Chapter 8

Analysis and Forecasts for U.S.-China Trade to 2022

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Executive Summary

Since China's reform and opening up, its economy has experienced 30 years of rapid growth. During the 34-year period from 1978 to 2012, the average annual gross domestic product (GDP) growth rate was 9.8% – much higher than other major world economies – and China's economy in aggregate now ranks second in the world, next to the U.S. Along with fast economic growth, China's foreign trade has also experienced rapid development: the total import and export of goods has increased from US$20.64bn in 1978 to US$3,866.8bn in 2012, at an annual average growth rate of 16.6% – much higher than the economic growth rate over the same period. The rapid growth of China's foreign trade has provided a significant boost to economic growth. With China as the largest developing country in the world and the U.S. as the largest developed country, U.S.-China bilateral trade has experienced rapid development. According to Chinese Customs statistics, in 2012 total U.S.-China trade reached US$484.68bn, of which US$351.79bn was China's exports to the U.S.; and China's imports from the U.S. was US$132.89bn. In the period 1978 to 2012, the average growth rate of China's total imports and exports to the U.S., imports from the U.S. and exports to the U.S. were 19.97%, 23.47% and 16.58% respectively. As such, China and the U.S. have become each other's most important trading partners[1, 2].

In the next ten years, from 2012 to 2022, the question will be whether China's rapid economic growth will continue as it has over the past three decades, or will the growth rate drop substantially? Will China's foreign trade and U.S.-China trade continue to see growth rates decelerating as seen in recent years? This article will consider the favorable and adverse factors affecting China's economic growth, foreign trade and U.S.-China trade from 2012 to 2022, in order to analyze the operating environment of the Chinese economy and foreign trade in the next decade, and make a quantitative forecast for the major economic and trade indicators. The research results show that for the period 2012 to 2022, China's economic growth will experience a slowdown, but will continue to maintain a steady and comparatively rapid growth rate, with the average annual GDP growth rate of about 8%; there will be a very significant decline in the growth rate of China's foreign trade and trade with the U.S. in the 2002 to 2012 period, with the average annual export growth rate of around 10%, and average annual growth rate for exports of goods to the U.S. of around 7%.

1 Unless otherwise specified, all references to China in this paper means Mainland China.
2 This data is soured from the General Administration of Customs of the People's Republic of China. http://www.customs.gov.cn/1

Analysis and Forecasts for U.S.-China Trade to 2022

Forecast for China's Economic Growth, 2012-2022

Since China's economic reform and opening up, the country has experienced rapid economic growth. In the 34-year period from 1978 to 2012, the average annual GDP growth rate was 9.8%, making China one of the fastest growing economies in the world. According to our forecast, in the next 10 years, i.e. in the period 2012-2022, there will be a substantial slowdown in the economic growth rate. The main reasons for the declining growth rate are as follows:

First of all, the increase in the size of the economy is likely to result in a slowdown in the growth rate. In 2012, China's GDP already reached RMB51.93 trillion (US$8.26 trillion), ranking second in the world. On the basis of such a large aggregate economic output, it will be very difficult to maintain the rapid growth of the past 10 or 30 years.

Secondly, with the slowdown in the growth rate and the aging of China's population, the demographic dividend will be gradually reduced. Surplus labor in the rural areas has reduced as compared with the past and the labor costs will rise significantly. The advantages of cheap labor that underpinned China's rapid economic growth over the past 10 or 30 years will gradually diminish.

Thirdly, changes in the economic structure aimed at the elimination of high-energy consumption and high-polluting industries, and the easing of social problems – such as the extremely wide income gap between the urban and rural population – will reduce the rate of economic growth.

Finally, from the perspective of the external environment, for the period 2012 to 2022, the world's major economies such as the E.U. and the U.S. will experience slow growth due to the impact of the debt crisis, financial crisis and fiscal austerity. This will have a knock-on effect on the growth in demand for Chinese exports. In the next 10 years, the U.S. and the E.U. will demand a further appreciation of the renminbi (RMB) and trade protectionism is likely to rise. These will have a serious impact on China's export growth and China's economy.

We forecast that, in the next 10 years, China's economy will maintain steady and fairly rapid growth. The main arguments are as follows:

Firstly, China's current level of economic development is still low. Although China's aggregate economic output has reached or exceeded the level of developed countries, in 2012, China's per capita GDP was only US$6,076, only one eighth of the per capita GDP in the U.S. (US$49,922), half of that in Russia (US$14,247) and one quarter of that in Greece (US$22,055)[3]. China's per capita exports and per capita imports are both very low, so there is a lot of potential for economic development and foreign trade development.

Secondly, urbanization will become one of the main driving forces of China's economic growth in the next two decades. According to the China National Bureau of Statistics, China's urbanization rate increased on average by 1.36% each year, rising from 37.66% in 2001 to 52.6% in 2012. With about half of the population living in rural areas, there is a great potential for urbanization. In the world's developed economies, the urban population usually accounts for over 75% of total population. It is expected that in the next 10 years, the urbanization rate will increase by about 1% every year, with

3 World Economic Outlook Database, International Monetary Fund, April 2013.

about 15 million people migrating from rural areas to cities or towns. This will generate a huge demand for urban infrastructure and housing construction, which will, in turn, boost growth in the Chinese economy[4].

Thirdly, in various regions of China, especially in the less economically developed areas, there exists a strong desire for development, as well as the drive to change their economic backwardness. At the time when the 12th Five-Year Plan was being formulated, there were 19 provinces – or cities or districts – in China that proposed to double their local GDP or per-capita GDP in five years; for example, Liaoning province stated in its provincial 12th Five-Year Plan that it aimed at an average annual GDP growth of 11% during the 12th Five-Year Plan period, as well as doubling the province's per capita GDP by 2016. Fujian province has proposed that, on the basis of optimizing the industrial structure, improving efficiency, reducing consumption and increasing environmental protection, it will achieve a local average annual GDP growth of more than 10% and thus doubling the GDP in 2010.

Fourthly, China will maintain steady growth in consumption because income of the population, particularly for the lower-income residents, increases rapidly. The government's continuous implementation of new measures to improve income distribution (such as the "income doubling plan" and increases in the minimum wage), and a series of government policies specifically focused on promoting consumption and improving citizen's livelihood, will raise the marginal propensity to consume, generate greater demand on the quantity and quality of consumer goods and services, and result in more consumption in society. This will boost the rapid development of the Chinese economy.

Fifthly, while China's savings rate has declined over the past years it is still maintained at a very high level. China's urban and rural population has a high level of savings. With the expansion of the social security system and the increase in health insurance coverage, the population is less worried about the future and this has helped to increase consumption and private sector investment.

Sixthly, in the period 2012 to 2022, China will continue to have its 'demographic dividend', although to a lesser degree. In view of China's rapidly aging population and the 'recruitment difficulties' encountered in some areas of China in the last two years, some scholars have concluded that China will soon lose its 'demographic dividend' and enter the stage of slow development. We believe that even though China's labor advantage has weakened, China will continue to have the 'demographic dividend,' at least in the next 10 years. There are two main reasons: firstly, China's labor force engaged in agricultural production was 279.31 million in 2010[5]. At the existing technical and organizational level, assuming there are 250 working days a year, a total of 210.44 million agricultural workers are needed, which means that there will be a surplus of 68.87 million agricultural workers[6]. Currently in the developed economies, the proportion of the agricultural labor force in the total labor force is less than 5%. If we take into account the technological advances in agriculture and the continuous improvement of large-scale agricultural operations, it would be adequate to have 15% to 20% of the labor force engaged in China's agricultural production. In 2022, the number of agricultural workers in China could fall to 115 million to 152 million people, which means a surplus labor of 127 million to 164 million labor force could shift from agriculture to non-agricultural production. Secondly, China's current labor retirement age for men is 60 years of age, for women it is 50 years of age, and for female cadres it is 55 years of age. Currently the overall average retirement age for China's urban popula-

4 Refer to http://www.stats.gov.cn/was40/gjtjj_nodate_detail.jsp?channelid=75004&record=83

5 China Statistical Yearbook 2011, National Bureau of Statistics of China

6 Huijuan Wang, Input-Occupancy-Output with Classified Employment and Its Applications, Dissertation of Graduate University of Chinese Academy of Science, 2012. (Available in Chinese only).

tion is 56.1 years old, with the average retirement age for males being 58.3 years old and females 52.4 years old[7]. This is the regulation formulated in the 1950s when the average life expectancy was over 50 years. Today, the average life expectancy in China is over 70 years, therefore, retirement age could be increased to correspond with the increase in life expectancy, and a significant number of people could be added to the workforce .

Finally, from the perspective of international competition, compared to developed economies, China still has a significant advantage of cheap labor; and compared to other developing countries, China has the advantages of a high level of skills, excellent infrastructure and high manufacturing productivity. For the period 2012 to 2022, China still has the export advantage and remains attractive to foreign direct investment (FDI). Therefore, China's foreign trade is expected to maintain its rapid growth rate in the run up to 2022.

On the basis of the aforementioned integrated analysis, we use econometric models to carry out the forecast for China's economic growth in the period 2012 to 2022. The forecast results show that in the next ten years, the average annual growth rate of China's economy would reach about 8%, and the RMB cumulative appreciation would likely reach 10.5% – an average annual appreciation of about 1%. In 2022, China's economic scale at the forecast 2022 exchange rate may reach, or be approaching, the level of the U.S.', however, the per capita GDP is only about one quarter of that of the U.S.

Assuming the absence of major unexpected events – such as a major war – it is expected that there will be three scenarios for China's economic growth:

First scenario, and the most likely one: The average annual real growth rate reaches 8%. For the ten-year period from 2002 to 2012, China's GDP average annual growth rate was 10.5%. For the ten-year period from 2012 to 2022, according to our forecast, China's GDP average annual growth rate will be 8%. China's GDP was US$8.26 trillion in 2012, with a per capita GDP of US$6,076 – and assuming that in this period the average annual natural population growth rate is 0.4% and the cumulative appreciation of the RMB to the US dollar reaches 10.5% – in this scenario, in 2022 China's GDP will reach US$19.7 trillion, and the per capita GDP will reach US$14,040.

Second scenario, a conservative estimation: Average annual real growth rate is 7.5%. In 2022, China's GDP will reach US$19.34 trillion, and the per capita GDP will reach US$13,780.

Third scenario, an optimistic estimate: The average annual real growth rate will reach 8.2%. In 2022, China's GDP will reach US$20.07 trillion, and the per capita GDP will reach US$14,300.

According to the estimates based on the statistics of the U.S. Bureau of Economic Analysis, for the period 2002 to 2012, the U.S. average annual economic growth was 1.65%[8]. The main reasons for the comparatively slow economic growth in the U.S. in the past decade include the U.S. subprime mortgage crisis in 2007 and the consequent international financial crisis in 2008. According to our forecast, the U.S. economy will improve in the period 2012 to 2022, as compared to the previous decade, and we have three scenarios for U.S. economic growth:

- First scenario, the most likely scenario: The U.S. average annual real growth rate reaches around 2.3% for the period 2012 to 2022. In 2022, U.S. GDP will reach US$19.68 trillion and the per capita GDP will reach US$57,410.
- Second scenario, an optimistic estimate: The U.S. average annual real growth rate reaches around 2.6% for the period 2012 to 2022. In 2022, U.S. GDP will reach US$20.26 trillion, and the per capita GDP will reach US$59,120.

7 Jiang Wu, Xiaobao Tian, Human Resources Development Report (2011-2012), Social Sciences Academic Press, 2012. (Available in Chinese only).

8 Refer to http://www.bea.gov/national/index.htm#gdp

- Third scenario, a conservative estimation: The U.S. average annual real growth rate reaches around 2% for the period 2012 to 2022. In 2022, U.S. GDP will reach US$19.11 trillion and the per capita GDP will reach US$55,750.

On the whole, China's GDP in 2022 will be close to or reach the U.S. level. However, the per capita GDP still lags behind by a large gap, which is only about a quarter of that of the U.S.

Forecast of the Growth Rate of China's Foreign Trade and Trade with the U.S., 2012-2022

Forecast of the growth rate of China's foreign trade, 2012-2022

Since joining the World Trade Organization (WTO), China's foreign trade has grown in leaps and bounds. According to the statistics of Chinese Customs, the average annual nominal growth rate of China's total import and export of goods for the period 2000 to 2011 was 20.4% and average annual growth rate of exports and imports was 20.3% and 20.5%, respectively. Of the total, China's total trade with, exports to and imports from the U.S. recorded average growth rates of 17.7%, 18.1% and 16.7% respectively.

Since the global financial crisis in 2008, the global economic situation remains in the doldrums. Affected by this, China's foreign trade growth fell sharply. Total imports and exports of goods increased by 6.2% in 2012, with exports increasing by 7.9% and imports increasing by 4.3%. These growth rates are much lower than the average growth rate in the period 2000 to 2011. China's foreign trade growth will be facing challenges in the next decade, especially given the difficult international economic situation expected. China's foreign trade growth rate will drop substantially. The main reasons for the declining growth rate are as follows:

First of all, the fast growth of China's foreign trade in the period 2000 to 2011 has its own peculiar background. In 2001 China joined the WTO and this ushered in a period of continuous rapid growth. In addition, China's cheap labor, relatively developed infrastructure, preferential policies and stable socio-economic environment underpinned the rapid growth of China's foreign trade. In 2012, China has become the world's largest exporter. Taking into consideration the scale of China's current foreign trade, it is nearly impossible to continue with such a rapid growth over the next decade.

Second, the global economy will remain in the doldrums for a long time. In the future, economic growth in China's major trading partners - the E.U., the U.S. and Japan - will remain slow. The E.U., in particularly, which is China's largest export market, will continue to suffer from recession and experience slow growth. Economic growth of other countries in the world will also decline to various degrees. For the period 2012 to 2022, the growth of China's external demand will slow down.

Third, there will be further RMB appreciation, affecting the competitiveness of Chinese goods and the incentives of Chinese enterprises to grow their exports. It is expected that in the period 2012 to 2022 there will be a slowdown in rate of RMB appreciation. Currently the prices of most commodities in the U.S. market are fairly close to those in the Chinese market. However, the prices of services in China are significantly lower than those in the U.S. We expect an average annual RMB appreciation during the next 10 years of around 1%, with the cumulative appreciation of 10.5%.

Fourth, trade protectionism will be further enhanced and trade frictions will increase. With the slowdown of the global economy – especially in the major developed economies – and the increased trade imbalances, trade frictions targeting China's exports will intensify. The U.S. has launched the most trade investigations against China in terms of both quantity and depth. Although presently the global trade friction has shown a downward trend, the trade investigation against China initiated by

the U.S. – especially the investigations on anti-dumping and subsidies – are on the rise.

Fifth, the impact of international industrial transfer will affect growth. With the rapid growth of wages in China, its low-cost advantage has gradually weakened, and as a result, export product processing has gradually shifted to other regions with lower wage levels, such as India, Indonesia, Vietnam, Thailand and other developing countries. For the period 2012 to 2022, growth in the export processing industries, which accounts for half of China's exports, will be most affected.

Lastly, in the period 2012 to 2022, the decline in economic growth in China will directly affect its demand for imports of commodities. Growth in imports such as the iron ore from Australia, as well as the import of parts and components from many Asian economies will decrease significantly.

Taking aforementioned analysis as a whole, we forecast that, in the period 2012 to 2022, the average annual real growth rate of China's total exports of goods may reach about 9% to 10%, slightly higher than the real GDP growth rate. The average nominal growth rate of China's total value of exports of goods (in U.S. dollars) may reach around 11% to 12%[9].

China will continue to have trade surpluses. However, the ratio of the trade surplus to GDP will decline. The reasons are as follows:

First of all, China's favorable trade balance comes from the processing trade, whereas the general trade has a deficit. For example, in 2011 the exports of processing trade were US$835.4bn, whereas the volume of imports amounted to US$469.8bn, resulting in a surplus of US$365.6bn. General trade exports were US$917.1bn, imports amounted to US$1,007.5bn, and the deficit was US$90.4bn. The proportion of processing trade in China's foreign trade will continue to fall, and the proportion of China's processing exports to total exports of goods is expected to fall from 44% in 2011 to 30% in 2022. The decline in the proportion of processing trade will bring a decline in the proportion of the trade surplus.

Second, the trade surplus has brought a lot of problems, and the Chinese government has no intention to continue with huge trade surpluses. The sustained trade surpluses have accumulated massive foreign exchange reserves for the Chinese government. This has increased the country's money supply and currency in circulation, as well as the long-term inflationary pressures. At the same time, major trading partners, such as the U.S. and other countries, have sustained a long-term trade deficit. This has led to constant trade disputes and a lot of pressure on China to reduce its bilateral trade surpluses with these countries.

Finally, further RMB appreciation will stimulate growth of China's imports while seriously affecting the competitiveness of Chinese goods, which will have a negative impact on China's exports. From the beginning of 2005 to the end of 2012, the nominal exchange rate of RMB has appreciated by more than 30%, which has greatly affected China's foreign trade environment

It is expected that in 2022, the proportion of China's goods trade surplus to GDP will decline. The trade surplus in 2011 was US$155.1bn, equivalent to 2.1% of GDP in the same year. In 2022 this proportion is expected to fall to about 1%.

Forecast of the Growth Rate of China's Trade with the U.S., 2012-2022

It is estimated that for the period 2012 to 2022, the growth rate of exports from China to the U.S. will be significantly lower than exports to other countries. Judging from the data associated with China's export business partner in recent years, in the period 2006 to 2011, the average annual growth rate of China's total exports of goods was 14.4%. Among this, the rates of growth of exports of goods to the

9 Currently, export growth rates are in nominal terms. Assuming that U.S. inflation averages 2% per annum during 2011 – 2022, it could be roughly estimated that the nominal growth rate of China's exports would be around 11% to 12%.

U.S., E.U. and Japan were 9.8%, 13.4% and 10.1% respectively, each of which is lower than the average growth rate of China's exports of goods. Whereas the average growth rates of China's goods exports to India, Brazil and Russia were 28.2%, 33.9% and 19.7%, respectively, each of which is higher than the average growth rate of China's exports of goods. The main reason for the low growth rate of China's exports to the U.S. is as follows:

Firstly, due to the impact of the debt crisis, financial crisis, and fiscal austerity, the U.S., EU and Japan and other developed economies are experiencing a low economic growth rate, and as such there is a sluggish demand for the growth of imported goods.

Secondly, the proportion of processing exports is particularly high in China's exports of goods to the U.S. In 2002, the proportion of processing exports stood at 55.3% of the China's overall exports of goods, whereas the proportion of processing exports accounted for 66.9% of China's overall exports of goods to the U.S. In 2011, the proportion of processing exports stood at 44% of China's overall exports of goods, whereas the proportion of processing exports accounted for 54.1% of China's overall exports of goods to the U.S. Due to the higher cost of wages in China, some of the processing export production has shifted from China to countries with lower wage levels, such as Mexico, India, Indonesia and Vietnam, which has a greater impact on the growth rate of China's exports to the U.S.

Finally, due to the return of U.S. manufacturing and a series of policies to stimulate employment, the U.S. manufacturing sector – especially high-end manufacturing – will have a certain degree of development, which will have a greater impact on China's exports to the U.S., in particular, the processing exports.

According to the preliminary forecast, in the period 2012 to 2022, the annual average growth rate of China's exports of goods to the U.S. will be 7%, and the average annual growth rate of exports of services will be 10%. In 2022 China's exports of goods to the U.S. will be US$683.2bn and exports of services to the U.S. will be US$32.3bn. According to estimates, in 2022, China's exports of goods and services to the U.S. will be US$715.4bn (in U.S. dollars at 2011 exchange rate).

It is expected that for the period 2012-2022, the growth rate of China's imports from the U.S. will be greater than the average growth rate of China's exports to the U.S. And it is mainly based on the following:

First of all, it is expected that China's level of consumption in 2022 will be greatly improved; in particular, there will be a surging emerging middle class, whose annual income will be between US$30,000 and US$60,000. This middle class require high-quality and high-class consumer goods, which will provide the U.S. trade industry with tremendous business opportunities, and will greatly stimulate U.S. exports to China.

Among the U.S. exports of goods to China, resource-based products, high-end consumer and luxury goods, healthcare products, high-tech manufacturing and service products have a high competitive advantage, and it is estimated that in 2012 to 2022 China will expand imports in these sectors from the U.S.

The preliminary estimate shows that in 2012 to 2022 the average annual growth rate of U.S. exports of goods and services will reach 12%. In 2022, U.S. exports of goods to China are expected to reach US$424.9bn and the exports of services will reach US$92.9bn. In the same year, U.S. exports of goods and services to China are expected to reach US$517.8bn. China's trade surplus with the U.S. is expected to be US$197.7bn.

With respect to China's balance of trade with the U.S., due to the huge U.S.-China trade imbalance, the trade surplus with the U.S. will continue. It is expected that in 2022, China will also continue to maintain the trade surplus with the U.S., but the relative proportion of the surplus will be greatly reduced. And it is mainly based on the following:

Figure 1: **Non-Competitive IO Model**

Input \ Output			Intermediate use		Final use					Domestic output or Imports
			Production sectors 1,2, ..., n	Total	Consumption	Gross Capital Formation	Exports	Others	Total	
Intermediate Inputs	Domestic intermediate inputs	1 — n	X_{ij}^{D}		F^{DC}	F^{DI}	F^{DE}		F^{D}	X
	Intermediate inputs from imports	1 — n	X_{ij}^{M}		F^{MC}	F^{MI}			F^{M}	M
	Total intermediate inputs									
Primary inputs	• Depreciation of fixed capital • Compensation of Employees • Net taxes on production operating surplus • Operating Surplus		V							
	Total value added		X^{T}							
Total inputs										

Note: The depreciation of fixed capital and operating surplus can be combined with gross operating surplus.

First of all, the proportion of export processing is comparatively high in China's exports to the U.S., and one of the important features of export processing is that the value of exports must be greater than the value of the imported parts and raw materials, because the processing costs must be positive.

Secondly, it is expected that in 2022, the price of labor in China is only about one fifth of that of the U.S. In the U.S. market, the cheap consumer goods and industrial manufactured goods produced in China are still very popular among the majority of Americans; again, due to the U.S. government's trade restrictions, the U.S. cannot make a full play of its high-tech advantage in exports trade to China.

Lastly, the improvement in the calculation methods has also affected the figures. Presently, the calculation of the balance of trade between the two countries is based on the value of total exports. However, a country's total exports are not all of the products from that country, which includes the value of parts, raw materials and energy imports from other countries. With the ever-increasing development of the international division of labor, the complete import coefficient of the exports will be increasingly high. At present, many experts advocate the use of trade value-added in the measurement of a country's actual level of exports and the measurement of the balance of trade between the two countries. China's exports is characterized by the high proportion of processing and assembly exports, with the complete import coefficient of the exports being very high, and the complete value-added rate being very low, therefore, if the calculation is based on the value-added, the U.S.-China trade surplus will be significantly reduced compared with the calculation based on the total exports.

Value-added Trade Calculation Method

Value-added trade calculation method – non-competitive input-output model and Processing Exports and Non-Processing Exports model

When using the input-output (IO) technique to study the value-added exports and the impact of exports on employment, usually the non-competitive IO model is used (see Figure 1).

The economic assumptions of this model is that, taking the entire economy as a whole, it is assumed that the product of any given sector, regardless of its use, or whether it is for consumption, investment or export, the coefficients of the product's consump-

Figure 2: A Non-Competitive Input-Occupancy-Output Model capturing Processing Exports and Non-Processing Exports

Input \ Output				Intermediate use				Final use					Gross output or Imports
				Production for domestic use (D)	Processing Exports (P)	Non-processing exports and other production of FIEs (N)	Total	Consumption	Gross capital formation	Exports	Others	Total Final use	
				1,2, ..., n	1,2, ..., n	1,2, ..., n							
Inputs Part	Domestic intermediate inputs	Production for domestic use (D)	1 — n	X^{DD}	X^{DP}	X^{DN}		F^{DC}	F^{DI}	0		F^{D}	X^{D}
		Processing exports (P)	1 — n	0	0	0		0	0	F^{PE}		F^{P}	X^{P}
		Non-processing Exports and other production of FIEs (N)	1 — n	X^{ND}	X^{NP}	X^{NN}		F^{NC}	F^{NI}	F^{NE}		F^{N}	X^{N}
	Intermediate inputs from imports		1 — n	X^{MD}	X^{MP}	X^{MN}		F^{MC}	F^{MI}			F^{M}	X^{M}
	Total intermediate inputs												
	Value-added			V^{D}	V^{P}	V^{N}							
	Total inputs			X^{D}	X^{P}	X^{N}							
Occupancy Part	Capital of which: foreign capital			K^{D}	K^{P}	K^{N}							
	Employees			L^{D}	L^{P}	L^{N}							
	Natural resources etc.												

tion of intermediate inputs and initial inputs are exactly the same. For example, the production of steel, regardless of its usage, whether for domestic production, increase of inventory or export, its consumption coefficients, in terms of the consumption of domestic materials and electricity, etc. are the same. It is also assumed that the product's consumption coefficients, in terms of the consumption of imported products, as well as the unit level cost of compensation of employees, net taxes on production, depreciation of fixed assets and the operating surplus, etc. are all assumed to be the same.

Currently this model has been widely adopted. Based on the "use table, make table", imports matrix and other information released by the U.S. Department of Commerce Bureau of Economic Analysis, we have prepared the U.S. non-competitive input-output tables for the year 1992, 1997, 2002, 2007 and 2010. We have also calculated the value-added and employment for each US$1,000 export for the period 1987 to 2011 (see Appendix to this chapter, "Summary Sheet of the Impact of Exports on the Value Added and Employment in China and the U.S. for1987-2011")[10].

The most important feature of China's exports is a high proportion of processing exports of total exports, and the consumption structure of processing export products is considerably different from that of the products manufactured to meet domestic demand. Therefore, we have proposed the non-competitive input-occupancy-output model to reflect the processing trade. Its format is shown in Figure 2.

In Figure 2, the domestic production in China is divided into three parts: production for domestic demand (D), export processing production (P) and

10 Refer to http://www.bea.gov/bea/dn2/i-o_annual.htm

non-processing exports and other production (N). In Figure 2, if the non-processing exports and other production (N) is integrated into the production for domestic demand (D), the DP Model (Model 3) will be generated.

We believe that the Processing Exports and Non-Processing Exports (DPN) model or DP model should be used to study the impact of China's exports on the value-added and the employment for the following reasons:

Firstly, about 50% of China's total exports are export processing. There is a big difference in the consumption structures of export processing production and the production of other products; for export processing production, there is a high proportion of imported materials and parts being used. For example, in 2007, the imported materials and parts consumed in the export processing production accounted for about 58.5% of total processing exports, whereas there is a small portion of value-added, only 17.4%. Among China's exports to the U.S., the export processing percentage is as high as 60%. Therefore, in the study of the impact of China's exports on the domestic economy, we must treat the processing trade separately.

Secondly, a large part of China's non-processing exports is produced by foreign-funded enterprises, and the amount of imports consumed per unit of output in the production of the non-processing exports in foreign-funded enterprises is much larger than what is consumed in the products for domestic demand produced in domestic-funded enterprises. At the same time, the domestic-funded enterprises that produce non-processing exports often have frequent contact with foreign countries, and as such, these enterprises tend to have more imports. Due to the fact that the products for exports generally have higher quality requirements, to ensure the quality of the export products, more imported raw materials will be adopted in the production.

In 2007, in the production of domestic demand products, export processing products and non-processing exports products, per unit of output, the proportion of imports consumed directly were 58.5%, 13.7% and 3.1%, respectively. Among these three categories of products, per unit of output, the proportion of the value-added varied substantially. Among the domestic demand products, export processing products and non-processing exports products that were produced in 2007, per unit of output, the proportions of value-added were 17.4%, 27% and 34.7%, respectively.

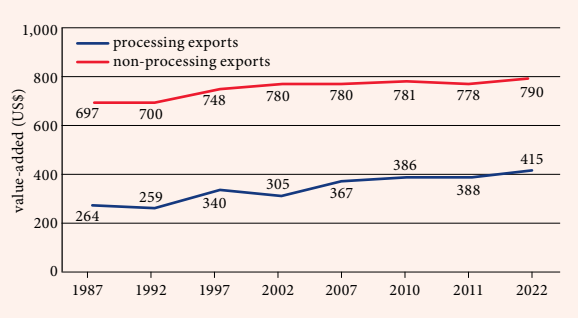
We believe that in the estimates of the impact of a country's exports on its economy, model 1 (see Figure 1) should be used for the U.S. and E.U. countries, whereas those countries with export processing – such as Mexico and China – model 2 or 3 should be used. Presently, for China, model 3 should be used, however, in the future it might be more appropriate to use model 2, should the import coefficients for domestic consumption become close to those for the non-processing export goods.[11]

Calculation results for the value-added content of exports

In this report, the non-competitive IO table for China that reflects the processing trade has been used in the forecast for the roles of both China's total exports and China's exports of goods to the U.S., to drive China's GDP and employment in 1987, 1992, 1997, 2002, 2007, 2010 and 2011 (see the Appendix to this chapter, "Summary Sheet of the Impact of Exports on the Value-Added and Employment in China and the U.S. for 1987-2011"). Presently, non-competitive IO tables for China that reflect the processing trade in 2002 and 2007 have already been compiled by the National Bureau of Statistics and the Chinese Academy of Sciences, based on the

11 Please refer to the following article on the calculation methodologies of input-output analysis and of the input-occupancy-output models of the non-competitive type (DPN model) that captures processing trade: Lawrence J. Lau, Xikang Chen, Cuihong Yang, Leonard K. Cheng, K.C. Fung, Yun-Wing Sung, Kunfu Zhu, Jiansuo Pei and Zhipeng Tang, 2010, "Input-occupancy-output models of the non-competitive type and their application – an examination of the China-US trade surplus", Social Sciences in China, Vol, XXXI, No.1, pp.35-54.

Figure 3: Value-Added Arising from US$1,000 of Chinese Exports in Processing Trade and Non-Processing Trade 1987-2022



survey data. On this basis, we further utilized 1987, 1992 and 1997 China IO table published by the National Bureau of Statistics, combined with the statistics from customs and other data, use the non-survey method and expanded the non-competitive IO table that reflects the processing trade to the year 1987, 1992 and 1997, and furthermore carried out the calculation for the impact of China's exports on China's GDP and employment over these years. At the same time, on the basis of 2010 non-competitive IO tables for China that reflects the processing trade, and by updating the value-added coefficient and employment coefficient, the research group has calculated the role of China's exports in boosting its GDP and employment in 2011.

See below for the development trend for the value-added by each US$1,000 export for the period 1987-2011, as well as the preliminary forecast for 2022 (see Figure 3).

Due to improved technology in China's manufacturing industry, some parts and components that were imported in the past have been replaced by domestic products that have the price advantage. For the period 1987 to 2011 there has been a steady increase in the value added of each US$1,000 export, which was US$264 in 1987, US$305 in 2002, US$367 in 2007 and US$388 in 2011. According to the forecast, in the period 2012 to 2022, this trend will continue. Also, in 2022, the value added per US$1,000 of export processing is approximately US$415.

The value added per US$1,000 of export processing is steadily on the rise. And there are two main factors: first, is the improvement in China's manufacturing level, with some of the imported parts and components used in processing production gradually being replaced with domestic products, which has increased the value-added in export processing; and second, is the increase in the level of wages of employees in China

The value-added of each US$1,000 non-processing export remains steady, but there is a slight upward trend. The main factors are: first, China has seen a steady increase in the value-added rate and an increasing wage level; second, through China's participation in global trade, the growth rate of exports was greater than the growth rate of output value, and the continuous rise of import consumption in non-processing export production offset the growth rate of value-added.

According to the forecast, the complete value-added coefficient of China's exports will show a rising trend during 2012 to 2022. And this is mainly because of the following[12]:

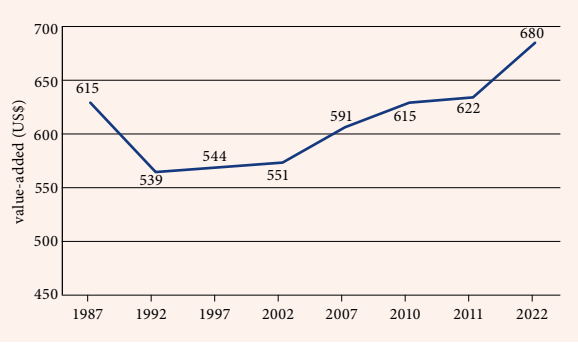
The first factor is the improvement in China's manufacturing level, with some of the imported parts and components used in processing production being gradually replaced with domestic products. For example, the imports consumed directly per US$1,000 exports processing production was US$733 in 1992, US$633 in 1997, US$666 in 2002, US$585 in 2007 and US$564 in 2011, an obvious downward trend (see Appendix, Figure A1). This has led to a rising value-added rate, which will be maintained in the future.

The second factor is the current low wage level of employees in China, which has more room to rise, leading to a steady rise in the rate of value.

The third factor is that the proportion of processing exports is showing a downward trend. In

12 The total value-added coefficient of exports refers to the direct and indirect domestic value added induced by producing per unit of exports, it is also called value-added share of exports.

Figure 4: Value-Added Arising from US$1,000 of Chinese Exports, 1987-2022



2002, China's processing exports as a proportion of total exports peaked at 55.27%, after which, it dropped to 44% in 2011. During 2012 to 2022, the proportion of export processing will continue this trend, and it is expected that in 2022, the proportion of export processing of total exports will drop to 30%. There is a strong correlation between the export value-added rate and the proportion of processing exports. In 1987, due to the very low proportion of processing exports (22.34%), the non-processing exports accounted for 77.66%, resulting in a high non-processing exports value-added rate. Therefore, the overall export value-added rate is high. In 1992 and 1997, the proportion of processing exports increased rapidly, thus the overall export value-added rate similarly dropped rapidly. After 2002, the proportion of export processing has dropped gradually, and there has been an increasing rate of value-added in export processing production. Figure 4 shows the steady rise in the rate of value added in export processing production after 2002 in China.

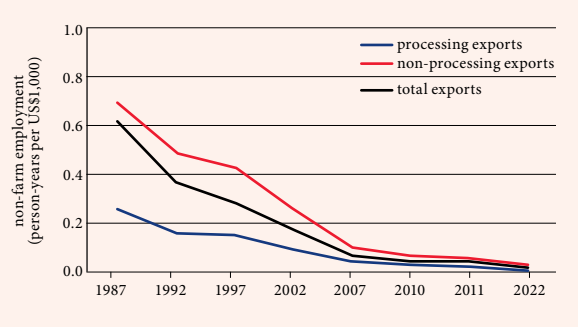
From the estimates, for the period 1987 to 1992, China's export value-added rate showed a downward trend, whereas in the period 1992 to 2011, there was a steady rise in value-added per US$1,000 exports (see Figure 4). According to the estimates, the export value added rate is 68%, i.e. the domestic value added per US$1,000 export is US$680.

It is estimated that during 2012 to 2022, the coefficient of complete consumption of imports by exports (vertical specialization share) is showing a downward trend, and there is an increase in the coefficient of consumption of domestic products. Based on the forecast, the coefficient of complete consumption of imports by export production is 0.32.

Regarding the export processing value-added rate: according to the forecast, during 2012 to 2022, the proportion of processing trade exports in China's overall exports will show a downward trend, as will the proportion of processing trade exports in China's overall exports of goods to the U.S. Based on the estimates, in 2022 the proportion of exports processing trade in China's total exports is around 30%. The forecast for the period 2012-2022 shows that the direct consumption coefficient of imported goods in export processing production will show a downward trend, as will the complete consumption coefficient of imported goods. Per US$1,000 export processing production, the complete consumption of imported goods is US$633 in 2007, US$612 in 2011 and it is expected to be US$585 by 2022. According to the forecast, the complete value-added coefficient of China's per US$1,000 exports processing products will show a rising trend during 2012 to 2022. It is expected that in 2022 the export processing value-added rate will be 41.5%, i.e. the complete value added per US$1,000 exports processing products will be US$415.

In light of the circumstances during 1987 to 2011, the non-farm payroll employment driven by China's unit export experienced a rapid decline (see Figure 5). With the substantial increase in China's labor productivity, it is expected that in the period 2012 to 2022, the coefficient of non-farm payroll employment in China's exports – the non-farm payroll employment directly driven by the unit export, or called the rate of non-farm payroll employment in export – will show a clear downward trend. It is expected that in 2022 non-farm employment driven by per US$1,000 export will be 0.0128 person-

Figure 5: Non-Farm Employment Generated by US$1,000 of Chinese Total Exports, Processing Exports and Non-Processing Exports



years, among which, non-farm employment driven by per US$1,000 processing export will be 0.0066 person-years, and non-farm employment driven by per US$1,000 non-processing export will be 0.0154 person-years (see Figure 5)[13].

Regarding non-farm payroll employment driven by total exports: in 2010, China's total export value was US$1,577.75bn, and non-farm payroll employment driven by per US$1,000 exports was 0.042 person-years, among which 0.019 person-years were directly driven by exports, and 0.023 person-years were indirectly driven by exports. Non-farm payroll employment driven by exports was 66.27 million person-years, among which non-farm payroll employment directly driven by exports and indirectly driven by exports were 29.98 million person-years and 36.29 million person-years, respectively. According to estimates, during 2012 to 2022, the overall number of non-farm payroll employment driven by China's exports will see a gradual rise. It is expected that in 2022 the overall number of non-farm payroll employment driven by exports will be 76.37 people, an increase of 12.1 people compared to 2010, with an annual growth rate of 1.3%.

13 This is the direct and indirect impact on non-farm employment per unit of exports, or termed non-farm employment rate of exports.

The Impact of China's Exports to the U.S, on China's Economy and Employment and the U.S.-China trade surplus

Utilizing the DPN model and the non-competitive input-occupancy-output model, we have calculated the value-added per US$1,000 in exports in the period 1987 to 2011, for China and the U.S.

Analysis of the impact of China's exports of goods to the U.S. on China's GDP and employment

The U.S. is China's most important trading partner. According to the *China Statistical Yearbook 2011*, in 2010, China's exports to the U.S. accounted for about 17.96% of China's total exports of goods, much higher than China's exports to any other countries. Therefore, China's exports to the U.S. have an important impact on China's GDP and employment. Based on China's non-competitive input-output table which reflects the processing trade, this report estimates the role of China's exports of goods to the U.S. in driving China's GDP and employment (see Figures A2 and A3).

The impact of China's direct exports of goods to the U.S. on China's GDP and employment

As shown in the Appendix, in 2010, China's per US$1,000 direct exports of goods to the U.S. brought US$563 of value-added and 0.038 person-years of non-agricultural employment to China, which is lower than the value-added and non-agricultural employment brought by China's per US$1,000 total exports, which was US$615 and 0.042 person-years, respectively. One of the main reasons is that there is a high proportion of processing trade exports in China's exports to the U.S., which is 57.4% in 2010, about 10.5% higher than the proportion of processing trade

Figure 6: The Impact of China's Direct Exports of Goods to the U.S. on China's GDP and Non-agricultural Employment

Years	Exports of goods (0.5 bns of U.S. dollars)	Total added value driven (0.5 bns of U.S. dollars)	Percentage of GDP (%)	Non-agricultural employment (Thousand Persons-years)	The proportion in the total non-agricultural employment (%)
1987	47	28	0.87	265	1.26
1992	73	33	0.67	204	0.74
1997	327	144	1.51	657	1.88
2002	699	317	2.18	958	2.62
2007	2327	1226	3.51	1326	2.97
2010	2833	1595	2.69	1076	2.23
2011	3245	1869	2.55	1071	2.15

Source: The data on China's direct exports of goods to the U.S. is from the China Statistical Yearbook, *various years; other data are estimates from the research group.*

exports in China's exports.

Over time, similar with China's unit exports, the value-added brought by China's per US$1,000 direct exports of goods to the U.S. is showing the U-shaped change (downward first then upward), which has first dropped from US$597 in 1987 to US$439 in 1997, and then risen to US$576 in 2011. With the continuous increase of China's labor productivity, the non-agricultural employment brought by China's per US$1,000 exports of goods to the U.S. continues to reduce over time.

Furthermore, we have estimated the impact of China's total direct exports of goods to the U.S. on China's GDP and agricultural employment (see Figure 6). The results show that China's exports of goods to the U.S. have a significant role in promoting U.S. exports of goods to China's GDP and non-agricultural employment. In 2010, the total value of China's direct export of goods to the U.S. was US$283.3bn, which has brought the value-added to a total of US$159.5bn, accounting for 2.69% of China's GDP; the non-agricultural employment to a total of 10.76 million people, accounting for 2.23% of the overall non-agricultural employment in China in the same year. Over time, during 1987 to 2011, China's total export of goods to the U.S. have experienced a rapid development, with the average annual nominal growth rate reaching as high as 19.28%, which has brought China ever-increasing value-added, from US$2.8bn in 1987, increasing to US$186.9bn in 2011, an average annual nominal growth rate of 19.10%. Relatively speaking, there has been a slow growth in nonagricultural employment brought on by China's direct exports of goods to the U.S., from 2.65 million people in 1987 to 107.1 million people in 2011, an average annual growth rate of only 5.99%. This is mainly due to the significant decline of non-agricultural employment driven by the unit goods export. In particular, after 2007, total non-agricultural employment driven by China's direct exports of goods to the U.S. have shown a downward trend, which has indicated that the growth rate of Chinese labor productivity is greater than the growth rate of China's exports of goods to the U.S.

The fourth and last column in Figure 6 shows the value-added by China's exports of goods to the U.S. and the proportion of nonagricultural employment in China's GDP and in the overall non-agricultural employment. These data have measured the degree of importance of China's exports of goods to the U.S. to China's economic and non-agricultural employment. The results show that since 1992, the importance of China's exports of goods to the U.S. to China's GDP and non-agricultural employment has shown a U-shaped change, i.e. the downward and upward trend, which has reached the peak value in 2007. This is mainly due to the rapid growth of China's total exports of goods to the U.S. before 2007. As noted earlier in this article, after 2007, affected by the financial crisis, China's exports to the U.S.

Figure 7: Impact of China's Direct Exports of Goods and Services to the U.S. on China's GDP and Non-agricultural Employment

Years	The total value of exports of goods and services (0.5 bns of U.S. dollars)	Total value-added induced (0.5 bns of U.S. dollars)	Percentage of GDP (%)	Non-agricultural employment (Thousand Persons-years)	The proportion in the total non-agricultural employment (%)
2002	740	354	2.43	1096	2.99
2007	2433	1316	3.77	1433	3.21
2010	2932	1680	2.83	1142	2.37
2011	3358	1967	2.69	1139	2.28

Source: The data on China's direct exports of goods to U.S. is from the China Statistical Yearbook, *various years; data on exports of services are from U.S. Bureau of Economic Analysis (BEA); other data are from estimates from the research group.*

sustained a shock to a certain extent, resulting in the slowdown in export growth, and as such its contribution to the value-added and non-agricultural employment has also declined.

Contribution of China's exports of goods and services to the U.S. to China's economy

The value-added and employment in China driven by per US$1,000 China's exports of goods and services to the U.S. is shown in A4 in the Appendix. It can be seen that after the exports of services are included, the value-added and employment in China driven by China's per unit exports to the U.S. are both showing some increase, which is mainly because of the higher coefficient of the complete value-added of service products and higher coefficient of employment.

Over time, after 2002, the value-added driven by China's unit export to the U.S. has been rising over the years, and the non-agricultural employment driven by China's unit export to the U.S. has seen a steady decrease.

Furthermore, we have estimated the impact of China's total exports to the U.S. on China's GDP and agricultural employment (see Figure 7). The total value of China's export of goods and services to the U.S. was US$293.2bn in 2010, and it has brought China a total of US$168bn of value-added, accounting for 2.83% of China's GDP in the same year, which is 0.14% higher than when only the impact of exports of goods is taken into consideration; and it has also brought non-agricultural employment to a total of 11.42 million people, accounting for 2.37% of the overall nonagricultural employment in China for the same year. Over 2002 to 2011, the value added induced by China's export of goods and services has seen a rapid growth, from US$35.4bn in 2002 to US$196.7bn in 2011, an average annual nominal growth rate of 21.00%. There has been slow growth in nonagricultural employment induced by China's exports of goods and services to the U.S., with an average annual growth rate of 4.24%.

Contribution of China's total exports of goods to the U.S. (including entrepôt trade) to the Chinese economy

In U.S.-China trade, a considerable part of U.S.-bound Chinese exports have undergone entrepôt trade in the Hong Kong region first and then been exported to the U.S. This portion of the exports have not been included in Chinese Customs statistics as part of China's exports to the U.S. In order to more accurately reflect the influence of U.S.-China trade in Chinese economy and employment, and meanwhile preparing for the estimates of the U.S.-China trade surplus (including Hong Kong entrepôt trade), this study has simultaneously carried out the estimates of the effect of China's total exports of goods to the U.S. (including Hong Kong entrepôt trade) on the Chinese economy and employment. The total amount of China's exports of goods to the U.S. via Hong Kong entrepôt is from the statistics of Hong Kong Customs, which are based on FOB Hong Kong price and are inconsistent with the free on board (FOB) China

port price used in the statistics of Chinese Customs. So we need to convert the prices for this part of entrepôt trade goods. We first used the data supplied by Hong Kong regarding the shipping and distribution fees for mainland China's exports of goods to the U.S. via Hong Kong entrepôt, then deducted the shipping and distribution fees from the value of these entrepôt trade goods so as to convert these values to the cost, insurance and freight (CIF) Hong Kong prices. Thereafter, the shipping and distribution fees incurred while the goods were transported from China to Hong Kong are deducted (assuming that the shipping and distribution fees account for 8% of FOB China port prices), and at this point we can obtain the value of China's exports of goods to the U.S. via Hong Kong entrepôt, calculated on the basis of FOB China port price.

The Appendices indicate that in 2010 the value-added for China and non-agricultural employment induced by China's per US$1,000 aggregated exports of goods to the U.S. was US$561 and 0.038 person-years, respectively, which is US$2 and 0.0001 person-years less than their counterparts induced by China's per US$1,000 direct exports of goods to the U.S. This is mainly because of the high proportion of processing exports in China's exports of goods to other countries via Hong Kong entrepôt, which was 72.9% in 2010[14].

At the same time, we can estimate the effect of China's total exports of goods to the U.S. to China's GDP and employment (see Figure 6). The results show that in 2007, 2010 and 2011, the value-added for China induced by China's total exports of goods to the U.S. was US$139.1bn, US$178bn and US$209.1bn, respectively, accounting for 3.98%, 3% and 2.86% of China's total GDP in the same year respectively; and China's total exports of goods to the U.S. in the aforementioned three years brought China 13.9 million, 17.80 million and 20.91 million person-years of non-agricultural employment, respectively, accounting for 3.4%, 2.5% and 2.34% of China's total non-agricultural employment in the same year, respectively. Compared to the value-added and employment brought by China's direct exports to the U.S., we can see that if China's exports of goods to the U.S. via Hong Kong entrepôt is included in the calculation, the results show that the value-added and the non-agricultural employment induced by China's total exports of goods to the U.S., will increase by 11%-14% and 9%-14%, respectively. In addition, the results also show that even though the portion of China's exports of goods to the U.S. via Hong Kong entrepôt were included in the calculation, in recent years, there has been a steady downward trend of the proportion of China's GDP and non-agricultural employment in China's overall GDP and nonagricultural employment.

U.S.-China goods trade surplus

The issue of the U.S.-China trade imbalance has long been a source of concern for scholars. According to Chinese Customs statistics, in 2012, U.S.-China goods trade surplus – China's total exports of goods minus China's total imports from the U.S. – was US$218.9bn. According to the statistics of U.S. Customs, in 2012, U.S.-China goods trade surplus – U.S. total imports of goods from China minus U.S. total exports of goods to China – was US$315.1bn. However, due to the existence of intermediate goods trade, there has been a serious problem of double counting when using the total imports and exports as the basis of the trade statistics. Therefore, in the import and export trade, the amount of domestic value-added in each country should be used as a standard to measure the balance of trade. In this study, the value-added measure is utilized in the re-

14 Statistics show that in 1997, the proportion of processing exports in China's exports to the U.S. is not very different from that in Chinese exports to the U.S. via Hong Kong. Affected by the product structure of exports, the value added to China's GDP per unit of total exports from China to the U.S. is higher than that of direct exports from China to the U.S.

Figure 8: **U.S.-China Goods Trade Surplus, 2007, 2010 and 2011**

	2007		2010		2011	
	Calculated according to total exports of goods (US$100mn)	Calculated according to the value-added (US$100mn)	Calculated according to total exports of goods (US$100mn)	Calculated according to the value-added (US$100mn)	Calculated according to total exports of goods (US$100mn)	Calculated according to the value-added (US$100mn)
China's exports of goods to the U.S.	2662	1391	3173	1780	3649	2091
Direct export	2327		2833		3245	
Hong Kong entrepôt trade	335		340		404	
U.S. exports of goods to China	712	612	994	863	1119	952
Direct export	652		919		1039	
Hong Kong entrepôt trade	59		75		80	
Sino-U.S. trade surplus	1950	779	2179	917	2530	1139

Note: Goods imported from the U.S. published in China in 2007 amounted to US$69.4bn; the statistics published by the U.S. imports from China to CIF goods amounted to US$340.1bn. Goods imported from the U.S. published in China in 2010 amounted to US$102bn, the U.S. announced the goods imported from China amounted to US$383bn. In 2011 China announced imports of goods from the U.S. amounted to US$122.1bn; published by the U.S. on goods imported from China amounted to US$417.4bn.

Source: Direct exports of goods to the U.S., data from the China Customs; U.S. on China's exports of goods from data in to the USITC strobe; China and the U.S. through Hong Kong to the other side of the re-export data from the Customs and Excise Department statistics.

evaluation of U.S.-China trade surplus[15, 16].

In addition, as we have stated before, in U.S.-China trade, a considerable part of U.S.-bound Chinese exports have undergone entrepôt trade in the Hong Kong region. In order to more accurately reflect China's trade surplus with the U.S., this study has already taken into consideration the U.S.-bound Chinese exports and China-bound U.S. exports which have undergone entrepôt trade in the Hong Kong region – the part of exports with its transit route via Hong Kong port, but not included in Hong Kong Customs statistics. To avoid the effect of price on the U.S.-China trade imbalance, in this study, China's exports to the U.S. (including entrepôt) and the U.S. exports to China (including entrepôt) were calculated using FOB prices. After a series of data processing, it is known that according to the statistics of total volume of trade, U.S.-China trade surplus in 2007 was approximately US$195bn. According to our estimates (see Figure 6), in 2007 the value-added induced by China's per US$1,000 exports to the U.S. was US$522 for China, whereas the value-added induced by the U.S. per US$1,000 exports to China was US$860 for China, with the former being only 61% of the latter (see Figure 5). Therefore, from the calculation using value-added measures it shows that in 2007, the U.S.-China trade surplus was US$77.9bn, a more than 60% reduction from the results calculated using the value of total exports (US$195bn).

According to the statistics for total exports, the U.S.-China trade surplus of goods in 2010 was US$217.9bn, among which China's exports to the U.S. was US$317.3bn (including entrepôt via Hong Kong), and U.S. exports to China were US$99.4bn (including entrepôt via Hong Kong); in 2010 the value added for China induced by China's per US$1,000 exports to the U.S. was US$561, and the value-added for the U.S. induced by U.S. per US$1,000 exports to China was US$868, with the former being only 64.6% of the latter. In accordance with the value-added measure of calculation, in 2010 China's exports to the U.S. was US$178bn (including entrepôt via Hong Kong), and U.S. export to China was US$86.3bn (including entrepôt via Hong Kong), and the U.S.-China trade surplus in 2010 was US$91.7bn. The U.S.-China trade surplus results calculated using the value-added measure is 57.9% less that the figure calculated using the total export value. U.S.-China goods trade

15 Refer to http://finance.china.com.cn/news/special/jjsj12/20130110/1230560.shtml

16 Refer to http://www.census.gov/foreign-trade/balance/c5700.html

surplus was US$253bn in 2011. The value-added for China induced by China's per US$1,000 exports to the U.S. (including entrepôt via Hong Kong) was US$573, and the value-added for the U.S. induced by the U.S. per US$1,000 exports to China (including entrepôt via Hong Kong) was US$851, with the former being only 67.7% of the latter. The results show that the U.S.-China trade surplus estimated using the value-added measure is 55% less than the estimates calculated using the total value of exports.

For expected bilateral trade in 2022, the value-added rate of China's exports to the U.S. would be 64.1%. In other words, for every US$1,000 of Chinese exports to the U.S., US$641 of domestic value-added and employment of 0.015 would be generated. The value-added rate of U.S. exports to China would be 86%. This means that for each US$1,000 of U.S. exports to China, US$860 of domestic value-added and employment of 0.0048 would be generated. Overall, in 2022, the U.S.-China bilateral trade will give the Chinese domestic value of US$456.5bn, accounting for 2.3% of China's GDP (US$19.7tr), and 10.68 million jobs. In 2022 bilateral trade would bring a domestic value-added to the U.S. of US$357.8bn, accounting for 1.8% of the U.S. GDP (US$19.68tr), and about two million jobs.

Chinese tourism in the U.S. domestic value-added and employment

In recent years, there has been a surge in the number of visitors to the U.S. and a rapid growth in tourism in the U.S. According to the U.S. Department of Commerce, in 2004 there were only 20.3 million visitors to the U.S., which increased to 108.9 million in 2011, an increase of 438%. Chinese tourism to the U.S. increased from US$1.115bn in 2004 to US$7.74bn in 2011, an average annual increase of 31.9%. China has become the fastest growing country in the development of the tourism market in the U.S. The Tourist Office of the U.S. Department of Commerce report shows, in 2011, Chinese mainland tourists in the U.S. spent more than any other overseas group[17].

In 2011, the number of tourists from China to the U.S. was 1.089 million. Total tourist expenditure was US$7.74 bn and per capita consumption was US$7,107.4. The consumption pattern of Chinese visitors to the U.S. is different from visitors from other countries, with shopping by Chinese tourists accounting for a larger proportion of expenditure. We estimate the Chinese tourists' consumption structure as follows: retail purchases account for 40% of expenditure; accommodation 15%; air transport 17%; food and meals 10%; and other expenditure 18%. Estimation results using the 2010 U.S. non-competitive IO table are as follows:

On the basis of a per capita consumption of US$7,107.4, according to our calculations, for every 1 million increase in Chinese visitors to the U.S., the total value-added value to the U.S. economy would be US$6.46bn, of which direct value-added is US$4.02bn. The total employment impact would be 78,000 persons per year, of which the direct employment impact is 59,000 persons per year.

Since the value added and employment impact arising from tourists' spending would not fully be captured in the year of impact, we have also estimated the time lag effect. The results show that the proportion of value-added and employment generated in the first year account for about 85% and 91% of the full impact. The indirect effects generated in the second year would account for 14% of the total value-added and 8% of the total employment. The remaining value-added and employment is less than 1% of the full effect. One could consider therefore that the indirect effects are quite weak after the first year.

For the forecast period 2012 to 2022, there was average annual growth of 15% of Chinese visitors traveling to the U.S. Chinese travel to the U.S. in 2022 generated about US$35.9bn in revenue for

17 Refer to http://tinet.ita.doc.gov/outreachpages/download_data_table/2011_China_Market_Profile.pdf

the U.S., pulling the US$32.3bn to U.S. domestic value-added, which directly increased the value to US$19.7bn for the U.S. and provided about 294,000 jobs.

Impact of U.S. exports of agricultural products to China on U.S. domestic value-added and employment

The U.S.-China agricultural trade has experienced a rapid development. From 2001 to 2010, the agricultural trade volume between the two countries increased from US$4.1bn to US$24.5bn, an increase of nearly five times in nine years, and an average annual increase of up to 22%. In 2010, China imported agricultural products from the U.S. for a total of US$18.6bn, accounting for 13% of total U.S. agricultural exports, making China the No. 1 destination for U.S. agricultural exports.

U.S. agricultural exports to China are mainly beans, cotton and corn. In 2011 the ratio of these three kinds of agricultural exports was: beans 61.1%; 15% for cotton; and 5% for corn. The three categories of products account for 81.1% of the total value of agricultural products exported from the U.S. to China.

According to our calculations, for every US$10bn agricultural products directly exported from the U.S. to China, a total of US$8.84bn of completely value-added generated, among which the directly value-added was US$4.21bn, and 67,000 persons per year complete employment can be generated, among which the direct employment will be 32,000 persons per year.

Due to the different lengths of the production process of various departments (an average of about two to three months), it is assumed that the time lag for each effect is around a period of three months. Assuming that export demand occurred in the middle of the year, it will have direct impact on the first round of indirect effects in the same year; and the second to fifth rounds of indirect effects will occur in the second year; and the sixth round of indirect effects in the third year. If it is believed that the value-added from the U.S. agricultural exports to China (employment), and the value-added generated in the first round of indirect effects (employment) occurred in the first year, they will account for about 75% of the total impact. The second year's indirect effects on the value-added in the fifth round value will account for 24%, and the remainder of the value-added will be less than 1% (about 0.8%). We believe that the indirect impact in the last two years will be very weak.

It is expected that in the period 2012-2022, the average annual growth of the U.S. agricultural exports to China will reach 10%, and as such in 2022, the U.S. agricultural exports to the China will reach US$58.4bn, driving a total of US$51.4bn U.S. do-

mestic value-added, among which US$29.2bn is the direct value-added, and 0.292 million jobs will be generated for the U.S.

Appendix

Summary Sheet of the Impact of Exports of Goods by China and by the U.S. on the Value-added and Employment, 1987-2011

Figure A1: Domestic Value-added and Employment Induced by US$1,000 of China's Exports

Year	Types of exports	Domestic value-added per US$1,000 China's exports (US$)			Direct and indirect imports per US$1,000 China's exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	237	385	622	291	87	378
	Processing	194	194	388	564	48	612
	Non-Processing	266	512	778	109	113	222
2010	Aggregate	235	380	615	308	77	385
	Processing	190	196	386	568	46	614
	Non-Processing	268	513	781	117	102	219
2007	Aggregate	226	365	591	342	67	409
	Processing	174	193	367	585	48	633
	Non-Processing	270	510	780	137	83	220
2002	Aggregate	204	347	551	406	43	449
	Processing	166	139	305	666	29	695
	Non-Processing	240	540	780	166	54	220
1997	Aggregate	191	353	544	410	46	456
	Processing	154	186	340	633	27	660
	Non-Processing	229	519	748	188	64	252
1992	Aggregate	196	343	539	439	22	461
	Processing	142	117	259	733	8	741
	Non-Processing	228	472	700	270	30	300

1987 Estimates	Aggregate	232	383	615	360	25	385
	Processing	147	117	264	729	7	736
	Non-Processing	251	446	697	274	29	303

Year	Types of exports	Employment per US$1,000 China's exports (Person-year)			Non-agriculture employment per US$1,000 China's exports (Person-year)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	0.016	0.035	0.051	0.016	0.020	0.036
	Processing	0.008	0.014	0.022	0.008	0.010	0.018
	Non-Processing	0.022	0.048	0.070	0.021	0.026	0.047
2010	Aggregate	0.019	0.043	0.062	0.019	0.023	0.042
	Processing	0.009	0.018	0.027	0.009	0.013	0.022
	Non-Processing	0.027	0.060	0.087	0.026	0.031	0.057
2007	Aggregate	0.026	0.070	0.096	0.026	0.038	0.064
	Processing	0.014	0.031	0.045	0.014	0.022	0.036
	Non-Processing	0.037	0.101	0.138	0.036	0.052	0.088
2002	Aggregate	0.095	0.160	0.255	0.091	0.082	0.173
	Processing	0.045	0.068	0.113	0.045	0.045	0.090
	Non-Processing	0.142	0.245	0.387	0.134	0.116	0.250
1997	Aggregate	0.159	0.242	0.401	0.150	0.136	0.286
	Processing	0.067	0.120	0.187	0.067	0.074	0.141
	Non-Processing	0.250	0.363	0.614	0.233	0.197	0.430
1992	Aggregate	0.218	0.449	0.667	0.199	0.167	0.366
	Processing	0.100	0.170	0.270	0.099	0.057	0.156
	Non-Processing	0.287	0.610	0.897	0.257	0.230	0.487

1987 Estimates	Aggregate	0.438	0.636	1.074	0.409	0.205	0.615
	Processing	0.188	0.152	0.340	0.186	0.064	0.250
	Non-Processing	0.496	0.749	1.245	0.461	0.238	0.699

Note, Exchange rates of US$100 to RMB (period average): 1987: 372.21; 1992: 551.46; 1997: 828.91; 2002: 827.70; 2007: 760.40; 2010: 676.95; 2011: 645.88

Figure A2: Domestic Value-added and Employment Induced by US$1,000 of Chinese Exports to the U.S. (including re-exports from Hong Kong)

Year	Types of exports	Domestic value-added per US$1,000 China's exports (US$)			Direct and indirect imports per US$1,000 China's exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	220	353	573	350	77	427
	Processing	192	205	397	554	49	603
	Non-Processing	254	535	789	99	112	211
2010	Aggregate	216	345	561	370	69	439
	Processing	191	207	398	555	47	602
	Non-Processing	252	537	789	110	101	211
2007	Aggregate	203	319	522	411	67	478
	Processing	176	199	375	577	48	625
	Non-Processing	250	540	790	111	99	210
2002	Aggregate	177	241	418	544	38	582
	Processing	168	152	320	647	32	680
	Non-Processing	210	554	764	177	58	236
1997	Aggregate	172	279	451	511	38	549
	Processing	156	177	333	642	25	667
	Non-Processing	212	534	746	184	70	254

1992	Aggregate	152	229	381	604	15	619
	Processing	140	93	233	760	7	767
	Non-Processing	172	470	642	329	29	358
1987 Estimates	Aggregate	227	303	530	449	21	470
	Processing	151	44	195	802	3	805
	Non-Processing	264	427	691	280	29	309

Year	Types of exports	Employment per US$1,000 China's exports Person-year			Non-agriculture employment per US$1,000 China's exports Person-year		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	0.014	0.033	0.047	0.014	0.018	0.032
	Processing	0.008	0.016	0.024	0.008	0.011	0.019
	Non-Processing	0.022	0.052	0.074	0.022	0.027	0.049
2010	Aggregate	0.017	0.039	0.056	0.016	0.022	0.038
	Processing	0.010	0.020	0.030	0.010	0.013	0.023
	Non-Processing	0.026	0.066	0.092	0.025	0.033	0.058
2007	Aggregate	0.023	0.061	0.084	0.023	0.034	0.057
	Processing	0.016	0.032	0.048	0.016	0.022	0.038
	Non-Processing	0.035	0.113	0.148	0.034	0.057	0.091
2002	Aggregate	0.062	0.110	0.172	0.062	0.065	0.127
	Processing	0.047	0.073	0.121	0.047	0.049	0.097
	Non-Processing	0.114	0.237	0.352	0.113	0.121	0.234
1997	Aggregate	0.110	0.182	0.291	0.108	0.110	0.218
	Processing	0.068	0.113	0.181	0.068	0.072	0.140
	Non-Processing	0.214	0.353	0.567	0.209	0.206	0.414
1992	Aggregate	0.133	0.321	0.454	0.122	0.111	0.233
	Processing	0.099	0.135	0.234	0.098	0.047	0.145
	Non-Processing	0.194	0.648	0.842	0.165	0.223	0.388
1987 Estimates	Aggregate	0.380	0.535	0.915	0.376	0.195	0.570
	Processing	0.162	0.098	0.260	0.162	0.048	0.210
	Non-Processing	0.440	0.657	1.097	0.435	0.235	0.670

Figure A3: Domestic Value-added and Employment Induced by US$1000 of Chinese Direct Merchandise Exports to United States (excluding re-exports from HK).

Year	Types of exports	Domestic value-added per US$1,000 China's exports (US$)			Direct and indirect imports per US$ 1,000 China's exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	220	356	576	346	78	424
	Processing	193	206	399	553	48	601
	Non-Processing	253	532	785	102	113	215
2010	Aggregate	216	347	563	366	71	437
	Processing	190	208	398	555	47	602
	Non-Processing	251	534	785	113	102	215
2007	Aggregate	204	323	527	404	69	473
	Processing	176	198	374	577	49	626
	Non-Processing	250	533	783	117	100	217
2002	Aggregate	180	273	453	507	39	547
	Processing	166	145	311	658	31	689
	Non-Processing	211	553	764	178	58	236
1997	Aggregate	170	269	439	525	35	561
	Processing	155	180	335	641	24	665
	Non-Processing	212	535	747	184	69	252
1992	Aggregate	156	289	445	536	19	555
	Processing	140	105	245	748	7	755
	Non-Processing	173	480	653	315	32	347
1987 Estimates	Aggregate	251	346	597	379	24	403
	Processing	155	89	244	750	6	756
	Non-Processing	277	418	695	276	29	305

Year	Types of exports	Employment per US$1,000 China's exports (Person-year)			Non-agriculture employment per US$1,000 China's exports (Person-year)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	0.014	0.032	0.046	0.014	0.019	0.033
	Processing	0.008	0.016	0.024	0.008	0.011	0.019
	Non-Processing	0.021	0.052	0.073	0.021	0.028	0.049
2010	Aggregate	0.016	0.039	0.055	0.016	0.022	0.038
	Processing	0.010	0.019	0.029	0.010	0.013	0.023
	Non-Processing	0.025	0.066	0.091	0.025	0.032	0.057
2007	Aggregate	0.022	0.061	0.083	0.022	0.035	0.057
	Processing	0.015	0.032	0.047	0.015	0.022	0.037
	Non-Processing	0.034	0.108	0.142	0.034	0.055	0.089
2002	Aggregate	0.067	0.122	0.189	0.067	0.070	0.137
	Processing	0.046	0.070	0.115	0.045	0.047	0.093
	Non-Processing	0.115	0.236	0.351	0.113	0.121	0.234
1997	Aggregate	0.098	0.179	0.277	0.096	0.105	0.201
	Processing	0.063	0.118	0.181	0.063	0.072	0.135
	Non-Processing	0.204	0.358	0.562	0.193	0.204	0.397
1992	Aggregate	0.139	0.393	0.532	0.136	0.141	0.277
	Processing	0.103	0.151	0.254	0.103	0.052	0.155
	Non-Processing	0.178	0.645	0.823	0.170	0.233	0.403
1987 Estimates	Aggregate	0.397	0.487	0.884	0.391	0.171	0.562
	Processing	0.204	0.055	0.260	0.204	0.024	0.228
	Non-Processing	0.490	0.695	1.184	0.480	0.242	0.722

Source: The data for China's exports of goods to the U.S. with the transit route via Hong Kong are from the customs statistics of the Customs and Excise Department of Hong Kong and the Hong Kong Census and Statistics Department.

Figure A4: Domestic Value-added and Employment Induced by US$ 1000 of Chinese Exports to the U.S. (including both direct merchandise exports and service exports)

Year	Types of exports	Domestic value-added per US$1,000 China's exports (US$)			Direct and indirect imports per US$1,000 China's exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	226	360	586	336	78	414
	Processing	193	206	399	553	48	601
	Non-Processing	261	529	790	98	112	210
2010	Aggregate	221	352	573	356	71	427
	Processing	190	208	398	555	47	602
	Non-Processing	260	530	790	108	102	210
2007	Aggregate	212	329	541	390	69	459
	Processing	176	198	374	577	49	626
	Non-Processing	265	523	788	112	100	212
2002	Aggregate	190	288	478	481	41	522
	Processing	166	145	311	658	31	689
	Non-Processing	231	544	775	167	58	225

Year	Types of Exports	Employment per US $1,000 China's exports Unit: person-year			Non-agriculture employment per US $1,000 China's exports Unit: person-year		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	0.015	0.033	0.048	0.015	0.019	0.034
	Processing	0.008	0.016	0.024	0.008	0.011	0.019
	Non-Processing	0.023	0.051	0.074	0.023	0.027	0.05
2010	Aggregate	0.017	0.04	0.057	0.017	0.022	0.039
	Processing	0.01	0.019	0.029	0.01	0.013	0.023
	Non-Processing	0.027	0.064	0.091	0.027	0.032	0.059
2007	Aggregate	0.024	0.061	0.085	0.024	0.035	0.059
	Processing	0.015	0.032	0.047	0.015	0.022	0.037
	Non-Processing	0.037	0.105	0.142	0.037	0.054	0.091
2002	Aggregate	0.076	0.125	0.201	0.075	0.073	0.148
	Processing	0.046	0.069	0.115	0.045	0.048	0.093
	Non-Processing	0.129	0.225	0.354	0.128	0.119	0.247

Figure A5: Domestic Value-added and Employment Generated by U.S.' Exports

Year	Types of exports	Domestic value-added per US$1,000 U.S.' exports (US$)			Direct and indirect imports per US$1,000 U.S.' exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011 *	Aggregate	434	402	836	104	59	164
2010	Aggregate	475	387	862	87	51	138
2007	Aggregate	451	410	861	84	56	139
2002	Aggregate	470	422	892	69	40	108
1997	Aggregate	489	411	900	62	38	100
1992 **	Aggregate	533	388	921	46	32	79
1987 ** Estimates	Aggregate	550	382	932	40	28	68

Year	Types of Exports	Employment per US $ 1,000 United States' exports (person-year)			Non-agriculture employment per US $ 1,000 United States' exports (person-year)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011 *	Aggregate	0.0030	0.0029	0.0059	0.0028	0.0028	0.0056
2010	Aggregate	0.0032	0.0029	0.0061	0.0031	0.0028	0.0059
2007	Aggregate	0.0035	0.0034	0.0069	0.0034	0.0033	0.0067
2002	Aggregate	0.0049	0.0046	0.0095	0.0048	0.0044	0.0092
1997	Aggregate	0.0050	0.0053	0.0103	0.0049	0.0051	0.0099
1992 *	Aggregate	0.0059	0.0062	0.0121	0.0058	0.0060	0.0117
1987 * Estimates	Aggregate	0.0077	0.0077	0.0154	0.0075	0.0074	0.0149

2011 IO table has not been released, nor the export data broken down by IO sectors. Therefore this article has used the HTS export data, and the IO table used is a 2010 non-competition table. The approach is: assign the HTS-10-digit code to the corresponding IO67 sector, convert the purchasers' prices of the export data into the producer prices using the export transformation matrix, and allocate the remaining exports to the corresponding service sector (including rail transport, waterway transport, air transport, pipeline transport, wholesale trade, etc.). Since all HTS are being applied to the exports of goods, as a result, the export driving effect calculated using this method is comparatively low;

** The sector classification of the 1992 and 1987 IO tables are based on Standard Industrial Classification (SIC). Using the matching of SIC to NAICS sectors available on the website of the Ministry of Commerce (http://www.census.gov/), , the 97 SIC-based sectors are matched to NAICS 67 sectors. Because many sectors have crossed-over features, the merged result has only 46 sectors. The calculation results here are based on the IO table using NAIC's 46 sectors.*

Figure A6: Domestic Value-added and Employment Induced by US$1,000 of U.S.' Merchandise Exports to China (including re-exports from Hong Kong)

Year	Types of exports	Domestic value-added per US$1,000 U.S.' exports (US$)			Direct and indirect imports per US$1,000 U.S.' exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	460	406	866	77	57	134
2010	Aggregate	469	399	868	76	56	132
2007	Aggregate	430	430	860	81	59	140
2002	Aggregate	433	448	881	76	43	119
1997	Aggregate	399	482	881	74	45	119
1992	Aggregate	460	444	904	58	38	96
1987 Estimates	Aggregate	478	448	926	42	32	74

Year	Types of exports	Employment per US$1,000 U.S.' exports (Person-year)			Non-agriculture employment per US$1,000 U.S.' exports (Person-year)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	0.0034	0.0030	0.0064	0.0030	0.0028	0.0058
2010	Aggregate	0.0033	0.0030	0.0063	0.0030	0.0028	0.0058
2007	Aggregate	0.0036	0.0036	0.0072	0.0034	0.0034	0.0068
2002	Aggregate	0.0048	0.0048	0.0096	0.0046	0.0047	0.0093
1997	Aggregate	0.0051	0.0060	0.0111	0.0048	0.0058	0.0106
1992	Aggregate	0.0064	0.0069	0.0133	0.0061	0.0068	0.0129
1987 Estimates	Aggregate	0.0080	0.0087	0.0167	0.0075	0.0081	0.0156

Note: The exports include exports of goods only (exports of service not included).

Figure A7: Domestic Value-added and Employment Induced by US$1,000 of U.S.' Direct Merchandise Exports to China (excluding re-exports from Hong Kong)

Year	Types of exports	Domestic value-added per US$1,000 U.S.' exports (US$)			Direct and indirect imports per US$1,000 U.S.' exports (US$)		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	455	409	864	78	58	136
2010	Aggregate	464	403	867	76	57	133
2007	Aggregate	428	431	859	81	60	141
2002	Aggregate	435	446	881	76	43	119
1997	Aggregate	396	487	883	71	46	117
1992	Aggregate	452	452	904	57	39	96
1987 Estimates	Aggregate	469	458	927	41	32	73

Year	Types of exports	Employment per US$1,000 U.S.' exports Person-year			Non-agriculture employment per US$1,000 U.S.' exports Person-year		
		Direct	Indirect	Total	Direct	Indirect	Total
2011	Aggregate	0.0034	0.0031	0.0065	0.0030	0.0028	0.0058
2010	Aggregate	0.0033	0.0030	0.0063	0.0030	0.0028	0.0058
2007	Aggregate	0.0036	0.0036	0.0072	0.0034	0.0034	0.0068
2002	Aggregate	0.0048	0.0048	0.0096	0.0046	0.0047	0.0093
1997	Aggregate	0.0051	0.0060	0.0111	0.0047	0.0058	0.0105
1992	Aggregate	0.0064	0.0070	0.0134	0.0061	0.0068	0.0129
1987 Estimates	Aggregate	0.0078	0.0089	0.0167	0.0072	0.0082	0.0154

Note: The exports include exports of goods only (exports of service not included).