

Trade Liberalization and the Economy of China: A Dynamic CGE Analysis, 1997-2010

By
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Abstract

China officially applied for membership in GATT in 1986 and China has made every effort to enter WTO since its establishment in January 1995. For the purpose of entering WTO, China has been promoting comprehensive liberalization in many fields, not only reducing and abolishing tariff and non-tariff barriers but also liberalizing finance, telecommunication, insurance, commerce, etc., including protection of intellectual property rights, implementation of trade-related investment measures (TRIM), and so on. As a member of APEC, China has been updating annually its Individual Action Plan (IAP) for trade and investment liberalization, though real action has been more profound and more rapid than planned.

Focusing on quantifiable measures such as the reduction of tariffs and the abolishment of non-tariff barriers, this paper quantitatively analyzes the impact of the trade liberalization promised by the government of China in its bid for membership in WTO. We will analyze this impact from the point of view of growth, industrial structure, employment, and the balance of payments. The method used here is dynamic simulation for the period from 1997 (benchmark) to 2010, based on a recursively dynamic CGE (Computable General Equilibrium) model of 35 industries. This paper provides, first, a standard projection of the Chinese economy for the year 2010, which is called a baseline scenario. Then, the paper analyzes and assesses the impact of trade liberalization by providing the following seven alternative scenarios and comparing their deviations from the baseline scenario: (S1) tariff reduction to the target 10% level by 2005; (S2) abolition of non-tariff barriers by 2010; (S3) abolition of export subsidies by 2005; (S4) S1+S2; (S5) S1+S2+S3; (S6) S5 with an exchange rate devaluation by 20% in 2000; and (S7) S5 with an increase in income tax rate by 5%.

Comparison of alternative scenarios reveals that the promised tariff reduction will not disturb China's economy but will offer fairly significant benefits. However, the abolishment of non-tariff barriers will be negatively serious in many respects, indicating the necessity to introduce proper supplementary measures such as yuan devaluation to mitigate negative effects.

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1. Introduction

China officially applied for membership in GATT in 1986 and made every effort to enter WTO since its establishment in January 1995. Although it has not yet succeeded in entering, China took a decisive step forward when it came to a bilateral agreement with the United States on November 15, 1999. China must complete the following four procedures before joining WTO: bilateral negotiations with other member countries; multilateral negotiations at the Working Committee on China; approval of the Ministerial Conference at WTO; and approval of the National People's Congress in China. It is anticipated with much certainty that China will join WTO by the year 2000.¹

China's economic environment drastically changed both internally and externally during the 14 years since its application for GATT membership in 1986. Internationally, the Uruguay Round, which started in 1986 and produced an agreement in 1994, brought into existence not only tariff reductions and the abolition of non-tariff barriers but also more comprehensive trade rules. Based on the Uruguay Round agreement, WTO was established in 1995, with the aim of creating a comprehensive trade organization. WTO deals with such new fields as service trade, intellectual property rights, trade-related investment measures (TRIM), and so on, in addition to the traditional trade of goods and commodities, which the GATT has heretofore mainly dealt with.²

In the Asia-Pacific region, APEC was established in 1989 to advance Asia-Pacific economic dynamism and a sense of community, with its three pillars of action being trade and investment liberalization, business facilitation, and economic and technical cooperation. China joined APEC in 1991, together with Hong Kong and Taiwan. At the Manila Meeting of 1996, China presented its Individual Action Plan (IAP) for trade and investment liberalization, which provides a general guideline for China in implementing its commitments for participating the APEC process of trade and investment liberalization. China has been updating its IAP annually, but its real achievement has surpassed its plan in terms of speed and action. It was confirmed at the Manila Meeting that the role of APEC is to strengthen and supplement the WTO system through its commitments to the global liberalization process of trade and investment.³

China has been strengthening its linkage with the world economy steadily year after year. As shown in Table 1, for the period 1986-1999, China's total trade increased by 4.9 times, exports by 6.3 times, and imports by 3.9 times (in nominal U.S. dollars), while China's total trade in 1998 ranked ninth in the world.

Since 1986, China has promoted trade liberalization in accordance with the rules of GATT/WTO and the demands of its member countries, with allowances for the domestic economic conditions, creating pressure for economic reform and a transition

¹ See *People's Daily*, January 13, 2000 (in Chinese). See Jia (2000) for the details of negotiations with the EU, Japan and the US.

² See Aoki and Umada (1998), MITI(1998,1999) for the vicissitudes of GATT and WTO.

³ See Zhang, Chen and Li (1998), APEC Secretariat (1995), and Aoki and Umada (1998, Ch.12).

to a market economy. In the 1990s especially, China implemented trade liberalization by extensively reducing tariff rates and abolishing non-tariff barriers summarized in Table 2, at the same time trying to liberalize finance, telecommunication, insurance, and commerce, as well as to strengthen the protection of intellectual property rights, implementation of trade-related investment measures (TRIM), and so on.

Table 1. Economic Growth and Trade in China (billion US\$, nominal)

	GDP	Exports	Imports	Exp.+ Imp.	FDI
1986	2957	309	429	738	19
1990	3880	620	533	1153	35
1995	7004	1488	1320	2808	375
1996	8169	1510	1388	2898	417
1997	8993	1827	1424	3251	452
1998	9600	1838	1402	3239	454
1999	10145	1949	1658	3607	

Source: China Statistical Yearbook 1999. Data for 1999 from People's Daily (Jan.13, 2000).

Table 2. Trade Liberalization Measures in China

Date	Trade liberalization measures	Tariff rates after revisions
1991	Abolition of export subsidy for export tax refund	
December 1992	Tariff rate reduction, 2898 items	Average tariff rate: 43.2%
December 1993	Tariff rate reduction, 3371 items	Average tariff rate: 35.9%
January 1994	Abolition of import control, 283 items	
May 1994	Abolition of import permit/allocation, 195 items	
April 1996	Tariff rate reduction, 4900 items	Average tariff rate: 23%
October 1997	Tariff rate reduction, 4874 items	Average tariff rate: 17%

Source: Aoki and Umada (1998), Chapter 3, pp.56-57.

Focusing on quantifiable measures such as the reduction of tariffs and the abolishment of non-tariff barriers, this paper quantitatively analyzes the impact of trade liberalization promised by the Chinese government in its bid for membership of WTO. Analysis will be done from the point of view of growth, industrial structure, employment, and the balance of payments. The method used here is a dynamic simulation for the period from 1997 (benchmark) to 2010, based on a recursively dynamic CGE (Computable General Equilibrium) model of 35 industries.

Section 2 presents our CGE model of the Chinese economy. Section 3 provides simulation analyses on the impact of trade liberalization. Section 4 is a summary and conclusion.

2. CGE Model of the Chinese Economy

2.1 Review of CGE studies on trade liberalization in China

Not a few studies have already been made on the analysis of trade liberalization and China's bid for WTO membership, based on the CGE modeling as shown in Table 3. Preceding studies can be classified into two types in light of the scope and structure of the model adopted. First is the study based on the world model in which simulation analysis is made on the impact of trade liberalization implemented either by all or some of the related countries in the world, or by China alone. Second is the study based on the single country model for China, in which the impact of trade liberalization on industry, employment, income distribution, etc. is analyzed in detail by simulation. The analysis in this paper is of the second type.

Table 3. Analyses of Trade Liberalization on China by CGE Models

Researchers	Nature of model	Objectives of analysis	Major conclusions
Yang (1995)	World model (GTAP)	Impact of liberalization package of the Uruguay Round	Full implementation of liberalization package generates big benefits to China
Feng and Huang (1997)	World model (GTAP)	Impact of trade liberalization in China on the economies of China and its partner countries	China gets the biggest benefits from its liberalization. It is most effective to implement liberalization in both China and APEC countries simultaneously.
Kawasaki (1997, 1999)	World model (GTAP)	Economic effects of liberalization measures proposed in "Manila Action Plan" for APEC region	World trade increases. Production and income increase especially in the countries with drastic liberalization.
Zhai, Li, and Wang (1996), Wang and Zhai (1998)	Country model	Impacts of tariff reduction on welfare and income distribution allowing for substitution tax to supplement decrease in revenue	Economic and distribution effects by trade liberalization are biggest when progressive income tax is substitution tax to supplement decrease in tariff revenue.
Wang, Wang, Li, and Zhai (1997)	World model	Effects of China's entry to WTO on world markets of labor intensive goods and agricultural exports of US	Best strategy for China is to acquire removal of restrictions on labor intensive goods in industrialized countries by opening food and agricultural imports.
Li, Zhai, and Xu (1999)	Country model and World model	Effects of China's entry to WTO on Chinese and world economies allowing for the abolition of MFA (Multi-Fiber Agreement)	Abolition of MFA increases textile exports of China, promoting employment and GDP growth. World export markets of labor intensive goods and import markets of agriculture affected seriously.
Zhang and Warr (1995)	Country model	Analysis of the 50% across-the-board tariff cut based on the double price model	Tariff cut increases both exports and imports, but the export increase is bigger, promoting production and employment.

Note: GTAP means Global Trade Analysis Project. See Hertel (1997) for GTAP.

2.2 Characteristics of the model

The CGE model of China in this paper uses the latest input-output table of 1997 for the Chinese economy. The model consists of 35 industries (agriculture, 5 energy industries, 20 manufacturing industries including construction, and 9 service industries), 2 private consuming sectors (urban and rural households), and 2 kinds of labor (non-formal and formal employment).⁴ The analysis in this paper focuses on growth, industrial structure, employment and trade, so that the supply or production aspects of the model especially are elaborated in detail, as shown in Figure 1. The model here is an extension of the environmental CGE model of China (Ezaki, Sun and Kinjo 1999). It originates basically from the CGE model of an open economy in Dervis, De Melo, and Robinson (1982, Ch. 7, Appendix).⁵

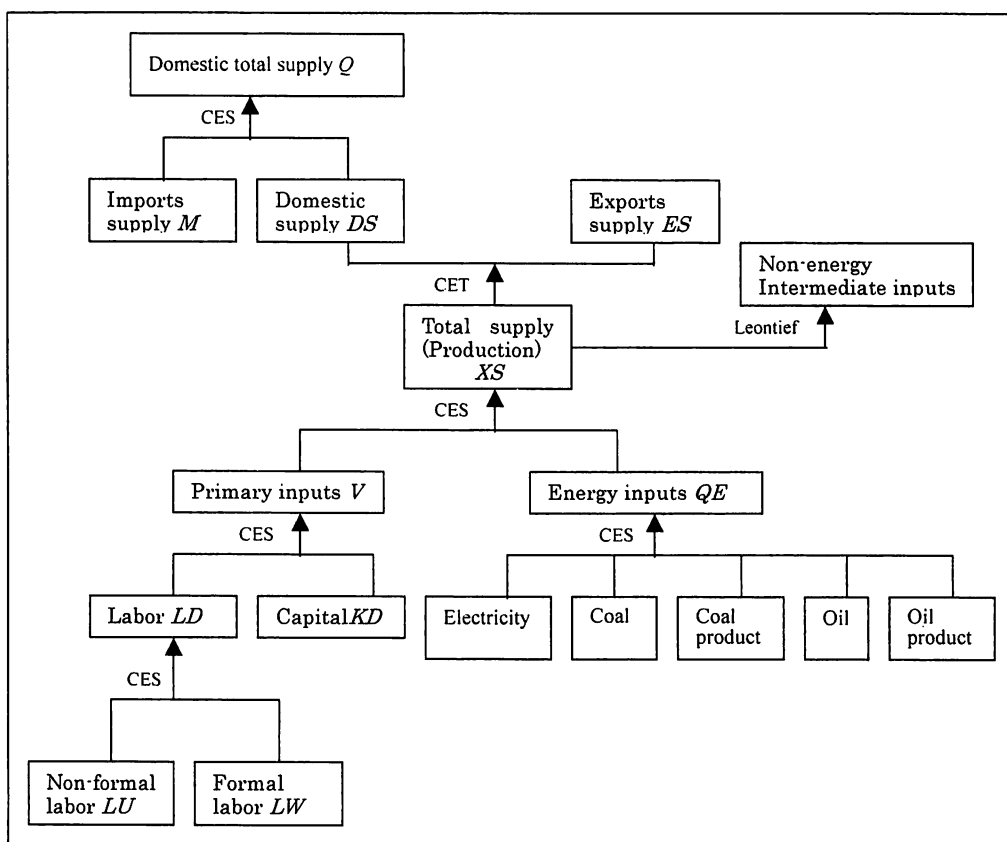


Figure 1. Supply Structure of the Model

⁴ Non-formal employment is defined in the statistical system of China as re-employment of the retired, employment in individual and private enterprises, employment in township and village enterprises, and rural and agricultural employment, while formal employment means all the remaining wage and salaried workers (See *China Statistical Yearbook*).

⁵See Appendices A1 and A2 for the system of equations in the model.

Production Structure

Production processes are described by CES (Constant Elasticity of Substitution) functions at various levels for each industry. First, the model determines total production by the CES production function, assuming substitutability between primary factors and energy inputs, both of which are aggregated as composite inputs. Intermediate inputs other than energy are determined by fixed coefficients of the Leontief type from total production. As for energy, the model determines total energy input by the CES aggregation function, assuming substitutability between 5 kinds of energy.⁶ Concerning primary factors, the model determines total primary input by the CES aggregation function, assuming substitutability between labor and capital inputs. Labor input is again an aggregation of non-formal and formal employment based on the CES function. In the case of formal employment, nominal wage is determined endogenously by assuming equilibrium in the market of formal labor. In the case of non-formal employment, on the other hand, nominal wages are treated as exogenous for non-agricultural industries, where demands for non-formal labor are assumed to be determined by marginal conditions. Then, the non-formal employment in agriculture is determined by residual as the difference between total supply and total non-agricultural demand.⁷

Substitution between imported and domestic goods is allowed for by the CES function based on the Armington hypothesis. On the other hand, substitution between exports and domestic supply is allowed for by the CET (Constant Elasticity of Transformation) function. In the case of international markets of exports and imports, prices of exports and imports are assumed to be affected by the amount of exports and imports due to the size of the Chinese economy, without adopting the small country assumption.⁸

Demand Structure

Utility functions of the Cobb-Douglas type are assumed for urban and rural residents, where energy is consumed as a composite commodity. A utility function of the Cobb-Douglas type is adopted also for government consumption. Investment and intermediate demands are determined by fixed coefficients.

⁶ Energy is subdivided into 5 components and separated from other intermediate inputs. This is because the model here originates from an energy-environmental model and also because it will be applied to the trade and environmental problems in the near future.

⁷ It is assumed, judging from the present conditions of the labor market in China, that there exists a massive labor surplus in rural areas, and conversely that if surplus labor (non-formal labor here) emerges in non-agriculture in recessions, it will be absorbed by agriculture. See footnote 4 for the definition of formal and non-formal labor.

⁸ The model here assumes low influence in general of Chinese exports and imports. We can assume high influence, say for agriculture, by setting high price elasticity for agricultural imports, resulting in significant changes in world agricultural prices due to Chinese imports of agricultural products.

Income and Savings

Income from production is divided between private and government sectors. Income of the private sector consists of labor and capital income, net of personal and property income taxes, to be distributed to rural and urban residents by fixed ratio. Income of the government sector consists of personal income tax, property income tax, tariffs and duties, and indirect taxes. These government revenues, however, are all lumped together as “production tax,” following the practice of input-output tables in China, where production tax appears as an item in value added and contains all kinds of tax revenues. As a result, personal income tax, property income tax, and tariffs and duties are assumed to be zero in the model. Savings consist of private and government ones.

Equilibrium Conditions

The model describes the economy of China as a market economy consisting of 6 kinds of markets: products, exports and imports markets for 35 industries; labor markets for formal and non-formal employment; the capital stock market; and the foreign exchange market.

There exist two alternative methods to attain equilibrium in each market: price adjustment and quantity adjustment (Ezaki, 1989). In the case of price adjustment, the balance between demand and supply is attained by letting price change flexibly. In the case of quantity adjustment, either demand or supply changes flexibly to attain a balance between the two with the price given exogenously.

In each of the product markets, equilibrium is attained by adjusting price endogenously.

In the market of formal employment, equilibrium is attained by adjusting nominal wage endogenously to attain equilibrium between total demand in non-agricultural industries and total supply (assuming zero formal employment in agriculture).

In the case of non-formal employment, the market is segmented between industries, and the quantity adjustment is adopted to attain balance. Demand for labor is determined in each of the non-agricultural industries by marginal condition with the exogenous nominal wage. Agricultural employment is the residual, i.e., total supply minus non-agricultural employment.⁹

In the case of the capital stock market, total supply is given by capital accumulation in each year and allocated to each industry, resulting in the determination of the rental rate of capital by marginal condition. That is, quantity adjustment is assumed for this market.

In the export markets, Chinese export prices are determined so as to attain equilibrium between supply of exports from China and demand for imports by foreign countries without assuming China to be a small country. The same is true for the

⁹ Non-formal wage may be treated as independent of formal wage (that is, the former is exogenous and the latter endogenous). Or non-formal wage may be linked with formal wage (say, by a constant ratio treating the former also as endogenous).

import markets.¹⁰

For the market of foreign exchange, the model can allow for either price or quantity adjustment. In the case of price adjustment, the balance between demand for and supply of US dollars is attained by adjusting exchange rate endogenously under a flexible exchange rate system. In the case of quantity adjustment, the balance is attained by adjusting foreign capital inflow (i.e., supply of U.S. dollars) under a fixed exchange rate system.

Numeraire

The model allows explicitly for an aggregate budget constraint which corresponds to the Law of Walras, making it clear that the balance between savings (of both domestic and foreign origin) and nominal investment is the equilibrium condition which determines all of the prices at their absolute levels. In other words, the balance equation ($S+F-I^N=0$), consisting of nominal investment (I^N), domestic savings (S), and foreign capital inflow (F), is the equilibrium condition that determines the absolute levels of prices. This balance equation is dropped as redundant in solving the model, making the price (of savings, i.e., unitary price) as numeraire, so that the model determines absolute prices but not relative prices and both nominal and real values of quantity variables are obtained.¹¹

Dynamic Linkage

The model here is a dynamic recursive model. That is to say, the model is solved year by year dynamically by using extrapolated values on such exogenous variables and parameters as supply of formal labor, supply of non-formal labor, nominal wage of non-formal employment, real investment, total factor productivity, scale factors of exports, and capital stocks. Extrapolation is made basically by assuming specific growth rates for those variables and parameters except for capital stocks. Total capital stocks are obtained by accumulating total real investment, and then allocated to industries in proportion to their rates of return, with the assumption of partial adjustment.

¹⁰ Strictly speaking, prices of exports and imports may better be determined by link or world model. See Ezaki and Ito (1995) for a link system of CGE models.

¹¹ The Law of Walras means that total sum of excess demands must identically be zero when added for all markets in the economy such as markets for products, labor, securities, money, foreign exchanges, and so on. Therefore, one of the equilibrium conditions ("excess demand = 0") becomes redundant and is dropped in solving the system, while the price of the corresponding market is set equal to 1 (one) as numeraire. In the model here, we allow for the market of securities only implicitly, assuming identically zero excess demand for the market (i.e., quantity adjustment), with the rate of interest given exogenously. Then, the balance between savings and investment coincides with the equilibrium in the money market, resulting in the determination of prices at their absolute levels with the price of money (i.e., unit) as numeraire. Note that ($S+F-I^N$) is equal to the sum of excess demands of the markets of securities and money.

3. Impact of Trade Liberalization on the Chinese Economy

3.1 Simulation Scenarios

As mentioned in Section 1, China has taken steps to implement trade liberalization for the purpose of joining WTO, responding at the same time to the APEC process of liberalization as well as to the need for domestic reform. Tariff rates declined from 43.2% in 1992 to 35.9% in 1993, 23% in 1996 and 17% in 1997. However, tariff levels even after the 1997 reduction are still higher than those of the developed and developing countries after the Uruguay Round. Especially high tariff rates remain in specific industries for specific commodities. For example, for an ordinary passenger car the tariff rate is 80%. China must reduce tariff rates and abolish non-tariff barriers further in order to join WTO. By the year 2000, the Chinese government has committed itself to decreasing the overall average tariff rate to 15%. By the year 2005, it has resolved to reduce the agricultural average tariff rate to 15%, the industrial average tariff rate to 10%, the tariff rate of ordinary passenger car to 25%, and 185 tariff rates of information technology-related goods to zero. Concerning the abolition of non-tariff barriers between 1992 and 1997, the government of China gradually shortened the list of items under import control or import licenses. It has committed to abolish almost all sorts of non-tariff barriers on imports by the year 2010.¹²

We will try to analyze by simulation the impact of these liberalization schemes on the Chinese economy. Tariff rates in 1997 (the benchmark year) used for simulation are weighted averages of those in April 1996 (Zhang, Chen and Li 1998) and in October 1997 (Wang (1998)). Tariff rates for services are assumed to be zero. Available data on tariff rates are adjusted when industrial classification does not match exactly between the tariff data and the model here. Committed tariff rates for the year 2005 are 15% for agriculture and 10% for industry. Tariff rates for individual industries within the industrial sector for 2005 are estimated by multiplying those in 1997 by the rate of reduction in the average tariff rate (10%/26%).¹³ Tariff-equivalent rates of non-tariff barriers for each industry are estimated (or guessed) based on the item-by-item estimates of Zhang, Zhang and Wan (1997) and the IAP data of 1998.¹⁴ Rates of export subsidy (export tax refund) are 17% for many industries such as garments, textiles, machinery, electrical and electronics, transportation equipment, meters, other machinery and electric, while they are 15%, 13% and 5% for the remaining industries.¹⁵

¹² For these liberalization commitments, see APEC's 1998 IAP (Individual Action Plan on Trade & Investment Liberalization and Facilitation).

¹³ Average tariff rate for the industrial sector is 26% in 1997, while the committed average tariff rate is 10% in 2005, so that the average reduction rate for the industrial sector is 10%/26%, which is applied to individual industries within the sector.

¹⁴ Tariff-equivalent rates of NTBs are estimated basically by the differences between domestic and international prices. See Zhang et al. (1997) for details.

¹⁵ The export tax refund is a refund of value added tax levied on exported products, introduced in 1991, when the export subsidy was abolished. It is supposed in this paper that the export tax refund is of a

Table 4. Tariffs and Non-tariff Barriers (NTBs) by Item (1994)

Item	(Unit:%)		
	Tariff rates	NTB rates	Tariffs + NTBs
Rape oil	25.0	88.60	113.60
Sugar	30.0	111.40	141.40
Drinks	65.0	40.56	105.56
Plywood	20.0	26.10	46.10
Wool	15.0	4.20	19.20
Color TVs	0.0	18.59	18.59
Video recorders	8.0	46.27	54.27
Motorcycles	120.0	11.20	131.20
Air conditioners	90.0	14.73	104.73
Steel	15.0	23.76	38.76
Copper & products	10.0	7.15	17.15
Aluminum ware	18.0	9.49	27.49
Gasoline	9.0	26.24	35.24
Light oil	6.0	18.70	24.70
Phosphoric acid	0.0	72.40	72.40
Synthetic fiber	15.0	7.01	22.01
Natural rubber	30.0	12.90	42.90
Synthetic rubber	30.0	12.90	42.90
Plastics	25.0	11.59	36.59
Automobiles	110.0	24.20	134.20
Petroleum	1.5	16.69	18.19
Personal Computers	7.0	6.02	13.02
Color TV tubes	15.0	18.59	33.59
Wheat	0.0	72.40	72.40
Auto telephone exc	12.0	8.98	20.98
Total	21.7	21.55	43.29

Notes: Tariff rate = tariff revenue / imports.
 NTB rate = tariff equivalent rate of non-tariff barriers.
 ETR rate = refunded value added tax / exports.

Table 5 summarizes tariff rates, tariff equivalent rates of NTBs, and refunding rates of export tax estimated in the above way. Based on Table 5, we have given external shocks to the model by reducing tariff rates and abolishing non-tariff barriers and the export subsidy step by step, and made simulation to the year 2010 by combining these shocks with changes in other external factors and policies. In giving shocks to the model, we have assumed possible decreases / increases in revenue by tariff reduction or abolition of the export tax refund to be attributed to the government sector, while possible decreases in revenue due to abolishing non-tariff barriers to the private sector.¹⁶

similar nature to the export subsidy, though the refund is not against WTO rules. Data on the rates of refund are derived from the *People's Daily* (July 19, 1999).

¹⁶ In the original input-output table, taxes are all included in "production tax," so that tariff rates and export subsidy (export tax refund) rates are set equal to zero in the model. Therefore, in the case of tariff reduction by 10%, for example, tariff rates would be changed from 0.0 to -0.1 in the model.

Table 5. Tariffs, Non-tariff Barriers (NTBs), and Export Tax Refund (ETR) by Industry

Industry	(Unit: %)			
	Tariff Rates		NTB rates	ETR rates
	1997	2005	1997	1999
Agriculture	26.0	15.0	50.0	15.0
Electricity	0.0	0.0	0.0	0.0
Coal mining	5.3	2.0	0.0	5.0
Coal products	5.3	2.0	0.0	5.0
Oil & gas	1.9	0.7	17.0	5.0
Oil & gas products	11.1	4.3	25.0	5.0
Metal mining	9.3	3.6	0.0	5.0
Non-metal mining	9.3	3.6	0.0	5.0
Food and tobacco	37.2	14.3	50.0	5
Textiles	29.4	11.3	10.0	17.0
Apparel & leather	28.5	11.0	10.0	17.0
Wood products	20.5	7.9	25.0	5.0
Paper, printing, toys	23.5	9.0	0.0	5.0
Chemicals	14.0	5.4	12.0	15.0
Non-metal products	23.8	9.1	20.0	15.0
Metals	13.1	5.0	0.0	15.0
Metal products	17.6	6.8	25.0	15.0
Machinery	17.9	6.9	10.0	17.0
Motor vehicles	38.3	14.7	24.0	17.0
Other trans. mach.	6.7	2.6	10.0	17.0
Electric machinery	18.8	7.2	20.0	17.0
Electronic, telecom	28.5	11.0	10.0	17.0
Precision machines	18.8	7.2	10.0	17.0
Repair of machinery	0.0	0.0	0.0	0.0
Other manufactures	27.9	10.7	10.0	15.0

The baseline scenario (S0) is the standard simulation result for 1997-2010 to be used as the basis for comparison. In order to get the baseline scenario, we must assign proper values to exogenous variables and parameters, including elasticities of substitution and transformation of various CES functions.

For major exogenous variables, we assume growth rates (1997-2010) of formal and non-formal labor supply to be 1% respectively,¹⁷ of nominal wage of non-formal labor to be 5%, and of real investment to be 9%, which is the target rate of the ninth five-year plan (1996-2000). Scale parameter of exports in each industry is extrapolated based on the growth performance of exports in the past (1987-1995) (Li and Xue, 1998), while TFP growth of each industry is derived from guesswork based on the TFP growth of the total economy in the past (Ezaki and Sun, 1999). Exchange rate is fixed at the 1997 level (zero growth). Coefficients of intermediate inputs are also fixed

Similar procedures are applied to the abolition of the export subsidy and non-tariff barriers.

¹⁷ Growth rates of labor for 1990-1996 are 1.2% for total employment and 0.9% for formal employment, so that we have assumed a common growth rate of 1% for formal and non-formal employment (though the two types of employment should be distinguished to be more precise).

basically. Tables 7 and 8 (first column) indicate average growth rates (1997-2010) of key macroeconomic variables and gross outputs by industry for the baseline scenario (S0).

Most of the parameters are computed by using the input-output table of 1997 and data from the *China Statistical Yearbook 1998*. The model uses six kinds of elasticity concerning CES substitution and transformation functions. We use GTAP data for the elasticity of substitution between labor and capital and between imports and domestic goods. We have referred to Martin (1993) and other studies for the elasticity of substitution between energy and primary inputs, between five kinds of energy and between formal and non-formal employment, and also for the elasticity of transformation between domestic and export supply. We have done a sensitivity test concerning these six kinds of elasticity, which shows that change in elasticity has only very small influences on the results of the model, except for the elasticity of substitution between labor and capital.¹⁸

In addition to the baseline scenario, seven alternative simulations are attempted for comparison in order to see the impact of trade liberalization. The contents of these seven alternative scenarios (S1-S7) are explained briefly in Table 6.¹⁹

Table 6. Simulation Scenarios

Scenario	Contents
S0	Baseline scenario (See text)
S1	Decrease in tariff rates from the 1997 level to the target 2005 level linearly for the period 1998-2005
S2	Decrease in non-tariff barriers (tariff-equivalent rates) from the 1997 level to zero linearly for the period 1998-2010
S3	Decrease in export subsidy rates (export tax refund rates) from the 1997 level to zero linearly for the period 2000-2005
S4	S1 + S2
S5	S1 + S2 + S3
S6	S5 + devaluation of yuan by 20% from 2000
S7	S5 + increase in personal income tax rate by 5% from 2000

Simulation Results

The main results of simulation are shown in Table 7 for key macroeconomic variables and in Table 8 for gross outputs by industry (and also in Appendices A3-A7 for other aspects).

¹⁸ GTAP uses common elasticity of substitution between labor and capital for all countries included in its world model. Elasticity adopted by GTAP seems to be high in general compared with several other country studies, but no data are available yet on China except for that of GTAP. Elasticity of substitution between domestic and imported goods is similar. See also Martin (1993) for elasticity.

¹⁹ Trade liberalization may bring about a severe negative impact on state-owned enterprises (SOEs), the reform of which is an important research topic concerning the current Chinese economy. However, no such scenarios as SOE-related alternatives are here allowed, due to the lack of proper data in the framework of the present CGE modeling.

Scenario S1 indicates basically the effects of tariff reduction through the decline in import prices and the decrease in government revenue. We can obtain the following observation from Column S1 for 2005 in Tables 7 and 8: at the macroeconomic level, if tariff rates are reduced, real private consumption increases; equivalent variation increases; deflators decrease; government revenue decreases; real government consumption decreases; current balance of payments deteriorates; real exports increase; real imports increase; and real GDP decreases. At the industry level, real production decreases drastically especially in public services (i.e., education, health and science, and government and other services), while it increases to a fairly large extent in consumption goods industries (i.e., agriculture, oil and gas, clothing and leather, electronic and communication appliances, and precision machinery). The former is due to negative income effects of the decrease in tariff revenue. The latter is due to positive price effects of overall price declines caused by liberalization.

As can be seen from Appendices 3 to 7, product prices decrease in all industries. Significant declines are observed especially in the consumption goods industries mentioned above. Demand for labor (formal employment) decreases drastically in public services (education, health and science, and government and other services), while it increases in all other industries. Demand for labor (non-formal employment) decreases drastically in public services. It decreases also in other industries to a considerable extent.²⁰ Real imports by industry increase especially in the industries with a high rate of tariff reduction (food, automobiles, etc.), while they decrease in many other industries. Real imports decrease in spite of tariff reduction in many industries, because declines in product prices due to cost down caused by overall price declines are remarkable in those industries. Real exports by industry increase in almost all industries except public services. This is again because of the decline in product price due to cost down.

We can see from Column S1 for 2010 in Tables 7 and 8 that the impact of tariff reduction in 2010 is almost in the same direction as in 2005 with the degree amplified to some extent. The negative impact on GDP, however, turns out to be zero, being cancelled out by the positive impact on consumption.

From the observations above, we can summarize the impact of tariff reduction as follows. Tariff reduction contributes to the welfare of consumers through declines in prices and increases in consumption. Its negative impact on production and growth is small, since decrease in real GDP is not significant. These effects accumulate over time in the same direction.

Scenario S2 indicates basically the effects of abolishing non-tariff barriers through the decline in import prices and the decrease in income of the private sector. As can be seen from Column S2 for 2005 in Tables 7 and 8, abolition of NTBs causes

²⁰ Demand for formal and non-formal labor decreases drastically, because tariff reduction causes first a decrease in government revenue, which is assumed to result in a decrease in government consumption consisting mainly of public service employment.

Demand for non-formal labor decreases in most cases due to the exogenous treatment of its nominal wage, which is assumed to grow at the rate of 5% whatever the level of inflation. An alternative treatment is to link it to nominal wage of formal labor, which changes endogenously as equilibrium price in accordance with demand and supply conditions.

increases in private consumption, declines in prices, and decreases in real government revenue and consumption, but to a smaller extent than in Scenario S1. This is because abolishing NTBs results in a decrease in the income of the private sector (negative income effect), unlike in the case of tariff reduction. Furthermore, real imports increase remarkably, and the current balance of payments deteriorates seriously, since the degree of reduction in tariff-equivalent rates becomes quite strong in the case of abolishing NTBs (See Table 5). Real GDP, on the other hand, decreases to a considerable extent due to a slow increase in consumption and a sharp increase in imports. Industries with increasing real production are more numerous than industries with decreasing real production. Obviously, the real production of the public sector decreases less.

Table 7. Impact of Trade Liberalization: Selected Macroeconomic Indicators

Macro economic indicators	Baseline scenario (1997-2010)	2005								
		S0	S1	S2	S3	S4	S5	S6	S7	
	Level	Level								
	Growth rate (%)	Billion. ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	
Real consumption	5.9	55852	3.4	0.8	-0.3	4.6	4.2	2.1	1.5	
Rural households	5.3	26451	3.5	1.4	-0.2	5.4	5.1	2.1	2.7	
Urban households	6.5	29401	3.4	0.2	-0.4	3.9	3.3	2.2	0.5	
Real government consumption	7.0	14912	-17.2	-1.7	3.1	-23.3	-19.0	-17.4	-1.1	
Real investment	9.0	56704	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Real exports	7.6	30027	2.3	1.5	-1.0	4.6	3.3	6.9	1.5	
Real imports	10.0	26510	1.3	5.8	0.6	8.2	8.9	4.6	12.5	
Real GDP	7.0	130986	-0.2	-0.7	-0.1	-1.3	-1.4	-0.4	-1.7	
Nominal government revenue	9.7	21471	-26.9	-8.6	3.7	-39.1	-35.0	-23.9	-16.1	
Nominal GDP	10.1	165824	-11.6	-10.1	0.4	-23.6	-23.2	-10.8	-21.1	
Nominal savings	9.9	68648	-10.2	-10.2	0.1	-22.2	-22.1	-9.6	-21.6	
Current balance of payment	-	2858	-16.7	-68.8	-6.4	-103.9	-111.1	-57.2	-150.1	
Real equivalent variation	4.7	53320	3.8	2.0	-0.1	6.4	6.2	2.6	3.8	
Rural households	3.3	23169	3.8	2.4	0.0	6.9	6.8	2.4	4.5	
Urban households	5.0	27193	3.6	1.0	-0.3	5.0	4.6	2.5	1.8	
Nominal average wage	9.8	1.28	-10.3	-9.0	-0.1	-20.9	-21.0	-6.9	-18.8	
Formal employment	5.5	1.55	-14.4	-7.0	1.0	-23.6	-22.6	-7.9	-14.9	
Non-formal employment	10.8	1.15	-8.6	-9.8	-0.5	-19.8	-20.3	-6.4	-20.4	
Deflator : GDP	2.9	1.27	-11.4	-7.4	0.5	-27.6	-26.9	-17.1	-24.4	
Private consumption	4.1	1.41	-12.4	-11.0	0.2	-24.8	-24.6	-10.8	-23.1	
Government consumption	2.5	1.23	-11.7	-7.0	0.7	-20.5	-19.7	-7.9	-15.2	
Investment	2.0	1.16	-9.8	-7.7	0.4	-18.6	-18.2	-7.5	-16.0	
Exports	0.9	1.05	-2.3	-1.5	1.0	-4.5	-3.2	12.3	-1.5	
Imports	1.1	1.08	0.3	1.0	0.1	1.9	1.9	22.1	2.1	

Notes: See Table 6 for S0 to S7. Change (%) means the rate of deviation of a trade liberalization scenario (S1-S7) from the baseline scenario (S0). Equivalent variation is computed by level x rate of change. The unit for nominal average wage of S0 (level) is 10 thousand yuans. The unit for deflator is 1.000 for 1997. The growth rate of the current balance of payments in the baseline scenario is not computable since it changes from surplus to deficits.

Table 7. (Cont.) Impact of Trade Liberalization: Selected Macroeconomic Indicators

Macro economic indicators	Baseline scenario (1997-2010)	2010								
		S0	S1	S2	S3	S4	S5	S6	S7	
	Growth rate (%)	Billion. ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	
Real consumption	5.9	75549	3.6	-0.6	-0.3	2.9	2.5	0.1	-0.4	
Rural households	5.3	34941	3.7	0.5	-0.2	4.5	4.2	1.0	1.5	
Urban households	6.5	40608	3.5	-1.7	-0.4	1.6	0.9	-0.6	-2.1	
Real government consumption	7.0	21031	-20.5	-4.0	2.8	-36.8	-31.8	-30.7	-13.2	
Real investment	9.0	87247	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Real exports	7.6	43021	3.4	4.3	-0.9	10.3	8.7	12.8	6.6	
Real imports	10.0	44220	-0.4	9.2	0.5	10.9	11.5	7.9	14.7	
Real GDP	7.0	182628	0.0	-1.9	-0.1	-3.2	-3.4	-2.4	-3.7	
Nominal government revenue	9.7	33980	-30.3	-16.9	3.3	-56.0	-52.0	-44.7	-35.5	
Nominal GDP	10.1	266018	-12.9	-21.1	0.4	-39.1	-38.5	-29.7	-36.8	
Nominal savings	9.9	110269	-11.3	-21.5	0.1	-37.5	-37.3	-28.3	-36.9	
Current balance of payment	-	-2305	-3.2	266.3	10.1	356.4	367.9	371.5	445.1	
Real equivalent variation	4.7	65965	4.5	4.0	-0.1	9.6	9.5	4.7	6.8	
Rural households	3.3	27264	4.4	4.2	0.0	9.7	9.6	4.4	7.1	
Urban households	5.0	34540	4.1	1.1	-0.2	5.4	5.0	2.2	2.0	
Nominal average wage	9.8	2.02	-11.5	-18.9	-0.1	-34.0	-34.0	-22.9	-32.2	
Formal employment	5.5	1.98	-15.7	-12.5	0.9	-34.2	-33.1	-21.4	-26.1	
Non-formal employment	10.8	1.89	-10.1	-21.0	-0.4	-33.9	-34.4	-23.3	-34.3	
Deflator : GDP	2.9	1.46	-13.0	-19.6	0.5	-37.1	-36.4	-28.0	-34.3	
Private consumption	4.1	1.68	-13.5	-21.2	0.2	-38.4	-38.1	-27.6	-36.7	
Government consumption	2.5	1.38	-12.3	-13.4	0.4	-30.4	-29.7	-20.2	-25.7	
Investment	2.0	1.29	-11.1	-15.6	0.3	-29.4	-29.0	-20.1	-27.0	
Exports	0.9	1.13	-3.4	-4.3	0.9	-9.5	-8.2	6.3	-6.4	
Imports	1.1	1.15	0.2	2.6	0.0	4.7	4.6	26.0	4.7	

As shown in Appendices Tables 3 to 7, declines in product prices are smaller in general compared with Scenario S1. Demand for labor decreases less in magnitude for the public sector, especially in government services compared with Scenario S1. But, generally in other industries, demand for labor increases less or decreases more compared with Scenario S1, depending on the level of NTBs to be abolished. Real imports increase in the industries with high NTBs (agriculture, food, oil and gas, etc.) but decrease in many other industries as a result of a decrease in income, consumption, and production. Real exports by industry change in accordance with real production by industry.

Table 8. Impact of Trade Liberalization: Real Production by Industry

Real Production	Baseline scenario (1997-2010)	2005								
		S0	S1	S2	S3	S4	S5	S6	S7	
	Growth rate (%)	Level Billion. ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	
Agriculture	2.1	29402	2.8	1.6	0.2	4.9	5.1	-0.7	4.1	
Electricity	7.0	7543	0.3	-1.1	-0.3	-0.7	-1.1	1.1	-2.2	
Coal mining & processing	5.4	3454	0.6	-0.9	-0.3	-0.2	-0.6	1.9	-1.8	
Coal products	7.4	789	1.6	-1.6	-0.5	0.4	-0.3	2.9	-2.9	
Crude petroleum & natural gas	7.2	3003	4.0	-2.0	-0.6	2.9	2.2	6.4	-0.5	
Petroleum & gas products	8.1	5390	0.2	-1.4	-0.2	-1.1	-1.4	0.7	-2.3	
Metal ore mining	9.0	2405	1.8	-0.6	-0.7	2.2	1.3	8.2	-1.9	
Non-ferrous mineral mining	8.3	3374	0.4	0.4	-0.2	1.1	0.8	3.1	-0.1	
Food & tobacco processing	2.5	17399	1.5	0.4	0.2	0.7	0.9	-3.8	-0.5	
Textile goods	6.4	15787	0.9	3.8	-1.1	6.2	4.5	7.6	2.3	
Wearing apparel & leather products	7.7	11258	3.9	1.6	-1.5	6.2	3.9	7.6	2.0	
Sawmills & furniture	8.3	4301	0.2	0.5	-0.2	0.7	0.5	3.0	-0.4	
Paper, printing & toys	7.5	7910	-1.6	0.2	-0.1	-1.5	-1.6	1.7	-1.5	
Chemicals	7.4	27395	1.5	-0.2	-0.5	2.0	1.3	4.2	-0.4	
Nonmetal mineral products	8.9	17570	-0.3	-0.2	-0.1	-0.6	-0.7	0.7	-1.1	
Metals	9.2	15995	1.0	-2.9	-0.6	-1.3	-2.2	2.8	-4.6	
Metal products	8.6	9661	0.1	0.0	-0.5	0.4	-0.2	3.2	-1.4	
Machinery & equipment	9.0	16475	-0.3	-3.4	-0.5	-3.5	-4.1	0.0	-6.0	
Motor vehicles	8.5	5850	-3.1	-0.3	-0.1	-3.4	-3.5	-1.2	-4.0	
Other transport machinery	9.5	4735	2.9	-1.6	-0.7	1.8	0.9	3.8	-1.4	
Electric equipment & machinery	9.1	11285	1.0	0.3	-0.8	1.7	0.7	4.7	-1.3	
Electronic & telecom. Machinery	9.4	10074	3.0	3.6	-2.2	8.2	5.2	12.8	2.2	
Precision machinery	9.0	1656	6.1	6.6	-0.5	15.2	14.4	21.6	10.9	
Maintenance & repair of machinery	7.9	1331	-1.8	-0.8	0.2	-3.2	-2.9	-1.1	-1.7	
Other manufacturing products	7.8	5203	-0.1	-0.3	-0.3	-0.2	-0.6	2.4	-2.2	
Construction	9.1	35149	-0.2	0.0	0.0	-0.3	-0.3	-0.1	0.0	
Transport & warehousing	7.9	6826	0.3	-0.6	-0.3	-0.2	-0.6	1.4	-1.6	
Passenger transport	8.0	2497	-2.2	-1.3	0.3	-4.5	-4.0	-1.6	-2.7	
Post & telecommunication	9.1	3959	-1.3	-1.2	0.0	-3.0	-2.9	-0.7	-2.4	
Wholesale & retail trade	7.7	19985	0.2	-0.8	-0.3	-0.7	-1.1	1.0	-2.4	
Eating & drinking places	6.3	3734	0.0	0.6	0.1	0.3	0.5	1.0	0.5	
Social services	7.9	13794	-1.5	-1.3	0.2	-3.6	-3.3	-0.6	-2.6	
Health, education & sciences	7.4	11652	-8.3	-1.7	1.5	-12.4	-10.4	-9.5	-2.4	
Finance & insurance	8.2	6778	-0.2	-1.7	-0.2	-2.2	-2.5	0.0	-3.8	
Public administration & others	7.1	7642	-17.2	-1.7	3.0	-23.2	-18.9	-17.2	-1.0	

Note: See footnotes to Table 7.

Table 8. (Cont.) Impact of Trade Liberalization: Real Production by Industry

Real Production	Baseline scenario	2010							
	(1997-2010)	S0	S1	S2	S3	S4	S5	S6	S7
	Growth rate (%)	Level Billion. ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	2.1	32422	3.7	3.1	0.1	8.3	8.5	2.0	7.2
Electricity	7.0	10397	0.5	-2.4	-0.2	-2.1	-2.5	-0.2	-3.7
Coal mining & processing	5.4	4402	0.8	-1.4	-0.3	-0.2	-0.7	1.8	-1.9
Coal products	7.4	1113	1.9	-3.4	-0.5	-0.6	-1.4	2.0	-4.2
Crude petroleum & natural gas	7.2	4016	5.1	-2.8	-0.6	5.1	4.2	9.5	1.3
Petroleum & gas products	8.1	7732	0.7	-2.2	-0.2	-1.1	-1.5	1.1	-2.4
Metal ore mining	9.0	3660	2.9	0.2	-0.7	6.6	5.4	13.2	2.0
Non-ferrous mineral mining	8.3	5008	0.9	1.2	-0.2	2.9	2.5	4.9	1.5
Food & tobacco processing	2.5	19060	2.1	1.0	0.2	-0.6	-0.3	-6.4	-2.0
Textile goods	6.4	20754	2.9	12.7	-0.9	21.6	19.5	22.4	16.7
Wearing apparel & leather products	7.7	15903	5.6	5.4	-1.3	13.9	11.1	14.5	8.9
Sawmills & furniture	8.3	6329	0.7	1.5	-0.1	2.3	2.0	4.2	1.0
Paper, printing & toys	7.5	11274	-1.0	1.6	-0.1	0.6	0.5	3.8	0.5
Chemicals	7.4	38356	2.8	2.0	-0.5	7.2	6.2	9.4	4.3
Nonmetal mineral products	8.9	26825	-0.2	-0.5	-0.2	-0.8	-1.0	0.4	-1.4
Metals	9.2	24421	1.8	-4.0	-0.6	0.0	-1.0	4.5	-3.6
Metal products	8.6	14637	0.6	0.4	-0.5	1.9	1.3	4.7	-0.1
Machinery & equipment	9.0	25090	0.3	-4.8	-0.5	-3.1	-3.8	0.8	-5.8
Motor vehicles	8.5	8765	-2.8	-0.2	-0.1	-2.7	-2.9	-0.5	-3.4
Other transport machinery	9.5	7443	3.1	-3.1	-0.7	0.9	-0.1	3.0	-2.5
Electric equipment & machinery	9.1	17343	1.6	0.7	-0.7	3.5	2.4	6.5	0.1
Electronic & telecom. machinery	9.4	15804	4.6	8.2	-2.3	17.9	14.2	23.4	10.6
Precision machinery	9.0	2550	7.6	13.5	-0.5	28.0	27.0	35.8	23.0
Maintenance & repair of machinery	7.9	1922	-2.0	-1.9	0.2	-5.5	-5.2	-3.3	-4.0
Other manufacturing products	7.8	7556	0.5	0.1	-0.3	1.2	0.7	3.8	-1.0
Construction	9.1	53889	-0.2	-0.1	0.0	-0.5	-0.4	-0.3	-0.2
Transport & warehousing	7.9	9924	0.6	-0.9	-0.3	0.1	-0.4	1.8	-1.5
Passenger transport	8.0	3690	-3.0	-4.5	0.3	-11.0	-10.3	-8.0	-8.8
Post & telecommunication	9.1	6045	-1.5	-3.1	0.0	-6.2	-6.1	-4.0	-5.7
Wholesale & retail trade	7.7	28875	0.5	-1.7	-0.3	-1.6	-2.1	0.0	-3.3
Eating & drinking places	6.3	5011	0.5	2.2	0.1	2.0	2.3	2.3	2.4
Social services	7.9	20244	-1.8	-3.5	0.2	-7.9	-7.5	-5.1	-6.7
Health, education & sciences	7.4	16628	-10.0	-4.6	1.4	-21.6	-19.1	-18.6	-10.9
Finance & insurance	8.2	10063	-0.2	-4.0	-0.2	-5.3	-5.6	-3.2	-6.9
Public administration & others	7.1	10771	-20.4	-3.9	2.8	-36.7	-31.6	-30.6	-13.0

Impact figures for the year 2010 (Column S2 for 2010 in Tables 7 and 8) indicate the consequences of accumulating negative effects for the whole period, since the process of abolishing NTBs continues steadily to the year 2010. For example, change in real consumption becomes negative, while the decrease in real GDP becomes -1.9%.

From the observations made above, we can see that abolishing NTBs will cause more serious effects to the Chinese economy than tariff reduction. In the year 2010 when non-tariff barriers are scheduled to be abolished completely, consumption decreases, GDP decreases, deficits in the current balance of payments drastically increase, and real production decreases in almost all industries. However, equivalent variation remains positive due to drastic declines in prices.

Scenario S3 indicates basically the effects of abolishing export subsidies (export tax refunds) through a decrease in exports and increase in government revenue. As can be seen from Column S3 for 2005 in Tables 7 and 8, the abolition of the export tax refund causes a decrease in real GDP, a decrease in private consumption, an increase in government consumption, deterioration in the current balance of payments, and an increase in prices. Its impact on the Chinese economy is basically negative in direction but small in magnitude. The same is true for individual industries as well as for 2010.

Scenario S4 is a combination of tariff reduction and the abolition of NTBs (S1+S2), which is expected to generate a sum of the two effects. Total impact, however, appears as synergy, as can be seen from Column S4 in Tables 7 and 8. In other words, decreases in real GDP, decreases in surplus (increases in deficits) of the balance of payments, and declines in prices are amplified to a greater extent than would result from a simple sum of the combined effects. On the other hand, the increase in consumption of Scenario S1 is more than cancelled out by the decrease in consumption of Scenario S2. As a result, Scenario S3 as a combination of tariff reduction (S1) and abolition of NTBs (S2) tends to generate a more negative than positive impacts.

Scenario S5 is a combination of reducing tariff rates, abolishing NTBs, and abolishing the export tax refund, so that the combined effects of S3 and S4 are expected to be obtained. As can be seen from Column S5 in Tables 7 and 8, however, total effects do not represent synergy due to the small effects of Scenario S3.

Scenario S6 is attempted from the point of view of compensating for the negative effects of trade liberalization (i.e., an increase in imports and a decrease in exports) by means of exchange rate devaluation. As can be seen from Column S6 of Tables 7 and 8, a devaluation of the yuan by 20% diminishes remarkably the decrease in real GDP, the deterioration of the balance of payments, and the decrease in government revenue, causing a significant increase in exports and decrease in imports. On the other hand, however, devaluation also remarkably cancels out an increase in real consumption, an increase in equivalent variation, and declines in prices. At the industry level, devaluation plays the role of mitigating and canceling out positive and negative effects of trade liberalization. Devaluation is different from tariff reduction and the abolition of NTBs in that its effects are uniform across all industries. It is effective to implement devaluation to mitigate the negative effects of trade liberalization, but with the awareness that devaluation may cancel out the positive effects of trade liberalization.

Scenario S7 is attempted from the point of view of restoring government revenue

in the case of trade liberalization by means of heavier tax. As can be seen from Column S7 of Tables 7 and 8, an increase in income tax by 5% brings about a remarkable improvement in government revenue, on the one hand, but it amplifies negative effects in many other areas. In other words, real private consumption increases less in 2005 or decreases absolutely in 2010. Real GDP decreases more, and the current balance of payments deteriorates further. Equivalent variation increases less, and declines in prices are cancelled out partially. It is, therefore, not very effective to impose heavier income tax in order to mitigate the negative effects of trade liberalization.²¹

4. Summary and Conclusion

In this paper, focusing on three measures of trade liberalization (i.e., tariff reduction, the abolition of non-tariff barriers, and the abolition of the export tax refund), we have investigated quantitatively its impact on the macro economy and industries of China from the point of view of growth, industrial structure, employment, and trade. We have adopted as methodology a dynamic simulation for 1997-2010 by means of the CGE model. We have constructed a CGE model of China on the basis of the 1997 input-output table. We have obtained the results of dynamic simulation, which are summarized below.

Tariff reduction contributes to the welfare of consumers through declines in prices and increases in real consumption. Its negative impact on production and growth is small in that the resulting decrease in real GDP is not large. Increases in production of consumption-related industries are fairly large. Tariff reduction's impact on government revenue, expenditure and production is negatively large. Abolition of NTBs causes more serious problems for the Chinese economy than tariff reduction. In the year 2010, if NTBs have been abolished completely as scheduled, real GDP will decrease, deficits in the balance of payments will drastically increase, and real production will decrease in almost all industries (compared with the case of no abolition). Abolition of the export subsidy (the export tax refund) is basically negative in direction concerning its impact on the Chinese economy, but the degree is generally small. A combination of tariff reduction and abolition of NTBs generates synergy effects on the Chinese economy, but positive effects are expected to be more than cancelled out by negative ones because of high tariff-equivalent rates of NTBs compared with tariff rates. Adding abolition of the export subsidy (export tax refund) to the combination of tariff reduction and the abolition of NTBs does not generate synergy but results only in a simple sum, since the consequence of abolishing the export subsidy are generally small. Adding exchange rate devaluation to trade liberalization measures is effective in mitigating negative effects of trade liberalization, but devaluation may cancel out the positive aspects of trade liberalization. Imposing

²¹ The model here treats all investment as exogenous without separating government and private investment, so that it does not allow for a possible increase in investment due to the recovery of government revenue. Neither does the model deal with tax revenues in detail, so that it cannot allow for the effects of income redistribution.

heavier income tax is not very effective in alleviating the negative impact of trade liberalization.

As can be seen from the summary above, implementing trade liberalization measures will bring about both positive and negative influences to the macro-economy and the industries of China. Positive effects are increases in consumption (economic welfare) as well as in production and employment of consumption-related industries. Negative effects are decreases in GDP as well as in production and employment in many other industries. As summarized in Table 3, our results on the trade liberalization in China are basically along similar lines with those of other studies, but differ from them especially concerning the negative effects on GDP. Kawasaki (1997, 1999) and Li, Zhai and Xu (1999) indicate explicitly the impact of trade liberalization on GDP, which is positive because the world model is adopted as the analytical framework, making it possible to allow for trade liberalization measures not only of China but also of other countries, including the abolition of MFA (Multi-Fiber Agreement).²² This paper presents the case where China implements trade liberalization measures unilaterally or one-sidedly, and especially worthy of note are the negatively large results obtained in the case where NTBs are abolished. While the abolition of MFA will have positive effects on the economy of China, especially on the textile industry, the analysis here, based on a one-country model, is limited. There is the problem of short-run comparative advantages, i.e., whether to give special priority to the textile industry with a comparative advantage at present. Equally important is the problem of long-run comparative advantage, i.e., how to nurture infant industries (e.g., automobiles) with strong linkages to other parts of the economy and of high potential comparative advantages in the near future.

In conclusion, China must draw forth the merits of trade liberalization by realizing entry into WTO as early as possible, joining the strong world stream of globalization. The important task of the government, however, is to discern how to take proper balance between short-run and long-run benefits, and to decide what policies to adopt in order to remedy the negative influences incurred in the process of liberalization.

²² Kawasaki (1997, 1999) provides, based on the GTAP world model, an analysis of comparative statics (on the impacts of tariff abolition only) for the case where the Bogor declaration is fully implemented by all members of APEC. Li, Zhai and Xu (1999) provide a simulation analysis (on the impacts of both tariffs and NTBs abolition) by using a dynamic one-country model combined with a world model, allowing especially for the abolition of MFA.

Appendices

Appendix A1. CGE Model of the Chinese Economy: System of Equations

Price identities:

- (1) $PM_i = PM\$_i \cdot (1 + \overline{tm}_i + \overline{tn}_i) \cdot ER$
- (2) $PES_i = PE\$_i \cdot ER \cdot (1 + \overline{te}_i)$
- (3) $PX_i = (PD_i \cdot D^S_i + PES_i \cdot E^S_i) / X^S_i$
- (4) $PN_i = PX_i - \sum_{j=2,3,4,5,6} P_j \cdot \overline{a}_{ji} - PX_i \cdot \overline{td}_i$

Supply for domestic and exports markets:

- (5) $D_i^S = \overline{A}_{Ti}^{\sigma_n \rho_n} \cdot (\alpha_{DSi} \cdot PX_i / PD_i)^{\sigma_{Ti}} \cdot X_i^S$
 - (6) $E_i^S = \overline{A}_{Ti}^{\sigma_n \rho_n} \cdot (\alpha_{ESi} \cdot PX_i / PES_i)^{\sigma_{Ti}} \cdot X_i^S$
- where $X_i^S = \overline{A}_{Ti} \cdot (\alpha_{ESi} \cdot (E_i^S)^{\rho_n} + \alpha_{DSi} \cdot (D_i^S)^{\rho_n})^{1/\rho_n}$
 $\sigma_{Ti} = 1/(1 - \rho_{Ti})$, $\rho_{Ti} > 1$

Production function:

- (7) $X_i^S = \overline{A}_{Xi} \cdot (\alpha_{Ei} \cdot Q_{Ei}^{\rho_{Xi}} + \alpha_{Vi} \cdot V_i^{\rho_{Xi}})^{1/\rho_{Xi}}$
- where $\alpha_{Ei} + \alpha_{Vi} = 1$, $\sigma_{Xi} = 1/(1 - \rho_{Xi})$, $\rho_{Xi} < 1$

Demand for energy:

- (8) $Q_{Ei} = \overline{A}_{Xi}^{\rho_{Xi} \sigma_{Xi}} \cdot (\alpha_{Ei} \cdot PN_i / P_{Ei})^{\sigma_{Xi}} \cdot X_i^S$
 - (9) $P_{Ei} = \overline{A}_{Ei}^{-1} \cdot \left(\sum_{j=2} \delta_{Eji}^{\sigma_{Bi}} \cdot (P_j)^{-\rho_{Bi} \sigma_{Bi}} \right)^{-1/\rho_{Bi} \sigma_{Bi}}$ ($j = 2, 3, 4, 5, 6$)
 - (10) $a_{Ei} = \overline{A}_{Xi}^{\rho_{Xi} \sigma_{Xi}} \cdot (\alpha_{Ei} \cdot PN_i / P_{Ei})^{\sigma_{Xi}}$
 - (11) $a_{ji} = \overline{A}_{Ei}^{\rho_{Bi} \sigma_{Bi}} \cdot (\delta_{Eji} \cdot P_{Ei} / P_j)^{\sigma_{Bi}} \cdot a_{Ei}$ ($j = 2, 3, 4, 5, 6$)
- where $a_{Ei} = Q_{Ei} / X_i$, $a_{ji} = Q_{ji} / X_i$ ($j = 2, 3, 4, 5, 6$)
- $$Q_{Ei} = \overline{A}_{Ei} \cdot \sum_{j=2}^6 (\delta_{Eji} \cdot Q_{ji}^{\rho_{Bi}})^{1/\rho_{Bi}}$$
- $$a_{Ei} = \overline{A}_{Ei} \cdot \sum_{j=2}^6 (\delta_{Eji} \cdot (a_{ji}^E)^{\rho_{Bi}})^{1/\rho_{Bi}}$$
- $$P_{Ei} \cdot Q_{Ei} = \sum_{j=2}^6 P_j \cdot Q_{ji} \quad P_{Ei} \cdot a_{Ei} = \sum_{j=2}^6 P_j \cdot a_{ji}$$

Demand for primary factors:

- (12) $V_1 = \overline{A}_{V1} \cdot (\alpha_{L1} \cdot L_1^{\rho_{V1}} + \alpha_{K1} \cdot K_1^{\rho_{V1}})^{1/\rho_{V1}}$

$$(13) \quad V_i = \bar{A}_{X_i}^{\rho_{X_i} \sigma_{X_i}} \cdot (\alpha_{V_i} \cdot PN_i / P_{V_i})^{\sigma_{X_i}} \cdot X_i^S \quad (i \neq 1)$$

$$(14) \quad P_{V_1} = \bar{A}_{X_1}^{\rho_{X_1}} \cdot \alpha_{V_1} \cdot PN_1 \cdot (X_1^S / V_1)^{(1-\rho_{X_1})}$$

$$(15) \quad P_{V_i} = \bar{A}_{V_i}^{-1} \cdot (\alpha_{L_i}^{\sigma_{V_i}} \cdot (W_i)^{-\rho_{V_i} \sigma_{V_i}} + \alpha_{K_i}^{\sigma_{V_i}} \cdot (R_i)^{-\rho_{V_i} \sigma_{V_i}})^{-1/\rho_{V_i} \sigma_{V_i}} \quad (i \neq 1)$$

where
$$V_i = \bar{A}_{V_i} \cdot (\alpha_{L_i} \cdot L_i^{\rho_{V_i}} + \alpha_{K_i} \cdot K_i^{\rho_{V_i}})^{1/\rho_{V_i}}$$

$$\alpha_{L_i} + \alpha_{K_i} = 1 \quad \sigma_{V_i} = 1/(1 - \rho_{V_i}), \quad \rho_{V_i} < 1$$

Demand for labor:

$$(16) \quad L_1 = L_{U_1}$$

$$(17) \quad L_i = \bar{A}_{V_i}^{\rho_{V_i} \sigma_{V_i}} \cdot (\alpha_{L_i} \cdot PV_i / W_i)^{\sigma_{V_i}} \cdot V_i \quad (i \neq 1)$$

$$(18) \quad W_1 = \bar{A}_{V_1}^{\rho_{V_1}} \cdot \alpha_{V_1} \cdot PV_1 \cdot (V_1 / L_1)^{(1-\rho_{V_1})}$$

$$(19) \quad W_i = \bar{A}_{L_i}^{-1} \cdot (\alpha_{U_i}^{\sigma_{W_i}} \cdot W_{U_i}^{-\rho_{L_i} \sigma_{W_i}} + \alpha_{W_i}^{\sigma_{W_i}} \cdot (W_{W_i})^{-\rho_{L_i} \sigma_{W_i}})^{-1/\rho_{L_i} \sigma_{W_i}}$$

where
$$L_i = \bar{A}_{L_i} \cdot (\alpha_{U_i} \cdot L_{U_i}^{\rho_{L_i}} + \alpha_{W_i} \cdot L_{W_i}^{\rho_{L_i}})^{1/\rho_{L_i}} \quad (i \neq 1)$$

$$\alpha_{U_i} + \alpha_{W_i} = 1 \quad \sigma_{L_i} = 1/(1 - \rho_{L_i}), \quad \rho_{L_i} < 1$$

Non-formal labor market:

$$(20) \quad L_{U_i} = \bar{A}_{L_i}^{\rho_{L_i} \sigma_{L_i}} \cdot (\alpha_{U_i} \cdot W_i / W_{U_i})^{\sigma_{L_i}} \cdot L_i \quad \text{and} \quad W_{U_i} = \bar{W}_{U_i} \quad (i = 2, \dots, 35)$$

$$(21) \quad L_{U_1} = \bar{L}_U^S - \sum_{i=2}^{35} L_{U_i}$$

$$(22) \quad W_{U_1} = W_1$$

$$(23) \quad W_U = \sum W_{U_i} L_{U_i} / \bar{L}_U^S$$

Formal labor market:

$$(24) \quad L_{W_1} = 0$$

$$(25) \quad L_{W_i} = \bar{A}_{L_i}^{\rho_{L_i} \sigma_{L_i}} \cdot (\alpha_{W_i} \cdot W_i / W_{W_i})^{\sigma_{L_i}} \cdot L_i \quad (i \neq 1)$$

$$(26) \quad W_{W_i} = \lambda_{W_i} \cdot W_W \quad (i \neq 1)$$

$$(27) \quad L_{W_i}^* = \lambda_{W_i} \cdot L_{W_i} \quad (i \neq 1)$$

$$(28) \quad L_W = \sum L_{W_i} \quad (L_W = \bar{L}_W^S) \quad \text{and} \quad W_W = W_W^e \quad (W^e \text{ equilibrium wage}) \quad (i \neq 1)$$

$$(29) \quad L_W^* = \sum L_{W_i}^* \quad (i \neq 1)$$

$$(30) \quad \lambda_W = L_W^* / L_W^S \quad (\lambda_{W_0} = 1.0, \quad L_W^S = L_W^*, \quad \sum W_{W_i} L_{W_i}^* = W_W L_W^* \quad \text{for 1997})$$

Capital stocks by industry:

$$(31) \quad K_i = \bar{K}_i$$

$$(32) \quad R_i = \bar{A}_{V_i}^{\rho_{V_i}} \cdot \alpha_{K_i} \cdot PV_i \cdot (V_i / K_i)^{1-\rho_{V_i}}$$

$$(33) \quad R = \sum R_i \cdot K_i / \bar{K}^S \quad \sum K_i = \bar{K}^S$$

Income distribution and savings:

$$(34) \quad Y_P = (1 - \bar{t}_{Y_U}) \cdot W_U \cdot \bar{L}_U^S + (1 - \bar{t}_{Y_W}) \cdot W_W \cdot \bar{L}_W^S + (1 - \bar{t}_{Y_K}) \cdot R \cdot \bar{K}^S \\ + \sum \bar{t}m_i \cdot PM\$_i \cdot ER \cdot M_i$$

$$(35) \quad Y_G = \bar{t}_{Y_U} \cdot W_U \cdot \bar{L}_U^S + \bar{t}_{Y_W} \cdot W_W \cdot \bar{L}_W^S + \bar{t}_{Y_K} \cdot R \cdot \bar{K}^S + \sum \bar{t}d_i \cdot PX_i \cdot X_i^S \\ + \sum \bar{t}m_i \cdot PM\$_i \cdot ER \cdot M_i - \sum \bar{t}e_i \cdot PES_i \cdot ER \cdot E_i$$

$$(36) \quad Y_{PA} = \psi \cdot Y_P$$

$$(37) \quad Y_{PN} = (1 - \psi) \cdot Y_P$$

$$(38) \quad S = \bar{s}_{PA} \cdot Y_{PA} + \bar{s}_{PN} \cdot Y_{PN} + \bar{s}_G \cdot Y_G$$

Real consumption expenditure by urban residents:

$$(39) \quad C_{Aj} = \gamma_{Aj} \cdot (1 - \bar{s}_{PA}) \cdot Y_{PA} / P_j \quad (j \neq 2, 3, 4, 5, 6)$$

$$(40) \quad C_{Aj} = \bar{A}_{ECA}^{\rho_{ECA}} \cdot (\delta_{ECAj} \cdot P_{ECA} / P_j)^{\sigma_{ECA}} \cdot C_{EA} \quad (j = 2, 3, 4, 5, 6)$$

$$(41) \quad P_{ECA} = \bar{A}_{ECA}^{-1} \cdot \left(\sum \delta_{ECAj}^{\sigma_{ECA}} \cdot P_j^{-\rho_{ECA} \sigma_{ECA}} \right)^{-1/\rho_{ECA} \sigma_{ECA}} \quad (j = 2, 3, 4, 5, 6)$$

$$(42) \quad C_{EA} = \gamma_{EA} \cdot (1 - \bar{s}_{PA}) \cdot Y_{PA} / P_{ECA} \quad (\gamma_{EA} = \sum_{j=2}^6 \gamma_{Aj})$$

$$\text{where} \quad C_{EA} = \bar{A}_{ECA} \cdot \sum_{j=2}^6 (\delta_{ECAj} \cdot C_{Aj}^{\rho_{ECA}})^{1/\rho_{ECA}}, \quad P_{ECA} \cdot C_{EA} = \sum_{j=2}^6 P_j \cdot C_{Aj}$$

$$(43) \quad C_A = \sum_{j=1}^{35} C_{Aj}$$

$$(44) \quad PC_A = (1 - \bar{s}_{PA}) \cdot Y_{PA} / C_A \quad (PC_A \cdot C_A \equiv \sum P_j \cdot C_{Aj})$$

Real consumption expenditure by rural residents:

$$(45) \quad C_{Nj} = \gamma_{Nj} \cdot (1 - \bar{s}_{PN}) \cdot Y_{PN} / P_j \quad (j \neq 2, 3, 4, 5, 6)$$

$$(46) \quad C_{Nj} = \bar{A}_{ECN}^{\rho_{ECN}} \cdot (\delta_{ECNj} \cdot P_{ECN} / P_j)^{\sigma_{ECN}} \cdot C_{EN} \quad (j = 2, 3, 4, 5, 6)$$

$$(47) \quad P_{ECN} = \bar{A}_{ECN}^{-1} \cdot \left(\sum \delta_{ECNj}^{\sigma_{ECN}} \cdot P_j^{-\rho_{ECN} \sigma_{ECN}} \right)^{-1/\rho_{ECN} \sigma_{ECN}} \quad (j = 2, 3, 4, 5, 6)$$

$$(48) \quad C_{EN} = \gamma_{NE} \cdot (1 - \bar{s}_{PN}) \cdot Y_{PN} / P_{ECN} \quad (\gamma_{EN} = \sum_{j=2}^6 \gamma_{Nj})$$

$$\text{where} \quad C_{EN} = \bar{B}_{ECN} \cdot \sum_{j=2}^6 (\delta_{ECNj} \cdot C_{Nj}^{\rho_{EN}})^{1/\rho_{EN}}, \quad P_{ECN} \cdot C_{EN} = \sum_{j=2}^6 P_j \cdot C_{Nj}$$

$$(49) \quad C_N = \sum_{j=1}^{35} C_{Nj}$$

$$(50) \quad PC_N = (1 - \bar{s}_{PN}) \cdot Y_{PN} / C_N \quad (PC_N \cdot C_N \equiv \sum P_j \cdot C_{Nj})$$

Real consumption expenditure by government:

$$(51) \quad G = (1 - \bar{s}_G) \cdot Y_G / PG$$

$$(52) \quad G_j = \gamma_{Gj} \cdot G \quad (\sum \gamma_{Gj} = 1)$$

$$(53) \quad PG = \sum \gamma_{Gj} \cdot P_j \quad (PG \cdot G = \sum P_j \cdot G_j)$$

Fixed capital formation:

$$(54) \quad I^n = PI \cdot I \quad (I = \bar{I})$$

$$(55) \quad I_i = \bar{b}_{Ii} \cdot I \quad (\sum \bar{b}_{Ii} = 1.0)$$

$$(56) \quad PI = \sum \bar{b}_{Ii} \cdot P_i \quad (PI \cdot I = \sum P_i \cdot I_i)$$

Demand for domestic goods and imports:

$$(57) \quad Q_i = \sum_{j=2,3,4,5,6} \bar{a}_{ij} \cdot X_j^S + \sum_{j=2,3,4,5,6} \alpha_{ij} \cdot X_j^S + C_{Ai} + C_{Ni} + G_i + I_i$$

$$(58) \quad P_i = \bar{A}_{Qi}^{-1} \cdot (\alpha_{Mi}^{\sigma_{Qi}} \cdot PM_i^{-\rho_{Qi}\sigma_{Qi}} + \alpha_{Di}^{\sigma_{Qi}} \cdot PD_i^{-\rho_{Qi}\sigma_{Qi}})^{-1/\rho_{Qi}\sigma_{Qi}}$$

$$(59) \quad D_i = \bar{A}_{Qi}^{\rho_{Qi}\sigma_{Qi}} \cdot (\alpha_{Di} \cdot P_i / PD_i)^{\sigma_{Qi}} \cdot Q_i$$

$$(60) \quad M_i = \bar{A}_{Qi}^{\rho_{Qi}\sigma_{Qi}} \cdot (\alpha_{Mi} \cdot P_i / PM_i)^{\sigma_{Qi}} \cdot Q_i$$

$$\text{where} \quad Q_i = \bar{A}_{Qi} \cdot (\alpha_{Mi} \cdot M_i^{\rho_{Qi}} + \alpha_{Di} \cdot D_i^{\rho_{Qi}})^{1/\rho_{Qi}}$$

$$\sigma_{Qi} = 1/(1 - \rho_{Qi}), \quad \rho_{Qi} < 1$$

Demand for Chinese exports by foreign countries

$$(61) \quad E_i = \bar{E}_i^0 \cdot (\Pi_{Ei} / PE\$_i)^{\eta_{Ei}}$$

Supply for Chinese imports by foreign countries

$$(62) \quad M_i^S = \bar{M}_i^0 \cdot (PM\$_i / \Pi_{Mi})^{\eta_{Mi}}$$

Foreign capital inflow:

$$(63) \quad F = F\$ \cdot \overline{ER} \quad \text{or} \quad F = \overline{F\$} \cdot ER \quad \text{and} \quad ER = ER^e \text{ (equilibrium rate)}$$

Equilibrium conditions:

Domestic products markets:

$$(64) \quad D_i = D_i^S \quad \text{and} \quad PD_i = PD_i^e \quad (PD_i^e: \text{equilibrium price})$$

Exports markets:

$$(65) \quad E_i = E_i^S \quad \text{and} \quad PE\$_i = PE\$_i^e \quad (PE\$_i^e: \text{equilibrium price})$$

Imports markets:

$$(66) \quad M_i = M_i^S \quad \text{and} \quad PM\$_i = PM\$_i^e \quad (PM\$_i^e: \text{equilibrium price})$$

Foreign exchange markets:

$$(67) \quad F\$ = \sum PM\$_i \cdot M_i - \sum PE\$_i \cdot E_i \quad \text{and} \quad ER = \overline{ER} \quad (\text{exogenous})$$

$$\text{or} \quad \sum PM\$_i \cdot M_i - \sum PE\$_i \cdot E_i - \overline{F\$} = 0, \text{ and}$$

$$ER = ER^e \text{ (equilibrium rate)}$$

GDP identity:

$$(68) \quad E = \sum E_i$$

$$(69) \quad PE = \sum \left(PES_i / (1 + \overline{te}_i) \right) E_i / E$$

$$(70) \quad M = \sum M_i$$

$$(71) \quad PM = \sum \left(PM_i / (1 + \overline{tm}_i + \overline{tn}_i) \right) M_i / M$$

$$(72) \quad GDP^n = Y_p + Y_G \\ = PC_A \cdot C_A + PC_N \cdot C_N + PG \cdot G + PI \cdot I + PE \cdot E - PM \cdot M$$

$$= \sum \left(PX_i - \sum_{j=2,3,4,5,6} P_j \cdot \overline{a}_{ji} - \sum_{j=2,3,4,5,6} P_j \cdot a_{ji} \right) \cdot X_i^S \\ + \sum \overline{tm}_i \cdot PM\$_i \cdot M_i \cdot ER + \sum \overline{te}_i \cdot PE\$_i \cdot ER \cdot E_i$$

$$(73) \quad GDP = C_A + C_N + G + I + E - M$$

$$(74) \quad GDP_i^n = (PX_i - \sum_{j=2,3,4,5,6} P_j \cdot \overline{a}_{ji} - \sum_{j=2,3,4,5,6} P_j \cdot a_{ji}) \cdot X_i^S$$

$$(75) \quad GDP_i = \left(1 - \sum_{i=2,3,4,5,6} \overline{a}_{ji} - \sum_{i=2,3,4,5,6} a_{ji} \right) \cdot X_i^S$$

$$(76) \quad PGDP = GDP^n / GDP$$

Social welfare:

$$(77) \quad U = \left(\prod_{i=2,3,4,5,6} C_i^{\gamma_i} \right) \cdot C_E^{\gamma_E}$$

$$(78) \quad EV = C \cdot (U^* - U) / U \quad (U^* = U \text{ of alternative scenario})$$

Law of Walras:

$$(79) \quad W_{LU} \cdot (L_U - \bar{L}_U^S) + W_W \cdot (L_W - \bar{L}_W^S) + R \cdot (\sum K_i - \bar{K}^S) + \sum PD_i \cdot (D_i - D_i^S) \\ + ER \cdot \sum PE\$_i \cdot (E_i - E_i^S) + ER \cdot \sum PM\$_i \cdot (M_i - M_i^S) + (S + F - I^n) \\ + ER \cdot \left\{ \sum PM\$_i \cdot M_i - \sum PE\$_i \cdot E_i - \bar{F}\$ \right\} \equiv 0$$

Capital accumulation and allocation for the next period

$$(80) \quad K_{t+1}^S = K_t^S + I_t - \delta \cdot K_t^S$$

$$(81) \quad K_{i,t+1} = \frac{K_{i,t}}{K_i} \cdot \left(1 + \mu \cdot \frac{R_i - R}{R} \right) \cdot K_{t+1} \quad (0 \leq \mu \leq 1)$$

N.B. Law of Walras extended to include money*:

$$(79)' \quad W_U \cdot (L_U - \bar{L}_U^S) + W_W \cdot (L_W - \bar{L}_W^S) + R \cdot (\sum K_i - \bar{K}^S) + \sum PX_i \cdot (X_i - X_i^S) \\ + ER \cdot \sum PE\$_i \cdot (E_i - E_i^S) + ER \cdot \sum PM\$_i \cdot (M_i - M_i^S) \\ + (M^D - M^S) + ER \left(\sum PM\$_i \cdot M_i - \sum PE\$_i \cdot E_i - \bar{F}\$ \right) \equiv 0$$

where $S + F - I^n = \Delta M^D - \Delta M^S = M^D - M^S$
 $\Delta M^D = M_t^D - M_{t-1}^D, \Delta M^S = M_t^S - M_{t-1}^S, M_{t-1}^D \equiv M_{t-1}^S$
 $M^D / PGDP = \bar{M}_o \cdot GDP^\psi, M^S = \bar{M}^S$ (or $I^n = \bar{I}$ or $F = \bar{F}$)

* This formulation assumes that the balance between demand and supply for non-money financial assets such as loans, net foreign assets, etc., holds automatically by quantity adjustment, so that the balance equations for these assets are not equilibrium conditions but identities.

Appendix A2. CGE Model of the Chinese Economy: Notation

Price Variables:

ER = Exchange rate (yuan /dollar or C¥/US\$)

$PM_{\$i}$ = Import price of industry i in US\$

$PE_{\$i}$ = Export price of industry i in US\$

Π_i = World price in the export market of industry i in US\$

PM_i = Import price of industry i in C¥

PD_i = Product price of industry i for domestic market in C¥

PE_{S_i} = Export price of industry i in C¥

P_i = Composite price of domestic and imported goods of industry i in C¥.

PX_i = Composite price of domestic and export goods of industry i in C¥

PN_i = Net price of industry i including energy cost

P_{Ei} = Composite price of energy inputs in industry i .

P_{ECA} = Composite price of energy consumption in rural households

P_{ECN} = Composite price of energy consumption in urban households

P_{vi} = Composite price of primary factor inputs in industry i .

W_i = Composite wage of formal and non-formal employment in industry i .

W = Composite wage of formal and non-formal employment for all industries

W_{Ui} = Wage of non-formal employment in industry i

W_U = Wage of non-formal employment averaged for all industries

W_{wi} = Wage of formal employment in industry i

W_w = Wage of formal employment averaged for all industries

W_w^e = Equilibrium wage of formal employment

R_i = Rental price of capital in industry i

R = Rental price of capital averaged for all industries

PC_A = Deflator of rural consumption

PC_N = Deflator of urban consumption

PG = Deflator of government consumption

PI = Deflator of investment

PE = Deflator of exports of goods and services

PM = Deflator of imports of goods and services

$PGDP$ = GDP deflator

Quantity Variables:

X_i^S = Real domestic production of industry i

X_i = Total demand for production of industry i

D_i^S = Supply of production for domestic markets by industry i

E_i^S = Supply of production for export markets by industry i

Q_{Ei} = Composite energy input in industry i

V_i = Composite primary factor input in industry i

L_i = Composite labor input in industry i

L_{Ui} = Non-formal employment in industry i

L_{Wi} = Formal employment in industry i

L_{Wi}^* = Formal employment in industry i (in efficiency units)

\bar{L}_U^S = Total supply of non-formal labor

\bar{L}_W^S = Total supply of formal labor

L_W^* = Total supply of formal labor (in efficiency units)

K_i = Capital stocks in industry i

K_i^S = Supply of capital stocks for industry i

\bar{K}^S = Total supply of capital stocks

C_A = Real consumption by rural households

C_N = Real consumption by urban households

C_{EA} = Real consumption of composite energy by rural households

C_{EN} = Real consumption of composite energy by urban households

G = Real consumption by government

G_i = Government consumption demand for composite goods of industry i

I_i = Investment demand for composite goods of industry i

I = Real investment

Q_i = Total domestic demand for composite goods of industry i

D_i = Total domestic demand for production of industry i

M_i = Import demand of industry i

E_i = Export supply of industry i

M = Real imports of goods and services

E = Real exports of goods and services

GDP_i = Real GDP of industry i

GDP = Real GDP

EV = Equivalent variation of rural and urban households

U = Utility level of rural and urban households

Value Variables:

Y_{PA}, Y_{PN} = Nominal income of rural and urban households

Y_G = Nominal income of government

S = Gross national savings

I^n = Nominal investment

GDP_i^n = Nominal GDP of industry i

GDP^n = Nominal GDP

F = Net inflow of foreign capital (Current Balance of Payment)

$F\$$ = Net inflow of foreign capital (in US\$)

M^D = Demand for money (M_2)

\overline{M}^S = Supply of money (M_2)

Parameters:

\overline{M}_i^0 = Scale factor of import supply function for industry i

η_{Mi} = Price elasticity of import supply function for industry i

\overline{E}_i^0 = Scale factor of export demand function for industry i

η_{Ei} = Price elasticity of export demand function for industry i

\overline{A}_{Ti} = Scale factor of CET transformation function for industry i

$\alpha_{ESi}, \alpha_{DSi}$ = Share parameters of CET transformation function for industry i

σ_{Ti} = Elasticity of transformation in CET transformation function for industry i

$\rho_{Ti} = (\sigma_{Ti} - 1) / \sigma_{Ti}$

\overline{A}_{Xi} = Scale factor of CES production function for industry i

α_{Ei}, α_{Vi} = Share parameters of CES production function for industry i

σ_{Xi} = Elasticity of substitution between energy and primary factors for industry i

$\rho_{Xi} = (\sigma_{Xi} - 1) / \sigma_{Xi}$

\overline{A}_{Ei} = Scale factor of CES composite energy function for industry i

$\delta_{Ej(i=2..6)}$ = Share parameters of CES composite energy function for industry i

σ_{Ei} = Elasticity of substitution between various energy inputs for industry i

$\rho_{Ei} = (\sigma_{Ei} - 1) / \sigma_{Ei}$

\overline{A}_{Vi} = Scale factor for CES composite primary factor input function for industry i

α_{Li}, α_{Ki} = Share parameters of CES composite primary factor input for industry i

σ_{Vi} = Elasticity of substitution between labor and capital for industry i

$$\rho_{V_i} = (\sigma_{V_i} - 1) / \sigma_{V_i}$$

\bar{A}_{Li} = Scale factor of CES composite labor function for industry i

α_{Ui}, α_{Wi} = Share parameters of CES composite labor function for industry i

σ_{Li} = Elasticity of substitution between formal and non-formal labor for industry i

$$\rho_{L_i} = (\sigma_{L_i} - 1) / \sigma_{L_i}$$

\bar{A}_{Qi} = Scale factor of CES composite goods function for industry i

α_{Mi}, α_{Di} = Share parameters of CES composite goods function for industry i

$$\rho_{Q_i} = (\sigma_{Q_i} - 1) / \sigma_{Q_i}$$

$\bar{a}_{ij(j=2\dots6)}$ = Intermediate input coefficient from industry i to industry j

$\bar{a}_{ji(j=2,3,4,5,6)}$ = Intermediate input coefficient of energy i to industry j

\bar{a}_{Ei} = Intermediate input coefficient of composite energy to industry i

$\bar{\gamma}_{Ai}, \bar{\gamma}_{Ni}$ = Share parameters of Cobb-Douglas utility function, rural and urban

$\bar{\gamma}_{EA}, \bar{\gamma}_{EN}$ = Share parameters of energy of Cobb-Douglas utility function, rural and urban

$\bar{A}_{ECA}, \bar{A}_{ECN}$ = Scale factors of CES composite energy consumption, rural and urban

$\bar{\delta}_{ECAj(j=2\dots6)}, \bar{\delta}_{ECAj(j=2\dots6)}$ = Share parameters of CES energy consumption, rural and urban

\bar{M}_0 = Scale factor of real demand function for money

ν = GGP elasticity of real demand for money

δ = Rate of depreciation for capital assets

λ_{Wi} = Efficiency parameters for formal labor

μ = Adjustment speed of capital allocation between industries

Tax and Subsidy:

\bar{tm}_i = Import tariff rate of industry i

\bar{tn}_i = Non-tariff barriers of industry i (tariff-equivalent rate)

\bar{te}_i = Export subsidy rate of industry i

\bar{td}_i = Indirect tax rate of industry i

\bar{t}_L = Income tax rate

\bar{t}_K = Property tax rate

Shares and ratios:

ψ = Share of rural income in total private income

\bar{b}_{Gi} = Share of industry i 's production in total government real consumption

\bar{b}_{Ii} = Share of industry i 's production in total real invest

s_G = Saving rate of government

s_{PA}, s_{PN} = Saving rates of rural and urban households

Appendix A3. Impact of Trade Liberalization: Price of Real Production by Industry

Real Production	2005							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level 1997=1.0	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	2.18	-13.7	-15.3	-0.7	-30.2	-30.9	-10.6	-30.7
Electricity	0.97	-9.6	-6.5	0.4	-17.5	-17.2	-6.0	-14.0
Coal mining & processing	1.11	-9.6	-6.2	0.5	-17.2	-16.7	-6.0	-13.3
Coal products	1.03	-10.4	-6.9	0.5	-18.6	-18.0	-6.7	-14.4
Crude petroleum & natural gas	0.89	-8.2	-6.5	0.1	-15.7	-15.5	-3.1	-12.6
Petroleum & gas products	0.87	-8.4	-7.5	0.5	-16.9	-16.4	-4.4	-13.8
Metal ore mining	1.07	-8.4	-6.0	0.3	-15.3	-14.9	-4.7	-12.5
Non-ferrous mineral mining	1.11	-8.5	-6.1	0.4	-15.7	-15.4	-5.3	-12.9
Food & tobacco processing	1.61	-12.6	-13.5	-0.3	-27.3	-27.6	-10.7	-26.9
Textile goods	1.26	-12.3	-9.9	0.1	-23.0	-22.9	-9.1	-21.4
Wearing apparel & leather products	1.20	-11.2	-8.9	0.3	-20.9	-20.7	-9.3	-19.2
Sawmills & furniture	1.16	-10.2	-8.0	0.3	-19.2	-18.8	-7.9	-17.0
Paper, printing & toys	1.13	-10.4	-7.9	0.3	-19.3	-18.9	-8.0	-16.9
Chemicals	1.10	-10.4	-8.7	0.3	-20.1	-19.9	-7.7	-17.9
Nonmetal mineral products	1.04	-8.8	-6.3	0.3	-16.1	-15.8	-6.1	-13.3
Metals	1.04	-9.7	-7.1	0.4	-17.9	-17.5	-6.4	-14.7
Metal products	1.05	-9.2	-6.9	0.4	-17.0	-16.6	-6.4	-14.1
Machinery & equipment	1.03	-9.8	-7.4	0.4	-18.1	-17.7	-6.9	-15.1
Motor vehicles	1.03	-10.8	-7.3	0.4	-19.2	-18.7	-7.6	-15.9
Other transport machinery	1.04	-10.0	-7.8	0.5	-18.8	-18.2	-7.2	-15.5
Electric equipment & machinery	1.06	-10.0	-7.5	0.5	-18.6	-18.1	-7.3	-15.7
Electronic & telecom. Machinery	1.05	-12.2	-6.8	0.5	-19.7	-19.3	-7.9	-17.5
Precision machinery	1.05	-10.8	-6.4	0.5	-18.2	-17.7	-6.3	-15.3
Maintenance & repair of machinery	1.12	-8.1	-5.7	0.4	-14.8	-14.3	-5.3	-12.1
Other manufacturing products	1.15	-9.5	-7.6	0.2	-18.1	-18.0	-6.2	-16.1
Construction	1.13	-8.4	-5.8	0.4	-15.3	-14.9	-5.8	-12.4
Transport & warehousing	1.11	-9.5	-6.2	0.5	-17.2	-16.8	-5.6	-13.3
Passenger transport	1.10	-9.8	-6.7	0.5	-18.2	-17.7	-6.4	-14.1
Post & telecommunication	0.93	-10.3	-6.6	0.4	-18.5	-18.1	-7.1	-15.1
Wholesale & retail trade	1.20	-9.1	-6.3	0.3	-16.6	-16.3	-6.2	-13.6
Eating & drinking places	1.52	-11.0	-11.3	-0.2	-23.5	-23.7	-9.5	-22.6
Social services	1.14	-9.4	-6.4	0.4	-17.3	-16.8	-6.3	-14.2
Health, education & sciences	1.23	-12.5	-7.7	0.6	-22.0	-21.3	-8.5	-16.5
Finance & insurance	1.15	-9.5	-6.0	0.3	-17.1	-16.7	-5.8	-13.4
Public administration & others	1.22	-11.4	-6.6	0.7	-19.7	-18.9	-7.8	-14.3

Appendix A3. (Cont.) Impact of Trade Liberalization: Price of Real Production by Industry

Real Production	2010							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level 1997=1.0	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	3.51	-15.7	-30.7	-0.5	-48.7	-49.2	-34.4	-48.9
Electricity	0.96	-10.3	-12.1	0.4	-26.1	-25.5	-16.7	-22.6
Coal mining & processing	1.18	-10.5	-12.0	0.4	-26.0	-25.5	-16.7	-22.3
Coal products	1.05	-11.2	-12.8	0.5	-27.7	-27.2	-18.0	-23.7
Crude petroleum & natural gas	0.86	-9.7	-11.2	0.2	-23.8	-23.5	-13.9	-20.4
Petroleum & gas products	0.82	-9.6	-13.1	0.5	-25.6	-25.0	-15.6	-22.3
Metal ore mining	1.11	-9.3	-11.3	0.4	-23.3	-23.0	-14.4	-20.5
Non-ferrous mineral mining	1.19	-9.6	-12.4	0.3	-24.9	-24.5	-16.0	-22.2
Food & tobacco processing	2.31	-14.7	-28.5	-0.3	-45.8	-46.0	-33.1	-45.4
Textile goods	1.53	-14.1	-21.3	0.1	-37.4	-37.3	-26.0	-36.1
Wearing apparel & leather products	1.39	-13.2	-19.0	0.3	-34.2	-34.0	-24.5	-32.7
Sawmills & furniture	1.32	-11.9	-17.2	0.2	-31.7	-31.4	-22.2	-29.7
Paper, printing & toys	1.26	-11.9	-16.7	0.2	-31.2	-30.9	-21.7	-29.1
Chemicals	1.22	-12.0	-18.3	0.2	-32.9	-32.6	-22.5	-30.8
Nonmetal mineral products	1.07	-9.9	-12.6	0.4	-25.2	-24.9	-16.7	-22.5
Metals	1.06	-10.6	-13.3	0.4	-26.9	-26.4	-17.4	-23.8
Metal products	1.08	-10.2	-13.1	0.4	-26.0	-25.6	-17.1	-23.3
Machinery & equipment	1.05	-10.7	-13.5	0.4	-27.0	-26.5	-17.6	-24.1
Motor vehicles	1.05	-11.3	-13.9	0.5	-28.3	-27.7	-18.7	-25.3
Other transport machinery	1.07	-11.0	-14.4	0.5	-28.4	-27.7	-18.8	-25.2
Electric equipment & machinery	1.10	-11.1	-14.5	0.5	-28.4	-27.9	-19.0	-25.6
Electronic & telecom. machinery	1.08	-13.3	-13.1	0.6	-28.5	-27.8	-18.3	-26.0
Precision machinery	1.08	-11.9	-12.7	0.5	-27.3	-26.8	-17.4	-24.4
Maintenance & repair of machinery	1.20	-9.0	-10.8	0.2	-22.4	-22.1	-14.3	-19.9
Other manufacturing products	1.30	-11.2	-16.4	0.2	-30.1	-29.9	-20.0	-28.1
Construction	1.22	-9.4	-11.4	0.3	-23.6	-23.1	-15.5	-20.8
Transport & warehousing	1.17	-10.2	-11.5	0.3	-25.4	-25.0	-15.9	-21.7
Passenger transport	1.15	-10.3	-12.8	0.4	-27.3	-26.8	-17.9	-23.7
Post & telecommunication	0.91	-10.8	-12.6	0.3	-27.1	-26.7	-17.8	-23.9
Wholesale & retail trade	1.33	-10.1	-12.6	0.3	-25.9	-25.6	-17.2	-23.1
Eating & drinking places	2.05	-13.3	-24.8	-0.2	-40.7	-40.9	-29.7	-40.0
Social services	1.23	-10.4	-13.0	0.2	-26.8	-26.4	-17.7	-24.0
Health, education & sciences	1.39	-13.2	-14.8	0.5	-32.7	-32.0	-21.8	-27.9
Finance & insurance	1.22	-10.1	-11.5	0.3	-25.5	-25.0	-16.3	-22.1
Public administration & others	1.37	-11.9	-12.5	0.4	-29.0	-28.2	-19.2	-24.3

Appendix A4. Impact of Trade Liberalization: Formal Employment by Industry

Real Production	2005							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level ('0000)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	379	5.0	-0.5	-1.1	5.5	4.2	4.0	-1.3
Coal mining & processing	544	4.0	0.2	-0.7	5.3	4.4	4.2	0.4
Coal products	72	4.2	-1.4	-1.4	4.2	2.8	4.2	-2.8
Crude petroleum & natural gas	179	12.3	-1.1	-1.7	14.5	12.3	14.5	3.4
Petroleum & gas products	77	5.2	-1.3	0.0	5.2	3.9	5.2	-1.3
Metal ore mining	100	7.0	1.0	-1.0	11.0	9.0	14.0	2.0
Non-ferrous mineral mining	187	4.8	2.1	-0.5	9.1	8.0	7.0	3.2
Food & tobacco processing	259	6.2	1.5	-0.4	6.6	6.2	-1.9	0.8
Textile goods	406	5.7	6.9	-2.0	16.7	13.5	14.8	7.1
Wearing apparel & leather products	221	10.4	4.1	-2.3	17.2	13.1	13.6	7.2
Sawmills & furniture	69	4.3	2.9	0.0	8.7	7.2	7.2	2.9
Paper, printing & toys	219	2.7	1.8	-0.5	5.9	5.0	5.9	1.8
Chemicals	678	6.2	0.9	-1.2	9.4	7.7	9.1	2.1
Nonmetal mineral products	377	3.7	1.1	-0.5	6.1	5.0	4.2	1.3
Metals	668	4.8	-2.5	-1.0	4.0	2.4	5.7	-3.4
Metal products	160	4.4	1.3	-1.3	8.1	6.3	7.5	1.3
Machinery & equipment	717	3.6	-3.2	-1.1	1.8	0.3	3.1	-5.2
Motor vehicles	203	0.0	1.0	-0.5	2.0	1.0	1.5	-3.0
Other transport machinery	235	7.7	-0.9	-1.3	8.5	6.8	7.7	0.4
Electric equipment & machinery	263	5.7	1.5	-1.5	9.1	7.2	9.5	1.1
Electronic & telecom. machinery	220	8.2	5.9	-3.6	19.1	13.6	20.9	5.9
Precision machinery	87	12.6	10.3	-1.1	27.6	26.4	32.2	17.2
Maintenance & repair of machinery	39	2.6	0.0	0.0	5.1	2.6	2.6	2.6
Other manufacturing products	62	1.6	-1.6	-1.6	1.6	0.0	6.5	-3.2
Construction	1624	4.4	1.7	-0.4	7.6	7.0	3.1	3.9
Transport & warehousing	923	4.3	0.4	-0.8	5.9	4.7	4.4	0.0
Passenger transport	260	0.8	-1.2	0.0	-0.8	-0.8	-0.4	-2.3
Post & telecommunication	197	4.1	-0.5	-1.0	4.1	3.0	1.5	-2.0
Wholesale & retail trade	1706	4.4	0.4	-0.8	5.9	4.8	4.0	0.2
Eating & drinking places	82	4.9	2.4	0.0	8.5	7.3	4.9	4.9
Social services	806	1.7	-0.9	-0.2	0.6	0.2	1.7	-2.0
Health, education & sciences	3344	-8.0	-1.5	1.5	-12.1	-9.9	-10.1	-2.4
Finance & insurance	556	3.8	-1.1	-0.7	3.1	2.0	2.5	-3.1
Public administration & others	1841	-16.8	-0.9	3.2	-22.5	-17.8	-17.9	0.3

Appendix A4. (Cont.) Impact of Trade Liberalization: Formal Employment by Industry

Real Production	2010						
	S0	S1	S2	S3	S4	S5	S7
	Level ('0000)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	385	6.2	-1.0	-0.8	8.8	7.3	6.8
Coal mining & processing	571	4.9	0.7	-0.7	9.1	8.1	7.7
Coal products	82	6.1	-2.4	-1.2	6.1	4.9	6.1
Crude petroleum & natural gas	169	13.0	0.0	-1.2	23.7	20.7	23.1
Petroleum & gas products	81	4.9	-2.5	-1.2	8.6	7.4	7.4
Metal ore mining	118	7.6	3.4	-0.8	20.3	17.8	23.7
Non-ferrous mineral mining	220	5.5	4.1	-0.5	15.0	13.6	13.6
Food & tobacco processing	192	6.3	3.1	-0.5	7.3	6.8	-1.6
Textile goods	372	8.3	20.7	-1.3	44.4	40.6	41.7
Wearing apparel & leather products	233	11.2	10.3	-1.7	31.3	26.6	27.5
Sawmills & furniture	75	5.3	4.0	-1.3	13.3	12.0	12.0
Paper, printing & toys	231	3.5	4.8	-0.4	12.6	11.7	13.0
Chemicals	669	7.8	5.2	-0.9	20.8	18.5	20.5
Nonmetal mineral products	423	3.8	1.4	-0.5	8.7	7.6	7.6
Metals	758	6.6	-2.4	-1.1	10.3	8.3	11.6
Metal products	179	5.6	3.4	-0.6	14.0	11.7	14.0
Machinery & equipment	785	5.1	-3.3	-1.0	7.5	5.6	8.8
Motor vehicles	216	2.3	2.3	-0.5	8.8	7.4	7.9
Other transport machinery	270	8.1	-1.5	-1.1	11.1	9.3	10.0
Electric equipment & machinery	293	6.5	3.1	-1.0	15.0	12.6	15.4
Electronic & telecom. machinery	244	9.4	13.1	-2.9	35.7	29.9	38.9
Precision machinery	97	13.4	19.6	-1.0	48.5	46.4	53.6
Maintenance & repair of machinery	47	2.1	0.0	0.0	2.1	2.1	2.1
Other manufacturing products	63	3.2	0.0	0.0	6.3	4.8	11.1
Construction	2070	4.3	2.7	-0.4	10.8	10.0	7.7
Transport & warehousing	1070	5.7	1.2	-0.8	11.1	9.5	9.2
Passenger transport	302	2.0	-4.0	0.0	-4.6	-4.6	-4.6
Post & telecommunication	198	6.6	-1.0	-0.5	7.6	6.6	4.0
Wholesale & retail trade	2053	5.1	0.7	-0.7	8.9	7.5	7.1
Eating & drinking places	89	5.6	6.7	0.0	14.6	13.5	11.2
Social services	924	2.3	-2.8	-0.3	-1.6	-2.1	-0.9
Health, education & sciences	4162	-8.0	-4.0	1.1	-19.4	-17.0	-18.0
Finance & insurance	652	4.8	-3.1	-0.8	3.4	2.0	2.3
Public administration & others	2316	-18.7	-2.5	2.5	-34.4	-29.1	-29.7

Appendix A5. Impact of Trade Liberalization: Non-Formal Employment by Industry

Real Production	2005							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level ('0000)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	33407	3.1	2.0	0.2	5.6	5.9	-0.5	4.9
Electricity	175	-2.9	-4.0	-0.6	-7.4	-8.0	0.0	-8.6
Coal mining & processing	470	-3.8	-3.4	-0.2	-7.9	-8.1	0.0	-7.2
Coal products	10	0.0	0.0	0.0	-10.0	-10.0	0.0	-10.0
Crude petroleum & natural gas	54	3.7	-5.6	-1.9	0.0	-1.9	9.3	-5.6
Petroleum & gas products	63	-3.2	-4.8	0.0	-7.9	-7.9	0.0	-7.9
Metal ore mining	288	-1.7	-3.1	-1.0	-3.8	-4.9	9.0	-6.9
Non-ferrous mineral mining	548	-2.7	-1.6	-0.2	-4.7	-5.1	2.7	-4.6
Food & tobacco processing	541	-1.8	-2.0	0.2	-6.7	-6.3	-5.9	-6.8
Textile goods	883	-2.3	3.1	-1.5	2.0	-0.1	10.1	-1.4
Wearing apparel & leather products	1486	1.8	0.3	-1.9	2.4	-0.4	8.8	-1.2
Sawmills & furniture	416	-3.1	-1.4	-0.2	-5.0	-5.3	3.1	-4.8
Paper, printing & toys	844	-5.3	-1.9	-0.1	-7.8	-7.9	1.3	-6.3
Chemicals	1260	-1.7	-2.6	-0.7	-4.3	-5.2	4.8	-5.8
Nonmetal mineral products	1807	-4.1	-2.7	-0.2	-7.4	-7.5	-0.1	-6.5
Metals	461	-3.0	-6.1	-0.7	-9.1	-10.0	1.3	-10.8
Metal products	786	-3.2	-2.2	-0.5	-5.5	-6.2	3.2	-6.1
Machinery & equipment	1016	-4.0	-6.6	-0.6	-10.9	-11.7	-1.0	-12.5
Motor vehicles	164	-7.9	-3.0	-0.6	-11.6	-11.6	-3.0	-11.0
Other transport machinery	193	-0.5	-4.7	-1.0	-5.2	-6.2	3.1	-7.3
Electric equipment & machinery	583	-2.4	-2.1	-0.9	-4.6	-5.8	5.0	-6.7
Electronic & telecom. machinery	542	0.2	2.4	-3.1	4.1	0.0	16.4	-2.0
Precision machinery	92	4.3	6.5	-1.1	12.0	10.9	27.2	8.7
Maintenance & repair of machinery	275	-5.5	-3.3	0.4	-9.8	-9.5	-1.8	-6.5
Other manufacturing products	431	-5.6	-4.2	-0.5	-10.2	-10.9	3.0	-10.4
Construction	5782	-3.4	-2.0	0.1	-6.0	-5.8	-1.1	-4.2
Transport & warehousing	573	-3.5	-3.1	-0.3	-7.5	-7.9	0.2	-7.9
Passenger transport	162	-6.8	-4.9	0.6	-13.6	-13.0	-4.3	-9.9
Post & telecommunication	35	-2.9	-2.9	0.0	-8.6	-8.6	-2.9	-8.6
Wholesale & retail trade	3176	-3.4	-3.1	-0.3	-7.4	-7.8	-0.1	-7.6
Eating & drinking places	604	-3.3	-1.2	0.2	-5.3	-5.1	0.8	-3.6
Social services	1630	-5.9	-4.4	0.2	-12.1	-11.8	-2.5	-9.6
Health, education & sciences	146	-15.1	-4.8	2.1	-23.3	-20.5	-13.7	-9.6
Finance & insurance	458	-4.1	-4.6	-0.2	-10.0	-10.3	-1.7	-10.5
Public administration & others	847	-23.0	-4.5	3.7	-32.2	-27.6	-21.1	-7.4

Appendix A5. (Cont.) Impact of Trade Liberalization: Non-Formal Employment by Industry

Real Production	2010							
	S0 Level (‘0000)	S1 Change (%)	S2 Change (%)	S3 Change (%)	S4 Change (%)	S5 Change (%)	S6 Change (%)	S7 Change (%)
Agriculture	32703	3.9	3.8	0.1	9.5	9.7	2.7	8.5
Electricity	178	-2.8	-7.3	-0.6	-11.8	-12.4	-5.6	-12.9
Coal mining & processing	493	-3.7	-5.7	-0.2	-11.4	-11.6	-4.5	-11.0
Coal products	12	-8.3	-8.3	0.0	-16.7	-16.7	-8.3	-16.7
Crude petroleum & natural gas	51	3.9	-5.9	-2.0	0.0	-2.0	9.8	-3.9
Petroleum & gas products	66	-3.0	-7.6	0.0	-12.1	-12.1	-4.5	-12.1
Metal ore mining	338	-0.9	-3.6	-0.6	-3.0	-3.8	9.8	-5.6
Non-ferrous mineral mining	645	-3.1	-2.5	-0.2	-6.7	-7.0	0.6	-6.4
Food & tobacco processing	401	-2.2	-3.5	0.2	-13.0	-12.7	-13.0	-13.0
Textile goods	808	-0.5	13.0	-0.9	17.2	15.1	25.5	14.1
Wearing apparel & leather products	1566	2.0	3.1	-1.3	6.3	3.6	12.8	3.1
Sawmills & furniture	449	-3.6	-2.2	0.0	-7.8	-8.0	0.2	-7.1
Paper, printing & toys	888	-5.1	-1.9	0.0	-8.8	-8.8	0.1	-7.2
Chemicals	1243	-1.1	-1.6	-0.5	-2.0	-3.0	6.8	-3.4
Nonmetal mineral products	2025	-4.6	-5.1	-0.1	-11.8	-11.9	-4.7	-10.7
Metals	523	-2.3	-8.8	-0.6	-10.7	-11.5	-1.1	-12.6
Metal products	883	-3.5	-3.6	-0.5	-7.9	-8.6	0.7	-8.3
Machinery & equipment	1112	-3.5	-9.5	-0.5	-12.8	-13.6	-3.5	-14.2
Motor vehicles	174	-6.3	-4.6	-0.6	-12.1	-12.1	-4.6	-12.1
Other transport machinery	221	-0.5	-7.7	-0.5	-9.5	-10.4	-2.3	-11.3
Electric equipment & machinery	649	-2.3	-3.5	-0.8	-6.6	-7.7	2.3	-8.3
Electronic & telecom. machinery	601	0.5	5.7	-2.3	10.0	6.3	23.3	4.5
Precision machinery	103	3.9	11.7	-1.0	20.4	19.4	35.0	16.5
Maintenance & repair of machinery	326	-6.1	-6.1	0.3	-15.6	-15.3	-8.0	-12.6
Other manufacturing products	443	-6.1	-6.5	-0.5	-14.4	-14.9	-2.5	-14.2
Construction	7364	-4.3	-3.9	0.1	-10.2	-10.1	-4.6	-8.4
Transport & warehousing	663	-2.9	-5.3	-0.3	-9.8	-10.3	-3.2	-10.3
Passenger transport	188	-6.4	-10.1	0.5	-22.9	-21.8	-15.4	-19.7
Post & telecommunication	35	0.0	-5.7	0.0	-11.4	-11.4	-5.7	-14.3
Wholesale & retail trade	3820	-3.6	-5.8	-0.2	-11.7	-12.1	-5.1	-11.8
Eating & drinking places	659	-3.6	-1.2	0.2	-7.6	-7.4	-1.5	-5.6
Social services	1867	-6.2	-9.1	0.1	-20.2	-19.9	-12.2	-17.9
Health, education & sciences	182	-15.9	-10.4	1.6	-34.6	-32.4	-27.5	-23.1
Finance & insurance	536	-3.7	-9.1	-0.2	-16.0	-16.4	-9.3	-16.8
Public administration & others	1064	-25.3	-8.7	3.1	-46.7	-42.0	-37.7	-23.5

Appendix A6. Impact of Trade Liberalization: Real Import by Industry

Real Production	2005							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level Billion ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	1893	-3.5	37.5	-1.0	34.1	32.4	44.4	31.8
Electricity	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coal mining & processing	14	-14.3	-14.3	0.0	-28.6	-28.6	-35.7	-21.4
Coal products	2	0.0	0.0	0.0	-50.0	-50.0	-50.0	0.0
Crude petroleum & natural gas	594	-13.6	3.4	0.7	-13.5	-12.8	-18.9	-7.7
Petroleum & gas products	491	-4.3	16.1	0.8	9.4	10.2	0.8	17.5
Metal ore mining	410	-3.7	-11.0	0.0	-16.1	-16.3	-21.7	-14.1
Non-ferrous mineral mining	209	-5.3	-11.0	0.5	-18.2	-17.7	-26.3	-13.9
Food & tobacco processing	1595	31.1	49.8	-0.6	132.5	131.0	135.5	133.6
Textile goods	2179	10.2	-9.7	0.2	-3.4	-3.2	-4.6	-1.1
Wearing apparel & leather products	827	10.6	6.0	2.3	17.2	20.6	9.1	23.5
Sawmills & furniture	264	1.9	-13.6	0.4	-15.5	-14.8	-21.2	-12.1
Paper, printing & toys	887	2.0	-3.9	0.9	-5.0	-3.8	-10.4	1.2
Chemicals	3967	-3.7	2.8	0.4	-2.9	-2.4	-6.6	0.5
Nonmetal mineral products	198	14.1	-14.1	0.5	-6.1	-4.5	-18.2	1.5
Metals	1566	-4.4	14.8	0.6	8.1	9.0	0.2	15.2
Metal products	610	1.0	-4.8	1.5	-7.2	-5.6	-17.5	0.3
Machinery & equipment	3223	1.2	12.1	1.1	12.8	14.4	3.8	20.8
Motor vehicles	272	36.0	-4.0	1.1	28.7	30.5	18.0	40.1
Other transport machinery	628	-12.7	5.4	1.4	-11.8	-10.0	-19.1	-4.8
Electric equipment & machinery	1008	0.3	-6.6	1.4	-9.9	-8.3	-17.7	-3.6
Electronic & telecom. machinery	3296	2.9	-3.9	1.0	-2.7	-1.6	-4.5	-0.2
Precision machinery	627	-6.1	-9.7	0.3	-18.2	-17.7	-21.2	-14.8
Maintenance & repair of machinery	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other manufacturing products	257	12.8	-13.6	-0.4	-5.8	-6.2	-10.9	-3.9
Construction	110	-12.7	-9.1	0.9	-23.6	-22.7	-31.8	-19.1
Transport & warehousing	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Passenger transport	185	-18.4	-12.4	1.1	-32.4	-31.4	-36.2	-25.4
Post & telecommunication	41	-17.1	-12.2	0.0	-31.7	-31.7	-36.6	-26.8
Wholesale & retail trade	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eating & drinking places	135	-17.0	-17.0	0.0	-35.6	-35.6	-36.3	-34.1
Social services	818	-16.5	-11.7	0.7	-29.8	-29.1	-34.6	-24.6
Health, education & sciences	66	-25.8	-13.6	1.5	-39.4	-37.9	-40.9	-27.3
Finance & insurance	94	-14.9	-10.6	0.0	-27.7	-27.7	-33.0	-23.4
Public administration & others	44	-29.5	-11.4	2.3	-43.2	-40.9	-43.2	-22.7

Appendix A6. (Cont.) Impact of Trade Liberalization: Real Import by Industry

Real Production	2010							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level Billion ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	4869	-6.8	62.4	-0.8	47.8	46.0	58.4	45.8
Electricity	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coal mining & processing	20	-15.0	-25.0	0.0	-45.0	-45.0	-50.0	-40.0
Coal products	3	-33.3	-33.3	0.0	-66.7	-66.7	-66.7	-33.3
Crude petroleum & natural gas	681	-16.0	4.8	1.0	-20.1	-19.1	-27.5	-13.4
Petroleum & gas products	565	-6.7	27.1	0.9	10.3	11.9	-1.1	20.2
Metal ore mining	621	-4.7	-19.3	0.0	-27.5	-27.5	-33.2	-25.4
Non-ferrous mineral mining	332	-6.9	-20.8	0.3	-32.8	-32.5	-40.1	-28.9
Food & tobacco processing	3733	24.3	80.2	-0.5	209.4	207.7	212.0	211.0
Textile goods	4123	6.7	-24.3	0.0	-27.9	-27.7	-28.8	-26.1
Wearing apparel & leather products	1522	6.0	-3.0	1.8	-5.6	-2.3	-13.0	0.3
Sawmills & furniture	449	-0.9	-28.1	0.4	-37.4	-36.7	-41.9	-34.5
Paper, printing & toys	1411	-0.9	-13.5	0.7	-23.1	-22.0	-27.7	-17.6
Chemicals	6152	-5.7	-1.7	0.3	-13.9	-13.4	-17.4	-10.8
Nonmetal mineral products	295	11.2	-26.8	0.7	-27.8	-26.8	-38.0	-21.7
Metals	2286	-5.9	22.7	0.7	8.5	9.7	-1.1	16.2
Metal products	892	-1.5	-13.1	1.5	-23.5	-21.7	-33.2	-16.5
Machinery & equipment	4635	-0.5	18.0	1.1	12.2	14.3	1.7	21.1
Motor vehicles	392	33.7	-11.7	1.0	10.2	12.0	-1.0	20.7
Other transport machinery	937	-14.7	3.4	1.5	-22.7	-20.7	-30.6	-15.8
Electric equipment & machinery	1531	-2.1	-17.0	1.3	-28.5	-26.9	-35.9	-22.8
Electronic & telecom. machinery	4989	2.1	-10.1	1.0	-13.7	-12.3	-16.0	-10.8
Precision machinery	904	-7.5	-19.7	0.3	-33.8	-33.3	-37.7	-30.3
Maintenance & repair of machinery	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other manufacturing products	439	10.3	-26.7	0.0	-27.1	-27.3	-31.2	-25.3
Construction	177	-14.7	-17.5	0.6	-35.0	-34.5	-42.9	-31.1
Transport & warehousing	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Passenger transport	287	-18.8	-23.7	1.0	-47.4	-46.3	-51.2	-41.8
Post & telecommunication	57	-19.3	-22.8	0.0	-43.9	-43.9	-49.1	-40.4
Wholesale & retail trade	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eating & drinking places	283	-20.1	-35.7	-0.4	-56.5	-56.5	-57.2	-55.5
Social services	1311	-17.8	-23.0	0.6	-44.5	-43.9	-49.0	-40.4
Health, education & sciences	108	-26.9	-25.9	1.9	-56.5	-54.6	-57.4	-46.3
Finance & insurance	145	-15.9	-20.7	0.0	-40.7	-40.0	-45.5	-37.2
Public administration & others	70	-32.9	-21.4	2.9	-60.0	-57.1	-61.4	-42.9

Appendix A7. Impact of Trade Liberalization: Real Export by Industry

Real Production	2005							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level Billion ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	468	3.8	2.8	-0.6	7.5	6.8	1.1	5.8
Electricity	66	1.5	0.0	0.0	1.5	0.0	3.0	0.0
Coal mining & processing	106	0.9	-0.9	-0.9	0.9	0.0	2.8	-0.9
Coal products	107	1.9	-0.9	-0.9	1.9	0.9	4.7	-1.9
Crude petroleum & natural gas	428	4.7	-1.2	-0.7	4.4	3.3	7.7	0.7
Petroleum & gas products	223	0.9	-0.4	-0.4	0.4	0.4	2.7	-0.9
Metal ore mining	19	5.3	0.0	0.0	5.3	5.3	10.5	0.0
Non-ferrous mineral mining	138	1.4	0.7	-0.7	2.9	2.2	5.1	0.7
Food & tobacco processing	929	2.7	1.7	0.1	3.7	3.8	-0.9	2.4
Textile goods	2914	2.0	4.4	-1.3	8.1	6.3	9.3	4.0
Wearing apparel & leather products	3974	4.7	2.3	-1.8	7.9	5.3	9.2	3.4
Sawmills & furniture	562	1.2	1.2	-0.2	2.7	2.3	5.2	1.2
Paper, printing & toys	1222	-0.5	0.9	-0.2	0.6	0.3	3.9	0.2
Chemicals	2746	2.4	0.7	-0.7	3.9	2.9	6.0	1.2
Nonmetal mineral products	600	0.7	0.5	-0.5	1.2	0.5	2.5	0.0
Metals	998	1.8	-2.0	-0.8	0.6	-0.4	4.7	-3.0
Metal products	1266	1.0	0.6	-0.6	2.1	1.3	5.0	-0.2
Machinery & equipment	970	0.7	-2.4	-0.8	-1.3	-2.5	2.0	-4.4
Motor vehicles	121	-1.7	0.0	-0.8	-1.7	-1.7	0.8	-2.5
Other transport machinery	514	3.5	-0.8	-1.0	3.5	2.3	5.6	-0.2
Electric equipment & machinery	1800	1.9	1.0	-0.9	3.5	2.2	6.4	0.1
Electronic & telecom. machinery	3665	4.0	4.0	-2.4	9.6	6.4	13.9	3.4
Precision machinery	826	6.7	6.7	-0.6	15.7	15.0	22.2	11.5
Maintenance & repair of machinery	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other manufacturing products	720	0.8	0.4	-0.4	1.5	1.3	4.4	-0.4
Construction	45	0.0	0.0	0.0	2.2	2.2	2.2	2.2
Transport & warehousing	510	1.2	0.2	-0.2	1.6	1.2	3.5	-0.2
Passenger transport	308	-1.0	-0.6	0.0	-2.3	-1.9	0.6	-1.3
Post & telecommunication	212	-0.5	-0.5	0.0	-0.9	-0.9	1.4	-0.9
Wholesale & retail trade	1984	1.1	-0.2	-0.3	1.0	0.6	3.2	-0.9
Eating & drinking places	171	1.2	1.8	0.0	2.9	2.9	3.5	2.9
Social services	1299	-0.5	-0.6	0.1	-1.6	-1.5	1.6	-1.0
Health, education & sciences	77	-6.5	0.0	1.3	-9.1	-6.5	-5.2	0.0
Finance & insurance	30	0.0	0.0	0.0	0.0	0.0	3.3	-3.3
Public administration & others	8	-12.5	0.0	0.0	-25.0	-12.5	-12.5	0.0

Appendix A7. (Cont.) Impact of Trade Liberalization: Real Export by Industry

Real Production	2010							
	S0	S1	S2	S3	S4	S5	S6	S7
	Level Billion ¥	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)	Change (%)
Agriculture	505	4.8	6.1	-0.8	13.5	12.7	6.1	11.5
Electricity	90	2.2	-1.1	0.0	1.1	1.1	3.3	-1.1
Coal mining & processing	134	1.5	0.0	-0.7	2.2	1.5	4.5	0.0
Coal products	149	2.7	-2.0	-0.7	2.7	1.3	5.4	-1.3
Crude petroleum & natural gas	573	5.6	-1.6	-0.9	7.2	5.9	11.7	3.0
Petroleum & gas products	318	1.6	-0.6	-0.3	1.9	1.3	4.4	0.0
Metal ore mining	29	3.4	0.0	0.0	10.3	6.9	13.8	3.4
Non-ferrous mineral mining	201	1.5	2.0	-0.5	5.0	4.5	7.5	3.5
Food & tobacco processing	1020	3.4	4.0	0.2	5.1	5.5	-0.7	3.7
Textile goods	3833	4.1	13.9	-1.1	24.6	22.3	25.2	19.5
Wearing apparel & leather products	5605	6.4	7.0	-1.5	17.0	13.8	17.5	11.6
Sawmills & furniture	825	1.8	3.0	-0.2	5.7	5.2	7.9	4.1
Paper, printing & toys	1744	0.2	3.2	-0.2	4.0	3.7	7.4	3.5
Chemicals	3859	3.7	3.7	-0.7	10.4	9.2	12.7	7.2
Nonmetal mineral products	918	0.9	0.8	-0.4	2.0	1.3	3.4	0.7
Metals	1528	2.6	-2.4	-0.8	2.9	1.7	7.5	-1.0
Metal products	1924	1.6	1.6	-0.7	4.6	3.6	7.6	2.0
Machinery & equipment	1483	1.3	-3.1	-0.9	0.0	-1.2	3.8	-3.4
Motor vehicles	182	-1.6	1.1	-0.5	0.5	0.0	2.7	-1.1
Other transport machinery	808	4.0	-1.5	-1.0	3.8	2.6	6.1	0.0
Electric equipment & machinery	2769	2.6	2.1	-1.0	6.4	4.9	9.5	2.6
Electronic & telecom. machinery	5750	5.5	8.8	-2.4	19.8	15.9	24.9	12.2
Precision machinery	1273	8.2	13.7	-0.5	28.9	27.9	36.7	23.9
Maintenance & repair of machinery	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other manufacturing products	1022	1.6	1.7	-0.3	4.5	3.9	7.3	2.1
Construction	66	0.0	1.5	0.0	1.5	1.5	3.0	1.5
Transport & warehousing	714	1.4	0.3	-0.3	2.7	2.2	4.9	0.8
Passenger transport	437	-1.8	-3.0	0.2	-7.3	-6.9	-4.1	-5.7
Post & telecommunication	312	-0.3	-1.6	0.0	-2.9	-2.9	-0.3	-2.9
Wholesale & retail trade	2746	1.4	-0.3	-0.3	1.3	0.8	3.4	-0.7
Eating & drinking places	217	1.8	4.6	0.5	6.9	7.4	7.4	6.9
Social services	1828	-0.7	-1.9	0.1	-4.5	-4.3	-1.4	-3.8
Health, education & sciences	106	-8.5	-2.8	0.9	-17.0	-15.1	-14.2	-7.5
Finance & insurance	43	0.0	-4.7	-2.3	-2.3	-4.7	0.0	-4.7
Public administration & others	11	-18.2	0.0	0.0	-36.4	-27.3	-27.3	-9.1

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