smaller shocks so as to be more close to the real economy. Next, subintervals[11] are chosen. In general, the more steps and subintervals the shocks are broken into, the more accurate the simulation results. Here, we use a simple Johansen solution.

[11] The solution method is employed across each subinterval with the multi-step calculations (usually with a small number of steps) and then extrapolated before starting the next subinterval.



Baseline (history) is between T^0 and T^* (AB)
Baseline (projection) is between T^* and T (BC)
Policy line is between T^* and T (BD)
Policy effect (CD)

Figure 2. Simulation from Baseline

Appendix III

Table 1. China's average annual GDP growth rates (%), merchandise world trade and FDI (US$ billion), 1960–2003

Year	**Real GDP Growth (% per year)**	**Exports[a]**	**Imports[b]**	**Trade Balance**	**FDI[c]**
1960-1978 (Pre-Reform Average per year)	5.1	4.6[d]	4.8[d]	-0.2[d]	N/A
1979-2003 (Post-Reform Average per year)	9.3	120.0[e] (2.41)	111.1[e] (2.24)	8.9[e]	499.8[f] (666.8)[f]
1990	3.8	62.9 (1.80)	53.9 (1.50)	9.0	3.5 (6.6)
1991	9.2	71.9 (2.05)	63.9 (1.76)	8.1	4.4 (12.0)
1992	14.2	85.5 (2.26)	81.8 (2.08)	3.6	11.0 (58.1)
1993	13.5	91.6 (2.43)	103.6 (2.68)	-11.9	27.5 (111.4)
1994	12.6	120.8 (2.80)	115.6 (2.61)	5.2	33.8 (82.7)
1995	10.5	148.8 (2.88)	132.1 (2.50)	16.7	37.5 (91.3)
1996	9.6	151.1 (2.80)	138.8 (2.51)	12.3	41.7 (73.3)
1997	8.8	182.7 (3.28)	142.2 (2.49)	40.5	45.3 (51.0)
1998	7.8	183.7 (3.34)	140.2 (2.48)	43.5	45.5 (52.1)
1999	7.1	194.9 (3.41)	165.8 (2.81)	29.1	40.3 (41.2)
2000	8.0	249.2 (3.87)	225.1 (3.36)	24.1	40.7 (62.4)
2001	7.5	266.1 (4.29)	243.55 (3.77)	22.55	46.9 (69.2)
2002	8.3	235.6 (5.02)	295.17 (4.40)	-59.57	52.7 (82.8)
2003	9.3	438.23 (5.84)	412.76 (5.31)	25.47	53.5 (115.1)

Notes: [a] China's share of world exports in parenthesis (%).
[b] China's share of world imports in parenthesis (%).
[c] Total amount of Foreign Direct Investment (FDI) actually used. FDI authorised by signed agreements and contracts in parenthesis.
[d] Data for 1962–1978.
[e] Data for 1980–2003.
[f] Accumulated FDI.
Sources: China Statistical Yearbook (Various Volumes), Almanac of China's Foreign Economic Relations and Trade, www.wto.org, and China Foreign Economic Statistical Yearbook.

Table 2. Exports by selected sectors (US$ billion), 1994–2003

Year	Total Exports	Textile and Garment	Electrical Machinery, Consumer Electrical and Electronic Products	Chemicals and Related Products	Plastics, Rubber and Related Products
1994	121.0 (32.0)	34.2 (31.0) [28.3]	19.7 (41.7) [16.3]	5.8 (31.8) [4.8]	3.1 (40.9) [2.6]
1995	148.8 (23.0)	35.9 (5.0) [24.1]	27.7 (40.6) [18.6]	8.4 (44.8) [5.6]	4.3 (38.7) [2.9]
1996	151.1 (1.5)	35.0 (-2.5) [23.2]	31.1 (12.3) [20.6]	8.4 (0.0) [5.6]	4.4 (2.3) [2.9]
1997	182.7 (20.9)	43.2 (23.4) [23.6]	38.3 (23.2) [21.0]	9.4 (11.9) [5.1]	5.8 (31.8) [3.2]
1998	183.8 (0.6)	40.5 (-6.3) [22.0]	43.6 (13.8) [23.7]	9.6 (2.1) [5.2]	6.2 (6.9) [3.4]
1999	194.9 (6.0)	41.3 (2.0) [21.2]	52.1 (19.5) [26.7]	10.0 (4.2) [5.1]	6.3 (1.6) [3.2]
2000	249.2 (27.9)	49.4 (19.6) [19.8]	72.9 (25.4) [29.3]	11.6 (1.6) [4.7]	7.9 (25.4) [3.2]
2001	266.1 (6.8)	49.8 (0.8) [18.7]	84.9 (16.5) [31.9]	12.7 (9.5) [4.8]	8.3 (5.1) [3.1]
2002	325.6 (22.4)	57.8 (16.1) [17.8]	115.9 (36.5) [35.6]	14.6 (15.0) [4.6]	10.0 (20.5) [3.1]
2003	438.2 (34.6)	73.3 (26.8) [16.7]	172.3 (48.7) [39.3]	15.8 (8.2) [3.6]	12.5 (25.0) [2.9]

Note: Sectoral share in total exports (%) in brackets; annual growth rate (%) in parenthesis.

Source: China statistical yearbook (various volumes).

Table 3. Share of China's agricultural and selected manufactured imports in total imports

Year	Total Imports (US$ billion)	Agricultural Imports[a] (US$ billion)	Agricultural Share of Total Imports (%)	Manufactured Imports (US$ billion)	Manufactured Share of Total Imports (%)	Chemical and Related Products	% of Total Imports	Light and Textile Industrial Products, Rubber Products, Minerals and Iron Products	% of Total Imports	Machinery and Transport Equipment	% of Total Imports	Effective Tariff Rate[b] (%)
1990	53.3	4.32	8.11	43.49	81.60	6.65	12.47	8.91	16.71	16.85	31.60	6.23
1991	63.79	3.52	5.52	52.96	83.02	9.28	14.54	10.49	16.45	19.60	30.73	5.52
1992	80.59	3.67	4.55	67.33	83.55	11.16	13.84	19.27	23.91	31.31	38.85	4.79
1993	103.96	2.71	2.61	89.75	86.33	9.70	9.33	28.53	27.44	45.02	43.31	4.28
1994	115.61	4.95	4.28	99.13	85.74	12.13	10.49	28.08	24.29	51.47	44.52	2.74
1995	132.08	8.74	6.62	107.67	81.52	17.30	13.10	28.77	21.78	52.64	39.86	2.65
1996	138.83	7.37	5.31	113.39	81.68	18.11	13.04	31.39	22.61	54.76	39.45	2.61
1997	142.37	5.99	4.21	113.75	79.90	19.30	13.55	32.22	22.63	52.77	37.07	2.71
1998	140.24	5.28	3.76	117.29	83.63	20.16	14.37	31.08	22.16	56.85	40.53	2.70
1999	165.7	4.99	3.01	138.85	83.80	24.03	14.50	34.32	20.71	69.45	41.91	4.10
2000	225.09	5.74	2.55	178.36	79.24	30.21	13.42	41.81	18.57	91.93	40.84	4.03
2001	243.55	5.74	2.36	197.81	81.22	32.10	13.18	41.94	17.22	107.02	43.94	4.17
2002	295.17	6.86	2.32	245.90	83.31	39.04	13.22	48.49	16.43	137.01	46.42	
2003	412.76	8.96	2.17	340.00	82.37	48.98	11.87	63.90		192.83		

Notes: [a] Agricultural imports here refers to Food & Live Animals, Animal and Vegetable Oils, Fats and Waxes.
[b] Ratio of total tariff revenue against total imports.
Source: China Statistical Yearbook.

Table 4. Regional macro-economies in 2002, (RMB 100 million)

No	Regions	Regional Gross Domestic Products[a]	Primary Industry[b]	Secondary Industry[b]	Tertiary Industry[b]	Exports[c]	Imports[c]	Total Trade[c]	Openness Index1 (Exports/GDP) (%)	Openness Index2 (Trade/GDP) (%)
1	**Beijing**	3212.71 (2.72)	98.05 (3.05)	1116.53 (34.75)	1998.13 (62.19)	690.04107 (2.56)	1520.0934 (6.22)	2210.134 (4.30)	21.48	68.79
2	**Tianjin**	2051.16 (1.74)	84 (4.10)	1001.9 (48.85)	965.26 (47.06)	917.41192 (3.40)	973.89913 (3.99)	1891.311 (3.68)	44.73	92.21
3	**Hebei**	6122.53 (5.19)	957.01 (15.63)	3046 (49.75)	2119.52 (34.62)	344.13117 (1.28)	221.11095 (0.91)	565.2421 (1.10)	5.62	9.23
4	**Shanxi**	2017.54 (1.71)	197.8 (9.80)	1083.79 (53.72)	735.95 (36.48)	227.74579 (0.85)	70.010177 (0.29)	297.756 (0.58)	11.29	14.76
5	**Mongolia**	1734.31 (1.47)	374.69 (21.60)	728.34 (42.00)	631.28 (36.40)	85.428572 (0.32)	135.18493 (0.55)	220.6135 (0.43)	4.93	12.72
6	**Liaoning**	5458.22 (4.62)	590.2 (10.81)	2609.85 (47.82)	2258.17 (41.37)	998.1971 (3.70)	940.80024 (3.85)	1938.997 (3.77)	18.29	35.52
7	**Jilin**	2246.12 (1.90)	446.17 (19.86)	978.37 (43.56)	821.58 (36.58)	154.62264 (0.57)	182.60883 (0.75)	337.2315 (0.66)	6.88	15.01
8	**Heilongjiang**	3882.16 (3.29)	447 (11.51)	2169.15 (55.87)	1266.01 (32.61)	199.67352 (0.74)	188.32327 (0.77)	387.9968 (0.76)	5.14	9.99
9	**Shanghai**	5408.76 (4.58)	88.24 (1.63)	2564.69 (47.42)	2755.83 (50.95)	2566.9361 (9.52)	3413.3032 (13.97)	5980.239 (11.64)	47.46	110.57
10	**Jiangsu**	10631.75 (9.01)	1119.12 (10.53)	5550.98 (52.21)	3961.65 (37.26)	3229.2567 (11.98)	2936.1888 (12.02)	6165.445 (12.00)	30.37	57.99
11	**Zhejiang**	7796 (6.61)	694 (8.90)	3982 (51.08)	3120 (40.02)	2612.611 (9.69)	1224.1774 (5.01)	3836.788 (7.47)	33.51	49.21
12	**Anhui**	3569.1 (3.02)	772.55 (21.65)	1552.21 (43.49)	1244.34 (34.86)	192.54868 (0.71)	155.47682 (0.64)	348.0255 (0.68)	5.39	9.75
13	**Fujian**	4682.01 (3.97)	664.78 (14.20)	2159.94 (46.13)	1857.29 (39.67)	1521.9143 (5.65)	988.43189 (4.05)	2510.346 (4.89)	32.51	53.62
14	**Jiangxi**	2450.48 (2.08)	535.98 (21.87)	951.77 (38.84)	962.73 (39.29)	87.564038 (0.32)	77.71027 (0.32)	165.2743 (0.32)	3.57	6.74
15	**Shandong**	10552.06 (8.94)	1390 (13.17)	5309.54 (50.32)	3852.52 (36.51)	1779.6121 (6.60)	1313.4655 (5.38)	3093.078 (6.02)	16.87	29.31
16	**Hehan**	6168.73 (5.23)	1288.36 (20.89)	2951.06 (47.84)	1929.31 (31.28)	193.32672 (0.72)	115.44015 (0.47)	308.7669 (0.60)	3.13	5.01
17	**Hubei**	4975.63 (4.22)	707 (14.21)	2446.05 (49.16)	1822.58 (36.63)	171.61118 (0.64)	203.51405 (0.83)	375.1252 (0.73)	3.45	7.54
18	**Hunan**	4340.94 (3.68)	847.25 (19.52)	1737.2 (40.02)	1756.49 (40.46)	149.27983 (0.55)	121.65617 (0.50)	270.936 (0.53)	3.44	6.24

19	**Guangdong**	11769.73 (9.97)	1032.8 (8.78)	5935.63 (50.43)	4801.3 (40.79)	9857.2084 (36.58)	8803.4023 (36.03)	18660.61 (36.32)	83.75	158.55
20	**Guangxi**	2455.36 (2.08)	595.68 (24.26)	863.96 (35.19)	995.72 (40.55)	122.22232 (0.45)	93.554103 (0.38)	215.7764 (0.42)	4.98	8.79
21	**Hainan**	604.13 (0.51)	228.95 (37.90)	125.33 (20.75)	249.85 (41.36)	55.83747 (0.21)	92.579073 (0.38)	148.4165 (0.29)	9.24	24.57
22	**Chongqing**	1971.3 (1.67)	315.78 (16.02)	827.55 (41.98)	827.97 (42.00)	92.383736 (0.34)	75.070735 (0.31)	167.4545 (0.33)	4.69	8.49
23	**Sichuan**	4875.12 (4.13)	1027.62 (21.08)	1982.44 (40.66)	1865.06 (38.26)	217.67103 (0.81)	151.60236 (0.62)	369.2734 (0.72)	4.46	7.57
24	**Guizhou**	1185.04 (1.00)	280.83 (23.70)	474.68 (40.06)	429.53 (36.25)	46.807263 (0.17)	34.331341 (0.14)	81.1386 (0.16)	3.95	6.85
25	**Yunnan**	2232.32 (1.89)	470.5 (21.08)	951.48 (42.62)	810.34 (36.30)	107.10686 (0.40)	85.546934 (0.35)	192.6538 (0.37)	4.80	8.63
26	**Tibet**	161.42 (0.14)	39.68 (24.58)	32.93 (20.40)	88.81 (55.02)	5.6416032 (0.02)	4.7220285 (0.02)	10.36363 (0.02)	3.49	6.42
27	**Shaanxi**	2035.96 (1.73)	303.79 (14.92)	925.78 (45.47)	806.39 (39.61)	130.56057 (0.48)	99.88187 (0.41)	230.4424 (0.45)	6.41	11.32
28	**Gansu**	1161.43 (0.98)	214.45 (18.46)	530.36 (45.66)	416.62 (35.87)	42.251602 (0.16)	43.687661 (0.18)	85.93926 (0.17)	3.64	7.40
29	**Qinghai**	341.11 (0.29)	44.9 (13.16)	154.01 (45.15)	142.2 (41.69)	13.431916 (0.05)	5.9726832 (0.02)	19.4046 (0.04)	3.94	5.69
30	**Ningxia**	329.28 (0.28)	52.84 (16.05)	151.16 (45.91)	125.28 (38.05)	29.745883 (0.11)	11.159879 (0.05)	40.90576 (0.08)	9.03	12.42
31	**Xinjiang**	1598.28 (1.35)	305 (19.08)	672.1 (42.05)	621.18 (38.87)	106.7973 (0.40)	148.32632 (0.61)	255.1236 (0.50)	6.68	15.96
	Total	118020.7 (100)	16215.02 (13.74)	55566.78 (47.08)	46238.89 (39.18)	26949.578 (100.00)	24431.232 (100.00)	51380.81 (100.00)	22.83	43.54

Notes: [a] Regional GDP share of total GDP in parenthesis (%).

[b] Regional industry (e.g. Primary, Secondary and Tertiary Industry) share of regional GDP in parenthesis (%).

[c] Service trade excluded. Regional share in parenthesis (%).

Source: China Statistical Yearbook (2003).

Table 5. Disaggregated tariff & NTB data for 1997–2006, %

No	40 Sectors in PRCGEM	MFN Tariff Rate [a] %						Tariff Equivalent Rate [b] %								
		2001	2002	2003	2004	2005		1997 [c]	2002 [d]	2001	2002	2003	2004	2005	2006	2007 [e]
1	Agriculture	22.52	21.455	20.415	19.392	19.288		0.38	2.91	52.73	40.52	32.44	26.98	24.07	22.31	19.29
2	Coal mining and processing	5.77	5.77	5.77	5.77	5.77		0.02	1.95	11.70	9.51	8.13	7.26	6.71	6.37	5.77
3	Crude petroleum and natural gas products	6.8	6.53	6.53	6.53	6.53		0.10	0.36	12.73	10.28	8.89	8.02	7.47	7.13	6.53
4	Metal ore mining	0	0	0	0	0		0.00	0.00	5.93	3.74	2.36	1.49	0.94	0.59	0.00
5	Non-ferrous mineral mining	2.989	2.981	2.968	2.964	2.964		0.33	1.20	5.48	4.55	3.96	3.59	3.36	3.21	2.96
6	Manufacture of food products and tobacco processing	26.963	24.479	22.118	19.932	19.169		0.98	5.51	28.44	25.41	22.71	20.30	19.40	18.80	18.65
7	Textile goods	16.071	13.806	11.726	10.033	9.204		3.07	9.43	20.49	16.60	13.48	11.14	9.90	9.65	9.20
8	Wearing apparel, leather, furs, down and related products	18.969	17.809	16.799	15.777	15.269		2.35	7.81	22.19	19.84	18.08	16.58	15.78	15.59	15.27
9	Sawmills and furniture	6.808	5.84	5.093	4.483	4.369		1.28	5.43	10.60	8.23	6.59	5.43	4.97	4.75	4.37
10	Paper and products, printing and record medium reproduction	12.221	10.293	8.494	7.102	6.13		1.74	5.68	17.72	13.76	10.69	8.48	7.00	6.68	6.13
11	Petroleum processing and coking	6.416	6.366	6.306	6.306	6.306		0.68	0.77	7.68	7.17	6.81	6.62	6.51	6.43	6.31
12	Chemicals	11.555	10.506	9.68	8.986	8.562		1.73	3.60	12.37	11.02	10.01	9.19	8.69	8.60	8.50
13	Non-metal mineral products	15.009	14.252	13.647	13.228	13.051		0.48	10.18	15.01	14.25	13.65	13.23	13.05	13.05	13.05
14	Metals smelting and pressing	8.779	8.321	8.159	8.081	8.069		0.79	2.06	11.30	9.91	9.17	8.71	8.47	8.32	8.07
15	Metal products	12.59	11.78	11.25	11.04	11.04		1.48	3.63	12.59	11.78	11.25	11.04	11.04	11.04	11.04
16	Machinery and equipment	5.607	5.151	4.834	4.636	4.605		3.04	3.08	7.50	6.35	5.59	5.12	4.91	4.79	4.60
17	Transport equipment	11.143	10.044	9.013	8.254	7.586		2.77	4.34	21.54	16.61	13.15	10.87	9.23	7.42	6.38
18	Electric equipment and machinery	12.563	11.187	10.283	9.84	9.764		2.30	3.86	16.42	13.62	11.82	10.81	10.38	10.15	9.76
19	Electronic and telecommunication equipment	9.896	7.642	6.475	6.065	6.007		2.19	2.68	14.82	10.74	8.43	7.30	6.79	6.50	6.01
20	Instruments, meters, cultural and office machinery	13.84	12.967	12.468	12.254	12.187		3.45	3.95	13.84	12.97	12.47	12.25	12.19	12.19	12.19
21	Maintenance and repair of machinery and equipment	0	0	0	0	0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Other manufacturing products	14.404	13.586	12.808	12.093	11.467		3.23	12.37	14.40	13.59	12.81	12.09	11.47	11.47	11.47
23	Scrap and waste	4.32	4.01	3.85	3.67	3.51		0.00	0.00	4.32	4.01	3.85	3.67	3.51	3.34	3.18
24	Electricity, steam and hot water production and supply	1.45	1.05	0.76	0.55	0.4		11.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.90

25	**Gas production and supply**	6.22	6	6	6	6		11.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.90
26	**Water production and supply**	0	0	0	0	0		11.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.90
27	**Construction**	0	0	0	0	0		13.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.84
28	**Transport and warehousing**	0	0	0	0	0		3.97	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.99
29	**Post and telecommunication**	0	0	0	0	0		0.18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.09
30	**Wholesale and retail trade**	0	0	0	0	0		1.84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.92
31	**Eating and drinking places**	0	0	0	0	0		1.84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.92
32	**Passenger transport**	0	0	0	0	0		3.97	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.99
33	**Finance and insurance**	0	0	0	0	0		8.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.04
34	**Real estate**	0	0	0	0	0		8.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.04
35	**Social services**	0	0	0	0	0		25.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.87
36	**Health services, sports and social welfare**	0	0	0	0	0		25.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.87
37	**Education, culture and arts, radio, film and television**	0	0	0	0	0		25.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.87
38	**Scientific research**	0	0	0	0	0		25.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.87
39	**General technical services**	0	0	0	0	0		25.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.87
40	**Public administration and other sectors**	0	0	0	0	0		25.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.87

Notes: [a] MFN tariff rate (or tariff bound) for 40 sectors is calculated according to the tariff rate for 124 sectors weighted by tariff revenue in 1997.

[b] Total trade barriers including tariff and non-tariff barriers. Tariff data in the period of 1997–2000 are from (http://trade.chinavista.com/tariffsearch.html) and (http://www.apectariff.org/) and NTB tariff equivalent data are taken from Li and Lejour (2000) and Wang (2001b). Considering the high tariff exemption in China, we use the MFN tariff rate here. China's updated WTO accession protocol assumes that NTB equivalents will be cut 100% for agriculture and the manufacture sector during the period 2001–2007.

[c] Data in sectors 1–23 use the effective tariff rate based in the actual tariff revenue in 1997. Data in sectors 24–40 use the tariff equivalent rate based on gravity equation estimates (Francois and Spinanger, 2002)

[d] Data in sectors 1–23 are effective tariff rate according to the real tariff revenue in 2002.

[e] Data in sectors 24–40 reflect an assumed 50% drop in cross-border trading cost estimates.

Other tariff data (2001–2006) are from China's WTO protocol in 2001.

N/A stands for None Available.

Table 6. Macro results, %

%	Short-run		Long-run	
	Only WTO	Full Economic Structural And Development	Only WTO	Full Economic Structural And Development
Macros	**2002–2007**	**2002–2007**	**2002–2007**	**2002–2007**
% (Balance of trade)/GDP	1.98	2.96	0.66	0.38
Aggregate employment-wage bill weights	13.82	13.82	13.82	13.82
Total sum of welfare (EV):Household+Investment+Government+Trade (RMB billion)	7191.32	25041.20	6191.83	74201.33
Welfare-Investment (EV) (RMB billion)	3144.53	10902.69	2719.46	54221.00
Welfare-Government (EV) (RMB billion)	896.05	10021.81	774.92	9918.45
Welfare-GDP (EV) (RMB billion)	7615.15	26403.15	6585.69	37278.37
Welfare-Net Export or Trade (EV) (RMB billion)	3150.74	4116.70	1769.47	3763.84
Sectoral Gross Allocation Effect (GAE)	1.38	6.29	1.44	6.20
GDP Price Index, expenditure side	-5.29	39.63	-1.17	35.06
Duty-paid Imports Price Index, RMB	0.33	0.33	0.33	0.33
Real devaluation	5.29	-39.63	1.17	-35.06
Terms of trade	-2.40	15.95	-2.02	8.57
Average capital rental	7.36	95.61	5.62	68.77
Rental price of land	5.24	15.74	8.52	16.14
Average input/output price	-4.99	14.49	-3.33	11.60
Aggregate Investment Price Index	-1.15	67.00	7.19	63.08
Consumer Price Index	-7.89	17.97	-6.04	17.06
Exports Price Index	-2.40	15.95	-2.02	8.57
Total demand for non-peasant labour	13.52	25.01	14.86	20.92
Total demand for peasant labour	14.45	-12.94	12.30	-4.64
CIF RMB value of imports	2.26	51.35	5.99	48.61
Nominal GDP from expenditure side	1.19	62.10	4.43	66.77
Value of imports plus duty	2.57	51.75	6.29	49.09
Aggregate tariff revenue	-40.60	11.25	-37.11	10.80
Aggregate payments to capital	7.36	95.61	8.20	90.08
Aggregate payments to labour	-4.51	61.71	-0.35	56.07
Aggregate payments to land	5.24	15.74	8.52	16.14
Aggregate primary factor payments	0.31	73.49	3.17	68.06
Aggregate nominal investment	-1.15	67.00	9.39	78.02
Nominal total household consumption	-1.41	40.44	-0.44	48.77
RMB border value of exports	9.61	66.19	8.08	55.74
Import Volume Index, CIF weights	2.26	51.35	5.99	48.61
Real GDP from expenditure side	6.48	22.46	5.60	31.72
Import Volume Index, duty-paid weights	2.24	51.42	5.96	48.76
Aggregate capital stock, rental weights	0.00	0.00	2.58	21.31
Aggregate output: primary factor cost weights	8.15	37.71	9.14	40.60
Activity level or value-added	7.80	39.84	9.20	43.26
Aggregate real investment expenditure	0.00	0.00	2.20	14.94
Real household consumption	6.48	22.46	5.60	31.72
Export Volume Index	12.01	50.23	10.10	47.17

Source: Simulation results

Table 7. Percentage change in sectoral real output, employment and real trade upon China's WTO accession, %

		Only WTO Effect (Tariff/Non-Tariff Deduction and 100% Duty Exemption Cut)								Full Economic Structural And Development							
		Real Output		Employment		Real Imports		Real Exports		Real Output		Employment		Real Imports		Real Exports	
		S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run
1	**Agriculture**	12.79	10.94	14.45	12.30	-6.51	0.89	43.53	34.37	17.57	27.12	-12.94	-4.64	102.41	102.59	-10.16	-4.58
2	**Coal mining and processing**	7.16	8.74	11.39	13.41	-0.33	8.11	15.02	9.87	40.90	33.39	5.15	-1.25	40.49	37.94	69.50	51.87
3	**Crude petroleum and natural gas products**	1.61	4.84	10.24	11.30	20.36	19.41	-10.04	-4.61	52.58	41.02	50.11	31.03	20.50	9.71	93.71	78.01
4	**Metal ore mining**	7.23	9.14	14.82	16.22	7.35	12.53	8.41	6.62	44.56	38.66	-2.67	-5.43	29.72	30.70	81.93	63.66
5	**Non-ferrous mineral mining**	6.43	10.29	11.05	14.89	-1.23	7.82	10.50	8.23	45.99	46.05	12.07	11.16	34.91	37.57	73.77	63.34
6	**Manufacture of food products and tobacco processing**	9.31	8.16	24.83	16.70	-16.63	-15.66	21.57	18.89	24.40	52.07	-14.71	33.45	31.86	73.47	34.24	29.26
7	**Textile goods**	12.09	11.31	26.80	21.28	7.65	8.67	15.86	14.11	35.97	36.07	13.18	10.36	54.87	53.54	43.56	37.64
8	**Wearing apparel, leather, furs, down and related products**	12.03	11.17	20.24	15.91	-6.57	-6.14	20.05	18.42	40.55	66.76	19.87	38.78	44.85	86.44	59.14	53.18
9	**Sawmills and furniture**	7.48	9.12	14.11	15.40	-0.50	8.03	15.13	11.52	39.29	36.33	19.44	7.57	68.37	58.82	39.31	37.19
10	**Paper and products, printing and record medium reproduction**	9.41	8.52	17.03	15.44	2.30	6.50	15.93	11.57	36.51	36.09	14.39	6.10	65.90	59.85	35.81	33.93
11	**Petroleum processing and coking**	7.35	9.40	22.71	28.66	2.78	6.57	3.94	3.68	43.57	36.25	30.85	49.71	29.70	21.70	70.18	57.59
12	**Chemicals**	9.05	9.62	20.63	16.94	3.56	4.68	8.38	8.39	37.35	31.37	14.89	7.08	41.61	36.00	50.30	39.56
13	**Nonmetal mineral products**	5.18	10.04	9.85	15.97	-5.93	4.58	12.25	8.91	44.83	49.64	32.33	26.78	75.58	70.25	33.57	35.62
14	**Metals Smelting and pressing**	7.37	9.91	12.64	18.13	-2.86	4.90	9.13	6.36	43.65	42.80	23.72	31.99	47.18	49.13	54.71	44.36
15	**Metal products**	7.03	9.78	12.75	14.48	-5.29	1.76	8.77	7.51	44.30	45.97	25.98	18.79	52.37	47.41	48.63	47.78

16	**Machinery and equipment**	6.60	10.35	14.34	16.61	1.23	8.85	8.56	8.27	43.04	49.68	27.46	22.65	60.82	58.83	46.95	52.07
17	**Transport equipment**	5.00	8.60	10.86	12.20	6.44	12.86	6.22	7.20	42.60	42.44	24.93	17.91	63.85	56.99	49.36	52.38
18	**Electric equipment and machinery**	5.86	7.64	12.06	10.67	-0.43	4.11	7.32	5.60	48.86	54.69	36.16	30.84	55.40	48.46	72.46	70.81
19	**Electronic and telecommunication equipment**	6.51	6.69	15.59	12.28	4.23	6.21	6.81	5.52	54.15	61.71	53.77	44.58	59.10	53.66	69.73	73.10
20	**Instruments, meters, cultural and office machinery**	7.98	9.25	16.42	13.24	0.17	3.57	6.37	6.29	52.36	59.08	44.88	30.36	52.66	40.42	61.99	69.47
21	**Maintenance and repair of machinery and equipment**	6.92	8.26	12.49	14.10	0.00	0.00	0.00	0.00	42.31	33.21	23.89	-0.66	0.00	0.00	0.00	0.00
22	**Other manufacturing products**	7.82	8.96	16.74	14.64	4.80	6.91	12.81	12.02	37.31	33.57	17.63	0.14	46.24	37.01	34.84	36.72
23	**Scrap and waste**	7.61	9.60	16.83	19.07	0.00	0.00	0.00	0.00	39.77	36.88	37.27	12.39	0.00	0.00	0.00	0.00
24	**Electricity, steam and hot water production and supply**	6.44	8.28	23.77	17.56	20.47	15.57	-7.78	-0.35	39.48	37.58	30.94	41.63	203.76	223.69	35.41	5.38
25	**Gas production and supply**	5.55	5.77	7.09	11.29	0.00	0.00	9.92	5.14	36.35	27.00	10.03	16.28	0.00	0.00	49.93	32.62
26	**Water production and supply**	5.93	7.39	20.85	18.92	0.00	0.00	0.00	0.00	46.19	37.13	-33.28	3.38	0.00	0.00	0.00	0.00
27	**Construction**	3.70	11.45	5.18	15.17	3.69	11.45	12.95	12.27	52.87	68.28	34.18	34.82	53.60	69.01	40.39	54.61
28	**Transport and warehousing**	7.50	8.64	15.86	21.22	0.00	0.00	10.67	2.85	39.11	30.07	22.26	22.42	0.00	0.00	32.51	7.93
29	**Post and telecommunication**	5.05	7.32	26.56	26.51	7.29	10.22	-3.15	-3.50	40.82	24.34	58.54	30.63	61.45	42.33	-0.92	-11.87
30	**Wholesale and retail trade**	8.15	8.84	13.70	15.33	0.00	0.00	16.09	10.98	37.08	36.05	17.45	6.96	0.00	0.00	30.79	29.05
31	**Eating and drinking places**	8.72	8.64	16.14	16.04	-1.35	1.31	25.91	20.41	35.84	29.75	12.42	-14.04	51.43	40.80	26.38	23.74
32	**Passenger transport**	6.69	5.15	15.47	14.96	6.23	6.72	10.96	3.79	40.49	25.26	29.54	17.08	51.75	43.23	29.87	3.65

33	**Finance and insurance**	5.99	7.73	13.81	10.90	6.79	7.97	1.80	8.40	37.29	25.84	30.26	-0.64	46.47	36.00	14.61	27.57
34	**Real estate**	1.23	4.16	8.60	10.25	0.00	0.00	0.00	0.00	27.97	14.12	22.60	5.57	0.00	0.00	0.00	0.00
35	**Social services**	6.75	7.51	11.41	10.70	3.93	5.31	9.33	8.57	42.21	36.08	23.37	12.98	51.94	40.18	29.30	22.78
36	**Health services, sports and social welfare**	5.24	4.19	6.15	4.96	0.05	0.34	13.21	9.93	51.53	61.72	28.21	34.38	69.23	74.41	38.00	46.85
37	**Education, culture and arts, radio, film and television**	6.56	5.72	7.71	6.75	-1.36	-0.03	19.77	14.59	57.70	53.13	36.28	25.76	82.82	64.50	7.08	14.59
38	**Scientific research**	6.57	6.16	8.51	7.95	0.00	0.00	0.00	0.00	65.80	63.72	49.45	40.21	0.00	0.00	0.00	0.00
39	**General technical services**	7.48	7.83	17.49	14.66	0.00	0.00	0.00	0.00	54.12	55.35	62.51	54.93	0.00	0.00	0.00	0.00
40	**Public administration and other sectors**	6.49	5.61	8.09	7.14	6.48	5.60	16.80	12.33	72.42	71.68	56.07	48.31	74.34	73.59	22.89	28.71

Note: S-Run stands for short-run simulation; L-Run stands for long-run simulation.
Source: Simulation results.

Table 8. Regional impacts of "Only WTO" and "Full Economic Structural and Development," %

	Only WTO								Full Economic Structural and Development							
	Real Output		Employment		Real Imports		Real Exports		Real Output		Employment		Real Imports		Real Exports	
	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run
Beijing	7.20	8.70	12.44	14.04	2.04	6.26	9.91	8.18	51.12	50.87	37.01	38.38	59.12	56.56	59.48	58.13
Tianjin	7.41	8.84	14.43	14.27	2.04	6.26	8.16	7.35	31.27	31.04	11.33	7.74	43.80	41.18	53.07	55.82
Hebei	8.09	9.34	14.15	13.58	0.66	5.01	13.17	10.93	42.64	43.43	8.77	11.73	55.68	56.20	48.88	43.71
Shanxi	7.71	9.17	13.40	13.63	2.68	6.61	12.01	9.43	40.56	40.60	11.08	13.25	42.37	40.91	47.30	40.55
Mongolia	8.11	9.05	14.10	13.21	1.34	5.84	14.54	11.55	54.97	55.37	19.03	23.95	66.11	65.38	54.13	47.56
Liaoning	7.66	9.23	13.78	13.86	3.36	7.07	10.88	9.01	21.54	21.03	-13.18	-11.99	32.76	29.37	34.84	30.85
Jilin	8.11	9.30	13.80	13.23	3.36	7.07	11.07	9.43	59.01	59.16	29.23	31.12	66.15	62.76	62.67	57.61
Heilong	7.61	9.21	13.65	13.27	3.36	7.07	9.68	8.29	24.51	23.49	-11.94	-11.96	34.08	30.55	37.36	30.73
Shanghai	7.74	9.22	13.83	15.07	1.88	6.01	10.67	9.09	36.62	35.30	21.17	15.68	44.00	41.39	51.13	48.67
Jiangsu	8.06	9.34	14.42	14.13	1.88	6.01	12.23	10.46	42.17	42.41	11.48	12.76	51.33	48.77	52.34	49.33
Zhejiang	8.11	9.34	14.35	13.97	1.88	6.01	13.44	11.41	29.37	30.46	-7.00	-1.99	39.57	37.09	41.28	37.88
Anhui	8.14	9.28	14.31	13.25	2.68	6.61	14.22	11.88	40.29	41.70	4.22	9.76	43.86	42.42	49.40	45.51
Fujian	8.07	8.94	14.32	13.09	2.61	5.70	13.65	11.33	45.12	44.43	7.96	11.23	50.95	47.65	53.51	50.16
Jiangxi	8.16	9.11	14.06	12.77	2.68	6.61	14.36	11.69	18.08	17.82	-17.77	-13.63	26.82	25.28	27.85	23.31
Shandong	7.97	9.29	14.23	13.51	0.66	5.01	12.86	10.87	60.51	60.55	27.76	29.70	69.85	70.31	65.41	61.35
Henan	8.08	9.28	14.24	13.32	2.68	6.61	13.55	11.29	41.23	41.78	5.74	9.17	51.90	50.38	46.50	41.71
Hubei	7.87	9.20	14.22	13.38	2.68	6.61	13.43	11.38	34.50	35.08	-2.09	1.88	45.70	44.24	41.64	37.72
Hunan	8.00	9.12	13.71	12.87	2.68	6.61	13.93	11.16	13.81	14.04	-21.89	-18.07	22.80	21.31	23.92	19.55
Guangdong	7.90	8.98	14.52	13.78	2.61	5.70	11.25	9.47	50.34	49.48	20.48	20.82	56.17	52.86	62.51	60.54
Guangxi	8.07	8.99	14.04	12.77	2.63	7.68	14.80	11.87	1.25	2.02	-36.43	-31.62	24.53	22.43	11.14	7.12
Hainan	8.99	8.95	14.23	12.47	2.61	5.70	17.29	13.84	38.02	39.14	1.77	7.78	47.71	44.46	37.97	33.47
Chongqing	7.62	8.95	13.05	13.04	2.63	7.68	12.15	10.04	20.76	20.83	-14.20	-11.61	39.98	37.86	28.01	24.00
Sichuan	7.81	9.06	13.46	13.01	2.63	7.68	11.86	9.70	30.88	32.01	-5.11	-0.56	48.84	46.75	43.51	41.45
Guizhou	8.00	9.05	13.80	12.67	2.63	7.68	13.72	11.28	18.24	20.05	-19.24	-12.94	36.97	34.93	27.03	23.10
Yunnan	7.86	9.02	13.81	12.88	2.63	7.68	15.41	12.37	34.02	36.33	-3.92	3.76	52.08	50.08	34.63	30.50
Tibet	8.32	8.56	13.26	12.03	2.63	7.68	17.73	13.31	33.79	35.42	7.80	12.31	38.53	36.46	29.57	25.17
Shaanxi	7.74	8.91	13.73	13.03	1.34	5.84	10.77	8.82	26.69	26.70	-6.42	-2.50	41.70	40.97	41.87	39.77
Gansu	7.88	9.13	13.88	13.68	1.34	5.84	11.07	9.20	42.87	42.24	9.39	11.75	55.07	54.24	52.09	45.70
Qinghai	7.65	8.96	13.06	13.31	1.34	5.84	10.86	8.85	35.66	35.04	9.18	11.08	47.49	46.70	43.04	36.12
Ningxia	7.80	9.09	13.74	13.71	1.34	5.84	11.26	9.29	37.48	37.27	5.72	8.69	50.59	49.83	43.85	37.63
Xinjiang	7.93	8.97	13.79	12.99	1.34	5.84	10.15	8.70	39.78	37.27	6.21	6.49	51.56	50.59	49.12	39.93

Note: S-Run refers to Short-Run Simulation and L-Run refers to Long-Run Simulation Source: Simulation Results

Table 9. Real output, employment, real imports and real exports; effects of regional blocks

	Only WTO								**Full Economic Structural And Development**							
	Real Output		**Employment**		**Real Imports**		**Real Exports**		**Real Output**		**Employment**		**Real Imports**		**Real Exports**	
	S-Run	**L-Run**	**S-Run**	**L-Run**	**S-Run**	**L-Run**	**S-Run**	**L-Run**	**S-Run**	**L-Run**	**S-Run**	**L-Run**	**S-Run**	**L-Run**	**S-Run**	**L-Run**
N_Eastern	7.72	9.23	13.74	13.49	3.36	7.07	10.59	8.90	28.82	28.24	-1.23	-0.26	36.91	33.50	40.50	35.61
N_Munici	7.30	8.76	13.36	14.15	2.04	6.26	8.74	7.63	42.11	41.87	25.18	24.26	53.54	50.97	55.19	56.58
N_Coastal	8.02	9.31	14.20	13.54	0.66	5.01	12.96	10.89	53.79	54.11	20.06	22.42	67.67	68.14	60.27	55.87
C_Coastal	8.00	9.31	14.33	14.19	1.88	6.01	12.15	10.36	36.72	36.88	7.23	8.79	45.85	43.28	49.05	46.08
S_Coastal	7.97	8.97	14.43	13.46	2.61	5.70	11.81	9.90	48.66	47.89	15.06	16.76	55.59	52.29	60.40	58.13
Central	8.00	9.21	14.07	13.21	2.68	6.61	13.68	11.32	32.69	33.21	-2.94	0.94	40.32	38.84	41.00	36.57
N_Western	7.90	9.00	13.85	13.21	1.34	5.84	11.41	9.38	40.03	39.42	6.88	10.07	53.52	52.70	47.32	42.02
S_Western	7.86	9.02	13.61	12.90	2.63	7.68	13.13	10.67	23.39	24.58	-14.94	-10.03	42.57	40.50	32.44	29.28

Note: S-Run stands for short-run simulation; L-Run stands for long-run simulation.
Source: Simulation results.

Table 10. Regional EV, real consumption and per capita income with/without considering labour movement

	Only WTO								Full Economic Structural And Development							
	EV-Household (RMB 100 Million)		Real Consumption (%)		Per Capita Income[a] (RMB)		Per Capita Income[b] (RMB)		EV-Household (RMB 100 million)		Real Consumption (%)		Per Capita Income [a] (RMB)		Per Capita Income [b] (RMB)	
	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run
N_Eastern	297.59	276.10	6.49	6.02	11051.23	11426.95	11041.53	11413.47	577.31	928.14	12.60	20.25	18748.24	18133.26	18868.67	18241.83
N_Munici	203.29	184.04	9.67	8.75	20036.96	20504.53	17996.49	18327.80	730.72	881.06	34.76	41.91	37995.43	36133.87	30714.01	29477.04
N_Coastal	424.95	366.64	6.38	5.51	10214.85	10539.69	10228.69	10555.72	2640.84	3224.44	39.66	48.42	20618.26	20105.07	20281.74	19837.56
C_Coastal	812.45	724.17	8.54	7.61	18684.63	19142.65	17331.99	17720.65	2026.39	2839.88	21.31	29.86	33673.33	32185.36	29940.93	28924.88
S_Coastal	490.20	387.87	7.33	5.80	13171.31	13497.24	11659.81	11919.92	2309.52	2831.49	34.51	42.32	25702.99	24820.67	20572.64	20047.55
Central	535.89	453.04	5.15	4.35	6357.23	6584.04	6643.05	6890.88	1604.53	2719.71	15.41	26.11	11505.33	11254.54	12538.75	12172.33
N_Western	159.02	138.67	5.34	4.66	6125.56	6321.58	6045.06	6238.57	771.76	1051.16	25.92	35.31	11516.03	11181.86	11353.26	11099.44
S_Western	221.15	188.93	3.95	3.38	5000.68	5190.83	5193.33	5395.56	241.63	917.54	4.32	16.40	8844.27	8609.08	9565.59	9263.33

Notes: S-Run stands for short-run simulation; L-Run stands for long-run simulation.
[a] Labour movement not considered.
[b] Labour movement considered.
Source: Simulation results.

Table 11. Regional GINI coefficient with/without consideration of inter-regional labour movement

	Baseline in 2002		WTO				Full Economic Structural and Development			
	No Consideration of Labour Movement	Consideration of Labour Movement	No Consideration of Labour Movement		Consideration of Labour Movement		No Consideration of Labour Movement		Consideration of Labour Movement	
			S-Run	L-Run	S-Run	L-Run	S-Run	L-Run	S-Run	L-Run
All	0.310935	0.281246	0.311286	0.308682	0.284635	0.281251	0.316587	0.311986	0.26855	0.267544
N_Eastern	0.09875	0.092077	0.100349	0.101856	0.093809	0.094923	0.060516	0.059878	0.054799	0.055271
N_Munici	0.025707	0.002891	0.000276	0.002465	0.017459	0.016579	0.034728	0.038819	0.011938	0.009983
N_Coastal	0.061036	0.060173	0.072986	0.072287	0.071673	0.071039	0.093491	0.092834	0.081729	0.081885
C_Coastal	0.195252	0.158334	0.184675	0.182767	0.150435	0.147143	0.175569	0.171494	0.120679	0.121565
S_Coastal	0.137983	0.115887	0.146586	0.143717	0.127519	0.127803	0.141905	0.140123	0.13113	0.12914
Central	0.068304	0.065805	0.071821	0.071518	0.06745	0.066942	0.07772	0.078409	0.060792	0.061918
N_Western	0.112083	0.100102	0.103143	0.103076	0.093255	0.093018	0.113201	0.114811	0.105446	0.108636
S_Western	0.104282	0.104292	0.10908	0.109201	0.113026	0.113442	0.128262	0.123075	0.126765	0.122658

Note: S-Run stands for short-run simulation; L-Run stands for long-run simulation. Source: Author's calculations.

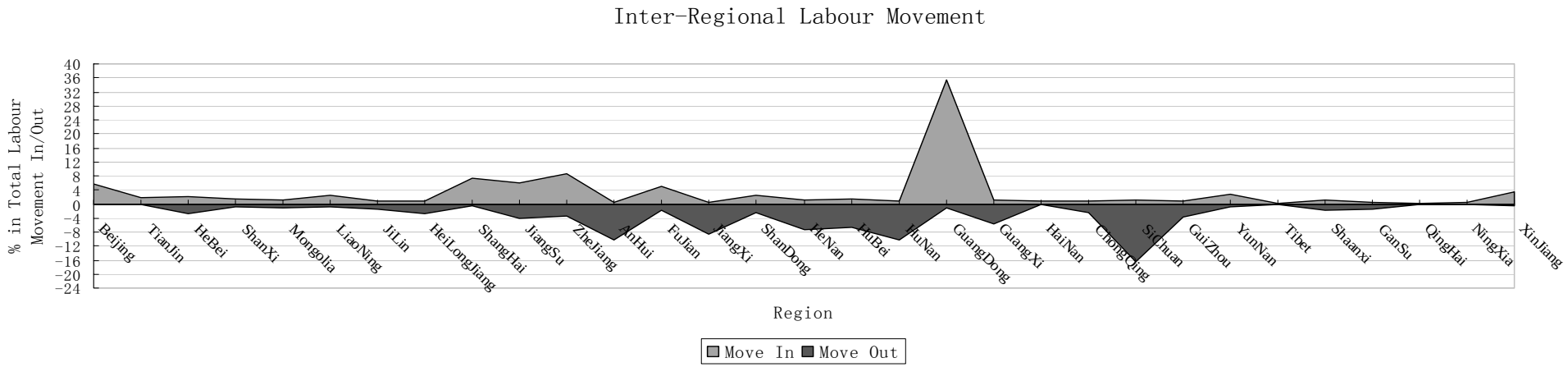


Figure 3. Inter-regional labour movement in 2002.

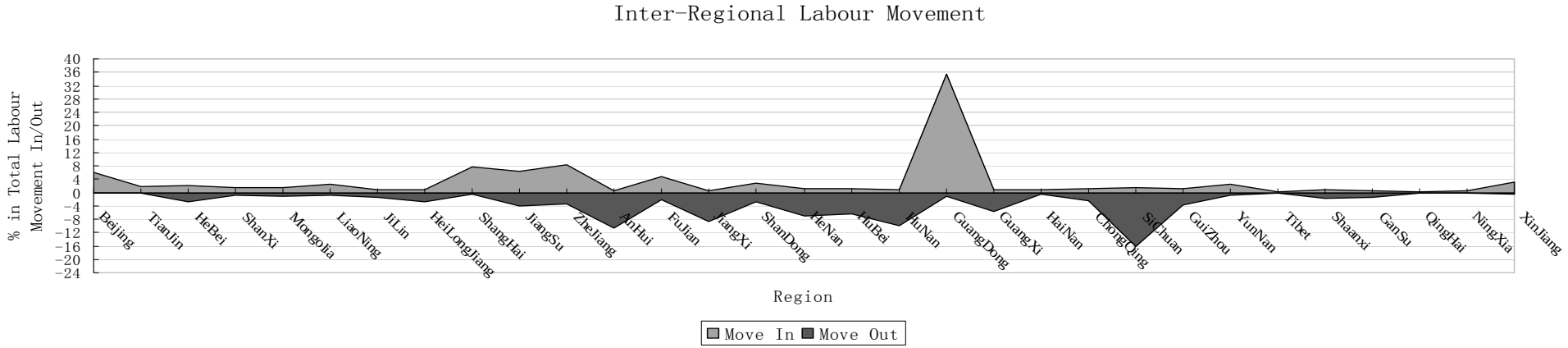


Figure 4. Inter-regional labour movement under short-run WTO shock.

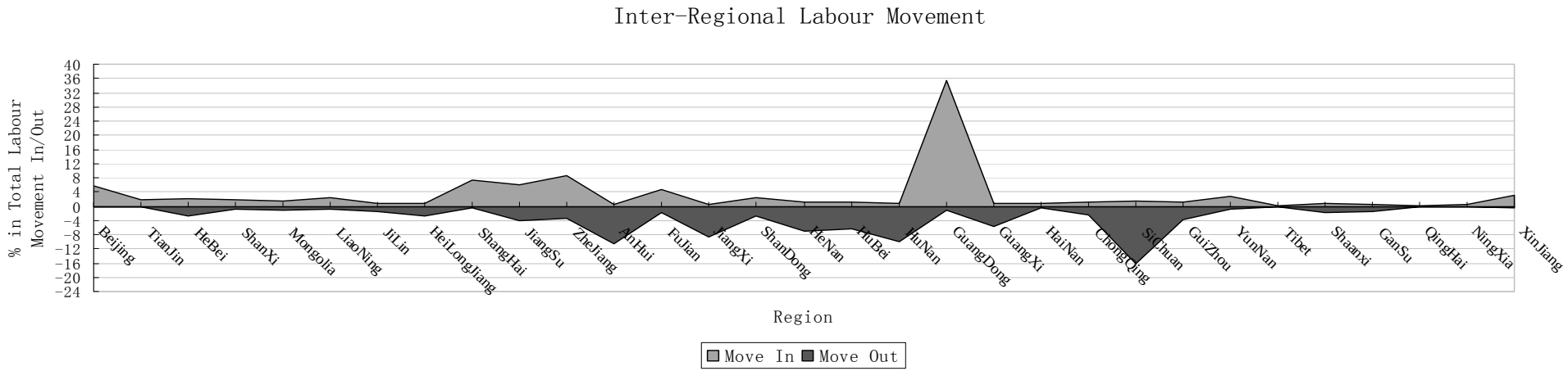


Figure 5. Inter-regional labour movement under long-run WTO shock

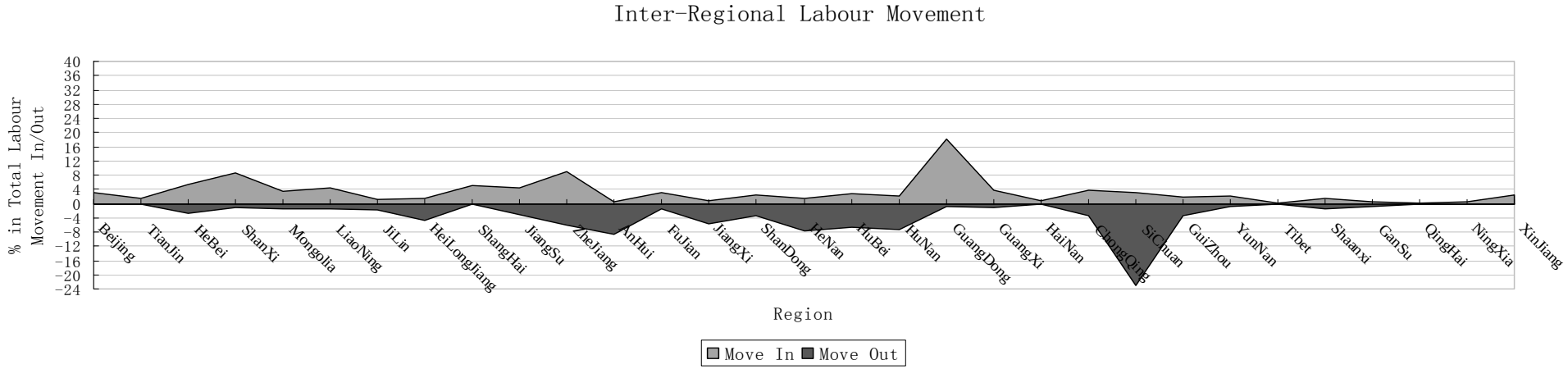


Figure 6. Inter-regional labour movement under short-run full economic structure and development shock

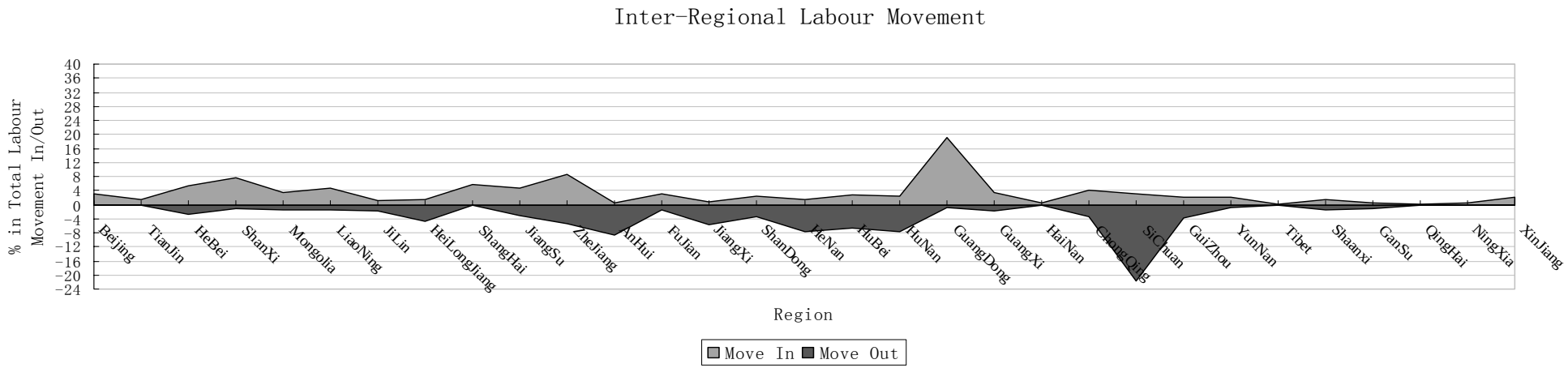


Figure 7. Inter-regional labour movement under long-run full economic structure and development shock.

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