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Direction of Trade Following China's Accession to the WTO

by

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Direction of trade following China's accession to the WTO

Hildegunn Kyvik Nordås, SNF*

Abstract

This paper analyzes the impact of WTO accession on China's international trade patterns. It starts with an analysis of historical trade patterns and the driving forces behind them. It is argued that China's trade has been dominated by foreign firms located in special economic zones, particularly in the electronics sector and other technologically advanced sectors. The paper continues with a discussion of China's WTO accession protocol and the changes in trade policy that it implies. It is argued that China's WTO accession can largely be seen as a unilateral reduction in tariffs and non-tariff trade barriers on the part of China, with one important exception; the textile and clothing industry. China will face substantially lower trade barriers in the European and North American markets in these two sectors and China will be able to double its world market share in the apparels industry, both at the expense of other developing countries and highly protected firms in the US and EU. Other developments are a widening Chinese trade surplus towards North America, and a widening trade deficit towards Asia. However, China's overall world export market share will not change much. These quantitative estimates are derived by running the GTAP world general equilibrium model.

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1 Introduction

China's accession to the World Trade Organization (WTO) was approved during the Ministerial Conference in Doha, Qatar 11th November 2001, and China became a member of the WTO 11th December 2001. This marks the end of a long process starting in 1986 when China first applied for membership.[1] Since participation in the WTO requires a transparent and market-based trading and production system, the accession process has involved comprehensive economic reforms in China. These reforms are probably more important for China's economic development than access to the WTO per see, although the two processes are closely related. Furthermore, having bilateral agreements with the United States and being a beneficiary to the General System of Preferences (GSP) have given China market access to the largest developed market economies already. Accession to the WTO can therefore mainly be seen as China's unilateral reduction in customs duties and non-tariff trade barriers towards the rest or the world. The major exception to this occurs in the textile and apparel industries where Chinese exporters have faced import quotas in the major developed markets. These will be phased out gradually during the period 2002-2005 under the Agreement in Textiles and Clothing.

In the year 2000, China was the world's 7th largest exporter, accounting for about 4 percent of world merchandise exports and about 2 percent of world services exports. At the same time China was the world's 8th largest importer, importing about 3.5 percent of the world's total merchandise imports and about 2.5 percent of the world's total services imports. The country had a significant surplus on its merchandise trade, but a deficit on its services trade (WTO, 2001). Finally, China received 3.2 percent of the world's total foreign direct investment (FDI) in 2000 (UNCTAD, 2001). China's share of global production (i.e., world GDP) was 3.5 percent in 2000 (World Bank, 2001). Thus, China's share in total world trade and capital flows is in line with the relative size of the economy. The trade volume relative to the size of the total economy indicates that China is a relatively open economy. However, Chinese companies are less integrated in the world economy and less exposed to international competition than these figures suggest. In a broad range of industries, exports are dominated by foreign firms, which operate in special export processing zones with few linkages to the local economy. Foreign companies accounted for 52 percent of total imports and 48 percent

[1] China was a signatory to the GATT agreement in 1948, but left the GATT already in 1949 after the revolution. The withdrawal was, however, an announcement made by the Taiwan government and was never confirmed by the Beijing government. China announced that it wanted to resume its status as a GATT contracting party in 1986.

of total exports in China in the year 2000 (China FDI, 2001). Furthermore, in a number of industries the local market is quite insulated from foreign competition; even foreign companies producing in China have limited access to the Chinese market in many industries.

China is a lower middle-income country and relatively abundant in labor, while natural resources are becoming relatively scarce. In a free trade regime, one would therefore expect China to specialize in labor-intensive industries and import raw materials and capital-intensive goods. One would also expect that in a liberal trade and investment regime, foreign investors would outsource labor-intensive production processes to China and integrate the country in their international supply chains. However, the sheer size of the Chinese economy suggests the country will attract market seeking foreign investors in most sectors. Furthermore, China's most dynamic economic zones and open coastal cities have relatively high income levels, a relatively well educated labor force and vibrant high-technology industries. These have been subject to a different trade regime than the rest of China, and probably have a different pattern of comparative advantage than the less developed provinces in the interior of China.

This paper analyzes the impact of China's accession to the WTO in three steps. First, it assesses the trade and investment patterns observed during the period 1978-2000 and its determinants. Second, it discusses the changes in trade policy following accession to the WTO. The paper finally discusses the likely changes in trade patterns following WTO membership. This discussion is based on results from running the GTAP model.[2]

The rest of the paper is organized as follows. Section two presents and analyzes recent trends in China's trade with the rest of the world, i.e., North America (NAFTA), the European Union (EU), Asia and "Other". The latter includes Latin America, Africa, Australia, New Zealand, the Middle East, Eastern Europe and former Soviet Union.[3] We focus on the extent of intra-industry trade, FDI and developments in China's comparative advantage. Section three discusses the trade and industrial policy changes that follow from accession to the WTO in some more detail. We finally provide qualitative and quantitative estimates of the impact of these reforms. Section four briefly outlines the theoretical backdrop of these assessments,

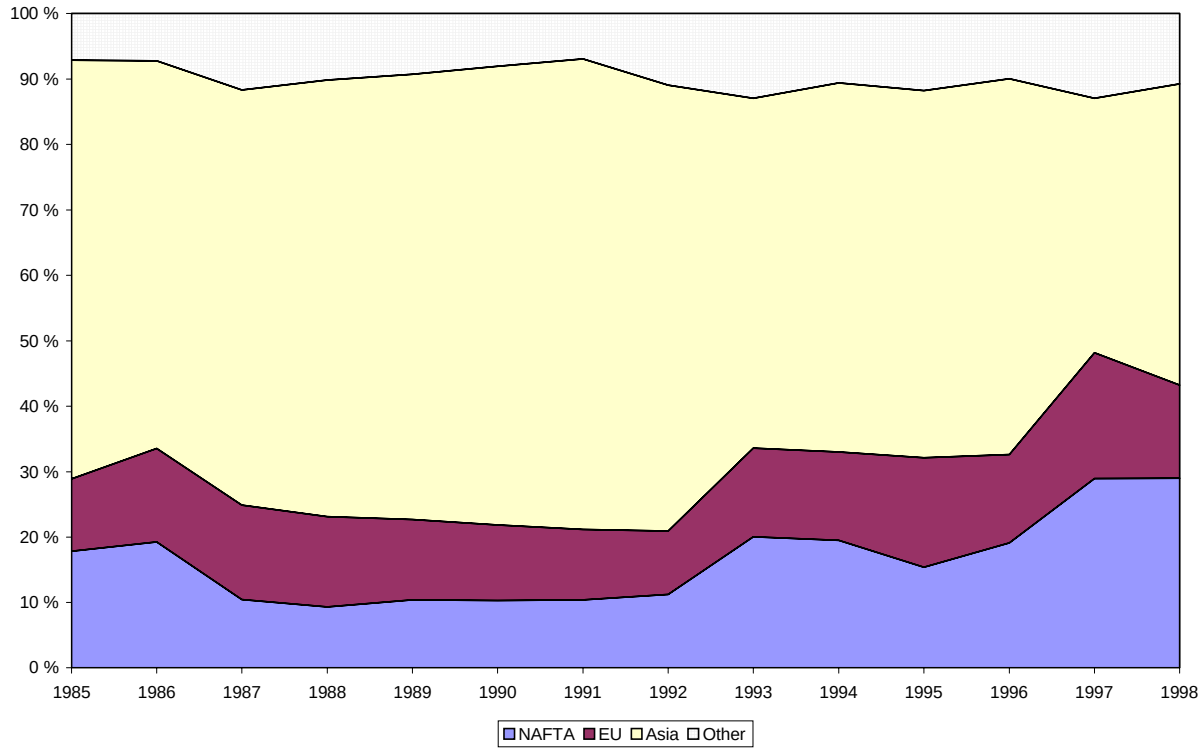
[2] Global Trade Analysis Project (GTAP) is a database and modeling framework developed by the Purdue University in cooperation with the World Bank, OECD and WTO.
[3] We have included EFTA in the EU.

while section 5 presents changes in trade flows as a consequence of accession to the WTO. The projections are made using the GTAP model. Section 6 summarizes and concludes.

2 China's trade patterns

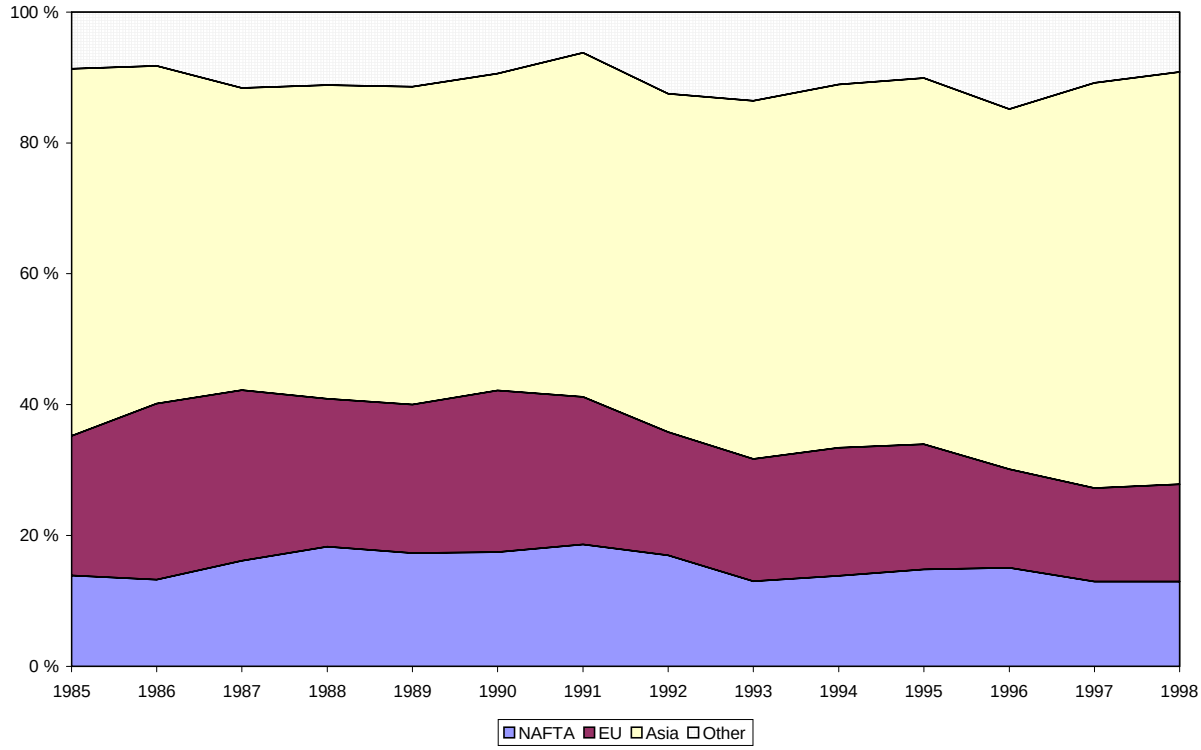
China's international trade has increased tremendously over the past two decades following economic reforms and liberalization of international as well as internal trade. In the sixties and seventies, China accounted for only 0.5-0.8 percent of world exports, increasing to 1.7 percent by 1990 and to 4 percent in 2000, implying an 8-fold increase in export market share. During the same period an increasing share of China's economic activities has been subject to international competition, either through exports or import competition. Not only has the total trade volume increased tremendously over time, the composition of exports and imports and the direction of trade have also changed. Figures 1 and 2 show the direction of exports and imports respectively.

Figure 1. Destination of China's exports



Source: GTAP database

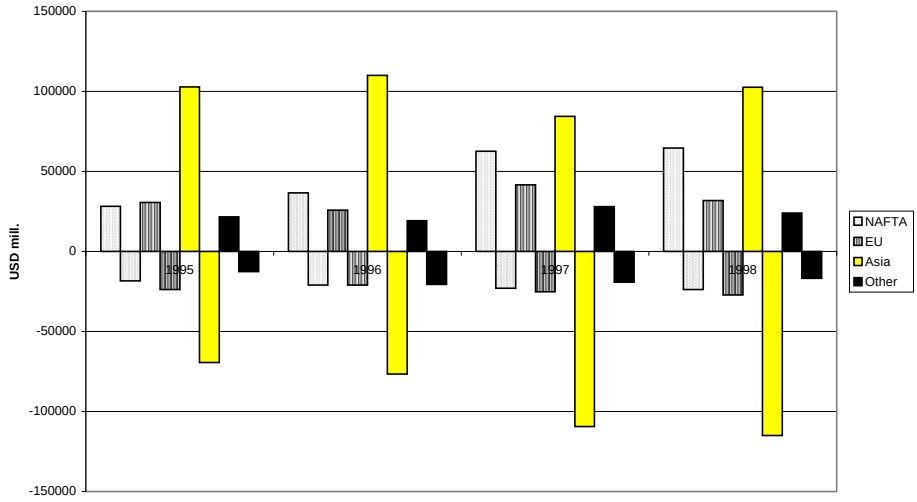
Figure 2. Imports to China by region



Source: GTAP database

While imports increasingly stem from the Asian region, the share of exports going to North America and the European Union has increased sharply over time, particularly since 1992 following the implementation of the eighth five year plan which introduced export promoting trade policies and encouraged foreign direct investment (FDI). In addition, China entered bilateral trade agreements with the US and it benefited from the General System of Preferences (GSP) awarded developing countries in several OECD markets. The absolute levels of exports and imports between China, NAFTA, the EU, Asia and "Other" are shown in figure 3 where exports are shown as a positive number and imports as a negative number.

Figure 3. China's exports and imports by region



Source: GTAP database

We note that Asia is by far the largest trading partner to China, and that there has been a rapid growth in imports from Asia since 1995. The Asian financial crisis gave imports from this region a further boost in 1997 when South East Asian currencies depreciated sharply against all major currencies, including the Chinese yuan. Exports to the NAFTA countries have increased substantially during the 4-year period, while imports from NAFTA have remained constant. The overall changes amount to a shift from a trade deficit to a trade surplus towards NAFTA (the shift occurred in 1993) and the EU (the shift occurred in 1995), while there was a change from a trade surplus to a trade deficit towards Asia (the shift occurred in 1997).

The share of manufactured products increased from 37 percent of China's merchandise exports in 1985 to 87 percent in 1999, while high- and medium technology goods accounted for 17 percent of manufactured exports in 1999 (Dahlman and Aubert, 2001). Table 1 presents trade flows between China and the major trading partners in 1998. The figures are given in millions of 1997 U.S. dollars. China's largest exporting sector was "other manufacturing". This category mainly consists of toys and sound recording equipment, which both are large industries in China. The next largest exporting sectors are apparel and electronics. The largest importing sectors are machinery, chemicals and electronic equipment. We note that electronics is both the third largest exporting sector and the third largest imports. Asia is the most important source of imports in all the largest importing sectors, while NAFTA is the most important destination for China's largest exports, "other manufacturing".

Table 1, China's trade by region and sector in 1998 (millions of 1997 U.S. dollars)

Sector	**NAFTA**		**EU**		**Asia**		**World**	
	Exports	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**
Agriculture	289	1240	611	261	3096	409	4631	1136
Fuel (raw)	120	7	351	4	1487	261	2161	893
Food (processed)	544	774	521	322	4437	1316	6226	3841
Beverages and tobacco	28	7	31	105	625	22	797	135
Textiles	1333	725	1337	718	8964	16568	14217	19052
Apparel	7449	12	3459	40	19023	2380	34691	2464
Leather prod	5574	479	2393	599	10008	2608	19911	3896
Wood	2058	114	939	153	2910	1314	6367	1672
Paper and printing	155	1504	113	668	767	3251	1157	5879
Petroleum (refined)	322	265	106	114	1822	3961	2552	7008
Chemicals	1904	4444	2219	3466	4584	18236	10437	28055
Metals	2521	1122	1612	1913	5073	11249	10532	19166
Metal products	1795	272	1456	423	2961	1489	7312	2305
Motor vehicles	1015	178	442	1096	1382	1773	3350	3079
Transport equipm	197	1682	848	1356	666	127	2259	3585
Machinery	8972	6746	4658	11664	12826	30433	29351	49765
Electronics	12216	3639	5071	3753	12752	13759	31912	21309
Other manufactures	18061	489	5585	571	9112	5829	34897	7048
Total	64553	23699	31752	27226	102495	114985	222760	182647

Source: GTAP database

In order to assess the driving forces behind China's trade, we present estimates of the country's comparative advantage and the relative importance of intra-industry trade. A commonly used measure of a country's comparative advantage is the so-called Balassa index of revealed comparative advantage (Balassa, 1965). This index measures normalized export shares relative to world exports or relative to a group of reference countries. Revealed comparative advantage of sector *j* in country *a* relative to reference countries *ref* can be expressed as follows:

$$BI_j^a = X_j^a / X^a \Big/ X_j^{ref} / X^{ref}$$

where X denotes exports, sectors are indicated by subscripts and countries by superscripts. When the BI > 1, the country is commonly assumed to have a comparative advantage in the sector in question, and one should expect positive net exports. The index is convenient because it does not require information on countries' endowments of production factors, a kind of information that is unavailable for a number of countries. However, the Balassa index is based on actual trade flows, which are subject to tariffs and other trade barriers as well as transport costs. The index may therefore be biased when trade is distorted and we compare countries that face different trade barriers (Hinloopen and Van Marrewijk 2001) or different

industrial policy. Distortions due to industrial policy are probably more severe than concerns about trade policy in the Chinese case. Thus, except in the apparels and textile industries, the trade barriers facing China is not very different from those facing other countries. In addition exports to China are a relatively small share of total exports for the regions we compare China to. Table 2 presents the Balassa index for 18 sectors in three selected years, a decade apart.

Table 2, China's revealed comparative advantage

Sector	**NAFTA**			**EU**			**Asia**			**Other**		
	1978	**1988**	**1998**	**1978**	**1988**	**1998**	**1978**	**1988**	**1998**	**1978**	**1988**	**1998**
Agriculture	1.56	1.60	0.47	5.73	3.79	0.85	2.85	3.30	2.00	1.70	1.01	0.25
Fuel (raw)	2.90	1.82	0.72	5.19	3.82	2.27	2.60	3.85	1.14	0.25	0.27	0.18
Food (processed)	2.29	2.23	0.83	1.81	1.39	0.52	2.45	2.75	0.92	1.48	0.93	0.35
Beverages and tobacc.	0.54	0.56	0.39	0.22	0.37	0.23	3.43	3.49	2.78	1.79	1.86	0.41
Textiles	5.91	5.19	3.44	2.61	2.59	2.04	2.01	2.02	1.27	12.00	6.23	1.98
Apparel	14.97	29.09	8.92	3.03	5.94	7.05	1.36	2.77	3.49	6.72	4.85	2.54
Leather products	12.74	11.81	22.62	2.54	2.64	6.93	1.84	1.32	6.96	6.83	3.24	6.78
Wood	1.29	0.76	1.37	0.81	0.49	1.28	1.01	0.59	2.09	30.4	1.17	1.54
Paper and printing	0.34	0.18	0.16	0.38	0.18	0.18	1.57	0.75	0.57	3.19	0.74	0.35
Petroleum (refined)	2.81	1.32	0.51	1.08	1.12	0.50	1.91	1.59	0.54	0.86	0.39	0.05
Chemicals	0.65	0.70	0.45	0.46	0.52	0.31	1.08	1.19	0.61	1.20	0.95	0.65
Metals	0.82	1.06	0.95	0.51	0.71	0.58	0.55	1.02	0.78	0.72	0.44	0.29
Metal products	1.02	1.09	1.59	0.71	0.79	1.21	0.87	1.10	1.79	4.71	2.37	2.22
Motor vehicles	0.01	0.38	0.12	0.01	0.47	0.12	0.01	0.42	0.16	0.19	3.25	0.42
Transport equipment	0.13	0.17	0.16	0.14	0.24	0.48	0.08	0.32	0.52	0.74	0.75	0.72
Machinery	0.21	0.31	0.48	0.20	0.30	0.58	0.28	0.33	0.47	2.62	1.73	1.68
Electronics	0.02	0.34	1.42	0.04	0.71	1.95	0.02	0.21	0.76	0.39	4.06	6.52
Other manufactures	3.59	2.79	3.38	2.56	2.06	2.94	1.19	0.81	2.68	10.66	7.61	8.31

Comparing tables 1 and 2, we see that the prediction that a sector with a BI >1 has a trade surplus is borne out in the data for most sectors and towards most trading partners. The expectation that there is a trade deficit when BI < 1 is not born out in the data to the same extent. This bias towards sectoral surpluses can probably be explained by the fact that China has an overall surplus on its trade balance. This in turn reflects a situation where domestic demand is lower than domestic income and China is a net exporter of capital.

We notice that China's comparative advantage has shifted over time. Compared to NAFTA and EU, China has had a comparative advantage in labor-intensive industries (textiles, apparel, leather products and other manufacturing) during the entire period. Comparative advantage towards these regions has, however, changed over time from a comparative advantage to a comparative disadvantage in natural resource-intensive industries (agriculture, fuel, food and petroleum). We see a weakening of comparative advantage in natural resource-intensive industries also relative to Asia. Raw materials have apparently become increasingly

scarce, and China has changed from a raw materials exporting country to a raw materials importing country. China did not have a strong comparative advantage in labor-intensive industries in the first period compared to Asia, but comparative advantage in these sectors has strengthened over time. It is finally worth noticing that China has strengthened its comparative advantage in the electronics sector relative to all regions. Only relative to Asia does it still have a comparative disadvantage in this sector. Electronics is a skills-intensive sector and its strong growth in China mainly reflects a concentration of skilled workers in the special economic zones and high-technology parks.

Turning to intra-industry trade, a commonly applied definition is:

$$IIT_{ijk} = 1 - \frac{\left| exports_{ijk} - imports_{ijk} \right|}{exports_{ijk} + imports_{ijk}}$$

where IIT_{ijk} is the intra-industry trade index for trading partners *j* and *k* trading in sector *i* (Grubel and Loyd 1975). The index varies from 0 when all trade is one-way (either exports or imports are zero) to one when trade is balanced in the sector such that exports = imports. Table 3 below shows the intra-industry trade index by sector in 1978, 1988 and 1998 towards trading partners by region.

Table 3. Intra-industry trade as share of total trade by sector and region

Sector	**NAFTA**			**EU**			**Asia**			**Other**		
	1978	**1988**	**1998**	**1978**	**1988**	**1998**	**1978**	**1988**	**1998**	**1978**	**1988**	**1998**
Agriculture	0.16	0.30	0.38	0.01	0.08	0.60	0.33	0.35	0.23	0.38	0.78	0.57
Fuel (raw)	0.00	0.01	0.11	0.00	0.00	0.02	0.00	0.04	0.30	0.35	0.47	0.49
Food (processed)	0.73	0.80	0.83	0.23	0.30	0.76	0.31	0.57	0.46	0.60	0.47	0.67
Beverages and tobacc.	0.00	0.19	0.40	0.00	0.33	0.46	0.00	0.97	0.07	0.00	0.21	0.02
Textiles	0.91	0.77	0.70	0.71	0.92	0.70	0.75	0.89	0.70	0.00	0.23	0.57
Apparel	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.11	0.22	0.01	0.01	0.01
Leather products	0.00	0.02	0.16	0.00	0.03	0.40	0.00	0.11	0.41	0.00	0.02	0.20
Wood	0.00	0.42	0.10	0.00	0.45	0.28	0.00	0.57	0.62	0.00	0.69	0.33
Paper and printing	0.17	0.07	0.19	0.14	0.13	0.29	0.78	0.66	0.38	0.60	0.95	0.42
Petroleum (refined)	0.00	0.80	0.90	1.00	0.71	0.96	0.01	0.65	0.63	0.00	0.89	0.20
Chemicals	0.60	0.28	0.60	0.49	0.58	0.78	0.90	0.82	0.40	0.12	0.97	0.95
Metals	0.53	0.93	0.62	0.16	0.55	0.91	0.30	0.78	0.62	0.50	0.34	0.43
Metal products	0.73	0.44	0.26	0.58	0.67	0.45	0.99	0.97	0.67	0.13	0.34	0.20
Motor vehicles	0.00	0.59	0.30	0.00	0.20	0.57	0.00	0.52	0.88	0.00	0.31	0.12
Transport equipment	0.00	0.09	0.21	0.03	0.11	0.77	0.31	0.53	0.32	0.85	0.35	0.87
Machinery	0.09	0.19	0.86	0.11	0.06	0.57	0.61	0.58	0.59	0.00	0.94	0.48
Electronics	0.00	0.14	0.46	0.09	0.39	0.85	0.20	0.71	0.96	0.00	0.71	0.16
Other manufactures	0.05	0.29	0.05	0.01	0.24	0.19	0.06	0.70	0.78	0.00	0.36	0.14

The share of bilateral trade that is classified as intra-industry varies between almost zero in the sectors for which China has the strongest comparative advantage or the largest

comparative disadvantage to almost 100 percent in chemicals and electronics in recent years. We generally observe that the extent of intra-industry trade has increased in all sectors over time, although the indices fluctuate from one year to the next in most sectors. We also observe that the intra-industry trade share is higher in China's trade with Asia than it is for China's trade with overseas trading partners in the manufacturing sectors. As discussed in section 4 below, intra-industry trade is generally most prominent in sectors characterized by product differentiation and economies of scale, and among countries at similar income levels and with similar factor endowments. Examples of sectors where intra-industry trade is prominent are motor vehicles, electronics and machinery and equipment.[4] In these sectors between 93 and 97 percent of China's imports were for productive use (investment and intermediate goods), suggesting that intra-industry trade in components are more prominent than intra-industry trade in finished goods (i.e., there is mainly vertical intra-industry trade).

2.1 The role of FDI

FDI has played a major role in China's internationalization since the open doors policy was introduced in 1978. Foreign companies first entered the Chinese economy in specially designated areas. These were of four categories: Special Economic Zones, Open Coastal Cities, Economic and Technological Development Zones, and Open Coastal Areas. In addition there are 53 designated high-technology parks, employing 2.2 million people. These parks accounted for 10 percent of China's industrial production and 55 percent of computer-related products (Dahlman and Aubert, 2001). Investments in all these designated areas received tax concessions and could import inputs free of customs duties provided that the output was exported. Imports of capital goods for use in joint ventures were also free of import duties until the late 1990s.[5]

China received an annual average of USD 15 billion of FDI during the first half of the 1990s, increasing to about USD 40 billion on average during the second half of the 1990s. FDI accounted for about 14 percent of total investment in China during the second half of the 1990s (UNCTAD, 2001). The share of FDI in China mainland going to the high-technology sectors has increased sharply during the 1990s. All the major electronics companies in the

[4] The intra-industry trade indices are affected by the level of aggregation of the sectoral data. The higher the level of aggregation, the higher the intra-industry trade index. Therefore, we should ideally estimate the indices at a more disaggregated industry classification level, e.g., four-digit ISIC classification.

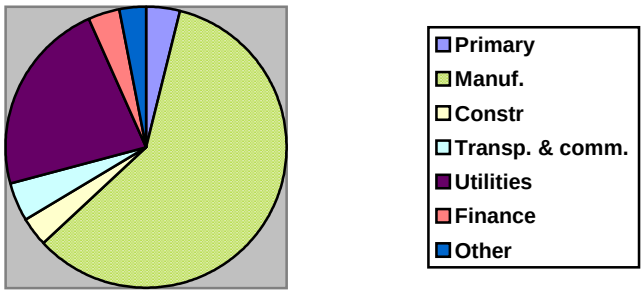
[5] Special Economic Zones are the most attractive locations with a profit tax rate of 15 percent (the general profit tax rate is 33 percent), the most comprehensive tariff exemptions and the lowest land use fees (Cheng and Kwan, 2000).

world have production facilities in China and there are now more than 100 R&D centers established by multinational firms in China. Exports of high-technology products by foreign affiliates increased from USD 4.4 billion in 1996 to about USD 30 billion in 2000 (UNCTAD, 2001). Foreign affiliates accounted for about 80 percent of total exports in the high-technology industries of which the electronics industry was the most important in 2000. Foreign firms are about a third as profitable and labor productivity is about twice as high in foreign firms as local firms in the same sector and of the same firm size (Dahlman and Aubert, 2001).

FDI has been subject to government regulations and there are large differences among industries and geographical areas concerning to what extent foreign ownership is allowed or encouraged. The State Planning Commission and the Ministry of Foreign Trade and Economic Cooperation classified projects into four categories: those to be encouraged, those to be allowed, those to be restricted and those to be forbidden (Lu, 2000). Those to be encouraged were found in the "pillar industries" such as telecommunications, energy and infrastructure. In addition, export oriented and import-substituting investments were preferred. The encouraged projects were subject to a number of investment incentives and tax concessions, yet, they were also subject to restrictions on foreign ownership, business ranges and geographical scope. Furthermore, FDI has been subject to requirements of local content, technology transfers, trade balancing and export performance. In many industries, notably telecommunications and energy, foreign investors are only allowed to enter through joint ventures. The policies are spelled out in the government's Direction Guide for Foreign Investment, first issued in 1995.

Figure 4 shows the sectoral composition of FDI in 1998. The encouraged sectors aiming at opening bottlenecks in the economy such as utilities (including real estate) and transport and communication have accounted for between 20 and 40 percent of FDI since 1992. Moreover, the FDI share entering these sectors has more than doubled since 1988, at the expense of manufacturing.

Figure 4. FDI by sector 1998



Source: Ding Lu (2000)

Cheng and Kwan (2000) did an empirical study on determinants of location of FDI in China during the period 1985-95. They found that good infrastructure, low wages and the investment incentives applied in the economic zones had a positive effect on FDI inflows. Moreover, they found a strong positive self-reinforcing effect of FDI on itself, i.e., foreign investments attract more foreign investments. We finally note that foreign involvement in the traditional labor-intensive industries has been reduced during the late 1990s. Local firms have taken over these sectors and some of them has undertaken outward investments and has become multinational firms in their own right (Liu and Woo, 2001). [6]

3 Trade policy following accession to the WTO

In this section we take a closer look at changes in trade policy following the accession to WTO. We first discuss foreign companies' access to the Chinese market and continue with a discussion of China's market access in other countries. Foreign companies' access to the Chinese market is not only determined by import tariffs, quotas, licenses and trade permits. Having crossed the international border, foreign goods also need access to local distribution networks, sales outlets, marketing etc. This has not been secured in the past when state-owned enterprises monopolized key industries, including transport and retail trade. Reforms with respect to national treatment of imported goods and more competitive local markets are therefore important aspects of China's accession to the WTO.

[6] Outward FDI from China has averaged about USD 2 billion annually during the period 1989-2000 (UNCTAD, 2001).

3.1 Foreign access to Chinese markets

International trade has traditionally been conducted within the framework of the plan economy. Import need was computed from the five-year-plan-estimated gaps between local production and local demand, while export targets were set in order to finance the needed imports (Ianchovichina and Martin, 2001). Trade was undertaken by a few state-owned trading corporations, which had monopoly in their sectors and/or region. Foreign companies were generally prohibited from distributing products other than those produced in China, and even for these products they were not allowed to control their own distribution channels in China.

The reform process started with the "open doors policy" in 1978. The new policy was one of export promotion, while imports remained largely under state control. Nevertheless, over time imports have been subject to reforms encompassing a change from direct control to indirect measures such as import tariffs, quotas and trade licenses. In order to obtain a trade license, companies had to satisfy certain performance requirements related to sales volume, registered capital and personnel qualifications. The requirements differed between sectors, locations and trading activity. The licensing system has been simplified and liberalized such that state owned enterprises satisfying the criteria can get the trade license through an automatic registration system. The number of state trading companies and other companies licensed to conduct trade increased substantially as a consequence, and reached 35 000 in 2000. The automatic registration system was extended to all manufacturing enterprises in the special economic zones, and from July 2001 to all manufacturing enterprises. China has committed to extend the automatic registration system to the entire economy following WTO accession (Zhang, 2001).

There was a comprehensive reduction in tariffs in 1992, and again in 1996 when tariff rates were reduced by 35 percent on average. The reform affected more than 75 percent of all existing tariff items (Chen and Feng, 2000). The tariff reductions were particularly steep for industrial raw materials where tariffs were typically reduced by half. Some raw materials were even zero-rated. The motivation behind this was partly to protect the environment and prevent excessive exploitation of local resources, and partly to lower the cost of finished products in order to improve international competitiveness.[7] Tariffs on electrical machinery

[7] China has had rather high export duties on a number of raw materials and basic industrial inputs. These will be maintained at rates ranging from 20 to 50 percent even after WTO accession (WTO, 2001b).

were reduced by almost 40 percent in order to lower the cost of technological innovation (Chen and Feng, 2000).

In the early 1990s China had tariffs as high as 60 percent on light consumer goods in spite of having comparative advantage and being highly competitive in these industries. Furthermore, exchange controls, import permits and import licenses requirements remained serious obstacles to foreign suppliers' access to the Chinese market (Chen and Feng, 2000). They amounted to the equivalent of about 9 percent protection rate on average in the mid 1990s (World Bank 1997). Tariffs on light consumer goods were reduced to about 40 percent in 1996, and the simple average tariff rate came down from 42.9 percent in 1992 to 16.4 percent in 2000, still high by international standards.[8] During the accession negotiations and as a result of bilateral trade agreements, particularly with the US, non-tariff trade barriers have also come down significantly during the second half of the 1990s.

Chen and Feng (2000) conducted an econometric analysis of the structure of tariff rates in 1995. They found that the rate of protection of a particular industry was positively related to the presence of foreign capital in the industry, the tax revenue extracted from the industry and the value added per worker in the industry. The first finding suggests that tariff jumping is an important motivation for FDI in China, despite restricted access to the Chinese market.

Accession to the WTO implies comprehensive additional reforms. Tariff rates will be further reduced. Upon accession the simple average tariff rate will be 15 percent, declining to 11.2 percent after the adjustment period ending in 2004 for most sectors. Annex table 1 gives a more detailed presentation of the tariff rates following China's accession to the WTO. Clearly, since the simple average tariff rates had already come down to about 16 percent before accession, further tariff reductions are not the most significant policy change following WTO membership. Quantitative restrictions on imports such as quotas and licensing will be phased out following WTO accession. The accession protocol lists 424 products for which import licenses, quotas or import tendering will be phased out by 2004 at the latest. Another 15 products, including motor vehicles and parts and color TV sets, will maintain quotas, but the quotas will increase by 15 percent annually.[9]

[8] The mean tariff rate was reduced from 47.2 percent in 1991 to 17.8 percent in 1997. The trade-weighted average tariff rates declined from 40.6 percent in 1992, to 18.7 percent in 1998.
[9] In 1999 8.45 percent of total imports (by value) was subject to licensing.

Accession to the WTO implies that within three years after accession, all enterprises have the right to export or import almost all goods. This will apply to foreign companies as well and already from the accession date there will be no export performance, trade balancing, foreign exchange balancing or prior experience requirements for obtaining or maintaining the right to trade. The state trading system will not be completely abolished, however. Remaining sectors with state trading are raw materials considered essential and of strategic importance. There are 83 items subject to state trading on the import side including grain, sugar, crude oil, fertilizers and cotton. China has committed to increase the import share outside the state trading system in the affected sectors by 15 percent per year. On the export side, there are 134 items including a number of raw materials and minerals. There are no statements about liberalization of state trading on the exports side.[10] In addition to state trading there is the designated trading system where trading rights are restricted to a small number of firms, many with geographically restricted trading rights. The designated trading system will be abolished within three years after accession.

National treatment of imports in terms of taxes, product registration and certification, and access to distribution and marketing networks will take effect upon accession.[11] This implies amendments of laws and regulations in several areas, including internal sale, transportation and distribution (WTO 2001a). In the accession protocol to the WTO, China commits itself to ensure that all state-owned enterprises make purchases and sales based solely on commercial considerations. China has also committed itself to respect enterprises' freedom of contract.

Turning to exports, China will abolish all export subsidies, including in the agricultural sector, but maintain some export duties and export licensing for security reasons. China also states that it will comply with the Agreement on Subsidies and Countervailing Measures (SCM). This means that incentives in the special economic zones and other areas subject to investment incentives will no longer be conditioned on export performance. Furthermore, subsidies through the state-owned banks are not compatible with the SCM agreement. If implemented, this will indeed require substantial reforms in the state-owned enterprises and

[10] State trading is not incompatible with the WTO agreement.
[11] National treatment of imported pharmaceuticals, spirits and chemicals will be secured after a one-year transitional period.

the financial sector, as non-performing loans to state-owned enterprises accounted for about 30 percent of GDP in 1999 (Dahlman and Aubert, 2001).[12]

Requirements for local content are regulated by the TRIMs Agreement.[13] China has committed to complying fully with this agreement from the day of accession. This means that foreign investors will no longer be met with requirements of local content, foreign exchange balancing or trade balancing.

Upon accession, China will join the Information Technology Agreement and thus eliminate all tariffs on information technology products.[14] China has also joined the TRIPS Agreement and has undertaken to amend its legislation on patents, trademark and copyrights in order to make it compatible with the TRIPS Agreement.[15] China entered a memorandum of understanding with the US on the Protection of Intellectual Property Rights in 1992 and 1995. Since then, China's legal framework on intellectual property rights has improved considerably (Kong, 2001). It is, however, pointed out in the Accession Report by Working Party Members that there are still significant discrepancies between the TRIPS standards and Chinese practices, particularly regarding trademarks and copyrights, but also regarding enforcement of the patent legislation.

China is not a party to the Government Procurement Agreement (GPA) upon accession to the WTO, but the country intends to join the GPA later (WTO 2001a).

China became a member of the GATS upon WTO accession.[16] One of the most important general commitments under the GATS is transparency in regulation and dissemination of information, particularly related to obtaining, renewing or extending licenses in the services sectors. China must reform its regulation of services industries in order to comply with the GATS agreement. In particular, the country is committed to separate relevant regulatory authorities from the services suppliers they regulate.[17] China has made commitments in most

[12] Recent reforms have included the establishment of three special policy banks in order to separate policy loans from the rest of the banking sector. Furthermore, non-performing loans have been transferred to four specialized asset management institutions.
[13] TRIM stands for Trade Related Investment Measures.
[14] Information technology products include computers, computer software and telecommunication equipment.
[15] TRIPS is an abbreviation for Trade Related Intellectual Property Rights.
[16] GATS stands for General Agreement on Trade in Services. For details about China's commitments see WTO (2001a).
[17] Courier and railway transport services are exempted from this.

of the services sectors included in the GATS agreement. Upon WTO accession foreign access to services markets through commercial presence is limited to the special economic zones and open cities for many services sectors, including wholesale and retail trade and telecommunications, but the geographical restrictions will in most cases be removed after a three-year transition period. In many services sectors foreign enterprises can only enter the market through joint ventures, but this restriction will in many cases be lifted after a transition period of up to five years. Notable exceptions to this are real estate, oil field services, wholesale and retail trade where the joint venture requirement will be retained.[18] In the construction sector, wholly owned foreign companies can only conduct businesses in foreign funded projects.

In the transport sector, China allows cross-border supply in international shipping, and foreign service suppliers are allowed to establish joint ventures with Chinese shipping companies under Chinese flag. In road and railway transport services, cross-border supply is unrestricted and wholly owned foreign subsidiaries will be allowed to establish themselves in China after three years.

In telecommunications services, China allows foreign companies to enter as minority shareholders in value added services, basic telecommunications services, and mobile services. In all the telecommunications sectors, entry is limited to special economic zones and open cities in the first year, while geographical restrictions are gradually lifted over a period of 2-6 years. The ceiling on foreign share holding will be raised over time, but foreign majority share holding is not allowed even after the transition period.

In the financial services sector, China has committed to allow foreign wholly own subsidiaries in non-life insurance services within two years after accession and brokerage for insurance and reinsurance after five years, while foreign life insurance companies can only enter the market through joint ventures. In order to get a license to operate in China, however, an insurance company has to have 30 years of experience in a WTO member state. Cross-border banking services will be allowed, with some restrictions on transfer of financial information. Foreign banks will be allowed to establish subsidiaries in China and their operations will not be limited by geographical area, clients or scope of business, provided that they have total assets of more than USD 10 billion (20 billion for establishing a branch of a foreign bank).

[18] In retail trade there are also quantitative restrictions on the number of entrants.

Foreign banks can apply for license to engage in local currency business after three years of operation in China.

To summarize this section, China has committed itself to comprehensive trade liberalization, and deregulation of internal markets in order to comply with the letter and spirit of the WTO agreement regarding open and transparent markets. Furthermore, the transition period is short; only three years for most goods-producing sectors and 6 years for some key services sectors such as finance and telecommunications. The Working Party Group members are, however, concerned that sub-national governments will continue to use trade instruments inconsistent with the national government's policy and inconsistent with the WTO regulations. Although the Chinese state that sub-national governments' regulations and policies that are inconsistent with China's obligations will be annulled, the implementation is undoubtedly a huge task. As recently documented by Young (2000) and discussed in Kong (2001), China is far from an integrated market, and there are significant trade barriers between provinces within the country. Whether the Chinese market will be integrated shortly after WTO accession is therefore an open question.

3.2 China's access to world markets

Turning to China's market access to the rest of the world, the most significant gains from WTO membership are in the textile and apparel industry, where the developed countries have had relatively high protection rates in the past. During the Uruguay round, textiles and clothing were integrated into the GATT framework and import quotas have been gradually increased until they will be eliminated in 2005. China did not benefit from this as a non-member, but upon WTO accession the country will be part of the Agreement in Textiles and Clothing (ATC).[19] Due to China's competitiveness in textiles and apparel, and the country's perceived capacity to increase exports rapidly, China has agreed to restrain its exports if it disrupts the market in importing countries. This is spelled out as the importing countries' right to request consultations with China if such market disruptions occur. China has committed to restrain exports to 7.5 percent above the amount entered during the last year before the request for consultations was made. This right of consultation will stay in force until the end of 2008.

[19] The promised increases in quotas have been delayed and will only materialize during the period 2002-2005.

China will also benefit from rules-based trade making it less vulnerable to arbitrary anti-dumping charges by major trading partners. WTO members have used the anti-dumping clause in the GATT agreement towards China extensively. In fact, 22 out of 134 anti-dumping charges under the WTO anti-dumping agreement were against China during the first half of 2001 (WTO, 2001b). As a member of WTO, China will be able to avoid anti-dumping charges to some extent, at least if it complies with the WTO rules. And when anti-dumping charges are raised, China will have a better opportunity to advance its interests and present its case as a member of the WTO.[20]

All remaining prohibitions, quantitative restrictions and other measures maintained by WTO members against imports from China in a manner inconsistent with the WTO agreement are listed in an annex to the accession protocol and will be phased out or dealt with in accordance with mutually agreed terms and time schedules (WTO, 2001a). Most of the countries having such reservations are emerging markets (Argentina, Thailand and Turkey) and countries in transition in Eastern Europe, but also the European Union has reservations in a few sectors. We thus notice that China does not get immediate most favored nation type market access in all the WTO member countries upon accession.

4 The theoretical backdrop

This section discusses three aspects of international economic relations; trade in final goods, trade in intermediate inputs and foreign direct investment.

4.1 Determinants of trade

Consider two countries, e.g., China and USA, endowed with two factors of production, labor and capital, the latter broadly defined including human capital. Further, assume that production activities can be classified into two sectors, high-technology and low-technology. The high-technology sector uses capital more intensively than the low-technology sector in both countries. The US has relatively more capital than China, and therefore has a comparative advantage for the high-technology sector, while China has a comparative advantage in the low-technology sector.[21] When goods from both sectors are freely traded between the two countries and all markets are competitive, USA will export high-technology

[20] See Martin and Ianchovichina (2001) for further discussions.

[21] China's income per capita, a common proxy for comparing relative capital endowments, was about 2.5 percent of the US' in the year 2000, while the Chinese population, a proxy for the relative size of the labor forces, was about 4.5 times higher than the US population the same year (World Bank, 2001).

goods to China in exchange for low-technology goods. Both countries will gain from the interaction, and world output and income will increase as a result of each country specializing in what they do relatively best. If the initial differences in factor endowments between the two countries were not too large, trade would also lead to a narrowing of relative factor price differences and eventually complete factor price equalization. As table 1 indicates, China is indeed a net exporter of labor-intensive products and largely a net importer of capital-intensive products. Revealed comparative advantage data presented in table 2 also indicate that China's comparative advantage lies in the labor-intensive sectors, and increasingly so over time.

Even in the absence of comparative advantage, specialization and trade between countries can arise as a consequence of economies of scale. If the minimum efficient scale in traded goods sectors is large relative to the size of the domestic market, countries may specialize in a few sectors in order to fully exploit economies of scale, and import goods that are not produced locally and in which other countries specialize in order to exploit economies of scale. In this case economies of scale at the plant level give rise to specialization and trade, even if countries have the same factor endowments, the same technology and market sizes. Both China and USA have large markets relative to the minimum efficient scale of most industries. We would therefore not expect economies of scale to be a major determinant of trade between the two, although it is probably not irrelevant.

The driving force for intra-industry trade is the coexistence of economies of scale and love of variety on the part of consumers. The idea is that an industry consists of many products which each is produced subject to economies of scale. Consumers prefer to have the choice between many varieties of a product and the varieties are imperfect substitutes. Because of economies of scale, the size of the market limits the number of varieties being produced locally. As a result, a country specializes in a subset of the varieties produced by a particular industry, and trades these with other countries who specialize in other varieties. In this way consumers get access to the entire product range although only a subset of it is produced in the home market.

Another version of this argument applies to trade in intermediate inputs. Final output is produced by means of capital and labor and intermediate inputs. Intermediate inputs are imperfect substitutes to each other, and there are returns to diversity in the sense that the

producer is more productive the more varieties of intermediate inputs he uses. These models are often interpreted as models of specialization where the production process is fragmented into the production of a large number of components and the assemblage of such components. In the absence of transaction and coordination costs, the manufacturer is more productive the finer the division of labor or the degree of specialization; i.e., the more differentiated intermediate inputs he can use. When each component is produced subject to economies of scale, the extent of specialization is again determined by the size of the market. Finally, by the same token as in the discussion of consumers' love of variety, firms get access to the full range of existing intermediate inputs through trade. In these models vertical intra-industry trade arises. In long-run equilibrium overall trade is balanced, which means that a small country has a higher share of trade to GDP than a large country.

If we introduce transport costs into the models of trade driven by increasing returns and love of variety/ returns to diversity, there is an incentive for producers to locate their production in the largest market both in order to realize scale economies and to minimize transport costs. A country will then export goods for which it has a relatively larger market (the home market effect). Furthermore, the country with the largest market will have the highest per capita income.

If we combine the insights from this research, we can analyze both inter- and intra industry trade. The economy consists or a number of industries, which may differ widely in terms of factor intensity. Each industry consists of a number of differentiated products, such as models and makes in the motor vehicle industry. In addition, production can be fragmented into a number of separable stages, which may or may not differ in factor intensity. Finally, each stage may consist of a number of differentiated components. Then countries will specialize in the sectors and/or production stages for which they have a comparative advantage. In most industries or production stages they will produce only a subset of all the differentiated products that have been developed within that industry. How large this subset is, in turn, is determined by the size of the home market. A model spelling out such a combination of comparative advantage, economies of scale and love of variety is Krugman (1981). He shows that the extent of intra-industry trade increases with similarity in factor endowments between the two trading partners.

The relative factor endowments of the US and China are not similar at all. Yet, the extent of intra-industry trade is high, as table 3 illustrates. However, only about 10 percent of total imports to China were for final consumption in the late 1990s (GTAP database, 2001). The high share of intra-industry trade can therefore be explained by vertical fragmentation of production where China specialized in the labor-intensive stages in the production process. This has been reinforced by the introduction of export processing zones in the mid 1980s, which led to a surge in relocation of labor-intensive assembly plants from neighboring countries to China.

4.2 Trade versus FDI

Worldwide foreign affiliates' sales value was more than twice as high as world exports of goods and services in 1999 (UNCTAD, 2001). The theory of foreign direct investment (FDI) increasingly sees FDI as either an alternative (substitute) or a complement to trade. FDI theory therefore strongly relates to trade theory, and recent research has aimed at integrating the two strands (Markusen and Maskus 2001a, 2001b). FDI is commonly classified as vertical or horizontal. Vertical multinational enterprises (MNE) fragment production into stages, which have different factor intensities and then locate the activities to countries according to relative factor prices. Such MNEs are complements to trade. Horizontal multinational companies in contrast, produce the same product in multiple plants and service foreign markets through affiliate production rather than through trade. Such MNEs are therefore substitutes to trade.

Markusen and Venables (1998; 2000) have developed a two-country, two-sector, two-factor model of intra-industry trade and investment that identifies three types of firms. These are horizontal multinationals that maintain plants in both countries; national firms that maintain a single plant and headquarters in one country; and vertical multinationals that maintain a single production plant in one country and the headquarters in the other country. The national firms may or may not export, and the vertical multinationals may or may not export back to the home country (i.e., the country of the headquarter). The headquarters are more knowledge-intensive than the production plants, and the output of the headquarters can be shared among the production plants. The fixed costs of a two-plant firm are then less than double of a one-plant firm. This characteristic implies that there are firm-specific economies of scale. The model allows for transport costs and there are fixed costs related to establishing a new plant,

and thus there are economies of scale at the plant level as well. A multinational firm servicing a foreign market through FDI saves on trade costs, but incurs additional fixed cost.

Both horizontal intra-industry trade and horizontal affiliate sales are more prominent the more equal the two countries are in terms of market size and factor endowments, and the richer the two countries are. The income variable is particularly important for horizontal intra-industry affiliate sales. The relative importance of intra-industry trade versus intra-industry affiliate sales then depends on transport costs and other trade costs such as tariffs and non-tariff trade barriers. The relative importance of horizontal intra-industry trade increases as transport and other trading costs are reduced, i.e. when the trade regime is liberalized.

Vertical intra-industry trade within vertically fragmented multinational firms is in contrast more common among countries that differ in factor endowments, and often also market size. If the smaller country is relatively skills abundant, the headquarter will be located there while the production plants will be located in the larger country that is abundant in unskilled labor. This trade and investment pattern requires low trading costs, as least in intermediate goods and services.

China's total market size was about 18 percent of the EU monetary union market size, 23 percent of the Japanese market size, and 11 percent of the US market size in 2000 (World Bank, 2001).[22] Its market size is thus significant compared to the three largest markets in the world and fairly close to individual G7 countries such as the United Kingdom (76 percent). China has hitherto led a liberal investment policy in the open cities and the free economic zones, where also import barriers on intermediate and capital goods have been low. Outside these zones and in finished goods markets, trade costs have been high. According to Markusen and Venables' theory of FDI and international trade, such a regime will have little intra-industry trade in finished goods, some vertical FDI will occur, with headquarters located in more skills-abundant trading partners and production plants in China, producing for both the Chinese market and possibly exports.

Upon accession to the WTO trade barriers will be significantly lowered and the investment policy will become somewhat less distorted. In particular, foreign companies will get better access to local Chinese markets and they will receive less preferential treatment. We can

[22] We measure market size as GDP at current USD.

therefore look at the accession to the WTO as a shift in policy from a regime of permitting FDI but maintaining high trade costs to a regime of more liberal trade and investment policy, although tariffs will still be higher than the international average. As China moves from the high trade cost/ liberal investment regime to lower trade costs/liberal investment regime, we should expect horizontal FDI from other emerging markets, particularly in the light consumer goods sectors, and possibly more vertical FDI from the US, EU and Japan. However, trade with these richer trading partners will be more driven by comparative advantage.

5 Future trade patterns following WTO accession

In this section we report recent empirical research on the likely changes in China's trade flows following accession to the WTO and the results of our own estimates from running the GTAP model.

Liu and Woo (2001) argues that there are four distinguishable market types in China. First, there is the internationally integrated market where local producers are export oriented and face international competition in the international as well as the local market. The shipbuilding industry and the computer hard-disk drive manufacturing are mentioned as such markets. Second, there is the segmented market where local industries are export oriented, but faces little competition from abroad in the local market. The bicycle industry and the television industry are mentioned under this category. Third, there are insulated markets where local producers are oriented towards the local market and face little competition from abroad. Telecommunications, petrochemicals and motor vehicles are mentioned in this category. These industries are also largely state-owned. Finally, there is the closed monopolist market where state monopolies dominate. Examples are utilities and railway transportation. The study argues that it is category 2 and 3 that will be most affected by WTO accession, since category 1 has already been liberalized and category 4 will not be exposed to competition even after WTO accession. Together categories 2 and 3 account for around 70 percent of GDP. The study further argues that category 2 firms have increased their exports and domestic market share over the recent past in the face of increased international competition, and that they are competitive and will benefit from further trade liberalization. The type 3 market, and the motor vehicle industry in particular, is not competitive by international standards. Exports of finished cars are negligible and a locally manufactured car is 40-50 percent more expensive than a similar imported car. Unless the motor vehicle

industry is able to adopt state-of-the-art technology and management practices quickly, the sector is likely to lose market shares on the Chinese market when faced with more competition from abroad.[23]

A study by Wu (2001) estimates developments in labor productivity in Chinese industries relative to US industries during the period 1952-97. He finds that since trade liberalization gathered momentum in 1992, labor productivity in the manufacturing industry as a whole has increased from 5.27 percent of the US level to 7.59 of the US level. A study by Dahlman and Aubert (2001) reports that labor productivity in the manufacturing sector as a whole was only 92 percent of India's in he late 1990s. The sector that comes closest to the US in absolute productivity levels is clothing, where Chinese labor productivity was 73 percent of the US level in 1997, up from 23 percent in 1992. Other sectors with above average productivity levels relative to the US are tobacco, textiles, rubber and plastics, and leather. The relative productivity in the tobacco industry has nevertheless fallen sharply since 1992. The only other sector with a sharp fall in relative productivity compared to the US is petroleum refining. It is finally worth noticing that the electronics sector's labor productivity was only 3.44 percent of the US level in 1997, up from 2.59 percent in 1992. Apparently, the competitiveness of this sector is strongly based on relatively low wages for skilled personnel. Again we see that labor-intensive industries have improved their international competitiveness in the face of trade liberalization, while developments in capital-intensive and skills-intensive industries are more mixed.

Turning to agriculture, labor productivity is only 0.8 percent of that in the US, and it is lower than in India. Yet, cereal yields per hectare are close to the US figures, suggesting that the productivity problem in this sector is due to surplus labor. Trade liberalization and better access to export markets are therefore unlikely to boost production in agriculture. Instead one would expect an increase in imports.

5.1 Quantitative estimates of the impact of WTO accession

In this section we present the results of running the GTAP model in three steps in order to assess the impact of China's accession to the WTO.[24] The first step presents the impact of a unilateral lowering of tariff rates from those that prevailed in the base year (1997) to the rates

[23] Liu and Woo (2001) are convinced that the Chinese motor vehicle industry will be able to adjust to the new business environment and adopt state-of-the art technology and business practices.
[24] See annex 2 for a brief description of the model.

bounded upon accession (see annex 1). These are the only changes we make to the exogenous variables and parameters in the model. The results thus reflect the reallocation of a fixed set of endowments among sectors as a response to changes in relative prices following China's accession to the WTO. As opposed to a number of other studies using the GTAP model, our analysis applies comparative static analysis only. World Bank (1997) and Ianchovichina and Martin (2001) for example, also impose projected changes in factor endowments and productivity during the period 1995-2005 on the model. The problem with this approach is that it is not always easy to distinguish between the impact of changes in trade policy and the impact of factor accumulation and total factor productivity. Finally, it is not obvious that reallocation of resources takes place instantly following trade liberalization. The comparative static approach with fixed factor endowments is agnostic about the time it takes to adjust to the new trade regime, and compares the initial situation with the situation after the adjustment to a new set of relative prices has been completed. Our study should thus not be seen as a *forecast* of future trade flows, but rather as an estimate of the shift in the export and import functions as a consequence of WTO membership.

The second step in our analysis is a further unilateral lowering of tariffs to the final bound rate that will be in force for most sectors in 2004. In both the first and the second step we apply the rates presented in annex 1, or the rates applied in 1997, whichever are the lowest. In this we follow previous studies, assuming that China will not raise tariffs towards those countries which had preferential access to the Chinese market before WTO accession. These countries' *relative* position will, however, erode as tariffs towards other countries come down.[25]

We differ from Ianchovichina and Martin (2001) also concerning the base line tariff rates. Our base line tariff rates are the *applied* rates included in the GTAP database while the previous study used the much higher statutory rates for their base line estimates. The argument for using the statutory rates is that this will make the base line scenario compatible with the trade liberalization simulations since statutory rates are the only rates known in the liberalization simulations. We argue that this will overstate the tariff reductions actually taking place following WTO accession for two reasons. First, about 60 percent of all imports were subject to tariff exemptions or rebates in the late 1990s (Ianchovichina and Martin, 2001). Second, bringing down the peak rates and eliminating rebates and exemptions are the most important tariff reforms in China following WTO accession. We take the simple

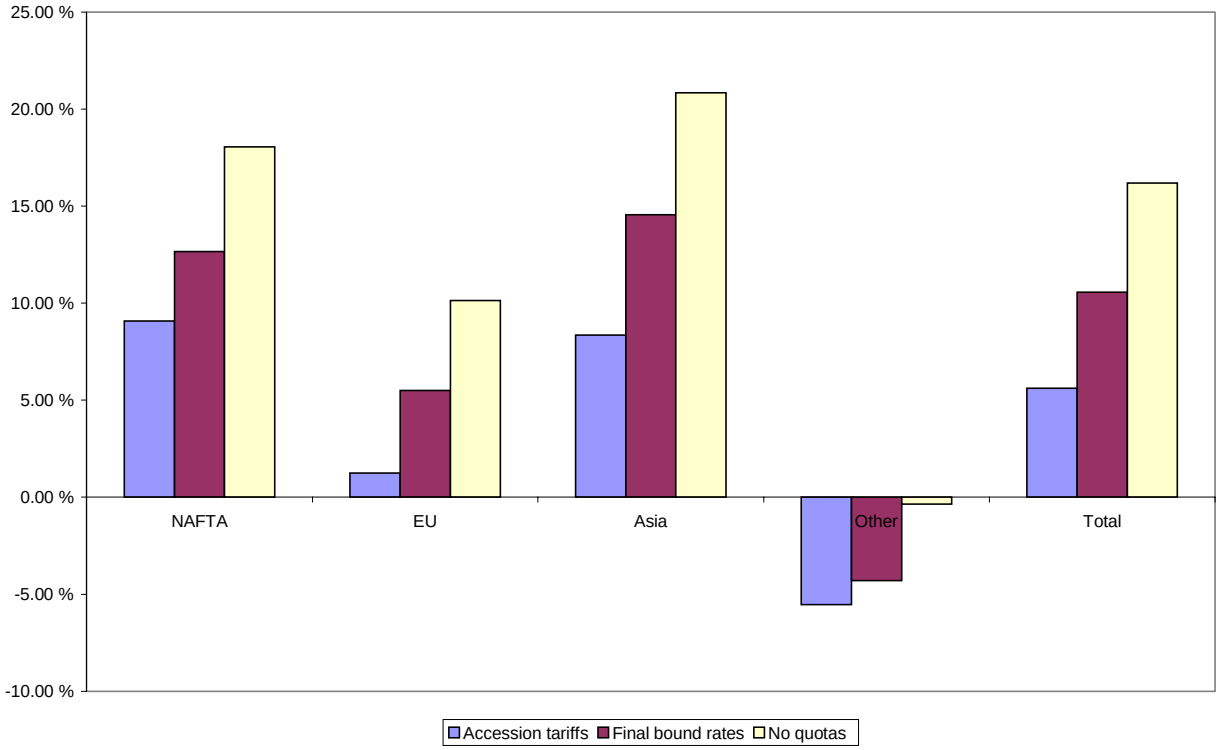
[25] See Ianchovichina and Martin (2001)

average of the tariff rates presented in table A1 in the annex in order to obtain the tariff rates for the more aggregated sector classification presented in tables A2-A4.[26] The tables show that the most significant tariff reductions will be in agriculture (particularly relative to NAFTA), processed food, beverages, paper and printing, motor vehicles and other manufactures.

The final step is to abolish the import quotas on textiles and apparel in the EU and NAFTA facing Chinese and other exporters from developing countries. The import quotas were equivalent to a tax on Chinese exports to the tune of about 20 and 12 percent on textiles to NAFTA and EU respectively and an export tax rate on apparel of 33 and 15 percent to NAFTA and EU respectively. The results of the third step can be seen as the accumulated effect of all three steps. If not otherwise stated, we present the results as percentage deviation from the 1997 benchmark trade regime. We start by analyzing changes in direction of trade on overall merchandise imports to China and exports from China. Figures 5 and 6 show the percentage deviation from the base line for imports and exports respectively.

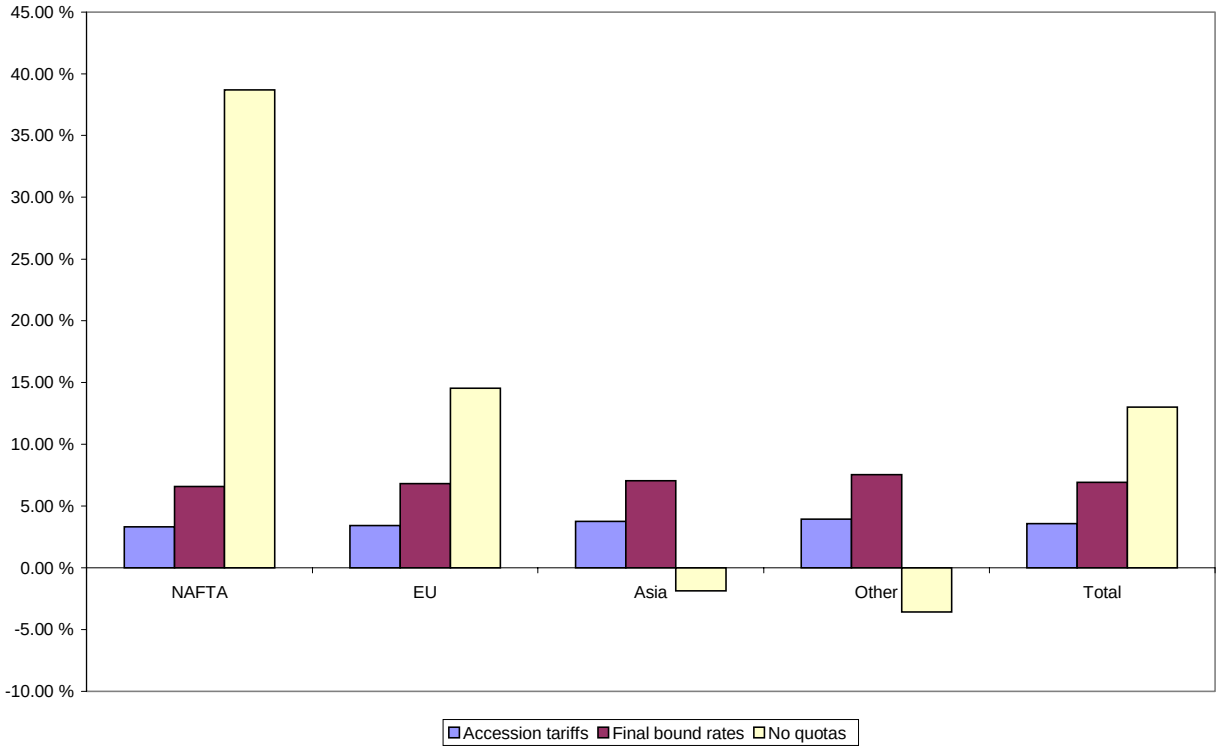
[26] Ideally we should have applied trade-weighted averages, but import data are not available at this level of aggregation. Since tariff peaks have been significantly reduced in the accession rates, the difference between the trade-weighted average and the simple average should not be too large.

Figure 5. Imports to China by source region, percent deviation from base line



As expected, lower tariffs lead to increased imports. Overall merchandise imports increase by about 5 percent after the effect of the accession rates has worked its way through the economy. Further lowering tariffs from the base line to the final bound rates adds another 5 percent to total merchandise imports, and the trading partners' abolishment of quotas in the textile and apparel industry adds yet another 5 percentage points. The change in China's import demand does, however, affect regions differently. "Other" loses market shares and also faces a decline in absolute import demand from China relative to the base line scenario. NAFTA gains the most in market share and exports to China from the first tariff reduction following accession, while Asia gains the most when the entire accession process is completed and quotas have been abolished.

Figure 6. China's exports, deviation from base line, percentage change



A unilateral tariff reduction on the part of China not only leads to an increase in imports. It also affects China's exports due to changes in relative prices and productivity. Thus, better access to lower-cost imported inputs together with more competition on the home market leads to more effective Chinese businesses and a reallocation of resources towards the sectors for which China has a comparative advantage. The impact of a unilateral tariff reduction on China's exports is about the same in all regions, while the elimination of quotas yields an enormous increase in exports to NAFTA. This increase falls entirely on textiles and apparel. These two sectors in fact attract capital and labor at the expense of other exporting sectors, such that most other sectors experience a decline in exports *relative to the base line scenario.* Recall that the labor productivity level in the Chinese apparels industry was about three quarters of the US level in the late 1990s, while the wage rate is only a fraction of the US wage level. The Chinese apparel industry is therefore very competitive on the North American market.

Figure 7 below shows China's merchandise trade balance by region in the base line case and the three trade liberalization scenarios. The most significant change is a shift in exports towards the NAFTA area and a shift in imports towards Asia. The trade regime following WTO accession thus leads to a growing trade surplus towards the NAFTA region and a

growing trade deficit towards the rest of Asia. China's overall trade surplus narrows following a unilateral reduction in tariffs, but the abolishment of quotas in the textile and apparel industries more than compensates for this and China has a larger trade surplus in the final scenario than in the base line scenario.

Figure 7. China's merchandise trade balance, millions of 1997 U.S. dollars

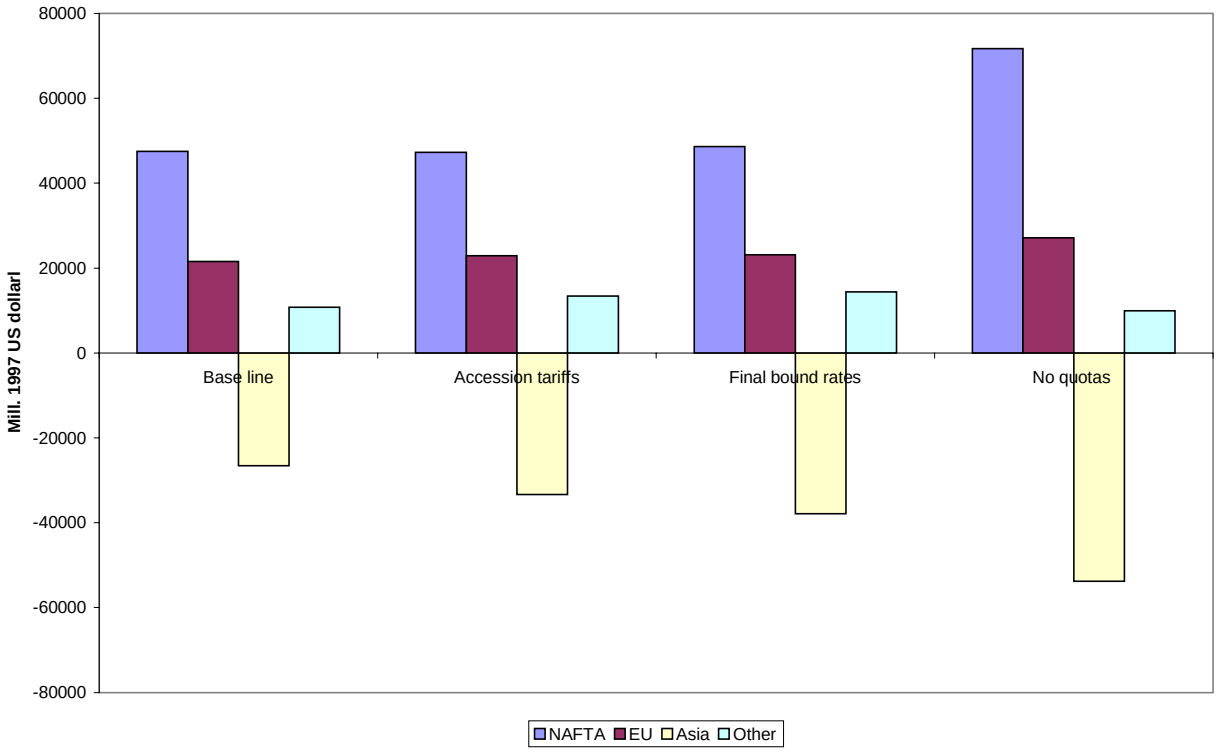


Table 4 shows the sectoral changes in imports to and exports from China in the three scenarios relative to the base line scenario. We have also included trade in services in this table.

Table 4. Changes in China's trade by sector relative to base line (percentages)

	Imports			Exports		
	Accession rates	Final bound rates	No quotas	Accession rates	Final bound rates	No quotas
Agriculture	39.85	45.81	56.80	5.82	7.80	-0.46
Fuel (raw)	-0.81	-1.05	-2.46	0.90	1.29	0.76
Food (processed)	10.97	22.90	28.13	5.01	6.71	-1.72
Beverages	39.64	98.12	114.28	6.82	10.03	-3.07
Textiles	8.68	20.72	46.33	4.46	8.08	12.34
Apparel	29.64	44.01	60.26	7.92	15.93	128.82
Leather	-1.92	-3.28	1.18	5.25	8.78	-2.89
Wood	7.72	9.77	14.55	4.55	7.02	-3.52
Paper and Printing	5.66	8.93	11.43	2.41	3.83	-2.39
Petroleum products	2.21	2.19	2.32	0.74	1.20	-1.12
Chemicals	2.63	3.88	5.80	2.43	3.91	-1.99
Metals and Minerals	4.98	5.73	9.43	2.41	3.98	-6.63
Metal products	6.66	7.51	12.87	2.50	3.97	-6.02
Motor vehicles	27.20	75.43	88.65	10.76	25.14	1.36
Other transport equipment	10.65	9.77	18.68	6.20	10.95	-11.31
Machinery (non-electrical)	4.18	9.25	13.81	2.53	4.78	-4.71
Electrical machinery and Electronics	0.43	4.81	3.39	1.63	7.15	-0.47
Other manufactures	13.31	32.53	41.27	2.62	4.63	-3.91
Electricity, gas and water	-0.60	-1.50	4.20	1.18	2.16	-6.47
Construction	0.05	0.22	6.59	1.45	2.35	-5.30
Air transport	-0.62	-0.84	1.24	1.87	2.41	-4.23
Sea transport	-0.43	-0.74	2.32	1.18	1.92	-3.59
Other transport	-0.19	-0.49	3.74	0.68	1.26	-6.45
Communication	-0.09	-0.49	4.48	0.60	1.35	-6.67
Finance	-0.52	-1.02	3.40	1.00	1.82	-6.22
Other services	-0.60	-1.25	3.93	1.10	2.03	-5.80

We notice that imports increase the most in the sectors for which China has a comparative disadvantage and where tariffs are substantially lowered, i.e., beverages, motor vehicles, and agriculture. The overall increase in imports of agricultural products conceals a remarkable shift in trade patterns. While imports from NAFTA increase by 150 percent from the base line scenario to the no quotas scenario, imports from all other regions decline relative to the base line scenario, and Asia incurs the largest loss in market share on the Chinese market for agricultural products. NAFTA gains market shares in China also in the beverages market, but here all regions increase their exports to China following better market access. It is, however, possible that our GTAP model projections overestimate the impact on trade in the beverages industry as multinational firms often choose to service foreign markets through local production, i.e., foreign direct investment or license production in this industry.

The Chinese motor vehicle industry is not very competitive by international standards. Trade liberalization therefore leads to a decline in total production in this sector relative to the base line scenario. However, China will be more integrated in the multinational automotive companies' supply chains following trade liberalization. This is reflected in an almost doubling of the import share of intermediate use of car parts in China when comparing the no quota trade regime with the base line scenario. Such supply chains are largely regional in scope in this industry, and Asia will consequently gain market shares in China following trade liberalization in the automotive sector. It is also worth noticing that there is an increase in exports of motor vehicles relative to the base-line scenario in all scenarios, which reflects the increase in vertical intra-industry trade.

The large increase in import demand for apparel and textiles falls disproportionally on Asian suppliers, which deliver textiles as raw materials for the expanding Chinese apparel industry and engage in intra-industry trade in the apparels industry. The largest increase in Chinese exports is to the North American market where GTAP simulations project an increase in exports of 450 percent following the abolishment of quotas!

Table 5 depicts the intra-industry trade indices for the three trade liberalization simulations by sector and region. The first column for each region shows the accession rates scenario, the second column the final bound rates scenario and the third column the no quotas scenario.

Table 5. Intra-industry trade indices by sector and region

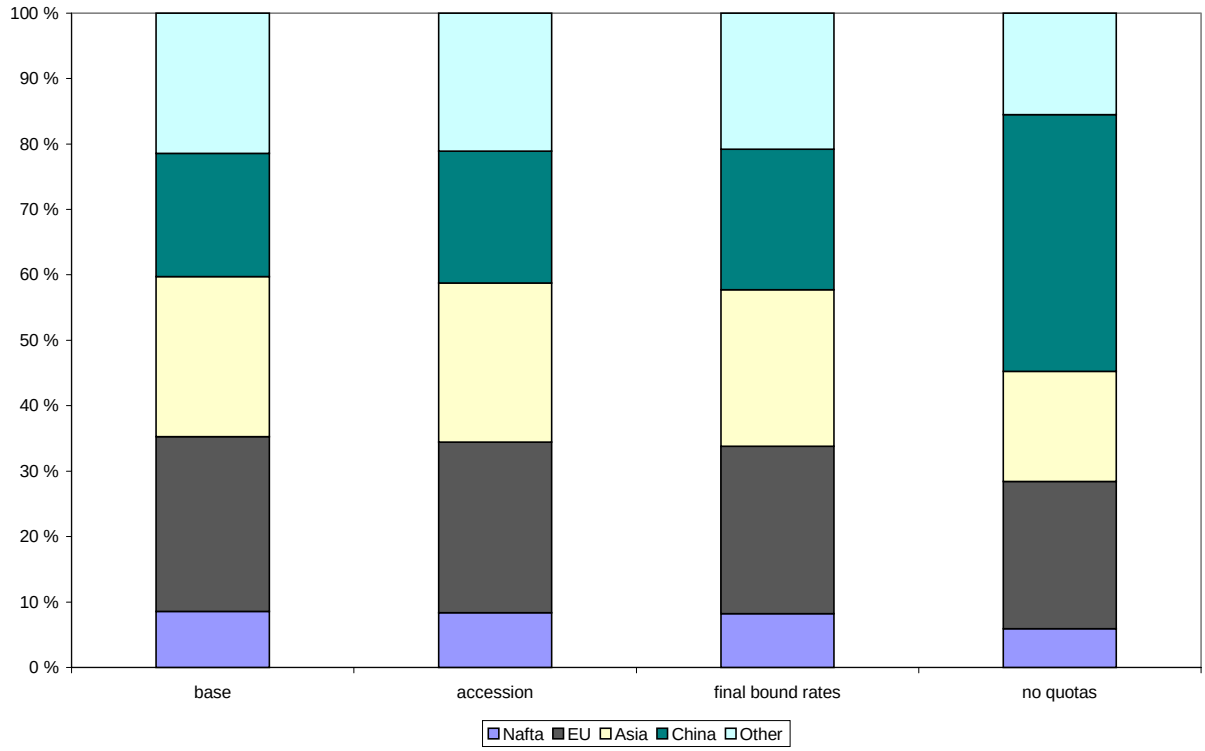
Sector	**NAFTA**			**EU**			**Asia**			**Other**		
	acc	**fin r**	**no q**	**acc**	**fin r**	**no q**	**acc**	**fin r**	**no q**	**acc**	**fin r**	**no q**
Agriculture	0.16	0.16	0.14	0.39	0.40	0.45	0.20	0.18	0.20	0.58	0.57	0.50
Fuel (raw)	0.46	0.45	0.45	0.88	0.88	0.88	0.45	0.45	0.44	0.10	0.10	0.10
Food (processed)	0.64	0.61	0.55	0.63	0.59	0.54	0.67	0.71	0.77	0.54	0.50	0.45
Beverages and tobacco	0.27	0.20	0.17	0.18	0.13	0.11	0.32	0.42	0.49	0.21	0.28	0.34
Textiles	0.32	0.34	0.27	0.40	0.42	0.40	0.86	0.82	0.70	0.27	0.28	0.36
Apparel	0.01	0.01	0.00	0.03	0.03	0.01	0.31	0.32	0.38	0.02	0.02	0.02
Leather products	0.04	0.04	0.04	0.10	0.09	0.11	0.66	0.64	0.71	0.08	0.08	0.10
Wood	0.16	0.16	0.19	0.29	0.29	0.33	0.72	0.72	0.79	0.61	0.60	0.67
Paper and printing	0.51	0.50	0.47	0.64	0.63	0.59	0.30	0.30	0.28	0.46	0.49	0.45
Petroleum (refined)	0.38	0.39	0.38	0.92	0.93	0.91	0.40	0.40	0.39	0.32	0.32	0.31
Chemicals	0.91	0.91	0.95	0.88	0.88	0.92	0.43	0.43	0.41	0.94	0.93	0.97
Metals	0.80	0.80	0.88	0.63	0.63	0.57	0.83	0.83	0.77	0.41	0.43	0.38
Metal products	0.32	0.32	0.36	0.50	0.50	0.55	0.97	0.97	0.96	0.17	0.17	0.19
Motor vehicles	0.74	0.76	0.91	0.29	0.24	0.19	0.41	0.35	0.28	0.48	0.56	0.69
Transport equipment	0.73	0.75	0.61	0.85	0.88	0.73	0.63	0.65	0.53	0.28	0.26	0.35
Machinery	0.65	0.66	0.73	0.86	0.85	0.79	0.63	0.62	0.56	0.22	0.22	0.25
Electronics	0.48	0.46	0.48	0.48	0.46	0.48	0.67	0.66	0.64	0.10	0.10	0.10
Other manufactures	0.03	0.04	0.05	0.07	0.07	0.08	0.67	0.74	0.81	0.08	0.09	0.10

We notice an increase in the intra-industry trade indices as trade becomes more liberal in trade with Asia in light consumer goods such as beverages, food, apparel, leather and other manufactures. Intra-industry trade indices for these sectors in trade with NAFTA and EU, however, decline with trade liberalization. In more "heavy" and technology intensive industries characterized by product differentiation, the picture is more mixed. Here intra-industry trade indices decline with trade liberalization in trade with Asia and EU, while the indices increase with trade liberalization in trade with NAFTA and to some extent the "other" category.

We have so far focused on the impact of China's accession to the WTO on China's trade with the rest of the world by region. It is also interesting to look at how China's accession to the WTO affects other regions more indirectly through gains and losses of world market shares. It turns out that the changes in total world market shares for merchandise exports are small. China gains a few tenths of a percentage point at the expense of EU and "other". The much more substantial gains in China's world market share found in other studies is more due to the assumption that China will continue to grow much faster than most other countries and that growth is driven by improvement in productivity and thereby improvements in relative cost and competitiveness. In our study the only sector which experiences a significant change in world market share is the apparel sector, where China's world market share doubles from the base line case to the no quotas case. China gains market shares in this sector at the expense of all other regions, but other Asian countries and "other" lose the most. NAFTA's market share is also substantially reduced, but from a lower level than the other two regions.[27] China in other words gains market shares from OECD countries and other poor, labor-abundant economies on the OECD markets for textiles and apparel following the implementation of China's WTO accession protocol.

[27] NAFTA's world market share of apparel exports is reduced by 30 percent, from 8.59% to 5.95%.

Figure 8. World exports of apparel by region (percentage of total)



To summarize this section, China's WTO access will most likely lead to a shift towards trade driven by comparative advantage and an increase in production and exports of labor-intensive goods. This will yield a somewhat more unbalanced trade both as far as individual sectors and individual regions are concerned. In particular, Asia will gain market shares on the Chinese market, while China will export more to NAFTA. Our model simulations do not predict major changes in overall world market export shares by region as a result of China's WTO accession.

6 Summary and conclusions

China's access to the WTO is a milestone in the country's economic reform process and integration into the world economy. It is also a milestone for the multilateral trading system having the world's most populous country and the 6th largest economy on board and committed to rules-based trade. We have, however, argued that China's accession to the WTO per see does not represent a dramatic change in trade and industrial policy in China. Rather, China has gradually liberalized its international trade and investment policy and reformed its industrial policy during a 15-year negotiation period and has during this process

become eligible for WTO membership. Further, we have argued that China still has a long way to go before its markets can be said to be open, transparent and competitive. In particular, state-owned enterprises still dominate a broad range of industries, distribution networks can be difficult to penetrate for foreign companies and foreign companies are not fully integrated in the local economy. Moreover, the Chinese market cannot be seen as one integrated market.

Nevertheless, China has moved far enough in the direction of a market economy to be admitted to the WTO and continue its market reforms inside the organization. In our quantitative simulations of China's WTO accession we have seen the accession first and foremost as China's unilateral lowering of tariffs. In addition, improved market access for textile and apparel industries for which China has a strong revealed comparative advantage is taken into account. The simulation results show that China's WTO accession per see will not lead to major shifts in regional world market shares at the aggregate level. There are, however, some interesting changes in trade patterns, which follow directly from China's access to WTO. These are increased market shares for North American exporters in agriculture and services industries, EU will gain market shares in processed food and metals on the Chinese market while Asia will make substantial gains in market shares in all the largest Chinese importing sectors (machinery, chemicals, electronics and textiles) and total imports.[28] China will increase its overall world market share slightly as a result of WTO accession, and the country will double its market share in apparel on the world market and more than quadruple its market share in the North American clothing market.

China's trade patterns will shift in the direction of trade driven by comparative advantage, exporting labor-intensive products and importing capital-intensive products and raw materials. Interestingly, the largest increase in raw materials imports and natural resource-based products come from NAFTA and the EU while the increase in imports in capital-intensive industries such as machinery and chemicals mainly come from Asia. The changes in intra-industry trade are mixed. Trade with NAFTA in the capital-intensive industries such as chemicals, machinery, motor vehicles and transport equipment becomes increasingly intra-industry in nature as trade is liberalized, while trade in these industries with Asia and to some extent EU becomes less intra-intra-industry as trade is liberalized. Trade with Asia in light

[28] "Other" actually has the highest growth in exports to China in the electronics industry, but from a very low base.

consumer goods becomes increasingly intra-industry as trade is liberalized. These results are compatible with the predictions of the trade and investment theory discussed in section 4: Trade with large and advanced countries is driven by comparative advantage and vertical intra-industry trade, while horizontal intra-industry trade is more prominent in trade with countries and regions with similar relative factor endowments.

We close the discussion with a cautionary note. The GTAP simulations do not take into account the internal market liberalization in China, which we have argued is the most important reforms for Chinese industrial performance. Based on previous theoretical and empirical research it is likely that multinationals will choose to service the Chinese market increasingly through FDI as foreign companies get better access to local marketing and distribution channels. Furthermore, it is possible that foreign companies will establish more backward linkages to the local market, purchasing more of their inputs from Chinese suppliers. China has committed to lift local content requirements for foreign investors, while foreign investors will no longer get tariff exemptions on imported intermediate goods. The net effect on local content is uncertain, but it is likely that local providers will become more competitive as they become exposed to international competition. Finally, China has a relatively high trade to GDP ratio given the size of its market. Moreover, we have seen that foreign companies account for about half of total trade and almost 90 percent of imports are for productive use, i.e., investment goods and intermediate goods. If foreign companies become more integrated into the local economy both in terms of input supply and sale of final goods, trade as a share of GDP may not change much, even if imports of consumer goods increases. We therefore conclude that China's WTO accession will indeed have a major impact on the world textile and clothing market, and open new markets for exporters, particularly of food and raw materials. But China's future share of aggregate world export markets will be determined by its productivity growth rate relative to the world economy at large, which in turn depends on trade and industrial policy and not least the future patterns of FDI and how foreign companies relate to the local market. We finally note that China will be a full member of the WTO during the forthcoming global trade round initiated in Doha, and it will carry significant weight in these negotiations. The country will therefore influence the global trade system more in the future than it has in the past, possibly contributing to better market access for itself and other developing countries in labor-intensive goods and services and agriculture on the major developed markets.

Annex 1. Tariff rates

Table A1: Simple average ad valorem tariff rates in China following accession to the WTO

HS2	Description	Bounded upon accession	Final bound rate (2004)
01	Live animals	5.9	5.9
02	Meat and edible meat offal	21.6	18.3
03	Fish and other seafood	16.4	10.5
04	Dairy produce; birds' eggs; natural honey; etc.	26.1	15
05	Products of animal origin nec	12.9	12.3
06	Live trees and other plants; bulbs, roots; cut flowers	9.5	7.9
07	Edible vegetables and certain roots and tubers	10.9	10.6
08	Edible fruit and nuts; peel of citrus fruits or melons	25.2	18.5
09	Coffee, tea, mate and spices	17.7	13.9
10	Cereals	28.7	24.9
11	Products of the milling industry	31.8	25.4
12	Oil seeds and oleaginous fruits etc.	10.3	8.6
13	Lacs; gums, resins and other vegetable saps and extracts	10.8	10.2
14	Vegetable plaiting materials; vegetable products nec.	11.5	11.1
15	Animal or vegetable fats and oils	23.7	13
16	Preparations of meat, fish and other seafood	19.6	11.8
17	Sugars and sugar confectionery	39	29.9
18	Cocoa and cocoa preparations	12.7	11
19	Preparations of cereals, flour, starch or milk	22.9	18.8
20	Preparations of vegetables, fruit, nuts etc.	25.1	20.9
21	Miscellaneous edible preparations	32.5	21.4
22	Beverages, spirits and vinegar	43.4	21.3
23	Residues and waste from the food industries	6.1	5.4
24	Tobacco and manufactured tobacco substitutes	43.8	29.1
25	Salt; sulphur; earths and stone; cement etc.	4.1	4.1
26	Ores, slag and ash	1.9	1.9
27	Mineral fuels, mineral oils and products of their distillation;	5.6	5.5
27	Petroleum refineries	6.6	6.4
28	Inorganic chemicals nec:	5.7	5.5
29	Organic chemicals nec	6.5	5.6
30	Pharmaceutical products	7.4	4.9
31	Fertilizers	8.9	8.9
32	Tanning or dyeing extracts etc.	8.4	7.4
33	Essential oils and resinoids; perfumery etc.	22.2	15
34	Soaps, washing preparations etc.	14.2	9.6
35	Albuminous substances; modified starches; glues; enzymes	11.3	9.6
36	Explosives; pyrotechnic products; matches, etc.	8.7	8.5
37	Photographic or cinematographic products	19.7	14.2
38	Miscellaneous chemical products	7.9	7.4
39	Plastics and plastic products	12.9	8
40	Rubber and articles thereof	11.9	11
41	Hides and skins (other than furskins) and leather	9.8	9.7
42	Articles of leather	20.2	15.8
43	Furskins and artificial fur; articles thereof	19.9	18.3
44	Wood and articles of wood; wood charcoal	7.6	4.2
45	Cork and articles of cork	7.1	5.9
46	Wickerwork and basketwork	10	10

47	Pulp of wood or of other fibrous cellulosic material	0.2	0.2
48	Paper and paperboard	13.9	6.8
49	Books, newspapers, other printing	4.4	3.1
50	Silk	13.8	8.7
51	Wool	19.5	14
52	Cotton	13.7	9
53	Other vegetable textile fibres	9.1	7
54	Man-made filaments	18.6	7.1
55	Man-made staple fibres	21.6	9
56	Wadding, felt and nonwovens;	19	8.6
57	Carpets and other textile floor coverings	24.2	13.3
58	Special woven fabrics	21.8	10.4
59	Impregnated, coated, covered or laminated textile fabrics	15.7	9.9
60	Knitted or crocheted fabrics	21.1	10.6
61	Articles of clothing accessories, knitted or crocheted	24	16.4
62	Articles of clothing accessories, not knitted or crocheted	24.1	15.8
63	Other made up textile articles	22.8	14.5
64	Footwear, gaiters and the like; parts of such articles	22.6	19.8
65	Headgear and parts thereof	21.2	17.2
66	Umbrellas, sun umbrellas, walking-sticks, etc	13.6	12.9
67	Prepared feathers and down	24	21.8
68	Articles of stone, plaster, cement, asbestos, mica etc.	14.1	13.1
69	Ceramic products	19.8	13.9
70	Glass and glassware	15.2	13.3
71	Pearls, precious or semi-precious stones, metals, etc	11.8	9.9
72	Iron and steel	6.2	5
73	Articles of iron or steel	10.8	10
74	Copper and articles thereof	7.1	7.1
75	Nickel and articles thereof	5.2	5
76	Aluminium and articles thereof	11.2	9.4
78	Lead and articles thereof	5.6	4.9
79	Zinc and articles thereof	5.4	5
80	Tin and articles thereof	7	6.5
81	Other base metals; cermets; articles thereof	5.9	5.9
82	Tools, etc. of base metal	10.6	10.5
83	Miscellaneous articles of base metal	12.6	11
84	Nuclear reactors, boilers, machinery	10.8	7.8
85	Electrical machinery and equipment	12.2	8.1
86	Railway transport equipment	4.4	4.3
87	Vehicles other than railway	26.6	15
88	Aircraft, spacecraft, and parts thereof	2.3	2.2
89	Ships, boats and floating structures	8.2	8.1
90	Scientific instruments	9.9	7.8
91	Clocks and watches and parts thereof	17.2	15.9
92	Musical instruments; parts and accessories for such articles	20.9	19.4
93	Arms and ammunition; parts and accessories thereof	13.4	13.4
94	Furniture	16.1	8.3
95	Toys, games and sports requisites	14.8	6.9
96	Miscellaneous manufactured articles	21.5	20.3
97	Works of art, collectors' pieces and antiques	10.2	10.2
	Simple average	15.0	11.2

Source: WTO, 2001

Table A2. Base line ad valorem tariff rates, GTAP simulations

	NAFTA	EU	Asia	ROW
Agriculture	55.3	23.2	12.1	25.0
Fuel (raw)	0.0	0.0	0.0	0.1
Food (processed)	33.0	44.2	33.2	31.0
Beverages	64.8	63.8	59.8	51.9
Textiles	17.2	21.7	25.9	17.1
Apparel	27.8	28.8	32.3	23.3
Leather	13.1	11.7	12.3	9.3
Wood	10.1	12.9	12.9	7.6
Paper and Printing	9.4	12.2	14.8	3.0
Petroleum products	8.4	7.8	8.4	8.3
Chemicals	10.3	10.9	15.0	9.4
Metals and Minerals	9.4	13.2	10.2	5.6
Metal products	12.7	12.0	14.0	13.7
Motor vehicles	24.6	27.8	40.1	26.7
Other transport equipment	3.6	3.9	18.0	3.9
Machinery (non-electrical)	13.3	13.0	13.8	12.7
Electrical machinery and electronics	10.6	11.0	12.3	12.0
Other manufacturing	23.9	11.2	22.8	13.8

Source: GTAP database

Table A3. Accession rates (percentage ad valorem rates)

	NAFTA	EU	Asia	ROW
Agriculture	17	17	12	17
Fuel	0	0	0	0
Food (processed)	25	25	25	25
Beverages	44	44	44	44
Textiles	17	18	18	17
Apparel	22	22	22	22
Leather	13	12	12	9
Wood	8	8	8	8
Paper and printing	7	7	7	3
Petroleum products	7	7	7	7
Chemicals	10	10	10	9
Metals and Minerals	7	7	7	6
Metal products	10	10	10	10
Motor vehicles	25	27	27	27
Other transport equipment	4	4	5	4
Machinery, non-electrical	11	11	11	11
Electrical machinery and electronics	11	11	12	12
Other manufacturing	15	11	15	14

Table A4 Final bound rates (ad valorem percentage rates)

	NAFTA	EU	Asia	ROW
Agriculture	14	14	12	14
Fuel (raw)	0	0	0	0
Food (processed)	18	18	18	18
Beverages	27	27	27	27
Textiles	10	10	10	10
Apparel	17	17	17	17
Leather	13	12	12	9
Wood	7	7	7	7
Paper and Printing	3	4	3	3
Petroleum products	6	6	6	6
Chemicals	9	9	9	9
Metals and Minerals	6	6	6	6
Metal products	9	9	9	9
Motor vehicles	15	15	15	15
Other transport equipment	4	4	5	4
Machinery (non-electrical)	8	8	8	8
Electrical machinery and electronics	8	8	8	8
Other manufacturing	7	7	7	7

Annex 2. Central features of the GTAP model[29]

The GTAP model is a global, general equilibrium model. Each country or region is represented by a regional household whose preferences are expressed by means of a Cobb-Douglas utility function in private consumption, government consumption and savings. This formulation implies that a country or region's private consumption expenditure, government expenditure and savings are fixed shares of total expenditure. It is, however, possible to change these expenditure shares exogenously by introducing a shock to government expenditure or to savings. Once the budget share for each expenditure category is determined, government expenditure is allocated between imported and locally produced goods according to a Cobb-Douglas function. Finally, government expenditure on each locally produced and imported good and service is determined in the same way as in equation (4) below. The allocation of "savings demand" or investment expenditure is determined in the same way as government expenditure. Allocation of private consumption is somewhat more complex. The GTAP model applies a constant difference of elasticities (CDE) functional form of private household preferences.

[29] The presentation is based on Hertel and Tsigas (1997).

The regional household is endowed with a given stock of production factors which it sells to firms. Firms combine these production factors with intermediate purchases in a constant returns to scale production function, which takes the form of a three-level CES function:

(1) $X = X(VA, INT)$

(2) $VA = VA(L, K, V)$

(3) $$INT = \left[\sum_j X_{\text{int},j}^{\sigma} + \sum_j M_{\text{int},j}^{\sigma} \right]^{\upsilon/\sigma}$$

(4) $$M_{\text{int}} = \left(\sum_r m_r^{\rho} \right)^{1/\rho}$$

At the top level is a Leontief function of primary factors of production and intermediate goods and services, while all the other aggregates in the production function are CES aggregates. X is gross output, VA is value added, L is labor, K is capital and V is land, INT is aggregate intermediate use, X_{int} and M_{int} are aggregate locally produced and imported intermediate inputs respectively, while m_r is imported intermediate inputs from region r. Thus, the Armington assumption where imports from different sources are distinguished is applied. Firms minimize costs and from that optimization problem derive demand for each primary and intermediate input. These demands are functions of relative prices, including taxes, and total output.

The model has two global sectors; transport and finance. The global transport sector represents trade costs other than taxes and tariffs and is estimated as the difference between fob and cif values of exports and imports. The global financial sector allocates savings such that global savings equal global investment.

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