



Trade Facilitation and Poverty Reduction: China-ASEAN Region Case Study



Laping Wu

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Abstract: Trade facilitation has been a key part in the opening up process of China. This paper aims to investigate the linkage between trade facilitation and poverty reduction in China. It discusses the impact of the trade facilitation practises in China and the China-ASEAN cooperation on trade between China and ASEAN countries. A provincial panel data set for China from 2000 to 2008 is employed to quantify the impact of agricultural imports, agricultural exports and trade facilitation on poverty. The results show that a 1 per cent increase in port efficiency results in a 1.051 per cent decrease in the poverty index.

JEL Classification: F15, I3, O24

Key words: Trade Facilitation, China, ASEAN, Poverty

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1. Trade facilitation and its impacts on poverty

Zhongying Sun (2009) applied a gravity model in his study of the role of trade facilitation; the results showed that the elasticities were different for the various trade facilitation measures. Port efficiency has positive effects in bilateral trade, both for importers and for exporters. Juanjuan Xie and Jing Yue (2011) made an empirical analysis of China-ASEAN trade using a gravity model. Junlan Shang and Ping Zhou (2012) also constructed a gravity model to analyse the impacts of trade facilitation on China-ASEAN trade, they also studied the impacts of trade facilitation on Chinese trade, and compared trade facilitation and tariff reductions; the results showed that trade facilitation could improve trade much more than tariff reductions. Lin Sun and Xufei Xu (2011) measured trade facilitation from port efficiency, customs environment, regulation and e-commerce. The results showed that the level of Chinese trade facilitation is near the world average, but among ASEAN countries there is a big gap. Singapore is much higher than average while Malaysia, Thailand and Brunei Darussalam are also near the world average. Viet Nam and Indonesia are lower than average.

Lin Sun and Xufei Xu (2011) also constructed a gravity model to test the impacts of trade facilitation on trade. The results showed that since the ASEAN Free Trade Zone was implemented in 2010, trade facilitation has had significant effects on trade. Air transportation is closely and positively related to exports of manufactured products. A 1 per cent improvement in air transportation infrastructure results in a 1.48 per cent increase in exports of manufactured products. However, the improvements both in customs procedures and in trade barriers are not significant. Finally, the author simulated the results of different forms of air transportation infrastructure. The results showed that when the infrastructure in all ASEAN members reaches an average level (5.2), exports of Chinese manufactures to ASEAN will increase by US\$ 4.733 billion at a growth rate of 39.34 per cent. When ASEAN air transportation infrastructure reaches the highest level, exports of Chinese manufactures to ASEAN will increase by 70.95 per cent.

2. Trade facilitation practices in China

This study focuses on four components of trade facilitation – transportation, customs clearance, institutions and policies, and e-commerce.

Transportation facilitation mainly refers to whether: (a) infrastructure, including ports, canals and other areas of water transportation, can meet business requirements; (b) air transport promotes the country's commercial development; and (c) infrastructure maintenance and development are scientifically planned and have adequate financial support.

Customs clearance refers to simplifying customs procedures through new technology in order to increase customs clearance efficiency.

Institutions and policies mainly refers to trade-related rules and policies, including whether: (a) competition-related laws and regulations limit unfair competition effectively; (b) the protection of intellectual property rights is fully implemented; (c) the legal and regulatory framework promotes the competitiveness of enterprises; (d) government policy is transparent; and (e) bureaucracy, bribery and corruption have hindered commercial and trading activities.

The last component is e-commerce, which includes the hardware and software environment for e-commerce development.

2.1. Overall development of trade facilitation practices in China

China has been continuously promoting trade facilitation as part of its reform and opening up process, from a single department to multiple departments, from a single link to multiple links, from the improvement of trade management to the extensive application of information technology, which has showed a high-level, wide-range, all-around feature. China first reformed foreign trade management on a large scale, and substantially reduced or removed the import quota. After joining the World Trade Organization (WTO), China's foreign trade policy has been inclined towards more active participation in regional trade and economic cooperation, such as implementing the China-ASEAN Free Trade Area, promoting trade and investment facilitation within the scope of the Shanghai Cooperation Organization, and actively pursuing transit transport agreement negotiations with the Russian Federation and Mongolia as well as making appropriate arrangements to boost the development of trade facilitation.

The amendment of the "Foreign Trade Law of the People's Republic of China" in 2004 both fulfilled its WTO commitments in advance and introduced the registration system for foreign traders, which created a more liberal foreign trade and business environment. In December 2011, the State Administration of Foreign Exchange and General Administration of Customs

signed a memorandum of cooperation to jointly promote foreign exchange reform for goods trade, so that both sides could strengthen supervision and information exchange including import and export declaration data of enterprises, other electronic data concerning the receipt and payment for goods trading so that they can share data and effectively promote trade facilitation.

2.1.1. Port efficiency in China

Since a port is the gateway to a country, port efficiency is an essential component in ensuring national or regional economic development and social prosperity. With the accelerating development of global economic integration and trade liberalization, efficient port management and clearance procedures have increasingly become an important indicator for measuring a country's competitiveness. After years of effort, the modernization of Chinese ports has greatly improved, particularly in the case of the coastal ports which are now close to the advanced level found in developed countries. This is especially seen in port construction as well as loading and unloading equipment.

According to data released by the National Bureau of Statistics of China, from 2005 to 2010 China's investment in coastal port construction totalled more than RMB 350 billion, with a number of large-scale, specialized ports having been built along the Yangtze River, the Xijiang shipping trunk and the Beijing-Hangzhou Grand Canal. As of the end of 2010, there were 96 ports above designated size and 32,148 berths for production, of which 1,659 were able to handle ships of more than 10,000 metric tons (mt). Port berths have been developed in a large-scale and specialized direction.

The container throughput of the ports above designated size was 130.6 million TEUs. China's port throughput has been the global leader for six consecutive years and port construction has made remarkable progress. In 2011, the throughput at the top five Chinese ports was 691 million MT at Ningbo Port, 620 million MT at Shanghai Port, 451 million MT at Tianjin Port, 429 million MT at Guangzhou Port and 380 million MT at Suzhou Port.

In recent years, China Air Transport has also developed rapidly. The Civil Aviation Administration of China signed air services agreements with 114 countries and regions at the beginning of 2012, including 43 Asian countries and regions. China's aviation transportation enterprises have opened up 443 international routes and navigable cities have reached 125 around the world. Asian regional routes totalled 143 to just 29 Asian cities. China and ASEAN member countries have opened up the third and fourth traffic rights, and close

communications have been maintained between China and North-East Asian countries – including Japan and the Republic of Korea – in order to ensure that the bilateral air transportation relationship is improved.

The “Port Law of the People’s Republic of China”, which came into effect at the beginning of 2004, adjusted the administrative system of the Chinese ports and established an administration system that ports were administrated directly by the local governments and separated government functions from commercial business. According to the National Plan for Coastal Ports, which was jointly issued by Ministry of Transportation and the National Development and Reform Commission in 2006, national coastal ports will be divided into five groups – Bohai Rim, Yangtze River Delta, the south-eastern coast, the Pearl River delta and the south-western coast – in terms of port situation in the region, transportation relations among ports and the rationality of the main cargo transport. At the same time, the national coastal ports have formed eight transportation systems for coal, petroleum, iron ore, containers, food, commercial automobiles and passenger transport. Recently, coastal ports have been gradually forming a convenient and efficient waterway system for passenger and freight transportation, which has a rational layout, a clear structure, explicit functions and resource saving features. The overall competitiveness of China’s coastal ports has significantly improved, based on adaptation to the development of the country’s economic, social, trade and defence requirements.

At present, most of the ports in China are attempting to use container tags and to implement the intelligent management of container transport, which has greatly enhanced the efficiency of container clearance and unloading, and the improvement of transportation security.

Together with the advancement of the China-ASEAN Free Trade Area and the continued growth of trade in the region, shipping demand is growing, resulting in higher demand for port services. The theme of the Seventh Conference of Ministers of Transport in September 2011 was “APEC security, stability and sustainable balanced development”, and unanimously adopted by the Joint Ministerial Statement of the Seventh Asia-Pacific Economic Cooperation (APEC) Transportation Ministerial Meeting. The Joint Declaration encourages members to further strengthen cooperation in the field of transportation, and to promote security, stability and sustainable growth of APEC transportation (APEC, 2004).

2.1.2. Reform and development of China’s customs procedures

Customs is a key department in China’s international trading. The efficiency of customs

clearance procedures will affect trade costs directly and extensively. Therefore, many countries take active measures to reform their customs procedures in order to improve international trade. Trade facilitation in China became more important after the 2008 economic crisis because many exporting firms were hurt financially. Therefore, the Government makes easy policies to encourage private enterprises to invest in China and other countries. A unified customs control could be of great benefit to China as this would create a fair competition environment.

2.1.2.1. Reform of China customs procedures

The “Golden Customs Project”, officially launched in 2001, is aimed at promoting electronic clearance in order to save time and costs. The core of “golden customs” comprises two parts: (a) an internal clearance system; and (b) an external port electronic system. As an important part of the “Golden Customs Project”, the China Electronic Port has established a public data centre and data exchange platform that relies on the national public telecommunication network. Based on the electronic data interchange (EDI) centre, the customs network is connected with other government departments and enterprises such as the industry and commerce departments, as well as the administration of taxation, foreign exchange, quality control, transportation, banks and enterprises. It strengthens supervision and management, improves the efficiency of trade, reduces trading costs, and is of great significance to trade promotion.

In 2002, the Internet-connected big customs clearance system was implemented throughout China. Cooperation between bonded shipment areas and ports was also officially launched in the eastern coastal areas in 2004. This makes it possible to take full advantage of coastal ports and bonded areas to speed up the flow of goods and increase trade efficiency.

In 2005, regional customs reform in China was launched with the goal of facilitating imports and exports by integrating coastal port and inland customs resources, standardizing and simplifying customs procedures, and reducing the costs and improving the efficiency of customs clearance. In October 2005, a trial inter-regional customs cooperation reform was launched in 11 areas: the Yangtze River delta, Pearl River delta and Bohai Rim region as well as Shanghai, Nanjing, Hangzhou, Ningbo, Guangzhou, Shenzhen, Beijing and Tianjin. In April 2007, seven cities – Tianjin, Shanghai, Fujian, Qingdao, Ningbo, Guangzhou and Shenzhen – jointly signed a “Customs Clearance Cooperation Framework Agreement between Coastal Port Provinces and Inland Six Provincial Ports”. The agreement proposes

the establishment of a cooperation platform between central regions and the coastal areas, and encourages innovating measures to simplify customs procedures and actively implement a 24-hour reservation system. For exports “apply at origin, check in port” has been introduced, which will save considerable time and costs.

2.1.2.2. International cooperation

Chinese customs authorities have established friendly exchanges with 117 countries or regions. China has carried out extensive cooperation with ASEAN in capacity-building since 2003. In addition, the Chinese customs authorities continue to broaden cooperation, and promote China-United States and China-European Union exchanges in traditional areas, including law enforcement, statistics, country of origin requirements, technical cooperation and trade facilitation as well as anti-terrorism efforts and protection of intellectual property rights.

In addition, in order to promote the implementation of the World Customs Organization’s (WCO) “International Trade Security and Facilitation Standards Framework”, China and the European Union have jointly launched the “China-European Union Safe and Smart Trade Lanes Pilot Programme” and the “Authorised Economic Operator (AEO)”, as well as promoting China-European Union trade facilitation.

2.1.2.3. Reform of Ningbo bonded area

Reform of customs procedures is an important symbol of China’s commitment to implementing trade facilitation. For example, after 20 years of exploration and development of the Special Zone, the Ningbo bonded area has become an important window to China’s opening up and development of an export-oriented economy.

The Ningbo Free Trade Area, which was approved by the State Council in November 1992, is divided into three districts in the east, west and south, covering a total area of 2.3 km². It is the only bonded area in Zhejiang province. The region, which enjoys a policy of “exempt, tax-free and bonded” and is supervised by the customs authorities, is one of the economic areas of China where policy is most favourable and the opening-up level is at the highest level. The bonded area has three main functions: import and export processing; international trade; and warehousing and logistics. In order to adapt to the rapid development of foreign trade, the Ningbo bonded area has implemented a series of reforms.

First, an application information management system has been developed for the customs area of Ningbo bonded area plus a Ningbo Export Processing Zone Customs information technology-assisted management system, a Ningbo Bonded Logistics Park information management system and other related systems. Ningbo is the first to implement a regional information management model among all the bonded areas in China. The regional “e-Customs” plays other roles too. Through these systems, goods, enterprises and the whole area are under the effective monitoring of the customs authorities. With this foundation, the area has been able to integrate and upgrade new information management systems for special supervised areas as well as accelerate the establishment of a smart card port clearance system, plus a carefully implemented “wise park” combined with a monitoring, clearance and information centre. Thus enterprises in the area can undertake all types of customs procedures.

Table 1. Facilitation measures in the Ningbo bonded area

Department	Main content
National inspection and quarantine department	Implement the integrated application, collection, inspection and quarantine, charge, and clearance model in inspections and quarantine; pre-inspection for imports, thus saving considerable inspection time; electronic sampling of exports of electric appliances to save time and cost.
Foreign Exchange Management Department	Implement online annual checks and improve its efficiency.
Industry and Commerce Administrative Department	Develop query system software for administrative licences to save time for enterprises when registering and getting the market access registration service.
Taxation Department	Provide on-site service in the bonded area for enterprises to process receipt issues, and an online application and electronic taxation system to save time and taxation costs.
Other	Launch a pilot linkage project for the bonded zones, export processing zones and bonded logistics park zone in China first. Then establish a convenient goods transfer mechanism among customs offices in different areas.

In order to support the restructuring and development of a regional “bonded economy”, the Ningbo bonded area has also developed special regional clearance guidelines, and actively assists the bonded area administrative committee to attract investment. It also creates a special channel for local and special products, implements on-site inspection services, strongly supports enterprises in expanding goods exhibitions, and implements priority for declaration and clearance of imported wines and fruit in hot weather, thus creating a good

customs environment.

In establishing the international trade demonstration area, the Ningbo bonded area gained strong support from many related government departments in establishing national inspection, foreign exchange, and business and the taxation as customs special supervised areas (table 3).

The Ningbo Free Trade Area customs authorities have introduced and reformed customs procedures to enable paperless customs clearance, centralized declarations, advance declarations and classification clearance among other measures.

The average time for import clearance has been reduced from 10.2 hours to 7.7 hours, while export clearance has been lowered from 51 hours to 43.6 hours, thus saving time by about 20 per cent. Regulatory models are being optimized, to establish powerful regional electronic customs procedures and enhance the level of trade facilitation.

2.1.3. Development of the Chinese institutional environment

Since joining WTO in 2001, China has greatly strengthened its trade-related legislation. In 2004, the Foreign Trade Law was revised and international trade was liberalized. The rights and obligations of foreign traders are clearly defined and protected, and the import and export environment has been greatly improved. In accordance with WTO rules, China has revised and improved related laws and regulations, including the trade remedy system, customs supervision, and the import and export inspection and quarantine system

In order to improve the fair competition environment, the Government of China has also enhanced the competition-related laws and regulations, including the Anti-monopoly Law, Anti-unfair Competition Law, Price Law, Advertising Law, Product Quality Law, Patent Law etc. Several laws have also been enacted and implemented for protecting intellectual property rights (IPR), including the country's patent, trademark and copyright laws.

China's customs authorities have established a perfect IPR enforcement system, including declaration auditing, inspection of imported and exported goods, detention and investigation of goods that infringe IPR, punishment for illegal imports and exports, and the disposal of such goods. In October 1995, China promulgated and implemented the Customs Protection of Intellectual Property Rights Regulations; then, in December 2003, these regulations were revised and the customs authorities were given more rights to punish illegal trade.

With regard to international cooperation on IPR protection, China actively participated in, and fulfilled the requirements of international protection of IPR conventions and treaties. Since joining the World Intellectual Property Organization (WIPO) in 1980, among more than 10 international conventions China has successively joined the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty, the Locarno Agreement Establishing an International Classification for Industrial Designs, the Madrid Agreement Concerning the International Registration of Marks, and the Trade-related Intellectual Property Rights Agreement, ..

The information of Import and Export management are published in the *International Business* newspaper. The Customs General Administration Office publishes China customs statistics, while customs regulations, import and export tariff rates, and customs procedures are published in the *Bulletin of the State Council* and other media sources.

2.1.4. Development of E-commerce and the formulation of related laws

2.1.4.1 Development of e-commerce

E-commerce in China has been developing rapidly since 2002. In many sectors, such as production, trade, transportation, finance and tourism, e-commerce is playing an ever-growing important role. Cross-border e-commerce is gaining more attention. Online purchases and sales by large enterprises are increasing, year by year. The e-commerce of small and medium-sized enterprises (SMEs) is also increasing rapidly, with the useage rate of online trading and marketing having reached 42.1 per cent in 2010. Online retail transactions are rising rapidly, with the average annual growth rate reaching 100.8 per cent between 2005 and 2010; in addition the share of total social retail sales of consumption goods is increasing year by year. The value of the online retail market reached RMB 192.4 billion in the second quarter of 2011; during the first half of that year, online retail transactions reached RMB 370.7 billion, an increase of 74 per cent compared with the same period in the previous year.

During the development of e-commerce, the related support systems have also advanced rapidly. From 2005 to 2010, the development of support systems such as the e-commerce platform service, credit service, e-pay, modern logistics and e-certification all accelerated. Related enterprises serving e-commerce, such as e-commerce information, transactions and technologies, are emerging; by 2010 the number reached 25,000. E-commerce information

and the transaction platform are becoming more and more professional and integrated. The improvement of the social credit environment also contributes much towards credible e-commerce transactions. New payment service systems, such as online payment, mobile payment and telephone payment, are growing rapidly; in fact, the size of the third-party e-payment grew by nearly 60 times from 2005 to 2010. Meanwhile, modern logistics are developing rapidly during the expansion of e-commerce.

The rapid growth of e-commerce also benefits from the continuously improving economic circumstances. During the eleventh five-year period (2005-2010), the network infrastructure in China improved continuously with user numbers growing rapidly; by 2010 the Internet penetration rate had reached 34.3 per cent. In the same year, the total number of Internet users reached 457 million while the number of mobile phone users reached 859 million, of whom 47.05 million were 3G users. With the improvement of Internet services, user fees are gradually being lowered.

2.1.4.2. Policies to promote the development of e-commerce

In order to improve the development of e-commerce, the central Government has introduced a series of policies and regulations (table 2). With the new policies, laws and regulations on e-commerce in place, the e-commerce development environment is gradually emerging. The environment for e-commerce development is therefore becoming mature.

In summary, although China's trade facilitation has made great progress, it is still in its early stage. Compared both globally and with Asia, China's trade facilitation level is relatively low, and a big gap remains with developed countries in many aspects (e.g., the overload runs of ports, poor transparency of policies and the unbalanced development of e-commerce). The positive side of this situation is that China has great potential for improving its trade facilitation.

Table 2. E-commerce policies and regulations of China

Date	File name	Issues
August 2004	Electronic Signature Law of the People's Republic of China	First law on information technology area to ensure security of electronic transactions, promote development of e-commerce and e-government in the legal system; create a favourable legal environment for e-commerce security certification, provide a foundation for a network trust system and electronic certification services sector.
January 2005	Opinions on accelerating the development of electronic commerce by the Office of the State Council	Put forward five basic principles to speed up the development of e-commerce, i.e. five combinations – government and enterprise, environment creation and application extension, network economy and real economy, key points and overall development, the acceleration of development and strengthen of management.
April 2005	Regulations on the Internet transaction platform service	First industry standards in China's e-commerce field to regulate e-commerce transactions, clarify rights and responsibilities of the traders, establish trade rules, and improve reliability and trust of e-commerce transactions.
May 2006	National development strategy on informationization 2006-2020	Put forward an Action Plan for e-commerce development to create environment, improve policies, speed up establishment of credit, certification, standards, payment and logistics, and improve the information clearing system; explore the multi-level and wide range of the e-commerce development mode.
June 2007	The eleventh five-year plan on electronic commerce development	Clarify the position of e-commerce and overall goals of e-commerce development in China; put forward the specific goals of e-commerce development from four aspects – to improve the level of e-commerce, foster the e-commerce service system, enhance the innovation ability of enterprises and improve the supporting environment.
March 2012	The twelfth five-year plan on electronic commerce development	Put forward the overall goals of e-commerce during the twelfth five-year development, further promote them in 2015, improve contributions to the national economy and social development, increase the proportion of e-commerce in the modern service industry, perfect the e-commerce system and form a network business environment

Data source: summarized by authors based on On-line information.(The Central People's Government of People's Republic of China, <http://www.gov.cn/>)

3. China-ASEAN cooperation and trade facilitation practices

On 4 November 2002, the leaders of China and the 10 ASEAN countries signed the China-ASEAN Comprehensive Economic Cooperation Framework Agreement, which decided to implement the “early harvest” programme from 2004 in advance in order to reduce and cancel tariffs on 600 types of agricultural products. In 2003 China and ASEAN officially launched customs cooperation, and in recent years have made great achievements due to the efforts of both sides. A regular department consultation mechanism and expert customs coordination commission (CCC) have been established to promote the rules of origin negotiations between China and the ASEAN Free Trade Area.

On 29 November 2004, the Trade in Goods Agreement was signed, under which about 7,000 tariff lines were to be reduced from 20 July 2005. In 2009, China’s tariff average on trade with ASEAN countries dropped to 2.4 per cent. In October 2009, at the China-ASEAN Customs and Business Cooperation Forum, the delegates signed the Nanning Initiative of China-ASEAN Trade Facilitation, and agreed to strengthen cooperation between China and the Free Trade Area countries. On 1 January 2010, the China-ASEAN Free Trade Area was fully established, and bilateral economic and trade relations entered a new stage.

The China-ASEAN Economic and Trade Cooperation Report (2010-2011) showed that China had become the third-largest trading partner of ASEAN and that ASEAN was China’s fourth-largest trading partner. Economic and trade activities between China and ASEAN countries are strongly complementary. With this expansion of China-ASEAN trade and economic relations, the reduction and elimination of obstacles to trade, the reduction of transaction costs and the establishment of an efficient trade facilitation system have become important issues.

3.1. Impacts of ASEAN trade facilitation on Chinese trade

ASEAN trade facilitation measures comprise two main characteristics. First, the ASEAN countries are emphasizing business partnerships and cooperation. The ASEAN customs authorities are taking the following measures to improve trade facilitation: (a) establish a single customs window to provide services and coordination between each member country; (b) standardize the trade declaration form among ASEAN members; (c) introduce electronic

customs procedures to save time and reduce costs of customs clearance; and (d) standardize the commodity classification and valuation systems, in order to simplify ASEAN taxation regulations and promote customs transparency, stability and consistency. Following years of effort, the customs clearance time has been greatly reduced from several days to two hours. The Green/Fast Channel makes rapid customs clearance possible for a Common Effective Preferential Tax (CEPT).

Second, ASEAN members have established a standard and consistent system; under this system international standards and quality management are applied. About 20 products, mainly electrical equipment have met the requirements of 59 related international standards. Seven unified standards and regulations for make-up technology have been formulated and put into effect. Public technical standards for medicine have also been established and implemented. Mutual Recognition Agreements can reduce repetitive detection and certification processes, thus reducing trading time and costs.

The trade facilitation measures taken by ASEAN have enabled China to become its biggest trade partner during the past three years. By the first half of 2012, ASEAN had invested US\$ 4.55 billion in China at an annual growth rate of 27.5 per cent. Direct investment in China from ASEAN also increased to US\$ 73.8 billion by the end of June 2012, accounting for 6 per cent of China's total foreign investment. China's border cities of Yunnan and Guangxi make full use of their advantageous locations, and benefit considerably from trade facilitation.

Trade between Yunnan and ASEAN members has an extensive history, and Yunnan has long been the trade frontier between China and South-East Asia and South Asia. The China-ASEAN Free Trade Area and Great Mekong Subregion (GMS) economic corridor give Yunnan favourable developing opportunities. Before the Kun-Man (Kunming-Bangkok) highway was constructed, Yunnan exported vegetables and fresh-cut flowers through coastal ports; this meant that vegetable- and flower-producing companies had to rely on intermediate firms. As a result, a large part of profits went to the latter companies. However, since the opening of the Kun-Man highway in 2008, vegetables and flowers can be shipped directly to ASEAN with most of the profit going to the producers. Yunnan also exports non-ferrous metal, electrical and agricultural products and electricity to ASEAN, and imports wood, tropical fruit, seafood and handicraft products from ASEAN with low or no customs duties. As a result, bilateral trade and investment between Yunnan and ASEAN has rapidly increased.

In general, trade facilitation has produced extensive benefits for Yunnan. For example, it

previously took seven to eight days to ship fresh-cut flowers from Kunming to Bangkok; however, following the construction of the Kun-Man highway, shipments now take only three days. The transportation cost has also been reduced from RMB 7 to RMB 3. These improvements are due to the high efficiency of customs officials, standardized and unified inspections and quarantine, and convenient transportation.

Yunnan's electronic port system was initiated in June of 2009, enabling members to share information between different regions, sectors and industries; as a result, customs clearance is made more convenient and faster. Customs clearance can be completed within 30 seconds at the key national electronic Red River port, whereas in the past it took about 10 minutes. This has allowed the trade flow of goods to increase by four to six times. In addition, import and export costs have been reduced, helping to improve trade.

Pingxiang in Guangxi province has become one of the largest fruit import and export distribution centres. A logistics park for the China-ASEAN Free Trade Area was set up and the Pingxiang Integrated Free Trade Zone (bonded area) was established in 2011. Customs clearance is becoming more convenient.

3.2. Impacts of Chinese trade facilitation on ASEAN trade

China has given a commitment to improving the general administration of customs to boost trade facilitation with ASEAN in three areas:

(a) Strengthening cooperation and communications, the promotion of standard and unified customs supervision, co-operation in law enforcement and information exchange;

(b) Building a strategic cooperative partnership with ASEAN, related governments and business associations;

(c) Taking into consideration proposals on trade facilitation in WTO negotiations as well as actively promoting trade facilitation.

Currently, various measures are being taken by the Chinese customs authorities to promote convenient customs clearance for ASEAN goods. At Shenzhen, which is one of the main import centres for ASEAN goods, customs authorities now use an automatic clearance system. Following the implementation of this system, the clearance time for vehicle imports has been reduced from about two minutes to five seconds, which represents an increase of more than 20 times in efficiency.

In 2010, the customs service at Pingxiang Port and Dongxing Port of Guangxi autonomous zone began an online one-station clearance service as well as implementing preferential and convenient measures for imports and exports, and introduced a round-the-clock, no-holiday service and 24-hour application system. This has greatly reduced transaction costs and improved the development of trade between Guangxi and ASEAN.

Benefitting from formal cooperation between China and the ASEAN Free Trade Area as well as the implementation of China-ASEAN trade facilitation measures, in 2011 ASEAN became China's third-largest trading partner and source of imports. Bilateral trade between China and ASEAN reached US\$ 362.85 billion in 2011. Compared with the low, decreased or zero growth of Chinese trade with other countries, bilateral trade between China and ASEAN has maintained a growth rate of 9.2 per cent. From January to June 2012, China-ASEAN bilateral trade amounted to US\$ 187.82 billion, with an annual growth rate of 9.8 per cent, which is higher than the total foreign trade growth of China. Bilateral investment between China and ASEAN accumulated nearly US\$ 93 billion. ASEAN has become an important destination of overseas investment by Chinese enterprises now. The major pattern of China-ASEAN Free Trade Region economic and trade cooperation is changing, such as the shift from the rapid growth of bilateral trade to bilateral investment.

In recent years, the trade surplus of ASEAN countries with China has increased significantly. For example, in 2001 Malaysia's trade surplus with China was US\$ 2.98 billion and it continued to rise in each subsequent year to reach US\$ 26.64 billion in 2010, which represented an increase of 792.63 per cent for that period (table 5). Thailand's trade surplus with China in 2001 was US\$ 2.37 billion, rising to US\$ 13.45 billion in 2010, an increase of 466.4 per cent. Trade between the other ASEAN members and China also increased considerably.

According to the Thai Bureau of Statistics, since the R3 highway was opened in April 2011, fruit exports from Thailand to China have increased by 100 per cent, with the trade value reaches more than Baht 722 million.

The 1,104-km R3 highway, which links Thailand's Chiang Rai port with Boten port in the Lao People's Democratic Republic and Mohan port of Yunnan province of China, has reduced transportation times to two or three days. The fresh fruit is distributed directly through the Yunnan market to south-western China, which is more convenient compared to the former distribution channel through the Guangzhou market.

China has also become Myanmar's largest trading partner. Myanmar Statistical Bureau data show that, from 2011 to 2012, the value of Myanmar's trade with China reached US\$ 5.001

billion, of which imports from China accounted for US\$ 2.786 billion and exports to China amounted to US\$ 2.214 billion. Currently, 215 investment projects are underway in Myanmar. Fourteen of the projects with a total of some US\$ 13.87billion are by Chinese investors, placing them at the top of the investment list.

According to Viet Nam's customs statistics, that country's exports to China totalled US\$ 6.1 billion during the first half of 2012. The main Vietnamese export commodities were: cassava and its products (US\$ 700 million); natural rubber (US\$ 576 million); rice (US\$ 459 million); cashew nuts (US\$ 120 million); aquatic products (US\$ 110 million); fruit and vegetables (US\$ 90 million); and wood and wood products (US\$ 56 million).

In the first half of 2012, Chinese investment in ASEAN totalled US\$ 1.488 billion, an increase of 34.3 per cent over the same period in the previous year. Chinese investment in ASEAN has been broadened to include construction, hotels, and the electrical, mining and transportation industries. At the same time, ASEAN investment in China has been steadily expanding.

On 12 July 2012, at the East Asia Summit of Foreign Ministers in Phnom Penh, China's Foreign Minister Yang Jiechi stated that: "Transportation and communications are the focus of the Government of China [in order to] to improve cooperation between China and ASEAN, and China therefore will establish a Fund for China-ASEAN Investment Cooperation, the overall amount of which will reach US\$ 10 billion to support ASEAN's infrastructure construction."

The investment projects include transportation, information and communications technology. In July 2011, the China-ASEAN Fund completed its equity investment in Thailand's largest port of Laem Chabang. In March of the same year and in June 2012, the China-ASEAN Fund invested in Cambodia's optical fibre communications network in order to assist the development of intraregional fibre-optic network and related businesses in the Indo-China Peninsula. In December 2010, the first investment by the China-ASEAN Fund was the purchase of the Philippines' largest and second-largest shipping companies.

The cooperation between China and ASEAN is comprehensive, involving not only trade, investment and technology cooperation, but also finance, culture, aviation, tourism, telecommunications, transportation, shipping and environmental protection, all of which have achieved remarkable progress.

The above analysis shows that international cooperation and trade facilitation measures between China and ASEAN members promote foreign investment, trade and economic

development.

Table 2. Imports and exports of China and 10 ASEAN members, 2003-2010

(Unit: US\$ million)

Country	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	19 348.62	26 682.07	33 146.86	40 857.91	47 143.98	52 477.07	47 855.87	57 075.98
Malaysia	20 127.22	26 260.80	30 699.56	37 109.50	46 386.26	53 556.57	51 967.69	74 248.84
Thailand	12 654.75	17 342.09	16 787.28	27 726.49	34 638.12	41 293.09	38 190.82	52 937.02
Indonesia	10 228.95	13 472.09	16 787.28	19 055.45	24 997.82	31 516.05	28 388.76	42 750.28
Philippines	9 399.52	13 328.16	17 557.32	23 412.69	30 615.76	28 636.98	20 539.00	27 762.23
Viet Nam	4 639.45	6 742.02	8 196.74	9 949.44	15 117.58	19 858.45	21 045.18	30 086.08
Myanmar	1 079.74	1 145.38	1 209.25	1 460.07	2 077.84	2 625.32	2 900.12	4 442.07
Cambodia	320.65	481.70	563.34	732.85	933.99	1 134.37	944.15	1 440.97
Lao PDR	63.96	109.44	113.53	128.93	218.37	402.37	751.80	1 085.12
Brunei Darussalam	346.26	298.95	260.87	314.94	358.76	219.43	422.44	1 031.94

Source: Based on the *People's Republic of China Statistical Yearbook*.

Table 3. Trade balance of China with 10 ASEAN countries

(Unit: US\$ million)

Year	China to Brunei Darussalan	China to Cambodia	China to Indonesia	China to Lao PDR	China to Malaysia	China to Burma	China to the Philippines	China to Singapore	China to Thailand	China to Viet Nam
2001	-131.08	170.81	-1 051.53	12.60	-2 984.95	363.16	-324.91	649.36	-2 375.40	-2 137.40
2002	-220.79	227.01	-1 081.90	46.95	-4 322.09	587.86	-1 174.92	-62.34	-2 642.25	2 032.49
2003	-278.48	268.65	-1 264.99	44.66	-7 845.60	740.70	-3 214.14	-1 621.08	-4 998.93	1 726.03
2004	-203.17	421.84	-959.25	87.04	-10 088.68	731.50	-4 790.72	-1 306.87	-5 738.93	1 778.04
2005	-154.59	508.72	-86.64	88.23	-9 486.86	660.45	-8 182.06	117.66	-12 172.59	3 091.06
2006	-115.68	662.67	-156.03	77.83	-10 035.36	954.77	-11 936.43	5 512.67	-8 198.37	4 977.28
2007	-133.40	831.86	204.85	119.07	-11 007.84	1 321.56	-15 619.92	12 096.61	-10 691.26	8 665.02
2008	41.66	1 056.71	2 870.18	133.85	-10 646.23	1 330.22	-10 372.51	12 134.55	-10 020.39	10 785.81
2009	141.55	870.37	1 052.30	2.54	-12 704.14	1 607.86	-3 357.82	12 248.01	-11 619.80	11 550.12
2010	-296.72	1 253.71	1 156.85	-117.87	-26 644.76	2 508.97	-4 681.71	7 618.48	-13 454.86	16 117.00

Source: Based on the *People's Republic of China Statistical Yearbook*.

4. Impacts of trade facilitation on poverty

4.1. Impact of trade on poverty

Increase trade is one of the main channels through which trade facilitation benefits the poor.

Based on the methods of Shenggen Fan et.al (2002), in this study trade is incorporated into the model for building a system and studying the contribution of trade to poverty reduction by using provincial panel data for China from 2000 to 2008. The other factors affecting rural poverty reduction are also analysed in the models. For the details of the system model, see the annex.²

4.1.1. The effects of agricultural imports on poverty

From the national perspective, elasticity of agricultural imports on poverty reduction is negative, which indicates that an increase in agricultural imports would worsen rural poverty in China. The elasticity of agricultural imports on poverty reduction is -0.05 (table 5), i.e., if agricultural imports increase by 1 per cent, the rural poverty index in China will increase by 0.05 per cent.

From the regional perspective, the marginal effects of agricultural imports on rural poverty, from high to low, are central, east and west. A large part of rural incomes in the central regions is derived from agriculture; therefore, farmers in the central region are affected to a great extent by agricultural imports.

Table 4. Elasticity of agricultural imports on poverty reduction

		National	Eastern region	Middle region	Western region
Elasticity on poverty reduction		-0.0500	-0.0559	-0.1454	-0.0228
Elasticity on agricultural production		-0.0166	-0.0185	-0.0482	-0.0076

² The model is based on a research project, "Trade liberalization and poverty reduction – a case study of China and ASEAN countries", which was funded in 2010 by the International Poverty Reduction Centre in China. The project studied the impacts of trade on poverty in detail.

4.1.2. The effects of agricultural exports on poverty

Nationally, the elasticity of agricultural exports on poverty reduction is 1.03 (table 6), which indicates that the increase in agricultural exports has had a positive effect on the alleviation of rural poverty in China; i.e., if agricultural exports increase by 1 per cent, then China's rural poverty index will decrease by 1.03 per cent. Output elasticity of agricultural exports is positive and the increase in agricultural exports raises farmers' income, so that they increase their agricultural production.

Table 5. Elasticity of agricultural exports on poverty reduction

	National	Eastern region	Middle region	Western region
Elasticity on poverty reduction	1.0300	0.3779	2.1160	0.5921
Elasticity on agricultural production	0.0825	0.0303	0.1695	0.0474

From the regional perspective, the marginal effects of agricultural exports on rural poverty, from high to low, are central, west and east. Agricultural exports have the greatest impact on rural poverty reduction in the central region, the main reason being that a large part of rural income in the central region is from agriculture.

When putting agricultural imports and exports together, the elasticity of net agricultural exports on poverty reduction is still positive, indicating that agricultural trade can help to reduce rural poverty in China. Trade liberalization also has positive effects on rural poverty reduction in China.

4.2. Impacts of trade facilitation on poverty: A case study of the manufacture industry and port efficiency

The impacts of trade facilitation on poverty reduction can be derived based on "trade facilitation on trade" and "trade on poverty". However, due to the difficulty in measuring trade facilitation, especially with regard to customs procedures, regulations and e-commerce, the case study here is mainly on port efficiency, with the manufacturing industry results being used to analyse the impacts of port improvement on poverty reduction.

Zongying Sun (2009) tested the elasticity of port efficiency on trade,³ the results of which have been used by the author together with the results of elasticity of trade on poverty,

³ A 1 per cent increase in port efficiency results in an increase of 1.07 per cent in exports and 1.02 per cent in imports.

to calculate the elasticity of port efficiency on poverty reduction (table 7).

Table 6. Results of elasticity of ports on poverty

	Imports	Exports	Overall effect
Results of elasticity of ports on trade	1.02	1.07	-
Results of elasticity of trade on poverty reduction	Agricultural product imports	Agricultural product exports	
National	-0.0500	1.0300	0.9800
Eastern region	-0.0559	0.3779	0.3220
Middle region	-0.1454	2.1160	1.9706
Western region	-0.0228	0.5921	0.5693
Elasticity of port on poverty reduction*			
National	-0.0510	1.1021	1.0511
Eastern region	-0.0570	0.4044	0.3473
Middle region	-0.1483	2.2641	2.1158
Western region	-0.0233	0.6335	0.6103

* Due to a lack of data, the effect of elasticity of ports on poverty reduction is simply multiplied by “elasticity of ports on trade” and “elasticity of trade on poverty reduction”.

The results show that a 1 per cent increase in port efficiency results in a 1.051 per cent decrease of the poverty index. In the middle region, the elasticity reaches 2.116 per cent while it, is lower for the eastern and western regions. The major reasons are: (a) in the eastern region the poverty problem has basically been solved, and the marginal contribution of trade facilitation is small; and (b) the western region is mainly a mountainous area, therefore the transportation system is not well-developed and its connections with international markets are not as strong as those of the eastern or middle regions. Therefore, the contribution of trade to the western region’s economic growth is not as high as the other regions, and the effect of trade on poverty reduction is small.

5. Conclusion and recommendations

In summary, although China and ASEAN have made great progress in trade facilitation, including port infrastructure construction, customs procedure reform, e-commerce development as well as laws and regulations, the level of trade facilitation is still low compared to that of other developed countries, and it is uneven in ASEAN countries. Therefore, China should learn from the experience of countries with a high degree of trade facilitation in order to enhance international cooperation to prompt trade facilitation and the development of the national economy.

5.1. Impacts of trade facilitation on poverty reduction

It is easy to understand the mechanism of trade facilitation impacts on poverty reduction, but the real situation is much more complicated than the theory. This is mainly due to the dynamics and complexity of trade facilitation as well as the complexity of the reasons for poverty and the impact channels between them.

Therefore the impact of port construction on poverty reduction is used in this study. The results show that a 1 per cent increase in port efficiency results in a 1.051 per cent decrease in the poverty index. For the middle region of China, elasticity is 2.116 per cent, but is less for the eastern and western regions. This is mainly because in the eastern region the poverty problem has basically been solved, and the marginal contribution of trade facilitation is small, while in the mountainous western region, the transportation system is not well-developed and its connections with international markets are not as strong as those in the eastern and middle regions. Thus, the contribution of trade in economic growth in the western region is not as high.

5.2. Enhancing capacity-building in trade facilitation

5.2.1. Promoting reform of customs procedures

In the global supply chain, customs clearance is the most important link. Burdensome and inefficient customs clearance measures and poor infrastructure create high costs and make corruption easy. Therefore, reform of customs procedures and the internationalization of customs rules will be conducive to the development of trade facilitation. Some developing countries feel that the costs of customs reform and modernization are too high and that there are technical difficulties. However, the experience of Chile and Singapore shows that the costs can be controlled, and that investment in trade facilitation is likely to bring a fast return.

5.2.2. Strengthening infrastructure construction for trade and investment facilitation

The improvement of physical infrastructure is an important component of trade and investment facilitation. Among the ASEAN members, only in Singapore and Malaysia has port infrastructure reached the advanced international level; however, in China and the other ASEAN members the port facilities are not as high or even below the world average level.

Therefore China and ASEAN must focus on investment in infrastructure – especially ports, airports and other related areas – and establish transportation systems that are compatible with economic development. Meanwhile, cooperation between customs authorities must be strengthened and customs procedures that meet international standards must be developed.

5.2.3. Improving development of e-business

The development of e-commerce in the ASEAN members is uneven. These countries need to enhance the level of information availability and give greater importance to the development of electronic commerce and its application in trade facilitation. Vigorous development and further investment in the network infrastructure should be given higher priority. At the same time, laws and regulations related to e-commerce should be improved.

5.2.4. Improve the institutional environment

Policy transparency should be further improved and policies should be stable and consistent. On the one hand, the trade and investment administrative department should increase the transparency of trade and investment policies. The laws and regulations concerning trade and investment should be made available in official publications or on the government websites; it can not be executed before publishing. On the other hand, approval procedures should be simplified and standardized. Enforcement of laws should be enhanced. Finally, a coordination mechanism for trade and investment facilitation should be established. The related administrative departments should continue to expand dialogue with foreign companies and formulate a new management model in order to achieve a “win-win” situation.

5.3. Enhance coordination between China and ASEAN in trade and investment facilitation

5.3.1. Promote unified standards

Adopting international standards is the simplest and most effective way of achieving trade facilitation within China and the ASEAN members. With the rapid development of economic integration in the China-ASEAN Free Trade Area, unified standards will play an increasingly

important role in the promotion of international trade and the establishment of technical trade measures. China and the ASEAN members should attempt to base their domestic standards on international standards, and adopt international standards in priority areas. Trade agreements as well as domestic laws and regulations related to international standards should be consistent within the China-ASEAN region.

5.3.2. Establish trade facilitation committees in China and ASEAN members

Trade facilitation involves wide areas and multiple sectors. Each country should establish an institute to coordinate the different sectors. On the other hand, a fast and effective coordination mechanism between countries should also be introduced. First, each country should: (a) achieve efficient and detailed domestic information sharing; and (b) establish a central database on trade facilitation and ensure data are updated regularly in order to provide complete and accurate information. Second, each country should establish an effective decision-making and information communications mechanism at the government level. Finally, each country should: (a) establish a consultative mechanism with foreign trade enterprises; (b) have a clear understanding of the issues involved and the impact of trade facilitation; and (c) solve problems in trade facilitation in a timely manner.

In general, China and the ASEAN members should give more attention to: (a) the establishment of a National Trade Facilitation Committee in the Doha Round negotiations; (b) cooperation in promoting the development of trade facilitation; (c) improving the level of China-ASEAN cooperation; (d) strengthening trade and investment cooperation partnerships; and (e) joint promotion of extensive trade facilitation development.

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Annex

Model used to test the impact of various factors on poverty

In order to test the impact of various factors on poverty, a four-set and nine equations system was formulated to analyse those factors, as follows. Equation (1) is a poverty reduction equation that is used to quantify different variables in rural poverty reduction contribution. The following factors were considered in the equation: agricultural GDP per worker; non-farm employment rate; rural non-farm employment wage rate; relative prices of agricultural produce; rural inflation rate; rural internal gap in income distribution; income gap between urban and rural areas; and international trade in agricultural products.

In equation (1), the agricultural GDP per worker mainly reflects the effect that agricultural output growth has on rural poverty reduction. Farmers' agricultural income forms a large proportion of their total income in the impoverished and backward areas of China. Off-farm income is an important source of rural residents' total income in China, and the wage level of the non-farm workforce is introduced in the model to capture off-farm income. In addition, not only can these two variables reflect the effect of non-farm sector wages change and employment changes on rural poverty reduction, but they can also provide better policy guidance for rural poverty reduction. If an improved rural wage ratio has a more significant effect than increased non-farm employment opportunities on rural poverty reduction, Governments should pay attention to improving the rural wage level, and conversely should pay more attention to increasing non-farm employment opportunities.

$$PI = f(AGDPPC, INFIAT, WAGE, NAGEMPLY, INEQ, ATT, TRADE) \quad (1)$$

The relative prices of agricultural products are mainly used to reflect the impact of relative price changes on rural poverty. If the impoverished rural population is a net buyer of agricultural produce, agricultural product price rises will cause a loss, but if the impoverished rural population is a net seller of agricultural produce, agricultural product price rises will provide a benefit. In the long term, agricultural produce price increases will lead to governments and farmers increasing agricultural production investment, and will lead to the total supply curve to shift upward. The rural gap in income distribution reflects the degree of rural poverty while the income gap between urban and rural areas reflects the relative rural poverty level, and the inflation rate reflects the economic environment's impact on rural poverty. International trade in agricultural products is demonstrated by imports and exports. The following table shows the meaning of each variable in equation (1).

Definitions of exogenous and endogenous variables

Variable	Definition	Variable	Definition
Exogenous variable		UCPI	Urban CPI
ALAND	Land area per worker	TRADE	Opening degree of trade index
AK	Agricultural capital per worker	AIMP	Agricultural imports

NAK	Capital per worker in rural non-agricultural sector	AEXP	Agricultural exports
PWRE	Government spending on rural power	NAGDPR	Rate of agricultural GDP to non-agricultural GDP
UGDPPC	GDP produced by urban sector	NAKR	Rate of rural per non-agricultural capital to urban per capital
IRRE	Government expenditure on irrigation	CPIR	Rate of rural CPI to urban CPI
RDE	Government spending on agricultural R&D	Endogenous variable	
AMACH	Total power of agricultural machinery	PI	Percentage of rural population below poverty line
EDUE	Government spending on rural education	SCHY	Average years of schooling of rural population 16 years and older
FERTI	Agricultural fertilizer	IRR	Percentage of total cropped area that is irrigated
POWERE	Government spending on rural energy	ELECT	Electricity consumption
PLOAN	Government expenditures for poverty alleviation per capita	WAGE	Wage rate of non-agricultural labour in rural areas
INFIAT	Rural inflation rate	NAGEMP LY	Percentage of non-agricultural employment in total rural employment
WATERD	Agricultural drainage areas	AGDPPC	Agricultural GDP per worker
LANDQ	Soil erosion areas	GAGDPPC	Agricultural productivity growth at the national level
LANDD	Land disaster areas	NAGDPPC	Non-agricultural GDP per worker in rural areas
EMPLOY	Urban unemployment rate	ATT	Terms of trade, measured as agricultural Prices divided by a relevant Non-agricultural GNP deflator
RCPI	Rural CPI	INEQ	Income gap between urban and rural areas

Equation (2) is an agriculture production function. The dependent variable is the agricultural GDP per worker while the independent variables include: (a) capital investment (land per worker) and capital; technology; infrastructure; and education (all of which may help to

improve agricultural labour and productivity as well as result in the total supply curve moving upwards); and (b) agricultural scientific research investment (R&D); planting areas; irrigation rate; the rural population's average years of education; rural disaster areas; soil erosion areas; agricultural electricity supply; rural machinery; and agricultural products trading. All these affect agricultural production and rural poverty reduction through the output effect.

$$AGDPPC = f(SCHY, ALAND, AK, RDE, AMACH, IRR, FERTI, ELECT, WATERD, LANDQ, LANDD, AIMP, AEXP) \quad (2)$$

Equations (3) and (4) are for rural off-farm sector wages and rural off-farm sector employment, respectively. The two equations are a simplified form of supply and demand under conditions of the labour market equilibrium. Labour and wages is the labour productivity function. At the same time, labour productivity is the capital/labour ratio and some elements that elicited the production curve outside shift function, including infrastructure and education. The independent variables include the capital per labour, infrastructure (water resources, electricity, education, training and irrigation), years of education and the agricultural GDP in the previous year. Off-farm capital investment in rural areas can promote non-farm productivity. An increase in the education level of workers can also improve work efficiency. Rural power development is also beneficial to farmers' entrepreneurship and improves agricultural productivity.

The work relief in the rural water conservancy project has great influence on non-farm employment and non-farm wages. Agriculture is the foundation of both the national economy and social development, and the lagged agricultural output determines the input in agricultural product processing industry. The influence of non-farm sector productivity on non-farm labour and non-farm wage levels is an important factor as it directly affects the ability of the economic environment to absorb surplus rural labour. Opening to the outside world and trade liberalization has played a direct role in promoting rapid economic growth in China; therefore, international trade also has a very important influence on rural non-farm labour and non-farm wage levels.

$$WAGE = f(NAEMPLY, SCHY, NAK, AGDPPC, UGDPPC, EMPLOY, AIMP, AEXP) \quad (3)$$

$$NAEMPLY = f(WAGE, SCHY, NAK, AGDPPC, UGDPPC, EMPLOY, AIMP, AEXP)$$

(4)

Equation (5) reflects the allocation difference in urban and rural areas. The variables that influence the allocation difference in urban and rural areas mainly include labour output value per head orural population and urban residents' income level, the amount of unit

labour own quantity in urban and rural areas, the ratio of the rural consumer price index to the urban consumer price index, the process of urbanization, the urban unemployment rate, domestic and international trade, and finance transfer payments in urban and rural areas. In addition, the rural internal income gap is an important variable that affects rural poverty reduction; however, it is very difficult to calculate the rural internal Gini coefficient because of limited available data. So the factors having an impact on rural internal income distribution appear to be the rural off-farm employment situation, the process of urbanization, domestic and international trade, and financial transfer payments.

$$INEQ = f(NAGDPR, NAKR, CPIR, ATT, AIMP, AEXP, EMPLOY)$$

(5)

In conclusion, variables that need to be considered in equation (5) such as agricultural GDP per worker versus non-agricultural GDP per worker, the ratio of rural and urban unit labour capital quantity, rural CPI versus urban CPI, relative agricultural product prices, the unemployment rate in cities and towns, and imports and exports of agricultural products.

Equation (6) reflects the relationship between planting area irrigation rate and government irrigation expenditure while equation (7) reflects the relationship between the rural population's average number of years of education and government education investment. Equation (8) reflects the relationship between rural electricity consumption and government expenditure on power supply.

Equation (9) deals with trade conditions, particularly the relative price levels of agricultural and industrial products from the agricultural product supply and demand perspective. The growth of agricultural GDP leads to increased supply of agricultural products that, in turn, leads to decreases of agricultural product prices. The growth of GDP (exclusive of agricultural GDP) leads to increased demand for agricultural products, which improves the agricultural product trade environment. The growth of industrial output will be accompanied by greatly improved demand for agricultural products, thus creating a gap in supply and demand that is conducive to improved agricultural and industrial product trade conditions:

$$IRR = f(IRRE, IRRE_{-1}, \dots, IRRE_{-j}) \quad (6)$$

$$SCHY = f(EDUE, EDUE_{-1}, \dots, EDUE_{-n}) \quad (7)$$

$$ELECT = f(PWRE, PWRE_{-1}, \dots, PWRE_{-l}) \quad (8)$$

$$ATT = f(AGDPPC, GGDPPC, UGDPPC) \quad (9)$$

It is necessary to distinguish between internal variables and external variables in the simultaneous equation estimate model, for which the table above shows the specific variables.

In order to understand the specific region of the fixed effects, and through the virtual variables, the impact of trade liberalization on rural poverty reduction in the eastern, central and western regions of China can be measured and compared. By totally differentiating equations (1) to (9) it is possible to obtain the marginal impact and elastic ties of different types of government expenditures on growth in agricultural and non-farm productivity as well as on reductions in regional inequality and rural poverty.

For growth effects the marginal impact of R&D investment in year $t-1$ on agricultural labour productivity in year t can be derived as:

$$\left(\frac{\partial AGDPPC}{\partial RDE}\right)_{-i} = \frac{\partial AGDPPC}{\partial RDE_{-i}} \quad (10)$$

Equation (10) measures the direct impact of investment in research on agricultural productivity growth. By aggregating the total effects of all past government expenditures during the lagged period, the sum of the marginal effects is obtained for any particular year. Returns to other variables can be derived in a similar way.

For poverty effects, the impact of government investment in agricultural R&D in year $t-i$ on poverty at year t can be derived as:

$$\begin{aligned} \frac{\partial P}{\partial RDE_{-i}} = & \frac{\partial P}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial RDE_{-i}} + \frac{\partial P}{\partial WAGE} \frac{\partial WAGE}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial RDE_{-i}} \\ & + \frac{\partial P}{\partial NAGEMPLY} \frac{\partial NAGEMPLY}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial RDE_{-i}} + \frac{\partial P}{\partial TOT} \frac{\partial ATT}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial RDE_{-i}} \end{aligned} \quad (11)$$

The first term on the right-hand side of equation (11) captures the impact of government investments in R&D through yield-enhancing technologies, such as improved varieties, on poverty and therefore agricultural labour productivity. Increased agricultural labour productivity also affects poverty through changes in rural non-farm wages and employment, and relative prices, which are captured in the remaining terms on the right-hand side of the equation. As with government investments in agricultural R&D, the impact of government investments in irrigation is captured through improved productivity, rural wages and non-farm employment, and relative prices. Other variables have similar impacts on poverty.

The impact of government investments in rural electricity in year $t-n$ on poverty in year t is

derived as:

$$\begin{aligned}
 \frac{\partial P}{\partial PWRE_{-i}} = & \frac{\partial P}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial ELECT} \frac{\partial ELECT}{\partial PWRE_{-i}} + \frac{\partial P}{\partial WAGE} \frac{\partial WAGE}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial ELECT} \frac{\partial ELECT}{\partial PWRE_{-i}} \\
 & + \frac{\partial P}{\partial NAGEMPLY} \frac{\partial NAGEMPLY}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial ELECT} \frac{\partial ELECT}{\partial PWRE_{-i}} \\
 & + \frac{\partial P}{\partial ATT} \frac{\partial ATT}{\partial AGDPPC} \frac{\partial AGDPPC}{\partial ELECT} \frac{\partial ELECT}{\partial PWRE_{-i}} + \frac{\partial P}{\partial WAGE} \frac{\partial WAGE}{\partial ELECT} \frac{\partial ELECT}{\partial PWRE_{-i}}
 \end{aligned} \tag{12}$$

The first term on the right-hand side of equation (12) measures the direct effects on poverty of improved productivity that is attributable to greater availability of electricity supply. Terms 2, 3 and 4 are the indirect effects of improved productivity through changes in rural non-farm wages, employment and prices. Terms 5 and 6 capture the direct effects on poverty of higher non-farm wages and greater non-agricultural employment opportunities arising from government investment in electricity supply. Similarly, it is possible to derive the impact on rural poverty of increased investment in roads, irrigation and education.

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