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A CHINA/WTO PAPER

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Environmental Impact of China's Accession to WTO in the Manufacturing Sector

Abstract

This paper estimates the immediate impact of China's accession to WTO on water, air and soil pollution in the Chinese manufacturing sector. The pollution effects of WTO accession are decomposed into three categories: composition, technical and scale effects. The results suggest that the immediate environmental impact of China's WTO accession will be largely positive. The dismantling of import barriers on China's highly protected heavy industries and the phasing out of MFA enable China to specialize according to its comparative advantage. Its resources will be relocated from capital, land, energy and other natural resources intensive heavy industries and channeled into labor-intensive light industries. As the latter industries are cleaner than the former, the compositional change in Chinese manufactured output would reduce Chinese aggregate pollution level by 4 per cent. At the same time, China 's WTO accession enable China to gain increased access and induces it to adopt cleaner production technology. This would lead to significant drop in the pollution intensity of its manufacturing sector. Though the expansion of the Chinese manufactured sector as a result of China's accession to WTO is likely to increase the emission of all three pollutants, this negative scale effect is not large enough to offset the large environmental gains from increased specialization in light industries and increased access to best international practice in pollution abatement technology. As a result, China is expected to experience a fall in air, soil and aggregate pollution levels after its entry into WTO. However, water pollution is expected to rise.

Environmental Impact of China's Accession to WTO in the Manufacturing Sector

1. Introduction

China was a member of GATT when it was established in 1947. After the Communist Party came to power in 1949, China, following the steps of many Communist countries, considered GATT as a Western imperialist establishment and cut its ties in 1950. The introduction of the "open-door" policy in the late 1970s initiated the process of re-integration with the world economy, and China applied to re-join GATT in 1986. The negotiations for China's re-entry into GATT/WTO proved to be protracted and lasted for 13 years. During the negotiations China had to overcome several stumbling blocks. One of the main stumbling blocks has been China's state trading system, whereby trading rights are mainly reserved for state-owned trading companies and decision-making and trade barriers are non-transparent. Western trading partners have great difficulty in gauging the exact extent of tariff (TBs) and non-tariff barriers (NTBs) in place in China, , and therefore have difficulty determining the "price" China should pay for its admission into GATT/WTO (Chai, 1989). Another main stumbling block has been the issue of whether China should be admitted as a developing or a developed country. China insisted that in view of its relatively low income per capita, it should be admitted as a developing country. The developing country status would enable China to maintain relatively high TBs and NTBs to protect its domestic industries. The US , on the other hand, demanded that in view of China's importance in world trade, it should be admitted as a developed country. As a developed-country member, China would have to offer more substantial trade concession to its trading partners as a "price" for its entry into WTO. China's "long

march" to WTO finally come to an end on 15th November 1999 with the signing of the US-China bilateral WTO accord, after the US had extracted substantial market-opening concessions from China. It is widely expected that China will resume its membership in late 2000 or early 2001.

Accession to the WTO will commit China to significantly reduce its TBs and NTBs in its industrial sector, the opening up of its service sector for foreign investors and the liberalization of its agricultural trade. At the same time, China will gain increased access for its manufactured exports to international markets. In particular, with the phasing out of MFA, China's main manufactured export items, such as textiles and garments, will be free from quota restrictions in major Western markets. Thus, accession to WTO is likely to result in a profound change in the output and trade pattern of the Chinese economy.

The focus of this paper, however, is not directly the output and trade impact of China's accession to WTO, but rather the environmental impact. Specifically, it assesses the likely effects of the resultant changes in Chinese output and trade on its environment after accession to WTO. Owing to data limitations, the assessment will be confined to the manufactured sector only. The remainder of this paper is organized as follows. Section 2 sets up the framework adopted to analyze the relationship between China's WTO accession and the environment. Section 3 provides results and section 4 concludes the paper.

2. Analytical Framework

China has embraced trade liberalization over the last two decades (Chai, 2000). Its accession into WTO will further intensify its trade liberalization process. How will the resultant increased trade liberalization impact on its environment? As demonstrated in some studies (Beghin and Potier, 1997; Grossman and Krueger, 1993 and Tisdell, 2000), the pollution impact of trade liberalization can be conceptually decomposed into three sources, namely, the composition effect, the technical effect and the scale effect. The composition effect refers to the fact that the freer trade environment upon China 's accession into WTO allows China to specialize in the manufacturing activities where it has a comparative advantage. The resultant compositional change in its manufacturing output will have either a positive or negative impact on the environment. The impact is positive / negative if China has a comparative advantage in the production of less / more pollution intensive industries. The technical effect refers to the fact that increased openness to trade upon China's accession into WTO enables China to gain increased access to cleaner production technology. In addition, the increased demand for a cleaner environment generated by a rising income per capita caused by the growth effect of China's accession into WTO, will induce China to adopt cleaner production technology. Hence, the technical effect is positive for the Chinese environment. The scale effect originates from the increase of Chinese manufactured output as a result of entry into WTO. As a larger output leads to a larger emission of pollutants, its effect on the Chinese environment is negative. Thus, the net environment impact of China's accession into WTO depends on whether the positive compositional and technical effects are larger than the negative compositional and scale effects, or not.

To quantify the various effects, the following procedure can be adopted. The aggregate pollution of Chinese manufacturing activities, Y, can be described as:

$$Y = \sum_i s_i e_i Q \qquad (1)$$

where s_i is sector *i*'s share in total manufacturing output, e_i, the pollution intensity of sector *i* and *Q* is total output. The change in the aggregate pollution level as a result of the change in manufacturing output upon China's accession into WTO can be described as:

$$\dot{Y} = \sum_i \dot{s}_i e_i Q + \sum_i s_i \dot{e}_i Q + \sum_i s_i e_i \dot{Q} \qquad (2)$$

where a dotted variable represents that variable's time derivative. The first term on the right hand side is the compositional effect, which represents the change in pollution levels due to the change in China's manufacturing output composition. The second term is the technical effect, which indicates the change in pollution levels caused by a change in China's manufacturing sectoral pollution intensity. The third term is the scale effect, which represents the growth in pollution levels induced by the change in total Chinese manufacturing output, in the absence of change in output composition and sectoral pollution intensities.

3. The Impact of WTO

Output Effect

The output effect of China's accession into WTO can be assessed using either a partial or general equilibrium approach (see Laird and Yeats, 1990). Theoretically, the general

equilibrium approach is preferable as it takes into account not only the static, but also the dynamic or growth impacts, as well as the interaction of sectors, after China's WTO accession (Tisdell, 2000). There have been quite a few attempts to estimate the effects of China's WTO accession using both partial and general equilibrium approaches (see Rosen, 1999; USTR, 1999). Most of these studies, however, focus on the impact of China's WTO accession on the US economy. One of the few studies which focuses exclusively on the impact on the Chinese economy is the study by Lee et al.(2000). This study is based on a 41 sector computable general equilibrium model (CGE) of the Chinese economy, which Lee et al. adapted from an OECD model (Beghin et al. , 1994). The effect of China's accession into WTO in this study is estimated from two versions of the model. The first version of the model assumes perfect competition and constant returns to scale technology in all sectors. The second version of the model is identical to the first except that it assumes scale economies and monopolistic competition in 3 manufacturing sectors, namely, automobile, petroleum processing and metallurgy. The policy scenario in this study is based on the market access commitment made by China in April 1998 in Geneva. The policy package includes (1) tariff reduction in industrial products; (2) the liberalization of NTBs in industrial products; (3) the liberalization of agricultural trade and (4) China's participation in WTO's Agreement on Textiles and Tariffs.

Though the study of Lee et al. is based on China's commitment in April 1998, their results are by no means outdated. A comparison between China's most recent market access commitment made in November 1999 in the US-China WTO accord and that of April 1998 in Table 1 reveals that there is no significant major differences

between the two. Hence, their results can be taken as a reasonable guide as to what would happen to China's industrial output after accession into WTO. However, it is important to note the main limitation of their study, namely, they do not take into account the effect on industrial output of China's other market access commitments, such as the liberalization of China's services market, the reduction of barriers for foreign investment, the protection of intellectual property rights, the agreement on general dispute settlements, etc..

Table 1. China's Market Opening Commitments, 1998 and 1999.

	April 1998 (Geneva Commitment)	Nov. 1999 (US-China WTO Accord)
Industrial products		
a. TB's:	Average tariff reduced to 10% by 2005	Average tariff reduced to 9.44% during 2003-2005
b. NTB's:	Tariff equivalents of NTB's in following sector reduced to 0: food, textiles, petroleum, chemical, machinery, electric. machinery, electronic communication equipment and measuring instruments	With a few exceptions to be phased out no later than 2005
Agricultural Products	a. Import quota for food and agricultural products increased by 5% during 1998-2004 b. Elimination of import quota and replaced by 10% TBs	a. Progressive increment of import quota for US main agricult. exports(wheat, corn, cotton, rice and barley) up to 2004 b. Average TB's to be reduced to 17% by 2004 at the latest c. Elimination of all NTB's to be phased in over 5 years

Sources: Lee et al.(2000), Table 1.6 and USTR, 2000.

The estimates of Lee et al. consist of two parts. One is the predicted equilibrium in the benchmark year, 2005 in the absence of China's accession to WTO. The other is

counterfactual ("what if ") equilibrium with China's accession to WTO. The two parts are then compared with the differences being the output effect of China' s WTO accession. The results of their estimates reveal that China's WTO accession would boost China's GNP in 2005 by 1.5 per cent and its annual rate of growth by 0.5 to 1 per cent between 1998 and 2010.

Composition Effect

In what follows, the impact of output change in 14 manufacturing sectors as predicted by Lee et al. after China's WTO accession is estimated for three main categories of pollutants (air, water and soil) according to the analytical framework presented in section 2.

Table 2 presents the output change in the Chinese manufacturing sector as predicted by Lee et al. in 2005 with and without China's WTO's accession scenario. As evident from Table 2, the most significant change in the Chinese manufacturing composition after accession to WTO is the expansion of labor-intensive light industries such as textiles and garments, and the contraction of capital and natural resources intensive heavy industries such as machinery, metallurgy, construction materials, petroleum processing, chemical etc.. Since light industries, especially textiles and garments, have relatively low pollution intensities, whereas heavy industries with the exception of machinery and metal products are associated with relatively high pollution intensity (Table 3), the increased share of the former accompanied by a decreased share of the latter reduces Chinese manufacturing aggregate pollution intensity from 71.9 to

69.0 tons per 1997 million RMB. As a result, the aggregate pollution level in 2005 falls by 4 per cent as compared to the scenario without WTO accession.

Table 2. Impact of China's WTO Accession on Manufacturing Sector Output, 2005 (billion RMB)

	Baseline output[1]	% share	Projected output[2]	% share	Output share change
Processed food	1394.3	8.43	1468.2	8.46	0.03
Textiles	1532.6	9.26	1903.5	10.96	1.70
Garment	704.4	4.26	1205.2	6.94	2.68
Leather	448.3	2.71	474.3	2.73	0.02
Wood & furniture	360.0	2.18	358.2	2.06	-0.12
Paper, cultural & educational goods	875.0	5.29	885.5	5.10	-0.19
Petroleum processing	513.0	3.10	501.2	2.89	-0.21
Coke-gas	93.3	0.56	91.9	0.53	-0.03
Chemical	2481.6	15.00	2575.9	14.83	-0.17
Construction Materials	1442.9	8.72	1412.8	8.14	-0.58
Metallurgy	1700.0	10.30	1674.5	9.64	-0.66
Metal Products	675.0	4.08	672.3	3.87	-0.21
Machinery[3]	4234.4	25.60	4048.7	23.32	-2.28
Other industries	91.7	0.55	92.8	0.53	-0.02
Total	16546.5	100.00	17365.0	100.00	

Notes

1. Without WTO accession
2. With WTO accession
3. Excluding output of other transport equipment

Source: Lee et al. 2000, p.76.

Table 3.Pollution Intensity of Chinese Manufacturing Sector, 1997(tons per million RMB)

	Water pollutants	Air pollutants	Soil pollutants	Aggregate pollutants
Processed food	5.4	1.7	15.4	22.4
Textiles	1.5	1.7	14.1	17.2
Garments[1]	0.8	0.9	7.4	9.1
Leather	2.3	0.7	5.7	8.6
Wood & furniture[2]	1.5	1.8	30.5	33.8
Paper, cultural & educational goods	72.3	9.3	62.0	143.7
Petroleum processing	1.0	1.4	23.9	26.3
Coke-gas	1.0	1.4	23.9	26.3
Chemical	4.5	5.0	87.8	97.3
Construction materials	1.3	42.9	51.6	95.7
Metallurgy[3]	2.9	8.3	307.0	318.6
Metal Products	0.2	2.1	8.8	11.2
Machinery[4]	0.2	0.7	7.2	8.1
Other industries	1.5	1.8	30.5	33.8

Notes:.

1. Pollution intensity of garments is assumed equal to 0.53% that of textiles in US manufacturing (see Lucas, Wheeler and Hettige(1992), Table 5.1)).
2. Pollution data not available. Assumed to equal the pollution intensity of other industries.
3. Weighted average of pollution intensity of ferrous and non-ferrous metals with weights being their 1997 output shares.
4. Excluding other transport equipment

Sources: China Environment Yearbook, 1998, pp.580-1,586 & 588

The change in emission of the individual pollutants as a result of compositional change in Chinese manufacturing industries is presented in Table 4. This shows that both air and soil pollution are likely to be significantly reduced, whereas water pollution experiences only a mild reduction.

Table 4. Environmental Effects of China's Accession to WTO(% of total 2005 emmission without WTO accession)

	Composition effect	Scale effect	Technical effect	Aggregate effect
Water pollution	-1.8	5.0	-	+
Air pollution	-4.6	5.0	-	-
Soil Pollution	-4.1	5.0	-	-
Aggregate pollution	-4.0	5.0	-	-

Source: Table 2 & 3 and text.

Scale Effect

The scale effect, as shown in equation 2, depends solely on the rate of manufactured output expansion. As a result of China's accession to WTO Chinese manufactured output is likely to expand by 5 per cent (Table 2). Hence, compared with the scenario without WTO accession, aggregate pollution levels and the emission of the three individual pollutants are likely to expand by 5 per cent also (Table 4).

Technical Effect

As Chai (2000) shows, the technical effect of the globalization of Chinese economy over the last three decades has been positive. The opening up of China to the outside world increased public awareness of industrial pollution problems in China. At the same time it enabled China to gain increased access to advanced pollution abatement technology. These factors, together with the government 's increased effort to control industrial pollution through SEPA, led to a significant drop in the sectoral pollution intensity of Chinese manufactured output. Between 1993 and 1997, as the survey data of SEPA shows, all manufactureing sectors experienced a decrease in pollution intensity, with the rate of decrease ranging between 35 to 76 per cent (Chai, 2000, Table 3). Upon China's accession to WTO the globalization of the Chinese economy is expected to be intensified. Hence, a further reduction in Chinese manufactured sectoral pollution intensities is to be expected, along with a positive technical effect.

Aggregate Effect

As mentioned earlier, the aggregate effect of China's WTO accession depends on whether the combined positive compositional and technical effects are larger or smaller than the negative scale effect. As Table 4 reveals, for air, soil and aggregate pollutants, the large

positive compositional effect combined with the positive technical effect are likely to more than offset the negative scale effect. Hence, their emission is likely to decrease. For water pollutant, however, emission may increase slightly as the combined positive compositional and technical effects may not be large enough to offset the negative scale effect. Hence, water pollution may increase slightly.

4. Conclusion

This paper attempts to shed light on the environmental impact of China's accession to WTO. It focuses on the manufacturing sector and considers the immediate impact of China's WTO accession on the emission of three main categories of pollutants (water, air and soil waste). The results show that the immediate environmental impact of China's WTO accession is largely positive. The dismantling of import barriers on China's highly protected heavy industries and the phasing out of MFA after China’s WTO accession will enable China to specialize according to its comparative advantage. China's resources will then be relocated from capital, land, energy and other natural resources intensive industries and channeled into labor-intensive light industries. As the latter industries are cleaner than the former, this compositional change in Chinese manufactured output could be expected to reduce its aggregate pollution levels by 4 per cent. At the same time, China's WTO accession enable China to gain increased access and induces it to adopt cleaner production technology. This would lead to significant drop in the pollution intensity of its manufacturing sector. Though the expansion of the Chinese manufacturing sector as a result of China's accession to WTO is likely to increase the emission of all three pollutants, this negative scale effect is not large enough to offset the large

environmental gains from increased specialization in light industries and increased access to best international practice pollution abatement technology. As a result, China is expected to experience a fall in air, soil and aggregate pollution levels after its entry into WTO. However, water pollution is expected to increase.

It is important to note the limitations of the above analysis. Firstly, it considers the pollutant emission of the manufactured sector only. Secondly, within the manufactured sector, only the negative environmental impact associated with the direct scale effect of Chinese manufactured output expansion is considered. The indirect scale effect, namely the negative environmental impact of increased economic growth induced by higher manufactured output has not been considered. Finally, it is important to note that the results presented above depend very much on the output estimates of Lee el al..

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