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Approaching Digital Economy from the Perspective of Political Economics

Changhong Pei, Jiangfei Ni, Yue Li*

Digital economy is a more advanced and sustainable economic form. Information and communication technology (ICT), as the core technology, has played an unprecedented role in promoting the development of social economy in all aspects. This paper firstly explains the concept of digital economy based on economics, and then analyzes the social reproduction process of digital information products and the characteristics of digital industry before proceeding to discuss the features of the micro-entities of digital economy and the sharing economy by adopting the basic principle of political economics. The emergence of digital economy poses challenges to the traditional economics and there is a pressing need for theoretical research and innovation to explain the new economic phenomenon.

Keywords: digital economy, political economics, sharing economy, theoretical innovation

1. An Economic Explanation of the Concept of Digital Economy

1.1. The Background of Digital Economy Development

In early May 2017, "The World's Most Valuable Resource", *The Economist* cover article, pointed out that the data was oil in the digital age (The Economist, 2017). 100 years ago, oil became the most important commodity in modern society, and its exploitation, trading and refining promoted the development of many industries such as exploration, chemical industry, transportation and finance. 100 years later, data has become the latest commodity, and has become an important driver of technological innovation and economic development as a key input factor. According to *World Internet Development Report 2017*, 22% of the world's GDP is closely related to digital economy. The total size of China's digital economy reached 22.58 trillion yuan in 2016, leaping to the world's second, accounting for 30.3% of China's GDP, while that of the United States was 11 trillion U.S. dollars, ranking first in the world, accounting

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for 59.1% of US GDP. Digits have become a major engine for global economic growth, and it is estimated that the application of digital skills and technology will bring half of the global product increase from digital economy by 2020 (Knickrehm *et al*., 2016).

In the 1990s, with the extensive access to the Internet and the critical breakthrough in information technology, the vast amount of data generated by network connectivity on a global scale has gone far beyond the traditional decentralized terminal processing capacity. In this context, big data, cloud computing and other digital technology have rapidly developed. The term "digital economy" was coined by the famous economist Don Tapscott in his 1996 book *Digital Economy*, in which he elaborated on the impact of the internet on the social economy. Then Nicholas Negroponte's *Digital Survival* explained the future trends, applications, and great value of information technology. Once published, the book elicited a strong response around the world and became a bestseller. Since then, governments have begun to take steps to use digital economy as a new driver to boost economic growth. In 1997, Ministvy of International Trade and Industry of Japan first used the term "digital economy". Since 1998, the U.S. Department of Commerce has published research findings with "digital economy" as the subject. Since the 2008 financial crisis, countries have developed digital economic strategies and implemented them as national strategies to get out of the recession as soon as possible. In recent years, China also attaches great importance to the great promoting role of digital economy in leading economic growth and industrial structure upgrading, and has made important deployments. In March 2015, the Internet Plus action plan was unveiled for the first time in the government work report. In March 2016, the government work report proposed to promote sharing economy, and in October of the same year, General Secretary Xi Jinping stressed during the 16th collective study of the Political Bureau of the CPC Central Committee: "We should increase investment, strengthen the construction of information infrastructure, promote the deep integration of the internet and the real economy, accelerate the digitization and intelligentization of traditional industries, and make digital economy bigger and stronger and expand the new space for economic development." In March 2017, the government work report first proposed accelerating the development of digital economy, and in October of the same year, digital economy was included in the report at the 19th CPC National Congress.

1.2. Definition of Digital Economy

With the continuous improvement of information and communication technology (ICT) infrastructure, the integration of ICT and social and economic fields has become an important driving force to promote the structural upgrading of the real economy. Since Don Tapscott proposed the concept of digital economy, many institutions and scholars have defined digital economy from different perspectives. First, in terms

of its scope, Mesenbourg (2001) believes that digital economy is divided into three components: E-commerce infrastructure (hardware, software, networks, systems, etc.); e-commerce processes (business activities mainly through computer networks, such as e-mail, video conferencing, etc.), and E-commerce (commodity trading processes mainly based on computer networks, such as online sales of book and CDs, etc.). There are some difficulties in the statistical process for digital economy defined by this division, such as how to measure the economic scale of electronic services, although its composition is clear. Bukht and Heeks (2017) hold that part of the output that is caused by digital technology which is wholly or primarily based on a business model of digital products or services is digital economy. They divide digital economy into three levels, namely, the core sector or the digital sector, including software manufacturing, information services and other industries, and digital economy in a narrow sense, which includes, in addition to core sectors, new business models resulting from ICT, such as the platform economy, sharing economy, digital services, and digital economy in a broad sense—Digitalized Economy, which includes all the economic activities based on digital technology, that is, in addition to digital economy in the narrow sense, it also includes industry 4.0, precision agriculture, e-commerce and so on. This definition, while blurring the boundaries, is enough to incorporate new business patterns based on digital technology that will emerge in the future. The China Academy of Information and Communications Technology (CAICT) (2017) divides digital economy into the digital economic base (including electronic information manufacturing, information and communication industry, and software services) and the digital economic integration (the increased output resulting from the application of digital technology to traditional industries such as manufacturing and services). This classification method is recognized by many scholars and research institutions. Second, the digital economy is seen as an economic activity, China stated in the 2016 *G20 Digital Economy Development and Cooperation Initiative* that "Digital economy refers to a series of economic activities with the use of digital knowledge and information as a key factor of production, modern information network as an important carrier, the effective use of information and communication technologies as an important driver of efficiency gains and economic structural optimization". CCID Consulting (2017) argues that the digital economy is the sum of a series of economic activities based on digits. Third, from the perspective of output, Knickrehm *et al.* (2016) believe that the full range of economic output from all types of digital inputs is the digital economy. Digital inputs include digital skills, digital devices (hardware and software and communications equipment), and digital intermediates and services for production. Fourth, from a structural point of view, the Australian Government (DBCD, 2013) believes that the digital economy is a global network of economic and social realization through digital technologies such as the Internet and mobile phones. The European Parliament (2015) describes the digital economy as a complex multi-tiered or hierarchical structure connected by countless

and growing nodes. In addition, there are scholars and institutions that define the digital economy from a business model perspective, such as Mesenbourg (2001), European Commission (2013), and OECD (2012). Although the above definitions of digital economy differ in emphasis and scope, they all agree that the digital economy is an economy based on digital technology.

This paper defines digital economy from the perspective of the natural science meaning of the technical attributes adopted by the means of production. The first is agricultural production and agricultural products, embodied in agricultural economy and manifested as the biological economy in the sense of natural science; followed by industrial products and industrial production, embodied in industrial economy, manifested as physical and chemical economy in the sense of natural science; the last to appear is service production and service products, embodied in service industry and service economy, but it does not have a technical definition in the sense of natural science because, in the service economy, at least for a long time, its technical means is not important to productivity, or later, it uses comprehensive technology, any branch of technology is not decisive in its productivity.

Therefore, the emphasis of digital economy is on the fact that data information and its transmission is a technical means to determine productivity, is the representative of advanced productivity. Such a technical means can penetrate into industrial and agricultural production, as well as services, forming the so-called Internet Plus, which is used together with other technical means and plays a role at the same time in a variety of production activities, but what determines the productivity of these production processes is the technical means of data information and its transmission, therefore, this is the digital economy.

1.3. Characteristics of Digital Economy

Digital economy based on digital technology displays salient features in economies of scale, economies of scope, and long tail effect.

1.3.1. Economies of Scale

In the industrial economy, enterprises adjust the scale to the scale corresponding to the lowest average cost in the long term to achieve economies of scale. Because the enterprise's optimal production scale is limited by the enterprise management ability, enterprise asset stock, internal transaction cost and other factors, the long-term average cost of the enterprise presents the characteristics of first descending and then rising, which determines that the scale of the enterprise cannot be expanded indefinitely. In the era of digital economy, platform enterprises achieve economies of scale through network externality. The externality of the network is often positive, not negative.

The value of a network depends on the number of customers it connects to. The value of connecting to a network depends on the number of others who are already connected to the network (Shapiro and Varian, 1998). Thus, according to the Metcalfe law, the value of the network grows at the square of speed of the number of users. When network users exceed a certain critical point, the value of the network sees explosive growth. It can be seen that the economies of scale pursued in the industrial economy is to reduce the long-term average cost through the expansion of production scale, and then to maximize the benefits. What the economies of scale pursue in the era of digital economy is to maximize the income by expanding the scale of network users and increasing the average profit.

1.3.2. Economies of Scope

The traditional economies of scope are to achieve the total cost savings by supplying two or more products, and then to improve economic efficiency. The traditional economies of scope are based on the correlation of different products in production and sales, so it can be said that the degree of relevance of enterprise products is directly related to the degree of economies of scope. In the era of digital economy, the conditions for platform enterprises to achieve economies of scope shift from product relevance to economies of scale based on the number of users. Based on the vast user resources, platform enterprises provide various, small batches of products and services that meet the "niche" needs as well as high-volume, a single variety of products and services that meet the needs of the public. Platform enterprises can attract countless sellers and buyers and greatly expand the variety of sales, thus forming long tail theory most effectively (Jiang, 2017). For example, about half of Amazon's online bookstore revenue comes from bestsellers, while the other half comes from various rare books of fewer sales.

1.3.3. Lower Transaction Costs

Coase believes that market friction causes transaction costs, including the search costs arising from the search for the counterparty, the information costs arising from obtaining information about the counterparty and the communication with the counterparty, the bargaining costs before signing the contract, and the costs of supervision after the signing of the contract. The emergence of digital economy has greatly reduced the search costs, as the platform enterprises use big data to quickly link supply and demand directly together and effectively alleviate the information asymmetry between the two sides of the transaction, thus greatly reducing the search costs, information costs, bargaining costs and supervision costs of both sides of the transaction. 95% of the entities of China's logistics industry are small and medium-sized enterprises, with business model being mostly single-vehicle freight transport, and source organization capacity being poor. This business model results in a high

degree of fragmentation of China's logistics industry, fierce competition in certain sectors, high logistics costs, and low efficiency. The proportion of China's logistics costs in GDP is about twice that of the United States, and there are 40% of idling trucks in China, 3~4 times that of the United States and Germany.[1] Internet platform brings together enterprise users and logistics companies, so that they establish direct contact, effectively alleviate information asymmetry, thus greatly reducing transaction costs. For example, Guizhou "Truck Alliance" successfully applied big data, cloud computing and mobile internet to China's logistics, accurately matching the country's goods with goods vehicles, greatly reducing idling, thus fundamentally solving the mismatch of vehicles and goods. In 2016 Truck Alliance helped save 61.5 billion yuan in fuel, reducing carbon emissions by 33 million tons.[2]

1.3.4. Creative Destruction

Schumpeter (1990) believes that when the new combination is intermittent, the phenomenon with development characteristics will appear, and the new combination includes new products, new markets, new methods, new supplies, and new organizations. Schumpeter believes that the emergence of a new combination in a competitive environment will break the balance of the old combination, so that the new combination means destroying the old combination through competition. The wide application of digital information and communication technology has not only given birth to new products, new business forms, new services, but also greatly impacted or even destroyed some traditional industries and business forms. The widespread use of WeChat, for example, has had a huge impact on the voice and messaging services of Chinese telecoms operators, particularly the "devastating" blow to the messaging business. According to Ministry of Industry and Information Technology of China, in 2012, Chinese mobile phone users sent a total of 900 billion text messages, but after that the number has declined year by year. Especially for the vast number of young people, text messages sent monthly are numbered. In addition, with the expanding market share of e-commerce, offline sales industry has been impacted severely, 3C stores, bookstores, clothing stores, and supermarkets other stores being much less frequented.

2. The Social Reproduction Process of Digital Economy

2.1. Social Reproduction Process of Digital Information Products

Data are non-organized numbers, words, sounds, images, etc.; information is

[1] McKinsey Global Institute: China in the Digital Age: Building a New Economy with Global Competitiveness, December 2017.

[2] http://www.huochebang.cn/about#hash_social_value.

data that is arranged and processed in a meaningful form (meaningful data) (World Bank, 1998). An information product is any product that can be digitized, such as a book, a movie, or a record (Varian, 1998). Digital products can be divided into two categories: one is digital hardware products, that is, digital products; the other is digital information products, that is, digital information products. Digital information products are products that exist only in the form of binary code represented by 0 and 1 strings or exist in the form of bits, and their existence is based on the network and terminal equipment as the material carrier. Digital information products are essentially a non-material form of products, are different from the traditional products in material form, and are a totally new product. The invisible and digitalized information products are not only essential inputs and intermediate products, but also more and more common direct consumer goods. Their production does not mainly rely on fixed capital investment, but on the input of non-physical capital; their exchange does not mainly rely on the exchange of tangible markets, but on virtual market; their consumption does not mainly rely on offline consumption, but on online consumption.

2.1.1. Digital Information Products Are an Essential Input

Digital information products can not only be used as direct consumer goods, but also a key input, and they have distinct characteristics. First, the production cost of digital information products is very high, but can be replicated at an almost zero cost. The spread of the Internet and IoT generates massive amounts of data, and a lot of hardware and software input is required to clean, mine and analyze these massive and fragmented data. However, once the digital information product is produced, very low cost is needed to replicate it. Second, a lot of positive and negative externalities are generated in the production and use of digital information products. With the help of big data, enterprises have obtained the changes of industry trend and consumer behavior preference after processing large amount of data, which provides the conditions for accurate production and accurate marketing. The web TV series House of Cards, the first "big data" production, was so popular online that Netflix made great profits, which is a typical case with digital information products as a key input factor in the film and television industry. Netflix has 33 million users worldwide, and every day users generate over 30 million behaviors, over 4 million reviews, and over 3 million search requests on Netflix. The analysis of the massive amount of user data it has accumulated over the years shows that most of the fans of the BBC version of House of Cards are also fans of director David Finch and Best Actor Oscar winner Kevin Spacey. So Netflix, based on the findings, invited David Finch and Kevin Spacey to act as director and protagonist respectively of the new version of House of Cards, respectively. Netflix's findings have proved to be correct, and the House of Cards has made a huge commercial success.

2.1.2. Production of Digital Information Products

The production of products in the industrial economy is mainly based on the investment of fixed capital, and the digital information production in the ear of digital economy is mainly realized by the intangible capital such as ICT. We are in the age of information explosion, and in recent decades the vast amount of data generated by the Internet, IoT, and mobile terminals has outpaced the sum of the data produced by humans for thousands of years. According to data provided by IDC, the total global data was 1.8ZB (1ZB=1 trillion GB,1.8ZB equivalent to 1.8 billion 1TB hard drives) in 2011, 8.61ZB in 2015, 4.78 times that of 2011, and global data are now growing at about 40% per cent a year, and the world's big data reserves are expected to reach 44ZB by 2020. These vast amounts of data which are fragmented and non-structural are not entirely valuable and need to be collected, processed, cleaned, analyzed and mined, which is beyond the scope of conventional software processing, so it is necessary to use the virtualization technology, distributed data storage technology and management platform of cloud computing as the bottom of computing resources to support big data analysis and mining of massive data. The processed data become digital information products and an important resource or product. The production of digital information products is based on the continuous development of ICT as the premise. Therefore, it can be said that the production of digital information products mainly relies on intangible capital investment.

In addition, in terms of the product form, products of agricultural economy and industrial economy are mainly in material form. Value in use with material entities being carriers is the material bearer of value, the products' value in use can hardly exist without the material form. In the era of digital economy, data information products are mainly in non-material form, and are reproducible, variable, non-destructive, so their value in use is no longer based on material form as a carrier, but on the database and so on.

2.1.3. Exchange of Digital Information Products

At the end of the primitive society, there was the first social division of labor, and on the basis of social division of labor appeared the initial product exchange. With the continuous development of productivity and the emergence of the second and third social division of labor, the human commodity exchange evolved from the most primitive form of barter (W-W) into a simple form of commodity-currency-commodity (W-G-W), which eventually evolved into a form of developed commodity circulation of money-commodity-currency (G-W-G). From primitive society to industrial economy and society, the commodity form of human exchange is divided into tangible products and intangible products (mainly services). A tangible product is a product that

exists in the form of matter, a mixture of chemical substances, and an atom is its most basic constituent unit. Intangible products are products that exist in the form of non-material forms. The physical and chemical properties of tangible goods determine that the exchange of such goods cannot break through the limitation of time and space. The intangible products are in non-material form, but their existence needs to take the material as the carrier, and their production, exchange and consumption are integrated, cannot be carried out separately. And the consumption of these products requires the face-to-face communication between the buyer and the seller, which determines that the exchange cannot break through the limitation of time and space. As a result, commodities before the ear of digital economy were mainly exchanged through tangible markets. In these tangible markets, the seller obtains the value of goods by delivering the value in use, value and value in use moving in opposite directions. In the ear of digital economy, digital information products have become the main products of exchange. They exist in the form of bits or bitstream, which are stored in the form of bits and can be transmitted over the network in the form of bitstream. They are invisible, untouchable, not to be perceived, and can only be identified through terminal equipment. Although they are intangible, immaterial, their existence relies on the substances, that is, substances are needed for their storage and dissemination. Therefore, the characteristics of digital information products determine that their exchange is mainly carried out on the Internet, and that the two sides can break the limits of time, space and exchange at anytime, anywhere. This means that the market for digital information product exchange is an invisible, unfixed virtual market. In this virtual market, the seller only provides the buyer with the value in use of the product, rather than deliver it. Because the seller retains the value in use of the product after obtaining the exchange values paid by the buyer. Because digital information products can be replicated at nearly zero cost, sellers can retain the value in use of the product.

2.1.4. Consumption of Digital Information Products

Consumption, divided into productive consumption and individual consumption, is the human use of a variety of social products to meet their needs of production and development. Digital information products are the same. Combined with the definition of consumption and digital information products, the consumption of digital information products can be described as: human use of a variety of digital information products to meet their own needs for life. Since digital information products exist in the form of bits and is stored and propagated on Internet terminal devices, once the first digital information product is produced, they can be replicated at a little or no cost and can be supplied indefinitely, which determines that the consumption of the product is non-exclusive, that is, different consumers can use the same products at the same time without being affected by each other, and the premise that different consumers

can break through the limitation of time and space to use the same product is that the product is produced and consumed on the Internet, For example, the King of Glory Game, developed and run by Tencent, has a maximum of millions of people online, and these players play the same digital information products, although they play at different levels, they are indeed online playing the same game.

2.2. The New Social Exchange

Since the first industrial revolution, the degree of human labour productivity and technical specialization has reached unprecedented levels. Technical specialization means the production tasks of a particular product can be broken down into different steps (Lu, 2004). From the division of processing and manufacturing process of pins (Smith, 2005) to Fordist, to Vertical Integration (Williamson, 2004), Multi-Layered Production System (Sheared,1983) and Modularity Production (Baldwin and Clark, 1997) and Global Value Chains (Gereffi *et al.*, 2001), the scope of the technical speculation gradually extended from within the manual workshop to different spaces and even different countries, leading to intra-product specialization, that is, the various processes and links required by the production of a product are split into different regions or even different countries to complete. In addition to the deepening technical specialization, the decline in the transaction costs of the external market of enterprises provides a material basis for intra-product specialization. This decline in transaction costs in external markets is mainly reflected in the decline in information and communication costs and transport costs. First of all, the emergence and popularization of information technology, especially the invention and use of the Internet, remove the significant relationship between the transmission cost of high-density, large-capacity information flow and space distance; the information technology revolution has led to a declining cost of long-distance information transmission and a new situation of "distance extinction" (Cairncross, 1997). Improved quality of sound and image communication technologies and improvements in broadband and connectivity facilities have enabled remote regional service providers to seamlessly connect with service audiences and partner providers, making it possible to share files (Vashistha, 2005). Second, lower transport costs and increased efficiency. Over the past few decades, various transport costs have shown varying degrees of decline, particularly in the cost of air transport (Hummels, 2007), creating the conditions for cooperation between enterprises in different spaces and countries. In addition, the high-speed transport network composed of air transport, high-speed rail and urban rail has greatly improved the efficiency of transportation and enhanced the exchange of personnel in different regions. Therefore, it can be said that the development of ICT and the significant decline in transport costs provide a material prerequisite for the decline of transaction costs in the external market of enterprises.

Driven by the deepening technical specialization, the development of ICT, and the decline of transportation costs, enterprises, in order to gain a comparative advantage and achieve economies of scale, transfer production processes and links which are originally internal to external suppliers in different regions and countries to achieve the goal of reducing costs. On the one hand, knowledge-intensive and technology-intensive production chain links are transferred to the central areas of large cities to better utilize the rich human capital there, on the other hand, those standardized production links and processes are moved to small and medium-sized cities, towns and villages to reduce costs, thus obtaining comparative advantage and scale effect. Specifically, in the product value chain, links such as R&D, product design, and management control are transferred to large urban central areas where science and technology and human resources are concentrated, manufacturing; processing and assembly and other links are transferred to small and medium-sized cities, towns and villages. In this process, large cities, towns, small and medium-sized cities both specialize and cooperate in the product value chain, give full play to their comparative advantages, and achieve resources complementation, differentiated industrial development, and reasonable flow of factors, gradually forming a new pattern of urban and rural division of labor. This new pattern of urban-rural division of labor has increasingly changed the traditional social exchange relations, disrupting the traditional urban-rural relations. The contradiction between industrial production and agricultural production, and that between physical and chemical economy and biological economy, which used to be the basic content of the traditional urban-rural exchange and the urban-rural relations, are undergoing or about to undergo disruptive changes, which are reflected in the following. First of all, large cities and economic core areas mainly rely on scientific and technological research and development, service economy, data information, digital economy and public goods production. In 2014, the British journal *Nature* rated the scientific research capabilities of Chinese cities for the first time—WFC Index, and Figure 1 shows the top 10 cities in the WFC index. Beijing ranked No.1 with its WFC index being 1329, and Shanghai and Nanjing ranked the second and third, with the WFC indices being 712 and 310, respectively. The sum of WFC indices of the 10 cities accounts for 70.4% of the total WFC index of the nation. The above ranking and proportion show that cities with strong scientific research capacity are mainly those first-tier cities and some of the provincial capital cities. In early 2016, National Intellectual Property Administration of China announced the 10 cities with the largest number of invention patents in China in 2015. Among them, Beijing ranked the top with 35308 patents, followed by Shanghai and Shenzhen as the second and third with 17601 and 16956 patents, respectively. Secondly, small and medium-sized towns and non-economic core areas mainly rely on industrial and agricultural production, biological and physical and chemical economy. Driven by the inter-regional specialization in the industrial chain, specialized towns specializing in the production

of one or more industries have appeared in township and small and medium-sized cities in Guangdong, Zhejiang, Shandong, and Anhui, and their industries cover primary, second and tertiary industries in an all-round way. The new urban-rural division of labor in the age of digital economy promotes the formation of new urban-rural relations and regional relations, breaks the traditional one-way flow of factors, and thus makes the urban-rural boundaries more and more blurred, enabling them to give full play to their respective advantages and achieve win-win from interaction.

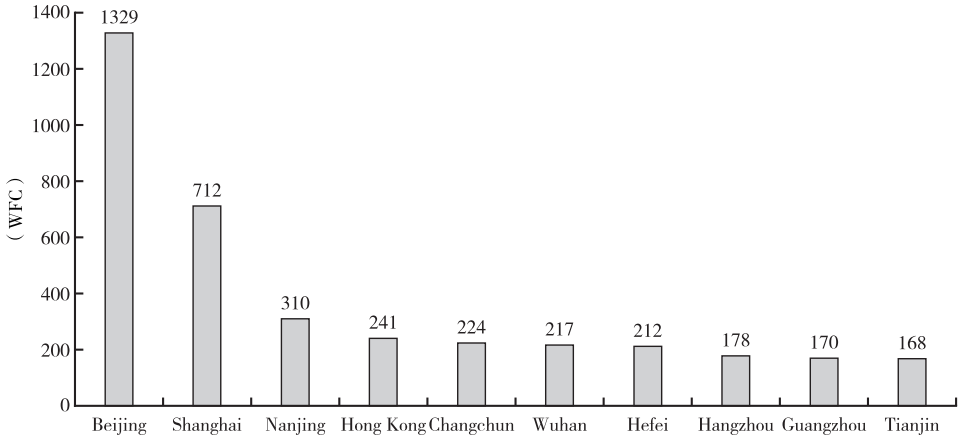

Figure 1. Evaluation of Scientific Research Achievements of the Top 10 Cities in China

Source: *Nature.*

3. The Micro-Entities of Digital Economy and the Emergence of Sharing Economy

3.1. The Micro-Entities of Digital Economy

The micro-entities of digital economy include platform enterprises, manufacturers, service merchants and consumers, who undertake the organization and consumption of production exchange, and form and consume social productivity.

3.1.1. Platform Enterprises Become the Subject of New Production and Exchange

The platform is a product or service that brings together bilateral network user groups (Eisenman *et al.*, 2006); it enables value creation interaction between external producers and consumers (Parke *et al.*, 2016); it brings together interdependent groups, forming low-cost and efficient point-to-point connections (Jiang, 2016). It can be seen that the platform is a business model that creates value by incorporating different user groups into the same network. The emergence of the platform has a long history and is not specific to the digital economy. For example, department stores link consumers and businessmen, and newspapers associate subscribers with advertisers. However,

the above entity platform makes the connection cost of different user groups high, and cannot break through the limitation of time and space, so the composition of the "tangible" network is limited, while the Internet platform relying on ICT enables its users to connect at a lower cost, the composition of the "intangible" network can break the space-time limit, significantly reducing transaction costs and improving efficiency. For example, in 2017, Tmall witnessed a total volume of trade of 168.2 billion yuan on "Double 11", with 1.48 billion transactions via Alipay, 256000 transactions per second at trading peaks, 812 million logistics orders, and trading coverage in 225 countries and regions around the world. Network effect is the basic feature of the platform, as more and more users join the platform, the platform becomes more attractive to potential users. Network effects include direct network effects and indirect network effects. Direct network effects mean that the more users there are, the more users there will be, just like more WeChat users attracting more WeChat users; indirect network effects mean that, the more users on one side of the platform (such as online gamers), the more users on the other side of the platform (such as online game developers). The platforms based on network effect can be divided into four types, namely trading platform (Taobao, Uber, etc.), innovative platform (Microsoft, Intel, etc.), composite platform (Google, Amazon, etc.) and investment platform (SoftBank, Naspers, etc.).

As the value of the platform increases with the number of users, the most valuable enterprises today are those that are able to "compile" and coordinate huge networks, rather than traditional ones with large amounts of resources all set in themselves. According to the closing price of July 31, 2017, the market capitalisation of the top ten global platform companies has exceeded that of the top ten multinationals (see Table 1), which have an average creation time of up to 129 years, while the average creation time for platform enterprises is 22 years. Platform enterprises, with a short establishment time, vigorous vitality, and strong development momentum, have become a leader in the digital economy. Compared with traditional enterprises, Internet platform enterprises based on network effect have the following distinctive characteristics.

First of all, in terms of the source of value creation and transfer path, the value created by traditional enterprises originates from within the inside, and the value transfer is unilateral, while the platform enterprises create the value from the outside of the platform, and the value transfer is multi-directional. In the industrial economy, most companies such as Walmart, Toyota, and GM were linear businesses. These companies created value by producing products or providing services, and by selling them to distributors and consumers downstream of the supply chain, the value was transferred from upstream to downstream in the supply chain. In the digital economy, platform businesses which are platform-based do not create value with the resources they have within them, but create value by creating connectivity, i.e., by connecting and coordinating producers and consumers in giant networks, it can be seen that the value created by the platform enterprise originates from the outside. In the platform business

model, companies are no longer the only source of value creation, and consumers can create value and share it with others. Consumers get proactively and deeply involved in product production through the super platform, leading the enterprise to produce a certain kind of products. The relationship between enterprises and consumers has shifted from the traditional unilateral value transfer, which was from the enterprises to the consumers, to joint value creation by the enterprises and the consumers. The relationship between enterprises shifts from emphasizing division of labor between the upstream and downstream in the value chain to the large-scale synergy between enterprises on the Internet platform. Therefore, in the platform model, the value can not only be transferred from the producer to the consumer, but also from the consumer to the producer, that is, the value transfer is multi-directional.

Table 1. Global Top Ten Platform Enterprises and Top Ten MNCs by Market Capitalisation

Platform enterprises		MNCs	
Name	Market capitalization (USD bn)	Name	Market capitalisation (USD bn)
Apple	780.8	Berkshire Hathaway	434.1
Google	649.1	Johnson & Johnson	359.6
Microsoft	561.9	Exxon Mobil	332.2
Amazon	472.1	JPMorgan Chase & Co	327.7
Facebook	484.1	Wells Fargo	269.7
Alibaba	394.6	Nestle	262.3
Tencent	381.1	Walmart	245.5
Princeline.com	99.7	AT&T	239.4
Baidu	78.4	P&G	232.5
Netflix	78.1	General Electric	223.3

Note: Market capitalisation based on closing price of July 31, 2017.
Source: Ali Research Institute: *Digital Economy 2.0*, January, 2017.

Second, in terms of economies of scale, traditional enterprises achieve supply-side economies of scale, while internet platforms achieve demand-side economies of scale. In the industrial economy, traditional enterprises expand the scale of production in order to reduce the cost of unit products and make greater profits. However, with the continuous expansion of the scale of production, the transaction costs and the difficulty of management within the enterprise also rise and increase accordingly, which restricts the scale of the enterprise from being expanded indefinitely. Each enterprise produces under the established scale, which in turn limits the value and value growth created by each enterprise. In the era of digital economy, the success of platform

enterprise is built on network effect, also known as demand-side economies of scale, that is, with more users accessing the platform, there will be non-linear growth in the value of the platform. WeChat has a market value of $800 billion, and this huge value is not based on the economies of scale that develop WeChat software. Admittedly, there are economies of scale in the development of WeChat software. There are several kinds of software on the market that are similar to WeChat in function, such as MiTalk, Flipchat, etc., but the market value of these software is very insignificant compared with that of WeChat. WeChat has a sky-high market value because of its wide range of applications, with more than 1 billion users. In addition, unlike the supply-side economies of scale, the demand-side economies of scale will not lead to diseconomies of scale with the expansion of scale, for example, if others use WeChat, then you have no reason to refuse to use it.

3.1.2. Non-Platform Production Subjects Become Smaller and More Specialized

In the era of industrial economy, the traditional large companies produce with rigid production methods of mass production and standardization, and the mainstream supply chain is linear; correspondingly, the enterprise organization is huge, the level is numerous and complex, and the internal transaction costs are high. In this mode of production, the enterprise is the party that dominates what is produced and how it is produced, while the consumer is the isolated and passive party that accepts the product. With the continuous enrichment of material products and the continuous upgrading of consumer concepts, as consumers pay more and more attention to personalized experience, the traditional large-scale and standardized production methods become inadequate for the market demand for varieties and small batches, unable to cope with the changing personalized needs of consumers. The contradiction between product standardization and mass production supply and consumers' demand for massive variety and small batches leads to oversupply on consumer goods market, and the personalized demands of large number of consumers cannot be satisfied. According to McKinsey, market demand forecasts were more than 90% accurate by 1970, but forecasts were only 40% to 60% accurate around the new millennium. This means that about half of the products produced by an enterprise are not needed by consumers. In the face of increasingly complex personalized consumer needs and market environment, the organizational structure of traditional enterprises has encountered unprecedented challenges. A survey of more than 100 listed companies in Europe and the US by Boston Consulting Group found that over the past 15 years, these listed companies have increased by 50% to 350% in terms of work procedures, coordinating bodies and decision approval steps. In the era of digital economy, with the infrastructure represented by the "cloud, network and port" improving, and the external transaction costs of enterprises declining faster than the internal transaction

costs, it is very uneconomic to maintain a bloated large organizational structure, so that large enterprises are divided into small enterprises and engaged in specialized production, with non-core business outsourced. In addition, compared with large enterprises, small enterprises are more mobile, flexible, more able to adapt to the needs of vast personalized customization, more able to quickly respond to the rapidly changing market environment. As a result, companies are changing smaller and more specialized.

3.1.3. Platform Economies Become the New Form of Social Production Organization

The Industrial Revolution brought mankind into the Age of Steam, and the large industrial production of machinery made the transformation of social production organization from workshop to factory, so that mass production could be realized; the Second Industrial Revolution, with the wide application of electricity as its main content, gave birth to the new social production organization—the company. The transnational corporations of production organization complying with Taylorism and Fordism are the main promoters of the globalization of production, and become the main body of economic activities in the industrial economy in the last century. In the new century, with the development of ICT, cloud computing and big data have spawned a new form of organization—the platform economies, that is, with the Internet platform enterprise as the center, thousands of service merchants and consumers are linked together, and great value is created through the efficient interaction between different groups. Platform economies go beyond the traditional concept of multinational corporations in their size, value creation, influence, inclusiveness and other aspects, and have become the main driver for the development of the digital economy. For example, there are about 10 million sellers on Alibaba's retail platform, with more than 500 million buyers and hundreds of thousands of service merchants. Alibaba sold more than $500 billion in 2016, surpassing international retail giant Walmart. In addition, if the turnover of Alibaba is regarded as the GDP of an economy, it can become the world's 21st largest economy, alongside Argentina. Compared to MNCs, platform economies are more equitable, inclusive and mutually beneficial.

First, platform economies are more equitable. In terms of organizational style, in the industrial economy, multinational corporations follow the chain organization mode and process. In this type of organization, the superior-subordinate relationship between multinational corporations and small enterprises is obvious. MNCs are at the top of global value chains and play a dominant role, while others are at the lower end of global value chains, providing supporting services to MNCs. In the era of digital economy, the platform economies use the "cloud system" to organize, namely, super platform + mass users + massive merchants and service providers. In this style of

organization, the platform enterprise and other participants are equal, and there is no absolute dominant party, as they are flexible community free to gather or separate.

Second, the platform economies are more inclusive. Inclusive means most economic players have the opportunity to participate in and share the fruits of economic development. The platform economies are more inclusive than the multinational corporations. First of all, it is reflected in the more diversified beneficiaries, with MSMEs as the biggest beneficiaries. In the industrial economy, large companies, especially multinational corporations, occupy most of the social and economic resources and most of the benefits of economic globalization. According to the 2013 UNCTAD report, MNCs monopolize 60% of global production and 80% of global trade. For small companies to survive and develop, they must be attached to large companies and become part of their supply chains. Unequal status between small companies and large companies determines the difficulty for small companies to grow independently. In the digital economy, small companies in the platform economy, with the help of the "cloud network" and the strong commercial infrastructure of platform enterprises, have greatly reduced operating costs, greatly expanded the market, and are able to stand on the same stage as the multinational companies, participating in and sharing the gains of the digital economy. Secondly, the platform economies can benefit poor and remote areas and effectively narrow the gap between rich and poor in the region. Platform enterprises help poor areas connect to a wider market, promote the upgrading of local industrial structure, stimulate local entrepreneurial enthusiasm, and raise income levels. For example, sales volume of national poor counties on Alibaba retail platform reached nearly 30 billion yuan in 2016, with more than 280 of the poor counties having sales of more than 10 million yuan and 41 poor counties having sales of more than 100 million yuan.[1] Finally, the platform economies bring inclusive economic and trade to developing countries. In the industrial economy, the pattern of international division of labour dominated by developed countries determined that developing countries were at the lower end of the global value chain, and the uneven distribution of the globalization dividend between developed and developing countries and the widening gap between rich and poor had not been reversed. In the era of digital economy, the various subjects in the platform economy are equal, with no dominance over a particular party. Through the Internet, vast number of small and medium-sized enterprises has the opportunity to participate in international trade on an equal footing, and compete with large companies in the global market. According to *2016-2017 China Importing E-Business Market Research* released by iiMediaResearch, China's cross-border e-commerce turnover was 6.3 trillion yuan in 2016, and it is expected to reach 8.8 trillion yuan that in 2020 (See Figure 2.).

[1] Ali Research Institute: *Digital Economies: New Engine in the Inclusive Age 2.0,* January, 2018.

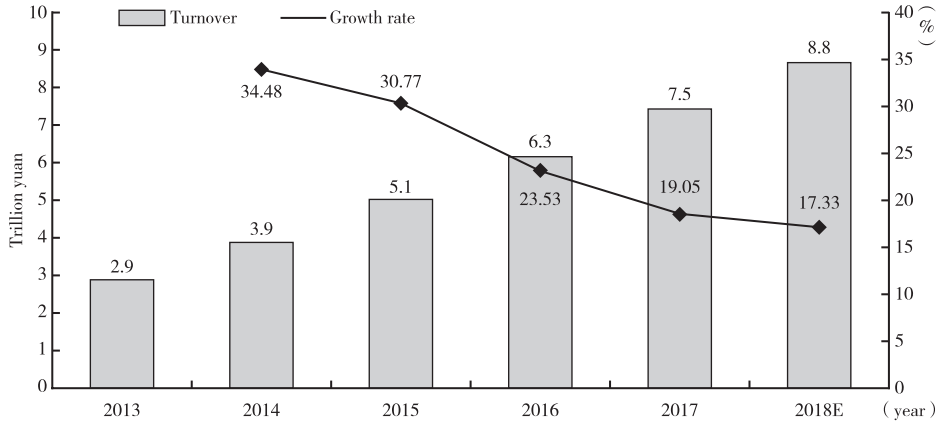

Figure 2. Scale of China's Cross-Border E-Commerce

Source: Ministry of Commerce, General Administration of Customs, iiMediaResearch.

3.2. Sharing Economy

Based on the massive user resources of Internet platform aggregation, individuals or enterprises "share" idle resources on the Internet platform at a lower cost for the purpose of obtaining a certain amount of compensation. This pattern of "sharing" maximizes the activation of the idle resources of society and gives rise to a new and sustainable economic model—sharing economy. The sharing economy is a concrete manifestation of the digital economy in improving the efficiency of resource utilization. With the increasing number of micro-entities in the digital economy, the scale of the shared economy has expanded rapidly. China's sharing economy grew from 1.956 trillion yuan in 2015 to 4.9205 trillion yuan in 2017, and the market size is expected to reach 6.3966 trillion yuan in 2018 (see Figure 3).

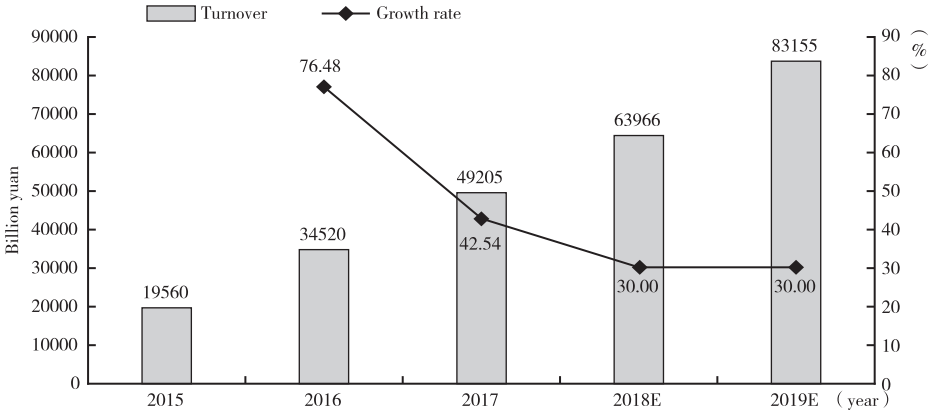

Figure 3. Market Size of China's Sharing Economy and Forecast in 2015-2019

Source: Information Research Department of State Information Center: *Annual Development Report on China's Sharing Economy 2018*, February, 2018.

The concept of sharing economy can be traced back to the collaborative consumption proposed by Felson and Spaeth (1978), which means individuals achieve point-to-point trading of goods and services through third-party platforms. Botsman and Rogers (2010) believe that collaborative consumption is an activity that uses products and services beyond ownership. The essence of collaborative consumption is sharing economy.

Belk (2007) believes sharing to be the act and process of providing one's own items for the use of others, or using other people's belongings. Koehn (2009) sees sharing economy as a system of direct exchange of goods and services between individuals, which includes the sharing of idle items, idle rooms and vehicles. Although the academic community has long proposed the concept of sharing economy, this concept has only been known to the public in recent years. Driven by the development of ICT, the increasing user demand and the transformation of consumption concept, the sharing has developed rapidly in recent years and has become popular all over the world. The sharing economy extends from the initial automotive and accommodation sectors to a wide range of fields and segments, including finance, healthcare, and diet. In terms of users' demands, the sharing economy can be divided into travel, accommodation, catering, etc. With the industrialization of many countries approaching the end, the world enjoys abundance but the distribution is uneven, there being vast quantities of idle resources, which is the premise of sharing economy; the rapid development of ICT has greatly reduced the transaction costs of sharing, which provides technical support for sharing economy; the emergence of a large number of interactive Internet platforms has greatly reduced the information asymmetry between the two sides of the transaction and enhanced the credit between them, so credit is the cornerstone of sharing economy; the pursuit of profit maximization is the fundamental driving force of sharing economy. As long as the price of sharing is higher than the cost paid to achieve sharing (such as asset depreciation), the user can obtain a certain amount of remuneration for transferring the right to use the resource at a specific time, and consumers can benefit as long as the cost of consuming the shared product or service is lower than the cost of leasing the product or service from the market directly or leased market, which improves consumer surplus and then increases the welfare of the whole society.

From the perspective of economics, the sharing economy has the following characteristics.

First, production methods rely less on the possession of fixed production conditions (such as platform enterprises), or the joint use of production conditions is more efficient; with more reliance on the intelligence, technology and data of producers, human capital is more important than materialized capital and, to a certain extent, freed from the "dominance of living labor by materialized labor". In the industrial economy, with intensified globalization, the world is increasingly becoming a unified market. Driven

by profits, enterprises carry out large-scale, mass production, continuously improve production technology and optimize assembly lines, so that more and more advanced and complex machines are produced in place of the workers. The direct consequence of this technological improvement is the unprecedented scale of enterprises, and in the production factors invested, the role of capital (machinery, plant, etc.) is highlighted while the status of labor force declines as part of the labor force is replaced by the machinery, materialized labor of machines and equipment dominating the living labor. Therefore, in the industrial economy, the production is more dependent on fixed capital. However, since the 1990s, the status of human capital and technology in production has been continuously enhanced, directly manifested in the continuous improvement of the digital economic infrastructure represented by "cloud, network and port". The sharing economy supported by "cloud, network and port" is less dependent on fixed capital in production, but more reliant on the rapid and low-cost self-matching of the resource supply pool and demand pool assembled on the Internet platform by technologies as cloud computing, big data, and artificial intelligence.

Second, the specialization and collaboration in the production process is less mandatory, but more reflected in the personalized willingness and participation. In the industrial economy, the providers of products and services are mainly enterprises. Large enterprises dominate the production and seize most of the profits of the product value chain by virtue of their advantages in capital, technology, scale and talent, while small enterprises, in order to survive and develop, have to be attached to large enterprises, becoming part of the production chain of large enterprise. In the sharing economy, the providers of products and services are mainly individuals. On the sharing platform, the relationship among the suppliers is equal, so is that among the demanders, and that between the supply and demand, and there is no dominating one party by the other. The supplier will cede the right to use the idle resources for a certain period in order to obtain some remuneration. The demander is focused on the value of the resource, not on the ownership of the resource itself. The participating subject on the sharing platform is a spontaneous and flexible community that rapidly gathers and disperses. In the production process, the specialization and collaboration between the various participants is not mandatory, but based on their own idle resources surplus status as well as sharing consumption and green consumption concept. For example, Airbnb landlords, by sharing their spare houses, can not only earn a substantial income, but also, by talking to tenants from all over the world, appreciate the customs of different regions, and possibly even make some like-minded friends to enhance their personal social capital. In addition, in the sharing economy, the boundary between the supplier and the demander is blurred, and the role of the two can be exchanged to a certain extent. Because each provider has a different type of idle resource and the

needs of each supplier are varied, the participants of sharing economy may be both a provider of one resource, and the demander of the other. This identity shift in supply and demand depends on the surplus or shortage of the participants at a given time and on a specific resource.

Third, in the distribution, human capital and all kinds of intangible assets gain more in the virtual space than from materialized capital. Human capital growth, intangible assets and new social exchange will promote the development of sharing economy. For example, as of December 10, 2017, Didi, based on its massive background data, had optimized more than 800 traffic lights nationwide with the help of artificial intelligence, big data, and machine learning, savings 10%~20% of the time in traffic peak. According to the 2017 traffic report released by Didi, Didi saved more than 30000 hours of travel time daily for residents in Jinan, the total annual savings being 11.58 million hours, which is equivalent to creating more than 360 million yuan of income additionally. The optimization of traffic lights reduced carbon dioxide emissions by 44000 tons throughout the year for Jinan. For example, on December 12, 2017, Airbnb announced that it would use virtual reality (VR) technology and augmented reality (AR) technology to enable tenants to preview their rooms in advance. Through VR technology, tenants can get full knowledge of every detail of the rooms available, and effectively solve the information asymmetry caused by the photos and descriptive phrases provided by the landlord, thus granting the tenants greater initiative in the selection of housing and stronger sense of security. AR technology can help tenants adapt to local life in advance, understand the history of the target city, provide real-time translation of historical relics, and tell the tenant how to use the room (such as unlocking) and so on.

4. Industrial Characteristics and Theoretical Challenges of Digital Economy

4.1. Industrial Characteristics of Digital Economy

The division of three industries is based on the historical evidence that the material production sector (agriculture, industry) accounts for the vast majority in the industrial economy and the non-material production sector is relatively small. This division reflects the historical fact that the industrial economy stresses the production of material products and neglects the production of non-material products. However, as countries have completed industrialization or entered the later stages of industrialization, the focus of production shifted from the production of material products to that of non-material products, the industrial structure was continuously optimized, especially the development of the Internet and ICT triggered the prosperity of the digital information industry, and the proportion of tertiary sector in the national economy gradually increased, exceeding that of the first and the second industry.

Although to some extent, the digital information industry belongs to the services, in view of the huge role of the digital information industry in promoting economic growth, the inclusion of it in the tertiary industry together with other low-value-added services does not reflect its position in the national economy, as it is not possible to measure its promoting role in the efficiency of economic operation and innovation ability, nor can we accurately grasp the development status and existing problems of the industry, thus unable to maximize the role of digital information industry in promoting economic development.

The industrial division is based on the objective order and intrinsic connection of the economic activities of the whole society, so it is a dynamic and historical development process in itself. In the present and future period, with the rapid development of data information products, the original division of three types industries in industrial economics is facing challenges, as digital information industry is likely to become the fourth industry in the future.

4.1.1. Digital Information Industry Is a Sector with High Labor Productivity

Digital information industry is featured by high labor productivity, which overturns the traditional economic view that the service industry has low labor productivity. The reason of the low labor productivity in the traditional service industry is that production and consumption fail to break through the limitation of time and space, and the attribute of the product determines that its production and consumption must be carried out simultaneously. The production of this product is mainly provided by people, and there is no large-scale standardized production through machines, therefore economies of scale cannot be realized. As for digital information products, their production and consumption can break through the limitation of time and space. While the initial cost of digital information products may be high, they can be replicated at almost zero cost, making it easy to form economies of scale. Therefore, the integration of digital information industry with high labor productivity characteristics into tertiary industry cannot explain its difference from other service industries.

4.1.2. Digital Information Industry Is Capital-Intensive and Technology-Intensive

The production of digital information products mainly depends on intangible capital investment such as science and technology, while the production of other service products is mainly provided by people. For example, Didi uses distributed computing technology to quickly match drivers and passengers, and quickly schedule drivers closest to passengers to pick them up. Didi mines and learns from the massive background data, designs the intelligent path planning algorithm to predict the future

road condition, and calculates the optimal path from the driver's real-time location to the passenger's location at the millisecond level.

4.1.3. Digital Information Industry Is Growing in Size and Its Structure Is Constantly Being Optimized

In recent years, China's digital information industry is stably growing. According to the research report of China Academy of Information and Communications Technology (CAICT), the growth rate of digital information industry is comparable to that of GDP, accounting for about 7% of GDP. In 2005 digital information industry reached the scale of 1.3326 trillion yuan, accounting for 7.3% of GDP, and in 2016 it reached 5.1955 trillion yuan, accounting for 7% of GDP. In the past decade, the size of digital information industry expanded 3.9 times. In addition, its internal structure is constantly being optimized, and the share of revenue based on the electronic information manufacturing industry is declining, while revenue from software and the Internet continues to rise. For example, in 2016, revenue from information and communication services reached 2.1 trillion yuan, of which business revenue from the Internet reached 1.3 trillion yuan, accounting for 63%.

4.1.4. Digital Information Industry Is Highly Permeative

In the industrial economy, the division of labor is mainly inter-industry specialization, which defines the clear boundary and little permeation among agriculture, industry and service industry, and their association is limited to the cross-use of certain products and the partial overlap of service objects. However, in the digital economy, the diversity and the extensive application of digital information products determine that digital information industry is a highly permeative. Digital information products promote traditional industries both in efficiency and volume by integrating digital technology and traditional industries with the Internet as the carrier. According to *White Paper on China's Digital Economy 2017*, the output accomplished by traditional industries with the help of digital technology reached 13.8521 trillion yuan in 2015, accounting for 20.5% of GDP; the output increased to 17.3867 trillion yuan in 2016, accounting for 23.3% of GDP.

4.2. Theoretical Challenges of Digital Economy

4.2.1. "Visible Hand" Increases Capability of Resource Allocation

Western economics holds that there is an "invisible hand" in the market economy guiding the flow of resources to the most efficient places. This "invisible hand" is

the market mechanism, where under the interaction of price mechanism, supply and demand mechanism and competition mechanism, producers and consumers make decisions that are beneficial to themselves. However, due to incomplete information, producers and consumers make "rational decisions" based on the limited information they have, which often leads to mismatch of market resources and waste of resources. Because of information asymmetry, producers cannot catch the change of consumer preference in time, which leads to the existence of a large amount of ineffective supply in society. In the digital economy, however, the "visible hand" plays a fundamental role in allocating resources. Platform enterprises hold massive data of supply and demand, match the producers and consumers online through the platform, and enable the two sides to engage in direct dialogue, solve the problem of incomplete information and achieve the improvement of resource efficiency and social welfare. First, through big data analysis, producers can accurately and timely understand consumer needs, especially personalized demand, to achieve effective supply, and then accomplish the "thrilling leap" of value of goods, increasing consumer utility as their own personalized needs are satisfied. Second, platform enterprises successfully match the supply and demand of idle resources of society and individuals, realize the reuse of idle resources, and create more value.

4.2.2. The Law of Diminishing Marginal Returns Cannot Be Used to Analyze Digital Information Products

In the agricultural economy and industrial economy, the law of diminishing marginal returns is a universal law, which shows that there is an optimal input ratio between the fixed factors and variable factors invested in the production of any material product under the condition that the technical level is unchanged, and when the variable factors input exceeds a certain tipping point, the remuneration obtained by the newly added variable element of each unit is decreasing. In addition, the whole western economics is based on the assumption of resource scarcity. Resource scarcity leads to competition, and the consequence of competition makes unit compensation decrease until the equilibrium where marginal returns equal marginal costs. However, there is no diminishing of marginal returns in digital information products. First, digital information products have the characteristics of diminishing marginal costs. The production of digital information products requires high-tech investment, so there is a high fixed cost, but once a product is successfully produced, it can be replicated at very low or even zero cost, that is, the cost of producing an extra unit of the product is almost zero. Second, digital information products have network externality, which is determined by their existence form, communication carrier and cost characteristic. The gains from the production of an additional unit of product increase with larger number of users. As Arrow (1989), an American economist, has said, "The use of information

can lead to increasing pay. For example, a piece of technical information can be used in production on an arbitrary scale."

4.2.3. Intangible Capital Investment Subverts the Logic of Economic Growth

Economic growth has always been an important issue in the study of western economics schools, although they have been debating on how to achieve economic growth, they believe that investment mainly refers to fixed capital investment, and the investment demand of growth refers to "fixed capital formation". Adam Smith (2005), for example, stresses the importance of infrastructure investment for economic growth in *The Wealth of Nations*, arguing that investment in infrastructure such as bridges, ports and roads could benefit society as a whole; Keynes (1983) believes that the lack of effective demand caused by the "three psychological laws" led to depression, so the government should step up public investment to increase output by several times through the "multiplier effect"; the Harrod-Domar model argues that economic growth requires higher savings rates and their transformation into investment, and that real economic growth rates are determined by the productivity of investments at a certain level of savings and investment (Harrod, 1981; Domar, 1983); and Development Economics considers government investment to be an important driver of economic growth in developing countries, dividing investment into infrastructure investment and direct productive investment. Rosenstein-Rodan (1943) and Nurkse (1966) believe that governments should give priority to investing in infrastructure to provide the necessary preconditions for the development of other sectors. Hirschman (1991) argues that developing countries should prioritize direct productive investment and then invest in infrastructure to ensure economic growth as they face constraints of limited resources. Therefore, traditional western economics holds that investment can promote economic growth, focusing mainly on the relationship between the increase of material capital stock and economic growth.

However, as fixed capital has the characteristics of rivalry, when the demand for this fixed capital increases, the only way is to increase investment, but because of the law of diminishing marginal returns, enterprises cannot expand indefinitely on the scale of fixed-capital investment, thus restricting the ability of fixed capital to create value. And intangible capital has the attributes of non-rivalry and increasing marginal returns to enhance its value creation ability. In recent years, the input of intangible capital has been increasing, triggering the upsurge of intangible capital investment. From a microscopic point of view, the enterprises' R&D investment continues to increase. The European Commission's survey and analysis of global companies with R&D investment of more than 24 million euros in fiscal year 2016 found that 6 of the top 10 were information and communications companies. R&D

investments of Alphabet (parent company of Google) and Microsoft were 12.9 billion euros and 12.4 billion euros, respectively, ranking the first and the second; companies ranking from the third to the seventh were Samsung, Intel, Huawei and Apple. Among them, Huawei from China ranked the 6th, with R&D investment of 10.363 billion euros accounting for 19.2% of its sales. In this report, there are 10 companies from China with R&D investments ranking among the world's top 100 (see Table 2). From the macroscopic point of view, the intensity of investment of intangible assets in various countries has been increasing in recent years. Although the statistical standards of intangible asset investment have not been established on a global scale, many scholars have used direct expenditure method to calculate the scale of intangible assets investment in some countries. For example, Corrado *et al.* (2005) measured the investment in intangible assets in the United States during the period of 1998—2000 and found that the average annual intangible asset investment was $1.2 trillion, accounting for about 13% of US GDP. Tian *et al.* (2016) calculated the scale of China's intangible assets investment during the period of 2001—2012 based on current prices and constant prices: at constant price, China's intangible assets investment grew at an average annual rate of 21.81% with the scale increasing from 388.7 billion yuan in 2001 to 3.4042 trillion yuan in 2012, and at current prices, the annual growth rate of China's intangible assets investment reached 25.28%. The growth rate of intangible asset investment, whether calculated at current prices or at constant prices, greatly exceeded that of fixed asset investment. In recent years, China's venture capital industry has developed rapidly, with total investment increasing significantly from $12 billion in 2011—2013 to $77 billion in 2014—2016, and from 6% to 19% in the global share. Most of the venture capital flows to artificial intelligence, big data, 3D printing, virtual reality and other digital technology. Capital invested in some of China's digital technology such as virtual reality, artificial intelligence, 3D printing and so on in 2016 ranked top 3 in the world. Large-scale intangible capital investment drives the rapid development of digital economy. According to *Annual Report on Development of Global Digital Economy Competitiveness (2017)* released by Shanghai Academy of Social Sciences in December 2017, in 2016 the scale of digital economy of the United States was the largest in the world, being $11 trillion, and that of China ranked the second, being $3.8 trillion. That of Japan and the United Kingdom ranked the third and the fourth, being $2.3 trillion and $1.43 trillion respectively. In terms of the digital economy as a share of GDP, the US digital economy accounts for as much as 59.2% of GDP, China at 30.1%, Japan at 45.9% and the UK at 54.5%. In addition, according to research by the McKinsey Global Institute, the popularity of automation generated by artificial intelligence can drive China's economic growth by 0.8%~1.4%.

Table 2. Selected Ranking of Chinese Enterprises' R&D Investment in Accounting Year 2016

Ranking	Company	R&D investment (EUR bn)	Net sales (EUR bn)	Share of R&D investment (%)
1(6)	Huawei	10.363	53.920	19.20
2(58)	Alibaba	2.329	21.605	10.80
3(63)	TSMC	2.092	27.845	7.50
4(70)	ZTE	1.861	13.819	13.50
5(84)	MediaTek	1.636	8.092	20.20
6(85)	Tencent	1.617	20.740	7.80
7(90)	PetroChina	1.533	220.714	0.70
8(94)	Foxconn	1.502	128.033	1.20
9(97)	CSCEC	1.446	128.038	1.10
10(100)	China Railway	1.422	86.388	1.60
11(103)	Baidu	1.390	9.630	14.40

Source: European Union (EU): *The 2017 EU Industrial R&D Investment Scoreboard*, December, 2017.

From the above discussion, it can be seen that relying mainly on the growing intangible capital investment to drive economic growth will pose severe challenges to traditional economics. The reality of ever increasing intangible capital investment is subverting the traditional theories of economic growth, which requires statistics and economics to re-study the concept of capital investment and the logic of economic growth.

5. Conclusions and Prospects

Digital economy is a kind of higher economic form after agricultural economy and industrial economy, and the unprecedented improvement of ability in resource allocation, permeative integration and synergy has promoted the increase of total factor productivity, and has become a powerful force to promote industrial restructuring and achieve sustainable economic development. First of all, this paper holds that the digital economy emphasizes that the technical means of data information and transmission spread into the traditional economy and improve the "quality" and "quantity" of the economy. On the basis of defining the digital economy, analysis is made in its remarkable characteristics such as economies of scale, economies of scope and long tail effect. Secondly, using the basic principles of political economies to analyze the new industries, new business forms and new models spawned by the digital economy, the paper reaches the following conclusions. (1) The production of digital information products mainly depends on the input of intangible capital, the exchange mainly depends on the virtual market, the consumption mainly depends on the line, and the digital information product itself is an indispensable input. (2) The digital economy makes the urban and rural boundaries more and more blurred, forming a new type of urban-rural relationship with complementary advantages, interaction and win-win. (3) With

the platform enterprises becoming the new production exchange entities and the non-platform enterprise more and more specialized and the miniaturized, the platform economy becomes the new organization form of social production. (4) To a certain extent, the production mode of sharing economy has got rid of the "dominance of materialized labor over living labor", and the production process embodies more the individualized will and participation of the production subject, and the compensation of intangible assets in the distribution is higher than the income of materialized capital.(5) The digital information industry is likely to be the fourth industry in the future as it is highly productive and permeative. Finally, the emergence of the digital economy poses challenges to the relevant principles of traditional economics, such as the principle of "invisible hand", the principle of diminishing marginal returns and so on.

Obviously, this paper has only conducted the preliminary research on digital economy, and further discussion can be made in the future in the following aspects. Firstly, the pricing of digital information products. Neoclassical economics holds that the intersection of demand curve sloping downwards from left to right and the supply curve sloping upwards from left to right produces equilibrium price, but the digital information product has high fixed cost and very low marginal cost structure, so it is unreasonable to set the price at the marginal cost level in that the manufacturer suffers losses. In addition, the digital information products update faster, and their prices fluctuate frequently, making it difficult to grasp the market demand. Therefore, the traditional price theory can hardly explain the pricing of digital information products, and it is necessary to adopt new ideas for research. Secondly, the study of antitrust rules in the era of digital economy. The traditional antitrust rules are formulated on the basis of the traditional theory of industrial organization, and this kind of industrial organization theory is based on the general equilibrium theory, which pursues the maximization of resource allocation efficiency under the condition that the production function and consumption function are basically stable in the industrial economy. In the era of digital economy, the continuous change of production function and consumption function caused by technological innovation makes the traditional antitrust rules face great challenges in regulating the digital economy, so it is necessary to re-study the antitrust rules and improve the social welfare.

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Industry Competitiveness and Complementarity between China and Eurasian Economic Union Countries under the Background of Strategic Docking between Silk Road Economic Belt and the Union

Xinxuan Cheng, Longfei Fan, Jiachen Wang*

The implementation of strategic docking between Silk Road Economic Belt and the Eurasian Economic Union (the Union) is of great significance to facilitate the stable expansion of bilateral trade volume, diversification in major areas of trade, and the continual improvement of technical content level of trade products. This paper first uses the revealed comparative advantage index to study the competitiveness of industries with different technical levels for China and the Union member countries. Then, the trade complementarity and trade integration between China the Union member countries are studied by using the trade complementarity index and trade intensity index. Based on these results, the paper gives some advice on expanding and deepening the bilateral economic and trade cooperation.

Keywords: comparative advantage, trade complementarity, trade integration, technological difference, asymmetry

1. Introduction

The Eurasian Economic Union (the Union), established by Russia, Belarus, and Kazakhstan on January 1st in 2015, was evolved from the customs union founded in 2010. The Union conducted the first round of enlargement shortly after founding. Armenia and Kyrgyzstan officially announced to join in the Union on January 2nd and August 12th in 2015, respectively. The Union was formed under the leading of Russia, and the ultimate goal is to build the regional economic integration organization similar to European Union (EU). At present, the Union is a unified large market with a population of 180 million and gross domestic product of over USD 1,480 billion.[1]

The establishment of the Union has attracted the attention from experts and

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[1] The data came from World Bank.

scholars in different fields worldwide. In terms of political strategy, the Union can be the institutional mechanism of leadership expansion of Russia in Eurasia (especially in Central Asia) (Kirkham, 2016). And it can also protect the internal market of member countries from invasion of economic forces outside the region (Yesevi, 2014). Although the realization of the inclusive and sustainable growth of economy are the major goals for establishment of the Union, such mandatory and fast institutional changes fail to generate the expected effect of trade diversification and trade creation. At the same time, the relationship among the union members is relatively loose and vulnerable due to internal causes such as huge difference in economic development level and serious industrial homogenization between member countries (Li and Li *et al*., 2015). In addition, the great differences in the fundamental interest demand of joining in the union (Kassenova, 2012; Maria and Kirsten, 2016) and the severe economic sanctions imposed on Russia by the Western countries make the Union still confronted with many realistic obstacles on the road to replicate the success of EU and turn into an influential integration organization in the world (Roberts and Moshes, 2016).

The internal inherent defects of the Union and the unfavorable international environment restrict the economic growth space of member states, so the Union needs to pay attention to the economic cooperation which focuses on the construction of free trade area and the strategy docking with non-union countries, such as putting the docking with Silk Road Economic Belt in prominent place. In 2015, China and Russia jointly published *Joint Statement on Cooperation on the Construction of the Joint Eurasian Economic Union and the Silk Road Economic Belt Projects*. Silk Road Economic Belt and the Union belong to two different economic cooperation forms. The former abides by the cooperation concept of the equality and voluntariness and the mutual benefit, while the latter pursues the all-round integration of political and economic fields (Li, 2015). However, both of them are committed to the underlying strategic goal of striving for the stability and prosperity of Eurasia (Zhang, 2016). Therefore, such difference is not necessarily the obstacle of bilateral strategic cooperation, on the contrary, the difference provides the cooperation space and potential (Zhan, 2017). Due to he common energy market construction of the Union and China's enormous overseas energy demands, corporation in energy can be the key to drive the cooperation in other fields such as finance, infrastructure construction, etc. (Wu and Zhu, 2015; Fu, 2016).

The expansion of cooperation scope and improvement of technical content level in trade products between China and the Union countries will play a vital role in facilitating the docking between Silk Road Economic Belt and the Union. However, the scholars rarely research the trade competitiveness, complementarity, and trade integration between China and the Union countries from perspective of trade product classification in accordance with different technical content levels. The reason why

the role of technology content is emphasized in trade product classification is mainly based on the following two points. Firstly, the analysis of the competitiveness and complementarity among industries with different technical levels of both parties can define the specific industry cooperation space in the future and provide the basis for the government to formulate the strategic industry policy. Secondly, analyzing the comparative advantage of industries with different technical content levels for both parties can contribute to concentrating efforts on propelling the cooperation in the industries (especially industries with medium technology and high technology), which is of great significance for promoting the optimization and adjustment of bilateral industrial structure and participating in global value chains deeply.

In view of this, this paper aims to answer the following research questions. First, what is the competitiveness level of industries with different technology levels of China and the Union countries in international product market? Second, what is the bilateral trade complementarity degree of industries with different technical levels? Third, does the industry with strong bilateral complementarity belong to the comparative advantage industry of exporting country? Fourth, do the main products of bilateral trade belong to the industries with comparative advantage and strong complementarity between countries at present? Through analyses on the above problems, some scientific and reasonable advice on effective docking between Silk Road Economic Belt and the Union to facilitate the inclusive economic growth in the region.

2. Model and Data

2.1. Model

The model for researching the international product competitiveness of countries at the earliest is the revealed comparative advantage index proposed by an American economist Balassa (1965). Then, on this basis, some scholars put forward the international market share, revealed technological advantage index, and revealed comparative competitiveness index to study the product competitiveness of countries. Considering that the main purpose of this paper is to measure the comparative advantage of some kind of industry of the country in the international product market, and the revealed comparative advantage index can eliminate the influence of fluctuation in gross volume of national exports and gross volume of world export, we use the revealed comparative advantage index to measure the industrial competitiveness. The formula is shown as follows:

$$RCA_{xij} = \frac{EX_{ij}}{EX_{it}} \Big/ \frac{WEX_j}{WEX_t} \tag{1}$$

In equation (1),RCA_{xij} represents the revealed comparative advantage index of industry j of country i. EX_{ij} represents the gross export of product j of country i in the world market. EX_{ij} represents the gross export of all products of country i in the world market. WEX_j represents the gross export of product j of all countries in the world. WEX_i represents the total volume of commodity trade in the world. Based on the judgment standard proposed by JERTO, when *RCA* is less than 0.8, it indicates that the competitiveness of the product is low and at the comparative disadvantage. When *RCA* is between 0.8 and 1.25, it indicates that the commodity has medium international competitiveness. When *RCA* is between 1.25 and 2.5, it indicates that such commodity has strong international competitiveness. When *RCA* is more than 2.5, it indicates that such a product has extremely strong competitiveness.

Trade complementarity index can be used to measure the matching degree between exported products with comparative advantage of one country and imported products with comparative disadvantage of the other country. In general, if the trade complementarity index between two economies is more than 1, it is deemed as strong economic complementarity. The data adopted by trade complementarity index is only the gross export or gross import of the product of the country, rather than reflecting the destination country of export and the country of origin of imported product. For example, for country *A* and country *B* with international trade, product *g* of country A has the comparative advantage in the international market, while product *g* of country *B* has comparative disadvantage with large foreign demand. Now if product *g* of country *B* is mainly imported from country *A*, it indicates that the trade relation between country *A* and country *B* is close. If the import of product *g* of country B is mainly from other countries of the world rather than country *A*, it indicates that the trade between two countries has great room for improvement. The mathematical expression for trade complementarity index of the industry between two countries is shown as follows:

$$C_j = RCA_{xij} \times RCA_{mij} \tag{2}$$

In equation (2), C_j represents trade complementarity index of commodity j between two countries. The larger the value of C_j is, the stronger the trade complementarity is. RCA_{xij} is the revealed comparative advantage index, and the calculation method is described as above. RCA_{mij} is the comparative disadvantage of country i in commodity j measured by imports. The calculation formula is shown as follows:

$$RCA_{mkj} = \frac{IM_{kj}}{WIM_j} \Big/ \frac{IM_{kt}}{WIM_t} \tag{3}$$

In equation (3), IM_{kj} represents the gross import of product j of country k. WIM_j represents the gross import of product j of all countries in the world. IM_{kt} shows the

gross import of all commodities of country k. WIM_t shows the gross import of all products in the world.

Trade complementarity index C_j only measures the complementary relation of both trade parties in the product, and it can not comprehensively reflect the trade complementarity intensity of the two countries. The composite trade complementarity index can be adopted to achieve this goal. The composite trade complementarity index is the weighted average of trade complementarity index of all categories of products, and the weighted coefficient is the trade proportion of various products in the world trade. The calculation formula is shown as follows:

$$C_{ik} = \sum_j C_j \frac{W_j}{W_t} \tag{4}$$

In equation (4), C_{ik} is the composite trade complementarity index between two countries measured with country i as exporting country and country k as importing country. C_j is the trade complementarity index mentioned as above. W_j is total trade volume of product j in the world. W_t is total trade volume of all products in the world. The larger the value of C_{ik} is, the higher the matching degree between exports of one country and imports of another country is, and the stronger the trade complementarity is.

Trade integration index is the theoretical concept firstly proposed by the economist Brown, and is perfected by the research of Kiyoshi Kojima, and also its significance in economics is defined. Trade integration index is generally regarded as the science indicator of measuring the closeness of bilateral trade relation in the international trade research. Its mathematical expression is:

$$TI_{ij} = \frac{X_{ij} / X_i}{M_j / (M_w - M_i)} \tag{5}$$

In equation (5), TI_{ij} is the trade integration index between country i and country j calculated by exporting of country i. X_{ij} represents the export of country i to country j. X_i is the export of country i to the world. M_j represents gross import of country j. $M_w - M_i$ is a numerical value which can be got by the gross import of the world minus the gross import of country i. If $TI_{ij}>1$, it means that the actual export of country i to country j is more than the expected export, and the bilateral trade relation is close. On the contrary, it indicates the bilateral trade relation is relatively loose.

2.2. Data

United Nations Comtrade database is the most authoritative database in the

international trade statistics field in the world at present, and contains 99% of commodity transactions globally. All data utilized in this paper are from this database, and classified in accordance with Standard International Trade Classification 2 (SITC2). SITC2 divides all trade products into 10 categories. Such method classifies all trade products in accordance with the product attribute well, but it fails to reflect the technology content of products accurately. It leads to the mixed classification of resource-based products, products with medium technology content, and products with high technology contents, and easily underestimates or overestimates the comparative advantages of products with certain class of technology contents.

In view of this, referring to the method of Lall (2000), we divide all manufactured products of international trade into four classes, i.e. resource-based manufactured products (RB), manufactured products with low technology content (LT), manufactured products with medium technology content (MT), and manufactured products with high technology content (HT), based on SITC2 three-digit encoding classification. Also we conduct the detailed classification of products in each class of technology content according to the product attribute, involving classifying the resource-based manufactured products into two classes of RB1 and RB2, and classifying the manufactured products with low technology content into two classes of LT1 and LT2. The detailed classification is shown in Table 1.

Table 1. Trade Products Classified by Technical Level

Class	Main products
Primary product (pp)	Fresh fruit, meat, rice, coffee, tea, timber, coal, crude oil, natural gas, silver, copper, nickel, aluminum, lead, zinc, and tin, etc.
Manufactured products:	
Resource-based manufactured products Agricultural / forestry products (RB1)	Prepared meat and fruit, beverage, wood products, and vegetable oil, etc.
Other resource-based products (RB2)	Ore concentrate, petroleum / rubber products, cement, cutting gems, and glass, etc.
Manufactured products with low technology content Textile / clothing (LT1)	Textile fabric, clothing, hat, shoes, leather products, and travel goods, etc.
Other manufactured products with low technology content (LT2)	Pottery, simple metal parts / structure, furniture, jewelry, toy, and plastic products, etc.
Manufactured products with medium technology content Automation equipment (MT1)	Passenger vehicles and parts, commercial vehicles, motorcycle and parts
Manufactured products with medium technology processing (MT2)	Synthetic fiber, chemicals and coating products, fertilizer, plastics, pig iron and iron alloy, and steel pipe, etc.
Manufactured products with medium technology engineering (MT3)	Engine, motor, industrial machinery, pump, switchgear, ship, and watch, etc.

Class	Main products
Manufactured products with high technology content Electronic and electrical products (HT1)	Office / data processing / telecommunication equipment, television, transistor, turbine, and power generating equipment, etc.
Other products with high technology content (HT2)	Pharmacy, aerospace, optical / measuring instrument, and camera, etc.
Other transactions	Electric power, movie, printing materials, gold, art, coin, and pets, etc.

In the classification of primary products, it is mainly considered that such products are some natural substances and mineral resources without processing or only simple processing. The comparative advantage of such products is mainly from the resource endowment, such as land and mineral products. The resource-based manufactured products always belong to the labor intensive products with low technology processing, such as food and leather products after simple processing, but some products such as petroleum refining are capital intensive. Such products gain the comparative advantage relying more on the abundant resource endowment, and have low dependence on technology. The production technology of products with low technology content does not have the monopoly effect, and generally has good diffusibility. These technologies are mainly reflected in the production equipment, and do not have very high requirements for the production skills of labor participants, which means low barriers to entry. Many products can be considered to be homogeneous with relatively strong substitutability. The size of competitiveness is mainly reflected in the price.

The products with medium technology content are the core of industrial activity in the mature economy, and generally they need a large amount of scale intensive technologies as the support. Besides, they are inclined to possessing the complex production technology and higher level of technical research and development ability in need for longer learning time. They can be divided into three classes. The first class is automation equipment (MT1), mainly including some vehicles, motorcycles and other automation vehicles and their parts. The second class is manufactured products with medium technology processing (MT2). The production of such products needs substantial investment for factory construction and capital facility purchasing, and subsequently needs a lot of investment involving physical capital and human capital in equipment improvement and production process optimization. The third class is manufactured products with medium technology engineering (MT3). The core production processes of such products are the product design, research and development, which need a large number of production and installation workshops and relatively mature and well-developed upstream industry supply network. Therefore, the entry threshold of these industries is high, and only the countries with strong economic strength and scientific research strength can produce these products. The manufactured products with high technology content often need highly advanced science and

technology, perfect design team and R&D team, and substantial investment in research. In most cases, these advanced science and technology and design concepts need the mature science and technology infrastructure, high level professional skills, close communication and cooperation between enterprise and university. The products with high technology content can be divided into two classes, i.e. electronic and electrical products (HT1), and other products with high technology content (HT2).

3. Results and Analysis

3.1. Analysis on Industry Competitiveness between China and Eurasian Economic Union Countries

According to the classification principle of technology content, *RCA* indexes for China and member countries of the Union are respectively calculated, and are shown in Appendix A. Based on the judgment standard proposed by JERTO, we present the international competitiveness of of China and the Union member countries in Table 2. When determining the *RCA* index of certain industry of a country, we comprehensively consider the international competitiveness in accordance with the majority principle (i.e. Among the years studied, which level of competitiveness appeared the most.) and tendency principle (i.e. the tendency occurring in recent years), rather than only taking the average value of data simply. It is because that we should consider the influence of world business cycle on export so as to make the *RCA* value fluctuate remarkably, and also we should consider the evolution tendency of *RCA*, since we are more concerned with the future rather than the past. Some important discoveries can be found from Table 2.

Table 2. International Competitiveness of Industry at Different Technical Levels Divided by *RCA* Indexes

	Weak competitiveness *RCA*<0.8	Medium international competitiveness 0.8<*RCA*<1.25	Strong international competitiveness 1.25<*RCA*<2.5	Extremely strong international competitiveness 2.5<*RCA*
China	PP RB1 RB2 MT1 MT2 HT2	MT3	LT2 HT1	LT1
Russia	RB1 LT1 LT2 MT1 MT3 HT1 HT2	MT2	RB2	PP
Belarus	PP LT1 MT1 MT3 HT1 HT2	LT2	RB1 MT2	RB2
Kazakhstan	RB1 LT1 LT2 MT1 MT2 MT3 HT1 HT2	RB2		PP
Armenia	LT1 LT2 MT1 MT3 HT1 HT2	PP MT2		RB1 RB2
Kyrgyzstan	PP RB1 LT2 MT1 MT2 MT3 HT1 HT2	RB2 LT1		

Firstly, Russia and Kazakhstan have very strong international competitiveness in the primary product field (PP), and Armenia has medium international competitiveness, while China, Belarus and Kyrgyzstan have low international competitiveness. To be specific, *RCA* in PP in Russia has been more than 3 in recent years, while that in Kazakhstan has been more than 4.5 for so long, and even up to 5.87 in 2016.The main exported products of Russia and Kazakhstan in PP field are quite similar, focusing on petroleum, coal, natural gas and metallic ore. Different from Russia and Kazakhstan, the export of Belarus in the primary product field mainly focuses on milk and cream, meat, vegetables, nuts and other farm and pasture products, while the proportion of mineral resources is small. The primary products mostly belong to the resource intensive products, and the comparative advantage is from the resource endowment. Russia and Kazakhstan are the countries with very rich natural resources, especially in oil gas, coal, various metallic ores, so these two countries show very strong international competitiveness in the primary product field.

Secondly, in the field of resource manufactured products, Armenia shows very strong international competitiveness whether it is in RB1 or RB2. As for Belarus, RB2 has extremely strong international competitiveness, and RB1 has strong international competitiveness. RB2 of Russia has strong international competitiveness. All other countries have unobvious comparative advantage or are at comparative disadvantage in the field of resource manufactured products. Specifically, *RCA* of RB1 in Armenia has always been more than 3 in recent years, while *RCA* of RB2 has always been more than 2.5 and has shown the trend of increasing year by year. The export of Armenia in RB1 field mainly focuses on tobacco products, beverages, cheese and fruit products, while the advantage products in RB2 field are mainly metal ore concentrate and its condensate, pearls, and gems and lime prefabricated building materials. The export of Belarus in RB2 mainly focuses on petroleum products, glass, mineral manufactured products and lime prefabricated building materials, while the exported products are mainly cheese and curd, butter, plywood, and timber and paperboard in RB1 field. By comparison with comparative advantage industry of Armenia in the field of resource-based manufactured products, it is found that, the main advantage products of Belarus in RB2 field mainly focus on the petroleum products and ore, while the main exported products of Armenia are mainly metal and ore. The advantage products of both countries mainly focus on a few classes of products, and the contact ratio of main product export is not high. The main exported products of two countries in RB1 field also have low contact ratio, and relative to Armenia, the comparative advantage products of Belarus in the field of RB1 show the diversity. RB2 of Russia has strong international competitiveness, but RB1 has weak competitiveness. The main exported products in RB2 are refined petroleum products, and only this item was 75.54% of RB2 gross export of Russia in 2016. Compared with Armenia and Belarus, the advantage products of Russia in RB2 field are more unitary. The performance of Kazakhstan and

Kyrgyzstan is slightly worse. Their RB2 has medium international competitiveness and RB1 has weak competitiveness. China is at comparative disadvantage fully in the field of resource-based manufactured products, regardless of RB1 or RB2.

Thirdly, in the field of manufactured products with low technology content, China performs better. LT1 has extremely strong international competitiveness, and LT2 has strong international competitiveness, but the international competitiveness of LT1 shows the significant falling trend year by year. *RCA* value declined from 3.91 in 2000 to 2.62 in 2015 and 2.68 in 2016. In LT1 field, the export of China mainly focuses on knitted outwear, shoes, textile products and travel goods, and the export of main products shows the diversity advantages, rather than focusing on very few products. In LT2 field, the advantage products focus on furniture, toy, plastic products and rolled steel. The industry of manufactured products with low technology content mostly belongs to the labor intensive industry with low technology content and low added value. With rising of labor costs in China, implementation of industrial structure optimization and transformation and upgrading plan in the national macro-level in recent years, a large number of enterprises select to build the plants overseas, aiming at some countries with relatively backward development with lower labor costs and institutional costs. Thus, although China has shown very strong international competitiveness in this field, but the comparative advantage is falling. Moreover, the Union member countries entirely show weak international competitiveness in such products, and have very obvious comparative disadvantage. To be specific, only LT2 of Belarus and LT1 of Kyrgyzstan have medium international competitiveness, and all others show weak international competitiveness.

Fourthly, in the field of manufactured products with medium technology content, China and five countries of the Union underperform. Only MT2 of Belarus shows strong international competitiveness, and MT2 of Armenia and Russia has medium international competitiveness, while MT3 of China has medium international competitiveness. The manufactured products with medium technology content mainly include vehicles (MT1), heavy chemical industry (MT2), and electromechanical and equipment manufacturing (MT3), which belongs to the capital intensive industry having requirements for high technology and product design ability that means high entry threshold. The developed countries and newly industrialized countries enter this field earlier, and possess abundant capital, advanced technology, brand advantage, perfect upstream and downstream industry chain, and mature world market, thus they have the absolute advantage for a long term. The developing countries can hardly stand out in these industries. China has accumulated a great deal of capital in some industries in this field and has achieved good results in the electromechanical and large equipment manufacturing after reform and opening up for many years, but such products are still in the medium competition level in the world market due to failing to overcome the technical barriers in some core parts fields which depend on importing

from abroad.

Fifthly, in the products with high technology content, only HT1 products of China have strong international competitiveness in the international market. HT1 and HT2 of the Union member countries are with weak international competitiveness. HT2 of China also shows comparative disadvantage. Relative to products with medium technology content level, HT products need much higher technology content and scientific strength which needs powerful basic science as the support. In recent years, China has made rapid progress in the fields of communication equipment, data processing equipment, transistor and power generating equipment, and all of the production has strong international competitiveness. The exports of HT1 in China mainly focus on telecommunication equipment, automatic data processor, hot electron, microcircuit, transistor, valve, and electrical machinery and equipment, and such four classes of products account for 80.55% of MT1 general export of China in 2016.

In a word, the products with comparative advantage of China are less similar to the products with comparative advantage of the Union member countries. The industries with high international competitiveness in China are mainly labor intensive LT1 and LT2, capital intensive MT3 and technology intensive HT1. However, the products with strong international competitiveness in the Union member countries mainly concentrate on resource intensive industry PP, RB1 and RB2, and capital intensive industry MT2. Relatively speaking, the competitive products of China have higher technology content, while the advantage of the Union member countries is mainly embodied in the domestic abundant natural resources. Both parties mainly show the complementary relation rather than competitive relation in the international product market, which means the greater possibility of expanding the economic cooperation further.

3.2. Analysis on Trade Complementarity between China and Eurasian Economic Union Countries

In this section, we use the trade complementarity that can measure the matching degree between one country's export and another country's import to depict the trade complementarity. In order to research the possibility and potential of bilateral trade cooperation comprehensively, we have calculated two types of trade complementarity, one of which is based on China's imports and the Union member countries' exports, and the other on the basis of the Union member countries' imports and China's exports. The results are shown in Appendix B. According to the principle that if trade complementarity index is more than 1, it indicates strong bilateral economic complementarity; and if it is less than 1, then it indicates weak economic complementarity, the trade complementarity relations between China and the Union countries are summarized in Table 3 and Table 4. Some important discoveries can be gained by analysis.

Table 3. Economic Complementarity of Industry between China and Eurasian Economic Union Countries Calculated by China's Imports

	Russia	Belarus	Kazakhstan	Armenia	Kyrgyzstan
Strong mplementarity C>1	PP RB2 MT2	PP RB1 RB2 MT2	PP RB2	PP RB1 RB2	RB2
Weak mplementarity C<1	RB1 LT1 LT2 MT1 MT3 HT1 HT2	LT1 LT2 MT1 MT3 HT1 HT2	RB1 LT1 LT2 MT1 MT2 MT3 HT1 HT2	LT1 LT2 MT1 MT2 MT3 HT1 HT2	PP RB1 LT1 LT2 MT1 MT2 MT3 HT1 HT2

Table 4. Economic Complementarity of Industry between China and Eurasian Economic Union Countries Calculated by the Union Member Countries' Imports

	Russia	Belarus	Kazakhstan	Armenia	Kyrgyzstan
Strong mplementarity C>1	LT1 LT2 MT3 HT1	LT1 LT2 MT2 MT3	LT1 LT2 MT2 MT3 HT1	RB1 LT1 LT2	RB1 LT1 LT2
Weak mplementarity C<1	PP RB1 RB2 MT1 MT2 HT2	PP RB1 RB2 MT1 HT1 HT2	PP RB1 RB2 MT1 HT2	PP RB2 MT1 MT2 MT3 HT1 HT2	PP RB2 MT1 MT2 MT3 HT1 HT2

Firstly, the trade complementarity index calculated by import of China and export of the Union member countries manifests that the industries with strong complementarity are PP and RB, and a few of products of MT. And the complementarity intensity shows great difference. To be specific, for China's imports and Russian's exports, the most complementary field is PP and its trade complementarity index in last two years are 4.79 and 4.31. In addition, they also show strong complementarity in RB2, and the trade complementarity index is increasing gradually from 1.85 in 2000 to 3.10 in 2016. However, although strong complementarity exists in MT2, the degree shows the falling trend from 2.18 in 2000 to 1.08 in 2016. The field with the strongest complementarity between China's imports and export of Belarus is RB2, followed by MT2, and then RB1. In PP field, it only shows strong complementarity in the last two years. However, from the above analysis, it is found that the *RCA* index of Belarus in PP is increasing distinctly, so we believe that they may maintain strong complementary relation continuously in this field. There are only two classes of industries with strong complementarity between China and Kazakhstan, i.e. PP and RB2, and the degree of complementarity has great difference. In PP field, the complementarity between China and Kazakhstan is even superior to the complementarity between China and Russia, because the trade complementarity index between China and Kazakhstan rose from 3.82 in 2000 to 7.20 in 2015 and 7.89 in 2016. But the performance in RB2 is ordinary, and the complementarity index is only more than 1. The industry with strong complementarity between China's imports and Armenia's exports is PP, RB1 and RB2.

The industry with strong complementarity between China and Kyrgyzstan is only RB2, which just meets the condition of strong trade complementarity relation and has obvious instability.

Secondly, the trade complementarity index calculated by China's exports and the Union member countries' imports reveals that complementary fields is mainly LT, and it has a small amount of MT and HT, and the complementarity intensity also shows great difference in all the fields. To be specific, the fields with strong complementarity between China and Russia are mainly LT1, LT2, MT3 and HT1, among which the trade complementarity index of LT1 is largest, followed by LT2, and then HT1 and MT3. The industries with strong complementarity between China and Belarus are mainly LT1, LT2, MT2 and MT3, and the complementarity intensity is slightly different, with a slim advantage in LT1 and LT2. The industries with strong complementarity between China and Kazakhstan are LT1, LT2, MT2, MT3 and HT1. They have shown strong complementarity in LT1 and HT1 in recent years, while they have always maintained strong complementarity in LT2, MT2 and MT3 fields for many years. The industries with strong complementarity between China and Armenia are mainly RB1, LT1 and LT2, with larger complementarity intensity in LT1 and LT2. The industries with strong trade complementarity between China and Kyrgyzstan are RB1, LT1 and LT2. The complementarity intensity of LT1 is the largest, followed by LT2, and then RB1.

Some important discoveries can be gained by above analysis. First, the fields at all technology content levels between China and the Union member countries have strong complementarity in different ranges and degrees. It means that both parties have the mutually beneficial and win-win cooperation space and the broad prospects for cooperation at all technical level fields. Second, the industries with strong trade complementarity calculated by China's exports have technology advantages, compared with the trade complementarity industries calculated by the Union countries' exports. Third, the quantity of fields with strong bilateral trade complementarity calculated by China's exports is generally larger than that calculated by the union countries' exports. So further market opening and trade facilitation can release all countries' potentials, and promote the economic growth from the breadth or depth of cooperation scope.

To further reflect the comprehensive economic complementarity between China and the Union countries, the comprehensive trade complementarity index is adopted to calculate the Union member countries' exports, and the results are as shown in Table 5. From Table 5, the comprehensive trade complementarity between China and Russia & Kazakhstan is strongest, followed by Belarus and Armenia, and then Kyrgyzstan. The statistical data of World Bank shows that gross domestic product (GDP) of Russia, Belarus, Kazakhstan, Armenia, and Kyrgyzstan in 2016 is respectively 1,283 billion dollars, 47.407 billion dollars, 137.278 billion dollars, 10.572 billion dollars, and 6.551 billion dollars.[1] Except for Kyrgyzstan, other four countries account for 99.56%

[1] The data is from World Bank.

of total GDP in all countries of the Union, so it is believed that the economic relation between China and the Union is mainly manifested as complementarity, so they have great potential for further cooperation.

Table 5. Comprehensive Trade Complementarity Index between China and Eurasian Economic Union Countries Calculated by Import of China

Data	Russia	Belarus	Kazakhstan	Armenia	Kyrgyzstan
2000	0.95	1.03	0.56	0.93	0.45
2001	0.87	1.03	0.94	0.90	0.38
2002	0.83	0.97	0.87	0.78	0.53
2003	0.82	0.95	0.88	0.88	0.39
2004	0.89	0.94	0.95	0.93	0.46
2005	0.88	0.95	0.92	1.02	0.55
2006	0.88	0.94	0.93	0.95	0.66
2007	0.93	0.97	0.98	1.04	0.76
2008	0.98	1.03	1.03	1.07	0.39
2009	1.01	1.06	1.07	1.06	0.31
2010	1.01	0.97	1.09	1.03	0.36
2011	1.00	0.98	1.09	0.96	0.38
2012	1.10	0.95	1.14	0.90	0.54
2013	1.08	0.91	1.13	0.89	0.51
2014	1.13	0.95	1.18	0.89	non
2015	1.12	0.93	1.20	0.86	0.42
2016	1.00	0.90	1.24	0.87	0.46

Note: non shows the data is missing for the corresponding year.

A large trade complementarity index only indicates that the import of country A for world market and the demand of country B for world product market have strong complementarity, but it is not deemed to have a close trade relation between countries in the industry, because the import of country B in the industry may be from other countries rather than country A. Therefore, it is necessary to research the commodity trade structure between China and the Union countries in details, and mainly inspect whether the main trade products of both parties are industries with strong trade complementarity. Thus, we measured the main trade product categories between China and the Union countries, and the results are as shown in Table 6. With the research results, it is found that most of products between China and the Union member countries belong to the industries with the advantage in international competitiveness and strong complementarity. Moreover, the further deepening of cooperation can enhance the division level of all countries, and then increase the bilateral trade benefits. However, it is noted that some industries with

strong international competitiveness and strong complementarity are not main trade products, so China and the Union countries should strengthen the cooperation in these industries and promote the expansion and deepening of bilateral trade in future.

Table 6. Main Trade Products between China and Eurasian Economic Union Countries under Ten Types of Products Divided by Technical Level

	Main mported products	Proportion in total import (average value)	Industry with high trade entarity lculated by import of China	International competitiveness level of the Union countries in the products	Main exported products	Proportion in total export	Industry with high trade entarity calculated by export of China	International competitiveness level of China in the products
Russia	PP RB1 RB2 (MT2)	47.27% 17.53% 15.87% (12.06%)	PP RB2 MT2	E W S M	LT1 [LT2] MT3 (HT1)	30.02% [11.12%] 15.49% (18.24%)	LT1 LT2 MT3 HT1	E S M S
Belarus	[RB2] MT2	[11.18%] 64.51%	PP RB1 RB2 MT2	E S	MT3 (HT1)	24.14% (31.50%)	LT1 LT2 MT2 MT3	M S
Kazakhstan	PP RB2	59.21% 16.00%	PP RB2	E M	LT1 [LT2] MT3 (HT1)	38.42% 11.74% 13.83% (12.17%)	LT1 LT2 MT2 MT3 HT1	E S M S
Armenia	[RB2] (MT3)	64.20% (11.32%)	PP RB1 RB2	E W	(LT1) LT2 MT3 [HT1]	(11.85%) 15.43% 22.02% [17.32%]	RB1 LT1 LT2	E S M S
Kyrgyzstan	PP RB2 LT1	37.24% 44.48% 16.55%	RB2	W M M	[LT1] (MT2)	[53.10%] (20.96%)	RB1 LT1 LT2	E W

Notes: [.] represents that the proportion of trade volume has the significant rising trend in recent years, and (.) shows that the proportion of trade volume has the significant falling trend in recent years. W represents weak competitiveness; M represents medium international competitiveness; S represents strong international competitiveness; E represents extremely strong international competitiveness.

3.3. Analysis on Trade Integration between China and the Eurasian Economic Union Countries

China and the Union countries have strong complementarity relation, but the trade complementarity index can only measure the matching degree of one country's exports and another country's imports, and fails to reflect the true situation of bilateral trade integration, so further analysis with trade integration index is required. We calculate the bilateral trade integration index for the Union countries' exports

and China's exports respectively, and the results are as shown in Table 7 and Table 8 respectively. Two important discoveries can be gained from the tables.

Table 7. Bilateral Trade Integration Index Calculated by Export of the Union Member Countries

	Russia	Belarus	Kazakhstan	Armenia	Kyrgyzstan
2000	1.38	0.5	2.1	0.05	2.37
2001	1.34	0.46	1.83	0.00	0.98
2002	1.33	0.56	2.19	0.16	1.80
2003	1.05	0.28	2.18	0.12	0.68
2004	0.84	0.33	1.48	0.45	0.83
2005	0.78	0.39	1.25	0.14	0.57
2006	0.73	0.28	1.32	0.01	0.67
2007	0.57	0.26	1.56	0.09	0.72
2008	0.58	0.24	1.39	0.02	0.35
2009	0.62	0.09	1.53	0.29	0.18
2010	0.49	0.18	1.73	0.30	0.19
2011	0.63	0.14	1.72	0.11	0.20
2012	0.61	0.08	1.59	0.19	0.32
2013	0.58	0.11	1.45	0.40	0.19
2014	0.63	0.15	1.04	0.97	non
2015	0.71	0.25	1.03	0.96	0.21
2016	0.86	0.15	1.01	0.49	0.49

Note: non represents the data is missing for the corresponding year.

Table 8. Bilateral Trade Integration Index Calculated by Export of China

	Russia	Belarus	Kazakhstan	Armenia	Kyrgyzstan
2000	1.67	0.12	3.05	0.03	5.05
2001	1.47	0.02	1.19	0.06	3.75
2002	1.49	0.04	1.79	0.04	4.96
2003	1.77	0.05	3.18	0.06	5.81
2004	1.82	0.06	2.63	0.13	7.97
2005	1.77	0.06	3.00	0.18	10.45
2006	1.39	0.12	2.46	0.18	15.09
2007	1.57	0.09	2.54	0.19	16.93
2008	1.34	0.10	2.85	0.19	24.84
2009	1.03	0.10	2.78	0.28	17.94
2010	1.21	0.22	3.69	0.30	12.2
2011	1.18	0.15	2.38	0.31	10.85
2012	1.20	0.17	2.16	0.23	8.28
2013	1.30	0.17	2.16	0.24	7.15
2014	1.46	0.22	2.43	0.23	non
2015	1.33	0.18	1.96	0.24	7.47
2016	1.50	0.29	2.44	0.26	10.82

Note: non represents the data is missing for the corresponding year.

Firstly, the bilateral trade integration indexes calculated by the Union member countries' exports reveal that China has close trade relation only with Kazakhstan. The trade integration index between Russia and China had been strong in the first few years since 2000, and has always been in the trend of declining with fluctuation in recent years. From the above analysis, China and the Union have strong economic complementarity relation, but for the bilateral trade integration calculated by the Union countries' exports, they all show loose relations except for Kazakhstan. It gives us the important enlightenment, i.e. the Union member countries' exports (except for Kazakhstan) to China has enormous room for improvement. For the bilateral trade cooperation, the opportunity of a new round of opening to the outside world characterized by "increase imports" of China can be taken to increase exports to China, which will promote the rapid development of bilateral economic and trade relations.

Secondly, the trade integration indexes between China and the Union member countries calculated by China's exports reveal that China has close trade relations with Russia, Kazakhstan and Kyrgyzstan. The trade integration index between China and Russia has always fluctuated between 1.03~1.82 for a long term, but with Kazakhstan, it has been more than 2 in recent years (except for 1.96 in 2015), which means that the real export of China to two countries exceeds the expected export value, and the bilateral trade relation is close. In addition, the data shows that the maximum trade integration index between China and Kyrgyzstan is 24.84, and the minimum one is 3.75, with larger fluctuation, which indicates that the economic and social development of Kyrgyzstan is highly dependent on imported products from China, thus it means there may be serious trade imbalance between China and Kyrgyzstan. The trade integration index between China and Belarus & Armenia calculated by China's exports is still less than 1, signifying the loose bilateral relations. The Chinese enterprises will have a brilliant future in exploiting the market of these two countries.

4. Conclusions and Policy Suggestions

In this paper, revealed comparative advantage index, trade complementarity index, and trade integration index are used to study the international competitiveness, the trade complementarity, and the trade integration between China and the Union member countries of the ten types of international trade products divided by technology contents respectively. And some important discoveries have been made.

Firstly, the products with high international competitiveness between China and the Union member countries are mainly primary products, resource-based manufactured products, and products with low technology content. All the countries are at the comparative disadvantage in the production of products with medium and high technology content except for few fields. As a whole, China and the Union member countries have strong trade complementarity relations, and China's exports have

higher technology content relative to the Union countries, which means that China has technical advantages. The difference of technical level means that the bilateral economic and trade cooperation is mainly inter-industry trade. The industry with medium technology content belongs to the capital intensive industry and has high requirements for science and technology, so such an industry is mainly controlled by a few developed countries and newly industrialized countries. China and the Union countries have low competitiveness in the field.

Secondly, the bilateral trade integration indexes calculated by China's exports and the Union member countries' exports respectively have significant difference. The closeness of trade relation between the Union member countries and China is mainly reflected in the Union countries' imports from China, while China's imports from the Union countries is generally lower than the expected value, which means that there is a huge potential for improvement. The Union member countries can promote the export to China by building more diversified industrial structures and developing products for market demand in China, which can effectively avoid the drastic fluctuation in the bilateral trade, and it also helps to alleviate the problem of trade imbalance.

Thirdly, the main trade products between China and the Union are mostly industries with high competitiveness in the international market and strong trade complementarity, which means that the bilateral trade cooperation is mutually beneficial and win-win, and it is beneficial for the improvement of social welfare in all countries. However, some industries that have the comparative advantage and strong trade complementarity have small proportion in the bilateral trade. In future, to accelerate more diversified development of bilateral trade, the cooperation in supply and demand must be deepened in these fields.

Referring to the above research results and considering the rapid construction of the Silk Road Economic Belt, in this paper, the author gives the following suggestions on how to facilitate the efficient docking between China and Eurasian Economic Union in the commodity trade field.

Firstly, it is necessary to consolidate and expand the main cooperative industries between China and the Union member countries actively, and also it is necessary to extend the industries with strong bilateral complementarity but in weak cooperation level at present actively. On this basis, the bilateral trade can be promoted to evolve toward high technology content. The economic development experience of some newly industrialized countries demonstrates that, the trade structure has the pulling effect on domestic industrial structure. The increase of gross export and diversification of exported products can enhance the total factor productivity by means of optimal allocation of resources, technology transfer and learning effect, and further promote the adjustment of industrial structure.

Secondly, China and the Union should promote the bilateral trade and investment facilitation actively, and the opportunity of expanding and deepening the economic

cooperation scope can be taken to build the regional value chain of Silk Road Economic Belt by virtue of technological advantages of China in the industry. At present, China is in the critical period of economic structural adjustment moving towards the phase of high quality economic development constantly, and it possesses the most complete manufacturing system in the world. Besides, China has the comparative advantage relative to the Union member countries. So both parties should keep sufficient interactions in the domestic industrial structural adjustment.

Thirdly, China and the Union member countries should promote the interconnection actively, and propel to establish multilateral and bilateral economic and trade cooperation agreement actively that can provide the institutional foundation for deepening and sustainability of cooperation. In the interconnection, policy communication should be emphasized so as to enhance the top-level design of trade relation and reduce the trade frictions and conflicts; the road connection shall be promoted so as to provide the convenience for cross-border trade; the tariff and non-tariff barriers hindering the trade development constantly shall be reduced so as to promote the trade facilitation; financing and trade settlement mechanism shall be innovated so as to enable the finance to serve the trade and investment better; all-round and multi-level social cultural exchange shall be promoted so as to reduce the communication barriers in the region. In addition, the multi-field economic and trade cooperation agreement should be signed to provide the institutional basis for bilateral cooperation.

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Sino-Russian Customs Cooperation under the Background of the Belt and Road Initiative

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This paper first studies the basis and standards of customs cooperation between China and Russia, then proposes concrete measures for customs cooperation to promote smooth trade between the two countries. It is of great significance to link China's Belt and Road Initiative with Eurasian Economic Union and regional economic integration.

Keywords: smoothness of trade, customs cooperation, regional economic integration

1. Introduction

The Silk Road Economic Belt is an important part of the Belt and Road Initiative. The core content of the Belt and Road Initiative is "Policy Communication, Facility Connection, Smoothness of Trade, Financial Integration, and Common Aspiration of the People" (hereinafter referred to as the "Five Connections"), which promotes the orderly and free flow of economic factors, efficient allocation of resources, and deep integration of markets. The core content also includes working together to create an open, inclusive, balanced, and equal regional economic cooperation framework. Among the "Five Connections", Policy Communication is the premise. Financial integration and Facility Connection are the foundation. Smoothness of Trade is the essence, and Common Aspiration of the People is the purpose. The Belt and Road Initiative is a unilateral initiative of China, thus, its realization relies on the history of cooperation, cooperation system, and cooperation ability in both China and countries along the route. Russia is the core country of the Silk Road Economic Belt and the bilateral economic and trade cooperation between Russia and China has been continuously enhanced.[1] The Customs

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[1] Source: https://baijiahao.baidu.com/s?id=1622267396345054765&wfr=spider&for=pc. According to Chinese statistics, from January to November 2018, the bilateral trade volume between China and Russia reached 97.24 billion US dollars, increased by 27.8% comparing to the same period last year. The growth rate of trade between China and Russia is the highest among China's major trading partners. China continues to maintain its position as Russia's largest trading partner, and Russia is China's tenth largest trading partner.

has the functions of supervision, taxation, anti-smuggling, and statistics on import and export goods, articles and means of transport, which plays a key role in the promotion of Sino-Russian trade and the smoothness of trade. Within the framework of the institutional agreements on international customs cooperation, regional customs cooperation and bilateral cooperation, the customs of the two countries shall strengthen collaborations on trade facilitation and political stability through measures such as tariff concessions, information exchange, system docking, and law enforcement assistance which is of great significance for trade facilitation, political stability, and regional economic integration.

To achieve above purposes, we adopt normative research method, which is mainly used to define the basic conceptual terms in the text, and comparative research method, which is used to compare the relevant contents between domestic and foreign countries, and between China and Russia. Another feature of this paper is that it is a cross-disciplinary research. We integrated the knowledge from international trade, public administration, law, and other disciplines to have a better view of the Sino-Russian customs cooperation.

2. Basis of Sino-Russian Customs Cooperation

2.1. Multilateral Cooperation Platform

The World Customs Organization (WCO) is the only specialized intergovernmental international organization dedicated to customs matters worldwide. Its predecessor, the Customs Cooperation Council (CCC), is a worldwide intergovernmental coordination organization established to unify customs duties and simplify customs procedures. The predecessor of CCC is the "European Customs Union Research Group" composed of some European countries in 1947. The group held a meeting in Brussels on December 30, 1950 to formulate three conventions on tariffs (the establishment of the Customs Cooperation Council Convention, the Convention on Classification of Tariff Commodities, and the Customs Commodity Valuation Convention). CCC was established in 1952 under the first convention. The council has a headquarter of 95 existing members with China joining in 1983. In 1994, in order to highlight the world position of the World Customs Organization, and distinguish it from many other organizations abbreviated as CCC, CCC is switched to WCO. The standards and tools developed by the WCO are the main source of international customs law and customs system (He, 2007). To promote trade security and facilitation, the WCO has developed a number of international agreements and legal instruments to promote customs cooperation and secure supply chains, including Revised Kyoto Convention (hereinafter

referred to as RKC)[1] and Globally Networked Customs Framework.

Take the RKC as an example. It provides a series of standards for deposit priority and customs declaration, which establish a balance between the interests of traders and customs administration. At the same time, the convention encourages WTO members to estimate and report the release time of their average cargo in a consistent manner, and encourage members to share with the Trade Facilitation Committee with their experience in assessing average release time. The experience includes the methods used, the bottlenecks discovered, and any achievements in efficiency promotion. WCO promotes the development of international trade by formulating, supporting, and promoting international documents, coordinating and unifying the customs systems and procedures of member states, and helping the customs of each member to communicate with other international organizations.

The World Trade Organization (WTO) is one of the most important international organizations in the world, with 164 members including China (2001) and Russia (2012). The total trade of members reached 98% of the world. The Trade Facilitation Agreement (TFA), adopted by the Ninth Ministerial Conference of the WTO on December 7, 2013,[2] went into effect on February 22, 2017. Many of the TFA's provisions reflect the content of customs cooperation and mutual assistance of border agencies, and help to promote the development of international customs integration (Wolffgang and Kafeero, 2014). The agreement aims to make import and export among all WTO members more efficient and less costly by increasing transparency and improving customs processes. For example, Article 7 of the TFA on the release and customs clearance of goods includes content about pre-arrival business handling, electronic payment, separation of release of goods from the final determination of customs, domestic taxes, fees and expenses, risk management, follow-up inspections, establishment and publication of average release time and trade facilitation measures for the Authorized Economic Operator (AEO) and so on. On July 1, 2014, China submitted the Notice of Commitment to the WTO Trade Facilitation Preparatory Committee, clearly promising that all the provisions of the first part of the TFA are Class A clauses.[3] "Single window", "Determination and publication of average release time", "Provisional import of goods and entry and exit processing" and "Customs cooperation" are category B provisions, which however will be implemented before the end of February 2020.

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[1] The Kyoto Convention is the abbreviation of the International Convention for the Simplification and Coordination of the Customs Operational System. As the name suggests, it is to promote the simplification and coordination of the customs business system. It is the only legal document in the world that comprehensively defines the customs business system and practice standards.

[2] "TFA" was adopted by the Ninth Ministerial Conference of the WTO on December 7, 2013 and became effective on February 22, 2017. According to Article 10, paragraph 3 of the WTO Agreement, it shall be effective upon acceptance by a two-thirds majority of the WTO members. Currently about 121 members have accepted. China accepted the agreement on September 4, 2015.

[3] Class A clauses are clauses that can be implemented immediately, and category B clauses require a transition period to be implemented. China will complete the Class B clause in 2020.

The Organization for European Economic Cooperation (OECC) was established in 1948. In 1961, it was renamed the Organization for Economic Cooperation and Development (OECD). As the inter-governmental international economic organization, it is composed of 35 countries. China joined the organization in 1995. The purpose of the organization is to help the national governments of member states achieve sustainable economic growth, stable employment and financial stability, and better living standards, thus contributing to the world trade and economy development. Since the late 1980s, the OECD has committed to strengthen the exchange of tax information among all tax departments so as to help member states to determine the income and assets of their residents in tax havens.

2.2. Regional Cooperation Platforms

2.2.1. Russia-Belarus-Kazakhstan Customs Union—Eurasian Economic Community—Eurasian Economic Union Sign an Agreement on Economic and Trade Cooperation with China

According to the modern economic theory, the implementation of economic integration is usually divided into four stages of development——Free Trade Zone, Customs Union, Uniform Market, and Economic Union. The Eurasian Economic Union initiated by Russia, Belarus and Kazakhstan was officially in operation on January 1st, 2015. Kyrgyzstan and Armenia actively followed up on their participation in the organization which is dominated by Russia. The EEU has already formulated a road map in its infancy to realize its most important task of the economic integration in the CIS region. The EEU adopts a four-step strategy. The first step is to establish a customs union within the framework of the Eurasian Economic Community; the second step is to elevate the customs union to a unified economic space; the third step is to further upgrade to the Eurasian Economic Union on the basis of a unified economic space; the last step is to march from the Eurasian Economic Union to the Eurasian Union, which means the overall integration in Politics, economy and diplomacy, which is also the ultimate goal of this organization.

Eurasian Economic Community originated from the Four-nation Customs Union. Customs Union refers to boarder agreements concluded between two or more States on concessions or cancellation of tariffs between States parties within the unified territory. Common tariff rates and foreign trade policies are imposed on imports of commodities from countries or regions outside the border areas. Its contents typically include reducing and eliminating tariffs between States parties leading to the eventual elimination of the national border within the State party, free circulation of goods between States parties and uniform external tariffs, which strengthen allies' competitive power in foreign trade. In March 1996, Russia, Belarus, Kazakhstan and

Kyrgyzstan signed an agreement on the establishment of the Four-nation Customs Union, aiming to coordinate the pace of economic reform in the four countries and accelerate the process of economic integration among the four countries.

2.2.2. The Shanghai Cooperation Organization

The Shanghai cooperation organization, abbreviated as SCO, is a permanent intergovernmental international organization proclaimed by China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan in Shanghai on 15 June 2001. On 9 June 2017, India and Pakistan joined the SCO. Seven working groups have been set up under the mechanism of the SCO Economic and Trade Ministers' Conference, including Electronic Commerce, Customs Cooperation, Inspection, Quarantine and the conformity in standards, Transit Potential, and Investment Promotion. The SCO Customs working Group carries out its work in accordance with *the Implementation Plan of the Framework for multilateral Economic and Trade Cooperation among member States under the Framework of the Shanghai Cooperation Organization* and it signs and promotes *the Agreement on Customs Cooperation and Mutual Assistance between the governments of SCO member States, the Agreement on the Exchange of Information on Customs Energy Supervision in the member States of the Shanghai Cooperation Organization* and *the Protocol of SCO member States on Cooperation in Customs training and the Enhancement of the Professional skills of Customs officers*, etc, to strengthen extensive and practical cooperation in risk management, tracking down on illegal acts of smuggling in Customs, intellectual property protection and other fields. The SCO has become a model of regional cooperation and its influence is increasing.[1]

2.3. Sino-Russian Political Mutual Trust and Frequent Trade Collaboration

Political mutual trust creates environment and opportunity for Economic and Trade Cooperation. The main connotation of political mutual trust is that the parties overcome the differences in ideology, political system, and social formation, understand and support each other's national self-determination on domestic issues as well as the position on international issues, and do not mistrust each other. China and Russia not only have the geographical advantages of cooperation, but also are traditional strategic partners, which provide natural advantages and good foundation for the development of cooperation. On the occasion of the Qingdao summit of the

[1] Currently, the total area of SCO member states exceeds 60% in Eurasia, accounting for nearly 50% people worldwide, and total GDP exceeds 25% globally. More and more countries follow the "SCO approach" to address problems facing their respective countries or regions. China's proposal Belt and Road Initiative is closely associated with Russia's Eurasian Economic Community and Kazakhstan's "Bright Road" policy, which accelerates Economic integration in SCO region.

SCO, Russian President's visit to China is of great significance to promote the building of Belt and Road and the docking cooperation of the "Eurasian Economic Union," and to further promote bilateral economic and trade cooperation, local cooperation, and people-to-people exchanges. When the heads of state of Russia, China, and Mongolia met on 9 June 2018, they also stressed the importance of deepening cooperation, and endorsed the cooperation among the three sides in the fields of transport, infrastructure, customs cooperation, and facilitating trade and personnel exchanges. In addition, the holding of the China-Russia year of Local Exchange, the fifth China-Russia Expo, and the first China International Import Expo provide policy support and opportunity to build a platform for pragmatic economic and trade cooperation between China and Russia.

Trade between China and Russia is frequent and structurally optimized, making customs cooperation and trade facilitation a necessity. China has been the largest trading partner of Russia for eight consecutive years, and Russia is the eleventh largest trading partner of China. The bilateral trade volume between China and Russia reached $84.07 billion in 2017, increasing by 20.8% over the same period last year. The bilateral trade grew by nearly 30% in the first quarter of 2018 and is expected to reach or exceed $100 billion for the whole year.[1]

3. Standard of Collaboration between China and Russia

Taking an overview of the above-mentioned documents of international, regional and bilateral agreements, Sino-Russian customs cooperation is mainly based on international standards for trade facilitation and aims at regional economic integration. It links China's Belt and Road five-link requirements with the Russian-led Eurasian Economic Union, and carries out extensive cooperation in accordance with the agreements reached between China and Russia on customs cooperation. According to the legal functions of customs, the standards of international cooperation of customs are divided into two categories, namely tariff concessions and elimination of non-tariff barriers.

3.1. Tariff Concessions

Tariff is a circulation tax levied on proprietors of goods or articles by customs set up by a government in customs territory, in accordance with international conventions, regional cooperation agreements, and bilateral treaties of which the State is a member. Tariffs have protective functions in addition to their fiscal function. Protective tariff rates are generally high and are not intended to increase fiscal revenues, but rather to protect

[1] Source：http://news.eastday.com/c/20180605/u1a13963356.html, visiting on June 10th 2018.

the national economy. Therefore, tariff is the most powerful means of trade and is also the oldest and most common regulatory tool in the national foreign trade management.

Tariff concession is a measure to reduce tariffs and promote trade among countries. Tariff concessions began with the General Agreement on tariffs and Trade (GATT) signed at Geneva on 30 October 1947 and applied provisionally on 1 January 1948. GATT, the predecessor of the World Trade Organization (WTO), is a multilateral international agreement on tariff and trade rules concluded between governments. The purpose of GATT is to eliminate the differential treatment in international trade and promote the liberalization of trade through the reduction of tariffs and other trade barriers. After the Second World War, countries negotiated tariff concessions on goods on the basis of GATT. There are two bases for negotiations on tariff concession: one is the commodity basis, the other is the tariff rate basis. The commodity basis of tariff concession negotiations is the import duties of customs in each country, including the tax number of import goods, the name of the goods, and the import tax rate corresponding to the tax number. The basis of tariff rate is the starting point for tariff concessions, which lays the foundation for further negotiations. Generally the last negotiated rate is taken as a binding rate. If there is no binding rate, the negotiators work together to fix a rate. The principles of tariff concession negotiations shall follow the principles of mutual benefit, consideration of the interests of members and confidentiality, etc. The types of tariff concession negotiation include tariff concession negotiation in the round of multilateral trade negotiation, tariff concession negotiation after joining WTO, renegotiation after revising or withdrawing tariff schedule, and so on. Agreed tariff concessions apply to all States parties in the Agreement in accordance with the principle of most-favored-nation treatment. The main forms of tariff concessions are to directly reduce tariff rates on the basis of unchanged current tariff rates, not to increase or decrease tariff items, nor to narrow the gap between ordinary and preferential tariff rates, and so on. The purpose of tariff concession principle is to reduce the general level of import and export tariffs of each member, especially the high tariffs that hinder the import of goods, in order to promote the liberalization of international trade.

3.2. Reducing the Non-Tariff Barrier

Tariff is a significant method of trade protection. Meanwhile, the non-tariff measures perhaps set a barrier in the process of international trade as well. According to Article 11, Paragraph 1 of GATT: “No prohibitions or restrictions other than duties, taxes or other charges weather made effective through quotas, import or export licenses or other measures, shall be instituted or maintained by any contracting party on the importation of any product of the territory of any other contracting party or on the exportation or sale for export of any product destined for the territory of any other contracting party.” (He, 2007) The non-tariff barrier means various restrictions

on imports apart from the tariff itself. Some of the restrictions are related to the laws and regulations, like import quotas, import licenses, foreign currency controls, discriminated internal taxes, discriminated government procurement, and import deposit etc. Some are associated with skills, like arbitrary customs valuation, lack of information sharing, and the inefficiency clearance etc.

Currently, international trade has stepped into the "the post-tariff era". The inefficiency of trade has been increasingly focused by international community and there is a growing appeal for trade facilitation. The development of Chinese economy has strong dependence on foreign trade and an urgent demand for trade facilitation. Trade facilitation is to simplify and harmonize the behaviors, formalities and practices involved in the process of international trade, and to ensure that all relevant actions occur in an effective, transparent, and predictable manner. At least, it should comprise the publication and attainment of information, the procedures of release and clearance, the collaboration between border organizations and customs, the legislation, expenses and procedures related to import and export, the procedures of clearance, the free flow of entry goods under the customs supervision, the freedom of clearance, the mechanism of communication and negotiation.

With reference to measuring the trade barriers and expenses, the Enabling Trade Indicator (ETI) and the Trade Facilitation Indicator (TFI) are two relatively typical indicators. Though both are designed to measure the process of international trade, the ETI is an integrated one used to assess series of factors connect to trade within a country and the TFI is used to evaluate the economy and trade impact result from only one specific trade-facilitation measure within a country. The ETI consists of four major respects: the market access, the border administration, the transportation and traffic facilities, the trade circumstance. This indicator is originally put forward by World Economic Forum (WEF) in The Global Enabling Trade Report 2008. The EFI is published every two years and with a range from 1 to 7 points, with the facilitation correspondingly increasing along with the increasing number. The TFI was raised by OECD on the No. 118th "trade policy documents", aiming to estimate the relationship between trade facilitation measures taken by member states of OECD and trade expenses. The TFI is published every two years with a range from 0 to 2 points, with the facilitation increasing along with the increasing number.

Table 1. The Indicator System of Trade Facilitation

First-grade indicator	Second-grade indicator	Third-grade indicator
Frame of policies and laws	Trade measures	Tariff barrier
		Providing information towards foreign customs
	Information sharing	Non-tariff barrier
		Information protecting

First-grade indicator	Second-grade indicator	Third-grade indicator
Administrative environment of customs and border	Administrative efficiency of customs	Customs procedure
		Customs service
	Procedures of import and export	Efficiency of clearance
		Information preparation of Import and export
		Internal process of import and export
		Security measures of prohibiting secret giveaway
		Measures of preserving documents of customs
	Transparency of border administration	Bribery in the course of levy
		Integrity indicator
		Bribery of import and export
The circumstance of logistic and infrastructure	The quality of transport facilities	Equality of air transportation facilities
		Equality of railway transportation facilities
		Equality of highway transportation facilities
		Equality of port infrastructure
	The quality of transport service	Ability of transshipment and connection
		Ability of loading and burdening
		Ability of logistic.
		Ability of tracing and detecting.
	The application of ICT	The efficiency of postal service
		The application of Internet
		The application of mobile phone
		The application of fixed phone
Circumstance of government and finance	The efficiency of government	The transparency of making policies
		The efficiency of solving conflicts of laws and regulations
	The efficiency of finance	The facilitation of financial service.
		The availability of financial service
The mechanism and framework	Easy to contact	Setting liaison offices and liaison person
		Clarifying the power in customs
The human resource management	Having the capacity to handle	The number and capacity of customs officers

Table 2. The Trade Facilitation of the Main Partner Countries of the Belt and Road Initiative from 2014 to 2016

Country	2014			2015			2016		
	TFI	Rank	Degree	TFI	Rank	Degree	TFI	Rank	Degree
China	0.72	5	MC	0.72	5	MC	0.73	5	MC
Russia	0.63	11	C	0.64	9	C	0.66	8	C
Indonesia	0.64	10	C	0.62	13	C	0.63	12	C
Saudi Arabia	0.75	3	MC	0.74	4	MC	0.71	6	MC
Turkey	0.68	7	C	0.67	7	C	0.66	7	C
Poland	0.63	12	C	0.64	11	C	0.64	10	C
Thailand	0.62	14	C	0.62	14	C	0.61	13	C
Iran	0.55	18	InC	0.57	17	InC	0.57	16	InC
Israel	0.70	6	MC	0.72	6	MC	0.77	3	MC
The Philippines	0.56	17	InC	0.54	19	InC	0.50	19	InC
Singapore	1.00	1	VC	0.99	1	VC	0.99	1	VC
Malaysia	0.85	2	VC	0.86	2	VC	0.83	2	VC
Pakistan	0.55	19	InC	0.55	18	InC	0.54	18	InC
Vietnam	0.57	16	inC	0.60	15	InC	0.58	15	InC
Greece	0.66	9	C	0.65	8	C	0.63	11	C
Czech	0.74	4	ore C	0.75	3	MC	0.74	4	MC
Romania	0.57	15	InC	0.58	16	InC	0.56	17	InC
Kazakhstan	0.62	13	C	0.64	12	C	0.65	9	C
Hungary	0.663	8	C	0.64	10	C	0.60	14	InC

Note: The Degree column indicates the degree of the trade facilitation: VC means Very Convenient; MC means More Convenient; C means Convenient; and InC means Inconvenient.
Source: Yang and Wu (2018).

From May 13th to 15th, 2017, General Administration of Customs collaborated with the "Belt and Road Initiative Forum for International Cooperation" to invite 11 countries' customs which include Russia and international organizations to join the conference held in Beijing. The conference has organized related activities like bilateral meeting between customs commissioners and has signed the bilateral cooperative documents of customs. At Parallel Theme Conference on "promoting smooth trade" in Guangzhou, the former Director of General Administration of Customs made the key speech entitled "deepening the cooperation mechanism of the great general clearance and promoting

the smooth trade of the Belt and Road Initiative", introducing the situation about the great general cooperation with the Belt and Road Initiative partner countries and "the exchange of information, mutual recognition of supervision and mutual assistance in law enforcement", and suggestions for further cooperation were put forward:

Deepening the mechanism of cohesion and cooperation. Intensifying the communication and cooperation on administrative rules, law-enforcement procedures, supervision measures, and reformation experiences.

Deepening the innovative supervision cooperation and exploring the way of mutual supervision recognition, expanding the cooperation of AEO mutual recognition, promoting the application of high-technology methods and equipment for achieving a precise and intelligent supervision.

Deepening the cooperation of sharing information, promoting the connection of international "single window" standard, targeting to realize the exchange of standard data and establish efficient, safe and normative data-exchange platforms for customs along the route.

Deepening the cooperation of trade security. Underpinning the cooperation of information exchange along the route. Expanding the cooperation of joint law-enforcement and anti-terrorism activities. Cracking down the illegal cross-border smuggling activities.

Deepening the cooperation of capacity construction. Keeping the customs along the route together, enhancing the sharing of experience and wisdom, and learning from each other for the joint improvement. These recommendations can become the cooperative direction between Chinese and Russian customs.

4. Concrete Measures for Customs Cooperation between China and Russia

Customs cooperation refers to the cooperation between government organizations of different countries or economies, especially customs departments, in customs affairs (Liu, 2015). Through the international cooperation of customs, we will improve information exchange and facilitation, simplify and coordinate the import and export customs clearance procedures of cooperative countries, and jointly combat smuggling and infringement of intellectual property rights, so as to realize the security and convenience of the goods supply chain and promote the standardized development of world customs. According to international conventions, regional cooperation and bilateral agreements, the customs of China and Russia mainly cooperate in the following aspects:

4.1. Tariff Concession

After reducing import tariffs on some consumer goods on December 1, 2017, the

import and export tariffs on some commodity were revised again in *Tarrif Adjustment Program 2018*. China's tariff rates include most-favored-nation (MFN) tax rate, agreement rates, preferential rates and general rates. The regulations of MFN tax rate include: (1) China will implement the provisional tax rate for 948 imported commodities from January 1, 2018, of which 27 information technology products will be subject to the tax rate until June 30, 2018. (2) the second reduction in MFN tax rate for information technology products listed in the *amendment of the tariff schedule of the People's Republic of China to the WTO* shall continue from 1 January 2018 to 30 June 2018. The third tax cut will take effect on July 1, 2018. (3) as of July 1, 2018, the MFN rate of 10% will be imposed on broken rice (tax Numbers 10064010 and 10064090). Both China and Russia are members of the WTO, and China's tariff reduction gives Russia the most preferential treatment of course. In addition, in order to promote the Belt and Road Initiative and the construction of free trade zones, agreed tariff rates will be imposed on some imports from 26 countries or regions. In 2018, China will continue to implement the APEC commitment to reduce taxes on environmental products and continue to grant zero-tariff treatment to the least developed countries.

Similarly, after Russia joined the WTO in 2012, the tariff reduction became a hot topic. Russia's entry into the WTO is important for enjoying most-favored-nation treatment in which other member countries reduce tariffs, while also committing and implementing the reduction of Russia's import tariffs. After entering WTO, Russia's average tariff was gradually reduced by 9.5% in 2012, 6.9% in 2013 and 6.0% in 2015. The export customs clearance cost of Chinese enterprises was greatly reduced.

4.2. Reducing Non-Tariff Barriers and Promote Trade Facilitation

On October 1, 2017, Chinese minister of commerce Zhong Shan held talks with Nikki Shenna, the trade committee member of the Eurasian Economic Commission (EEC), in HangZhou and signed the joint statement on the substantial conclusion of negotiations on the economic cooperation agreement between China and the EEU. This is the first time that China and the Eurasian economic union have reached an important economic and trade arrangement. It is also an important outcome of the joint statement on cooperation between the construction of the Silk Road Economic Belt and the construction of the Eurasian economic union signed by President Xi Jinping and President Putin in May 2015. The content includes 10 chapters covering customs procedures and trade facilitation, intellectual property rights, departmental cooperation and government procurement, as well as topics such as e-commerce and competition. The signing of the agreement will further reduce non-tariff barriers to trade, raise the level of trade facilitation, create a favorable environment for industrial development, promote cooperation between the construction of Belt and Road and the Eurasian

economic union, and promote in-depth development of economic relations with the Eurasian economic union and member states.

4.2.1. Customs Information Exchange

The interconnection and exchange of information, especially customs clearance information, that is very important for the trade convenience and security of countries along the Belt and Road. The importing country can obtain timely import information of goods, goods and means of transport, which is conducive to risk assessment. The exporter also controls the status of enterprises through information control, which is convenient for classification and supervision, reduces the cost of trade, and establishes the good international reputation of enterprises.

In response to the need for trade information exchange between customs administrations, the global customs community has developed a number of exchange mechanisms, including intelligence and individual trade information exchange, to facilitate trade. WCO also provides legal instruments and frameworks to support the exchange of information between customs administrations. WCO council in 1977 adopted the *International Convention on Mutual Administrative Assistance for the Prevention, study and Repression of Customs Offences, the Nairobi Convention*, in order to achieve multilateral cooperation, including the exchange of executive information, and mutual administrative assistance during the investigation. In order to improve Customs cooperation procedures, WCO revised a *Model Bilateral Agreement on Mutual Administrative Assistance in Customs Matters* in 2004. Based on this Model, many Customs administrations have concluded Mutual Assistance agreements and have voluntarily or as required exchanged implementation information and intelligence. Chapter 3 of the model is “information”, and articles 4 and 7 respectively provide “information on tariff collection” and “information related to violation of customs law”(He, 2015). It can be seen that the shared content includes customs clearance business operation process, laws, regulations and regulations, tariff price, anti-smuggling intelligence, AEO, and other statistical data. WCO is working on standardizing information exchange in the form of data modules to ensure information sharing.

To facilitate the exchange of Enforcement information, WCO has developed the Customs Enforcement Network (CEN) platform, which covers databases and communications tools. WCO encourages the exchange of information on drug, tobacco, counterfeit goods, and the smuggling of rare plants and animals through the CEN database and the coordinated implementation of actions and projects through CEN (Han and McGauran, 2014).According to the *Suggestions and Guide to Create a Single Window* (hereinafter referred to as “the number 33 proposal”, published by trade facilitation and electronic business center (UN/CEFACT) in 2005), the connotation of

the single window is a measure where all parties involved in trade should submit all standard data and documents that meet import, export and transit related regulations in a single registration point . For example, Hangzhou customs is the first comprehensive test area for cross-border e-commerce in China. It takes the lead in realizing real-time exchange of customs status data and corporate integrity data through "single window" platform. Cross-border enterprises only need to log in the "single window" and submit standard documents and information without multiple declaration. They can complete customs registration, commodity declaration and other procedures with one key, and check the follow-up treatment of taxation and release. It is more convenient for various departments of customs, foreign exchange administration, state taxation, industry and commerce, logistics and finance to realize data exchange and information sharing through "single window".[1]

The TFA sets requirements for WTO members to share information to ensure effective customs management while respecting the confidentiality of information exchanged. Paragraph 4 stipulates that a member of the requesting party shall make a written request to a member of the requested party in a mutually agreed WTO working language or other language in paper or electronic form, and that the member of the requesting party shall strictly keep confidential all information or documents provided by the member of the requested party. Information or document is only provided to the customs handling the matter in question and such information or document is only used for the purposes specified in the request, unless otherwise agreed in writing by the requested member; No information or documents shall be disclosed without the express written permission of the members of the requested party.

The OECD has been working to strengthen the exchange of tax information between tax authorities to help member states determine the income and assets of their residents in tax havens. WCO has adopted various methods and means to deal with the exchange of customs information between member states. Customs authorities want to strengthen the exchange of customs information, focusing on tracking the transactions and payment processes of exporters and other competitive importers (Han and McGauran, 2014). There are three types of tax information exchange: request, automatic, and spontaneous. Request-type information exchange refers to the tax information transmitted according to the specific requirements of the country of residence. Automatic exchange of information allows tax authorities in the country of origin to send all relevant tax information to the country of residence that agrees to exchange information on a regular basis. Spontaneous information exchange refers to the voluntary sending of information from the tax authorities of one country to the tax authorities of another country, which may be needed in the auditing process and is

[1] Trade information exchange between customs administrations is indicated in Article 12 Customs Cooperation of the WTO's Trade Facilitation Agreement.

believed to be useful to the tax authorities of that country (Keen and Ligthart, 2006). In comparison, request-type information exchange is activated passively, which is difficult for tax authorities to use without sufficient evidence of tax evasion. Moreover, information sharing with another country is not necessarily in the best interest of the country. As a result, the European Union and the US have opted for automatic exchange of tax information.

4.2.2. Mutual Recognition of Customs Supervision—Authorized Economic Operator (AEO) System

Mutual recognition of customs supervision refers to the mutual recognition of each other's supervision results by the respective customs, that is, the supervision results of the customs of the export place are recognized by the customs of the import place so as to reduce duplication of supervision and inspection and reduce the administrative costs of the customs and the clearance costs of enterprises. The results of mutual recognition supervision need to meet three conditions: mutual recognition countries have consistent risk management standards, share intelligence and risk information, and institutionalize mutual customs data providing. The authorized economic operator certification system initiated by the European union and WCO is determined by the Framework of Global Trade Security and Facilitation Standards (hereinafter referred to as the Framework) adopted by the 105th/106th annual meeting of the WCO Council held in June 2005. It is defined as the party that participates in the international circulation of goods in any way and is recognized by the customs authorities as meeting the world customs organization or the corresponding supply chain safety standards, including manufacturers, importers, exporters, customs brokers, carriers, tally people, middlemen, port and airport, cargo terminal operators, comprehensive operators, storage operators and distributors. In 2006, WCO further approved and passed the AEO Implementation Guide, refining and perfecting a set of standards about AEO qualifications, security measures, assessment and certification, mutual recognition and so on in order to promote the implementation in synchronization with the Framework.[1] AEO certification is the highest credit management level in the classified management of customs enterprises in countries in the world and the enterprises enjoy the highest convenience and preferential measures. Its mutual recognition procedure is: Firstly, the customs of various countries (or regions) will certify the local enterprise, and

[1] WCO and other countries in the world generally think that enterprises that have obtained the qualification of AEO have certificates of compliance with customs regulations, a trade record management system that meets the requirements, good financial solvency, good ability of negotiation, cooperation and exchange, and education training and awareness systems. They can realize the access and confidentiality of information exchange, safety of goods and means of transportation, and safety of goods and personnel, and have a complete crisis management and disaster prevention system, and a complete measurement, analysis and improvement system.

the enterprise must obtain AEO qualification; Secondly, international cooperation is carried out, that is, the mutual consultation and mutual recognition between the customs of one country and the customs of another country on AEO and its related policies; Thirdly, mutual signing of AEO mutual recognition agreement; Finally, the mutual recognition arrangement is implemented, that is, the customs of the contracting countries implement convenient customs clearance treatment for imported goods (the export of the opposite AEO enterprises to their own countries or regions), subject to the issuance of public notices. The 21st Century Customs document issued in 2008 as the blueprint for WCO's global strategy development points out that: Customs in the 21st century should establish strategic partnership with trustworthy operators.[1] DEEN, the newly elected president of the WCO Council, and MIKURIYA, the secretary general, are both actively promoting the implementation of the framework and the AEO certification and compliance facilitation system and are working hard to promote mutual recognition of law enforcement among countries. The three core elements of AEO system are standard, convenience and mutual recognition. The purpose of AEO implementation is to strengthen the cooperation between customs offices of various countries and implement mutual certification of AEO qualifications, thus forming an international chain of customs clearance facilitation. On December 1, 2014, the Chinese customs officially implemented the enterprise credit management system, grading the enterprise customs credit and authenticating the credit enterprise, implementing differentiated management, and let the AEO certification enterprises enjoy convenient customs clearance treatment.

4.2.3. Connection between China's the Belt and Road Initiative and Eurasian Economic Union

The five "Eurasian Economic Union" countries are all important partners in the construction of the Belt and Road Initiative. In May 2015, China and Russia signed the joint declaration on the Cooperation between the Silk Road Economic Belt Construction and the Eurasian Economic Union Construction, announcing the economic and trade cooperation talks between China and the Eurasian Economic Union, clearly establishing trade facilitation mechanisms in areas where conditions are mature, formulating common measures in areas of common interests, and coordinating

[1] In June 2008, the World Customs Organization formally adopted *21st Century Customs- Promoting Growth and Development through Trade Facilitation and Border Security* (hereinafter referred to as *21st Century Customs*) which aims to develop a new strategic direction for customs. It collects, processes and processes all kinds of data and intelligence through the establishment of a global customs cooperation network that strengthens cooperation between customs offices. At the same time, it builds a close relationship between the customs and the business community and coordinates cooperation between customs offices and other border management departments to create a safe and convenient international trade environment.

and compatible with relevant customary regulations, standards and economic and trade policies. On May 17, 2018, FU Ziying, China's commercial international trade negotiator and deputy minister, signed an economic and trade cooperation agreement with Sergei Sarkis, chairman of the Eurasian Economic Committee of the Eurasian Economic Union, and representatives of member States of the Eurasian Economic Union in Astana, the capital of Kazakhstan. The scope of the agreement covers 13 chapters, including customs cooperation, trade facilitation, intellectual property rights, departmental cooperation and government procurement as well as new topics such as e-commerce and competition. The two sides agreed to simplify customs clearance procedures and reduce the cost of goods trade by strengthening cooperation, information exchange and experience exchange. The agreement is expected to take effect in early 2019. This agreement is the first important institutional arrangement between China and the Eurasian Economic Union in terms of economy and trade. The economic and trade cooperation between China and the member countries of the union has entered the stage of system leading driven by the project, which is of positive significance in promoting the docking cooperation between the construction of the Belt and Road Initiative and the construction of EAEU.

Eurasian Economic Community originated from the customs union of four countries. Apart from meeting the minimum requirements of WTO on customs union, the customs union should also follow the international standards to innovate the border management model (risk management, simplification of coordination procedures, relatively consistent legal system, mutual recognition, elimination of duplication, etc.). Customs clearance of customs union member states is based on the Customs Code of the Customs Union (hereinafter referred to as CUCC), which came into effect on July 1, 2010. Members have gradually implemented WCO's legal documents, including the *International Convention on the Simplification and Harmonization of Customs Procedures* and the *Framework of Standards for Global Trade Security and Facilitation*. The customs union's import and export clearance procedures reflect Russia's domestic procedures, as most Russian legal provisions conform to the revised Kyoto Convention. The import and export counterpart should focus on the following aspects (Krotov, 2011):

(a) National Residency Principle. Article 368 of CUSS stipulates that the declaration must be submitted to the national customs office where the customs applicant resides or registers. Therefore, Russian legal entities and private business owners must submit their declarations to the customs authorities of the Russian Federation.

(b) Simplify customs declaration procedures and promote trade circulation. Foreign goods imported into any member state of the alliance in accordance with the relevant customs procedures and allowed to circulate freely as goods can circulate freely throughout the alliance. Imported goods must be taxed if tax rate adopted by member States is lower than that of ordinary duties; Import declaration forms and other

documents must be submitted before the end of the temporary storage period. This provision gives the declarant sufficient time to go through the customs formalities in a timely manner, and the time for the goods to be released is also reduced to one working day. Since July 2012, all road transport operators in the alliance shall submit in advance through electronic declarations as required, and the regulations will gradually be extended to other modes of transport. Remote release of goods is realized.

(c) Personnel that carry out customs activities. CUCC has expanded the registration list of personnel carrying out customs activities, currently including customs representatives, owners of temporary storage warehouses, owners of customs warehouses, customs consignors, owners of duty-free shops, and has introduced an authorized operator, namely the AEO system. In 2012, more than 120 AEO applications were submitted to the federal customs service in Russia. In Kazakhstan, a partner country, two regions launched pilot projects on electronic customs export declaration; Republic of Belarus's newly revised customs regulations have also greatly simplified the customs clearance process (Wolffgang, Brovka and Belozerov, 2013).

(d)Set up one-stop checkpoints. One-stop inspection enables immigration, customs and other border management departments to be more closely linked, such as customs officials from two border countries handling import and export affairs in adjacent offices or rooms. Of course, when setting up one-stop border checkpoints, there should be corresponding legal frameworks. The two sides reach agreements on one-stop management plans, procedures and documents with the information and communication technology conditions and infrastructure as well as corresponding human resources and supervision mechanisms (Kieck and Maur, 2010).

4.2.4. Mutual Assistance in Law Enforcement

Mutual assistance in law enforcement refers to the two countries (regions) customs, according to international conventions, regional cooperation agreements, and bilateral treaties, assisting each other's administrative law enforcement according to their application or their functions and powers. Mutual assistance in law enforcement is an important part of mutual assistance and cooperation agreements signed between customs offices of various countries. The assistance includes: (1) Information exchange, including intelligence clues such as suspected smuggling, drug trafficking and money laundering as well as data exchange for law enforcement purposes, such as X-ray scanning of images. (2) Document verification, including the authenticity of the declaration form, the authenticity of the declaration price, the certificate of origin and other accompanying declaration documents. (3) Case investigation, including special surveillance, participation in administrative procedures in the other party's territory, assistance in investigations, etc. (4) Joint law enforcement. Actively participation in and cooperate with the security when carrying out joint law enforcement for specific

periods, specific commodities, specific transportation routes, and specific cases. (5) Jointly study common problems in law enforcement, such as carrying out regular joint risk analysis and prediction, carrying out joint customs protection of intellectual property and joint training, etc. Implementing mutual assistance in law enforcement includes the following aspects:

Launch joint customs administration. From the experience of some Central Asian countries, the joint customs administration will begin first, and then the overall coordination management including all agencies will be carried out. Regarding joint customs administration, some countries have developed standardized operating procedures between border customs. The declaration form is filled in the country of entry and the information provided is shared with the country of exit. This is the precondition for further action. Customs inspection is only carried out in the country of entry unless the customs of the country of exit requires some information.

Prepare a memorandum of understanding (hereinafter 'MOU') for joint border management. International agreements provide the basis for simplification, standardization and harmonization of customs clearance procedures for joint border management. In this regard, we can make use of the support provided by international organizations such as WCO in capacity-building (Jain, 2012). In order to achieve efficient joint management, each border channel needs to extensively push forward the implementation of these memorandums. The governments of Thailand and Laos both joined CBTA in 1999, and then signed MOU in July 2005. The main contents include the supervision mode of implementing single window inspection[1] and one-stop inspection at the ports of Mukdahan in Thailand and Savannakhet in Lao People's Democratic Republic.

Launch joint border management in the interior area. In order to relieve the pressure on the border passage, joint border management measures should be initiated in the interior area. The inspection of exported goods, as well as the packing and sealing of containers, can be carried out jointly by customs and other border management agencies in inland container warehouses. Many countries in Central Asian Regional Economic Cooperation (CAREC) have already launched regional dialogues on joint customs control, and many countries now have functional joint control. At present, Kazakhstan has carried out joint border supervision with the Russian Federation, China and Kyrgyzstan, including promoting the use of unified cargo manifests.[2] The

[1] Single window inspection, i.e. joint offices of customs, border inspection, inspection and quarantine and other border agencies, which simultaneously implement inspection procedures for transit vehicles and goods to enhance the efficiency of customs clearance; One - stop inspection, that is, the neighboring countries send customs officers to carry out cross-border law enforcement and carry out joint inspection to reduce the number of inspections in the transit links of goods and save the time of release.

[2] Adoption of a unified cargo manifest coupled with simplified procedures has reduced customs clearance time by 35 per cent. *CAREC Transport and Trade Facilitation Progress and Work Plan* 2010-2011, p. 4, para. 25.

application of AEO facilitation measures should be encouraged in the border crossing. Mutual recognition of AEO between countries can greatly reduce the delay of goods at the border (Jain, 2012).

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Poverty Reduction Effect of Chinese Aid and Investment in the Belt and Road

Yuan Zhang*

China contributes to poverty reduction in developing countries along the Belt and Road (B&R) by the way of aid and investment, taking infrastructure construction as a break through and state-owned capital as the main force. The empirical study of the B&R countries' panel data of 2000–2017 shows that Chinese aid and investment help to reduce poverty rate, and there is a threshold effect between investment and poverty rate reduction. When the per capita GDP level is below the threshold value, the poverty reduction effect of Chinese investment is more significant. Different types of aid and investment generate different poverty reduction effects: construction project investment and green land investment have more significant effects, and poverty reduction mechanism based on infrastructure construction has better poverty reduction effect than transfer payment aid. The correlation between state-owned enterprise investment and poverty rate reduction is significant, and state-owned capital plays an important role in poverty reduction in the B&R developing countries. The research also finds that poverty reduction effect of Chinese aid and investment is realized mainly by capital formation and job creation in these countries.

Keywords: foreign aid, investment, poverty reduction, the Belt and Road

1. Introduction and Literature Review

Since the 1980s, along with the promotion of reform and opening-up and the implementation of large-scale poverty reduction plan, China has achieved significant achievement in poverty reduction. The proportion of absolute poor has declined from 61% in 1990 to 30% in 2002, and goes below the world average level in 2011 (as shown in Figure 1), which contributes more than 70% of the global poverty reduction (The World Bank, 2016). China's tremendous achievement in poverty alleviation[1]

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[1] "Poverty reduction" and "poverty alleviation" are interchangable in this paper, without other specification.

has won the high praise from the world and provides a "Chinese-style scheme" for the anti-poverty practice of neighboring developing countries. In 2013, President Xi Jinping proposed the "Silk Road Economic Belt" and "Maritime Silk Road in twenty-first Century", the cooperation and development between China and countries along the Belt and Road have been increasingly strengthened. However, in term of per capital GDP, industrialization level, proportion of agricultural population and infrastructure level, most of the countries along the Belt and Road[1] are still developing countries, and anti-poverty is still an important task faced by these countries.

Taking the Belt and Road Initiative as the opportunity, China actively links the development strategy of the countries along the route, and shoulders the responsibility of poverty alleviation. According to the historical data, China's total aid to the Belt and Road gradually stabilized to about 50% of China's global aid (as shown in Figure 5) after the 2008 of financial crisis, and China's investment in the countries along the Belt and Road has risen rapidly to about 80% of the total investment since 2013 (as shown in Figure 6). As China has gradually become the most important aid and investment country in the Belt and Road, the actual poverty alleviation effect of aid and OFID needs to be assessed. What is the mechanism of poverty alleviation in the cooperation between China and countries along the Belt and Road? Is it simply "giving the fish" or "teaching how to fish" to enhance the ability of poverty alleviation of recipient countries? What are the effect and influence channels? All these problems need to be analyzed in depth.

This paper has the following innovations from three aspects. First, this paper elaborates the basic logic of dual mechanism of China's aid and investment to promote the poverty alleviation of the Belt and Road. The single aid perspective has replaced by the integration framework of aid and investment, which studies the core role of poverty alleviation of infrastructure aid and investment in the Belt and Road, the leading role of state-owned capital, as well as the two-way promotion role of poverty alleviation at home and abroad. The second innovation is the empirical research. This paper contributes an empirical model of poverty alleviation of China's aid and investment in the Belt and Road, and uses the panel data of countries along the Belt and Road from 2000 to 2017 with the method of system GMM and threshold regression to analyze the actual poverty alleviation effect of aid and investment, to examines the possible threshold effect of investment, and compares the differences and causes of poverty alleviation effect of different types of aid and investment. Thirdly, the intermediary effect model is used to

[1] Since the the Belt and Road initiative was proposed, the number of countries that respond to the initiative has increased year by year. The statistics on the basis of participating countries would have the comparability problems in different years. Therefore, the concept of the Belt and Road in this paper is defined as the countries along the Belt and Road, which is based on the geographic route of "vision and action for promoting the construction of Silk Road Economic Belt and maritime Silk Road in twenty-first Century" issued by the National Development and Reform Commission, Ministry of Foreign Affairs and Ministry of Commerce in 2015, as well as countries that signed the cooperation agreement with China as of December 2017.

study the channels and mechanism of poverty alleviation of China's aid and investment to analyze their roles in capital accumulation and employment creation, which outlines the main paths for China's aid and investment to "teach how to fish".

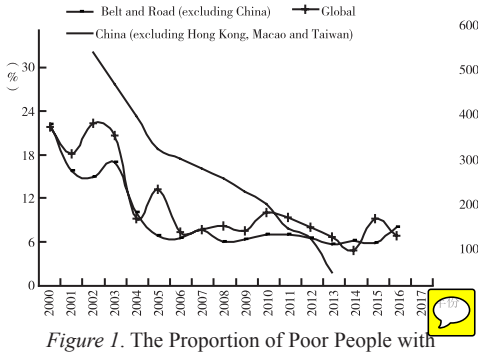

Figure 1. The Proportion of Poor People with the Living Cost below $1.9

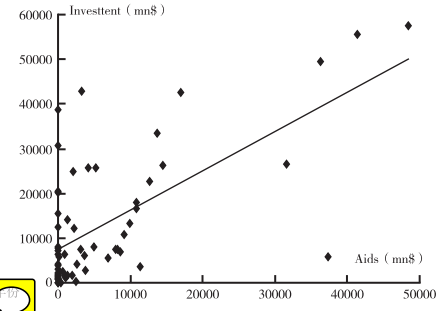

Figure 2. China's Aid and Investment on the Belt and Road

Sources: The data of proportion of poor is from the World Bank database and the data of foreign aid is from AidData of William Mary College in the United States. The data of outward investment is from the China Global Investment Tracker (CGIT), which excludes China's investment in Hong Kong, Cayman Islands, Virgin Islands and Bermuda. The charts and other data in the paper are from the above databases without special explanation.

2. The Mechanism of Poverty Alleviation of Chinese Aid and Investment in the Belt and Road: Statistical Observation

2.1. Promoting Poverty Reduction through both Aid and Investment

China has a long history of helping the developing countries along the Belt and Road. However, limited by the stage and capability of China's economic development, the total size and number of recipient countries before 1990s were relatively small. After 2000, it began to increase significantly. The first selected target country along the Belt and Road that China aids and invests is the traditional friendly country that needs poverty alleviation with less resistance. The main recipient country has gradually become investment host country, which shows a trend of expanding from point to panel. At present, China's aid and investment have a positive correlation in many countries that along the Belt and Road (as shown in Figure 2).

From the perspective of the flow of aid and investment, poverty alleviation is an important goal of China's cooperation with countries that along the Belt and Road. Since countries with high economic development level are not the main targets of aid, who receive less than 20% of China's total aid and investment. China's aid mainly moves to the poor countries, which leads to the negative relationship between aid and the GDP per capita. Investment also has similar characteristics. In countries with GDP per capita below

the median level, China's investment is also negatively correlated with host country's GDP per capita, as well as with the infrastructure, manufacturing and capacity cooperation investment. In countries with GDP per capita above the median level, China's investment accounts for 47.7%, and there is no such negative correlation. The "threshold effect" with the per capita GDP as the watershed indicates that China has different investment targets in different countries along the Belt and Road. Investment in developing countries has significant aid characteristics, which indicates that aid and investment simultaneously are important ways to promote poverty alleviation in these countries.

2.2. Relying on Infrastructure Construction to Promote Development-Oriented Poverty Alleviation

The causes of poverty in countries along the Belt and Road are different and there are also various ways to alleviate poverty. From the perspective of traditional international aid system, growth theory (economic growth promoting poverty alleviation), trade promoting theory (international trade promoting poverty alleviation), capacity promoting theory (capacity promoting poverty alleviation) and good governance theory (social system reform promoting poverty alleviation), to a certain extent, have all influenced the poverty alleviation ideas of these countries (Sebastian, 2015). China promotes the development of countries along the Belt and Road by the way of aid and investment, which is an innovation and exploration of existing aid system. The practice of poverty reduction in many countries and relevant international organizations over the years has also shown that direct transfer payments are usually difficult to achieve sustainable and effective poverty alleviation. However, raising the income levels by increasing employment opportunities and sharing the benefits of growth by participating in the process of economic growth are more effective in poverty alleviation (Jalilian and Weiss, 2002; Ye, 2005).

However, due to economic and geographical constraints, backward countries along the Belt and Road have long been constrained by the "poverty trap" formed by inadequate infrastructure. Self-help and development-based poverty alleviation mechanisms could not be effectively launched. From the perspective of the effect of poverty alleviation, infrastructure construction goes ahead of the rest, which includes road construction, water supply, agricultural water conservancy, and even power supply, communications and other fields. These infrastructures require large-scale and sustained investment, and they are not favored by private capital due to the low return and long payback period. According to the estimates of the Asian Development Bank, only if the annual investment in infrastructure such as transportation, water, electricity and communications in Asian economies between 2016 and 2030 would have the scale of 1.7 trillion US dollars and the total investment exceeds $26 trillion, the world average level could be achieved. However, the actual investment is only half of the demand

(Asian Development Bank, 2017). It is harder for the countries along the Belt and Road to bear, and the primary bottleneck of poverty reduction could not be solved. As a typical positive externality public good, infrastructure is essential in promoting the development of manufacturing, as well as other energy of resources. Local and foreign private capital prefer to invest countries with better infrastructure, which increases the employment opportunities and income, and further promotes the improvement of the investment environment and poverty alleviation is put on a sound track. For the countries with low infrastructure level, the shortage of private investment leads to the inadequate job opportunities, which results in a vicious circle of economic development.

2.3. Joint Mechanism of Government and Market

It is due to the large demand of infrastructure, high difficulty in development and low participation in private capital, state power has become the most important force in China's aid and investment in countries along the Belt and Road. At the same time, it is also the outward extension of the institutional advantages of "China-style poverty alleviation" (Zhang and Xu, 2016; Wang *et al*., 2017). These factors objectively determine the scale and duration of investment in China's state-owned capital.

From the perspective of investment, state-owned capital plays a major role, and the role of non-state-owned capital has also increased. In 2005, 98% of China's total investment in the Belt and Road came from state-owned enterprises. The proportion of state-owned enterprises accounted for 93.8% and almost all investments came from state-owned capital. In the rest of the world except for countries along the Belt and Road, the above two values were 87.8% and 80% respectively. In 2017, the share of state-owned investment in the Belt and Road dropped to 59.7% and the share of number of state-owned enterprise dropped to 62.9%, which is still higher than that of non-state-owned enterprises. In other parts of the world, non-state capital began to take the lead after 2015 (as shown in Figure 3). China's investment in the Belt and Road is still dominated by state-owned capital, but the trend towards diversification has gradually emerged.

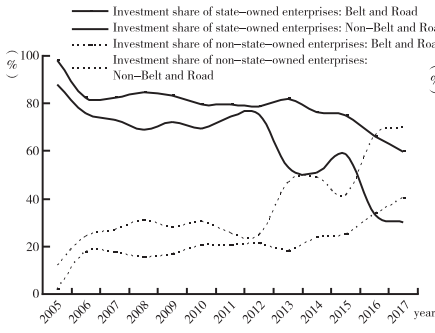

Figure 3. Investment Shares of Different Types of Chinese Enterprises in Different Areas

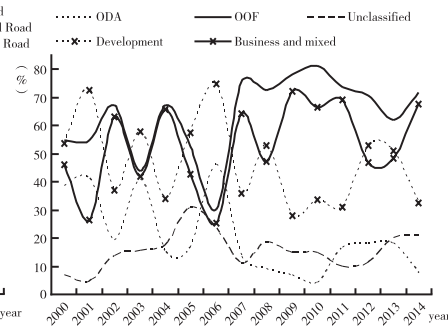

Figure 4. Proportion of Different Types of Foreign Aid Fund

3. Empirical Study on Poverty Alleviation of Aid and Investment: Analysis of the Effect of "Teaching How to Fish"

3.1. Econometric Method

China contributes to poverty alleviation in developing countries along the Belt and Road by the way of aid and investment, taking infrastructure construction as a breakthrough and state-owned capital as the main force. Whether this method of poverty alleviation could produce practical results needs to be evaluated by the empirical evidence. In order to further analyze the impact of China's aid and investment on poverty alleviation in the countries along the Belt and Road, this paper constructs an econometric model on the basis of model of Gohou and Soumaré (2012) and Collier and Dollar (1999):

$$POVR_{it} = \mu + \alpha_0 AID_{it} + \cdots + \alpha_T AID_{it-T} + \beta_0 OFDI_{it} + \cdots + \beta_T OFDI_{it-T} + \theta X_{it} + \varepsilon_{it} \quad (1)$$

$$POVR_{it} = \mu + \sum_{m=1}^{M}(\alpha_0 AID_{it}^{m} + \cdots + \alpha_T AID_{it-T}^{m}) + \sum_{n=1}^{N}(\beta_0 OFDI_{it}^{n} + \cdots + \beta_T OFDI_{it-T}^{n}) + \theta X_{it} + \varepsilon_{it} \quad (2)$$

In order to avoid the errors of index of per capita GDP or per capita income caused by the gap between rich and poor on measaring poverty, this paper uses the proportion of the poor population ($POVR_{it}$) as the dependent variable. Equation (1) mainly investigates the impact of China's total amount of aids (AID_{it}) and investment ($OFDI_{it}$) on the proportion of the poverty-stricken population, and i represents country while t represents time. Since there may be delays in the effect of aid and investment on poverty alleviation, current term and the earlier 1~T term of the index are also included in the regression analysis. The equation (1) also includes other factors X_{it} that affect the proportion of poor population, such as aids and investments received by other countries, net exports from other countries, capital formation per capita, unemployment rate, proportion of agricultural population, industrialization stage and location. Equation (2) further examines the poverty alleviation effects of m-types aid and n-types investment. The aids are divided into ODA and OOF to examine the difference of poverty alleviation effect between different types of aid while the investments are divided into project contract investment, green land investment and other direct investment to observe the difference between infrastructure investment and other types of investment. At the same time, this paper distinguishes the investment of state-owned enterprises and non-state-owned enterprises to analyze the poverty alleviation effects of different types of capital ownership, which could verify the effectiveness of cooperative poverty alleviation promoted by national forces.

There may be endogeneity or simultaneity bias between aid and poverty rate, which

is mainly solved by theoretical analysis and econometric models. First, aid-oriented investment may prefer to less developed countries, and it only accounts for a part of global outward investment. It can be seen from the trend of different types of aid funds in China in recent years (as shown in Figure 4) that since 2008, the share of aid-oriented development funds has been lower than that of commercial and mixed types in most years, and ODA funds have also been lower than that of OOF funds in the same period. There is no significant negative relationship between China's investment and per capita GDP of developed countries. Second, this paper uses the method of SYS-GMM with the lag terms as tool variables, which could be conducive to solve the possible endogenous problems. Regression analysis will test the problem of insufficient identification, excessive identification and weak instrumental variables, and adopt the one whose test is significant.[1]

The statistical observation shows that China's choice of recipient country along the Belt and Road is more diversified. The aid-oriented investment is mainly distributed in the less developed countries along the Belt and Road. There may be the threshold effect with per capita GDP as the watershed. The threshold regression model is further used to analyze the poverty alleviation effect (Hansen, 1999) with per capita GDP ($PERGDP_{it}$) as the threshold variable and invest as the main variable:

$$POVR_{it}=\alpha_0+\alpha_1 OFDI_{it}(PREGDP_{it}\leqslant\psi)+\alpha_2 OFDI_{it}(PREGDP_{it}>\psi)+\theta X_{it}+\varepsilon_{it} \quad (3)$$

ψ is the threshold of per capita GDP, and X_{it} is the other factor that affects poverty rate, which is same with equation (1) and (2).

3.2. Data Description

The data of regression analysis are mainly from College of William and Mary's "aid data" (Aid Data) and China's foreign investment tracking data (CGIT). The former includes China's data of 5466 projects that China aids 141 countries or regions in the world while the latter contains data of 2933 projects that China invests in 151 countries or regions in the world. The data of China's aid and investment in the countries along the Belt and Road is extracted from the database. Data on the proportion of poor people, net global aid and investment, import and export, per capita capital formation, per capita GDP, unemployment rate, proportion of agricultural population, and employment of three industries were mainly derived from the World Bank database, which forms the panel data of 62 countries along the Belt and Road from 2000 to 2017.

[1] There is no definite conclusion on whether SYS-GMM could solve the endogenous problem. Babajide, James and Jeffry (2012) hold the relatively optimistic conclusion that GMM could solve the heterogeneity and simultaneity errors. In the absence of better tool variables, SYS-GMM method may be more effective.

The distribution among ASEAN, Western Asia, South Asia, Central Asia, CIS, Central and Eastern Europe and other countries are 16.1%, 24.2%, 11.3%, 8.1%, 8.1%, 19.4% and 12.9% respectively. Proportion of countries that in the prime stage, mid-stage, late-stage of industrialization and post industrialization is 21.2%, 25.7%, 47.0% and 6.1% respectively (Zhang and Liu, 2017).

From the perspective of the overall size of aid and investment, China's aid and investment in the countries along the Belt and Road were basically flat before 2010. At the same time, the amount of aid even exceeded the amount of investment in some years, but the growth trends of aid and investment appeared to be divergent in that the growth rate of investment was obviously accelerated with the total amount rapidly exceeded the amount of aid. Before the financial crisis in 2008, China's aid to countries along the Belt and Road accounted for a relatively high proportion of China's global aid, which accounted for 86% in the peak period, then gradually dropped to below 30% and picked up again during the financial crisis in 2008, but continued to decline slowly and gradually stabilized (as shown in Figure 5). Overall, the amount of China's aiding in the Belt and Road shows a downward trend while that of investment shows a steady or slight increase. Since 2013, the proportion of investment stocks has increased significantly and 80% of the global investment stock of China is concentrated in the countries along the Belt and Road (as shown in Figure 6), which shows that investment may play a more important role in poverty alleviation than aid. From the perspective of national distribution of funds, the total number of countries along the Belt and Road that receive aid and investment is rising, but the growth of investment is more significant than aid. The concentration of aid and investment R_5 in China declined from 89.0% in 2005 to 47.3% in 2017, and R_{10} also declined by about 28%. [1]The concentration of aid distribution is higher than that of investment on the whole, but there is also a downward trend, which indicates the increasing of number of country and scale of funds.

3.3. The Impact of Aid and Investment on Poverty Rates

The preliminary regression of OLS shows that China's aid and investment could reduce the proportion of poor people with the lag effect (as shown in Table 1). This paper uses the system GMM method with the aid and investment, net exports, unemployment rate, proportion of agricultural population and per capita capital formation as the explanatory variables, and the estimated values of AR (1) and AR (2) showed that there was only one-order sequence correlation in the residual error, and the random error term of the model has no correlation. Therefore, the model

[1] The algorithm of R_5 is the proportion of the sum of China's investment funds in the top 5 countries in the total investment of China in the Belt and Road, while R_{10} is the top 10 countries.

was reasonable. The regression results show that poverty rate is relatively high in the countries along the Belt and Road that with the high unemployment rate, large agricultural population, and low per capita capital level. China's aid and investment has the effect of poverty alleviation with aid lagging for two years and investment lagging for one year. The comparison between the correlation coefficients of aid and investment shows that the latter plays a slightly higher role than former. However, the global aid and investment (except for China) have no significant impact on poverty alleviation.[1] Two reasons may lead to the conclusion.

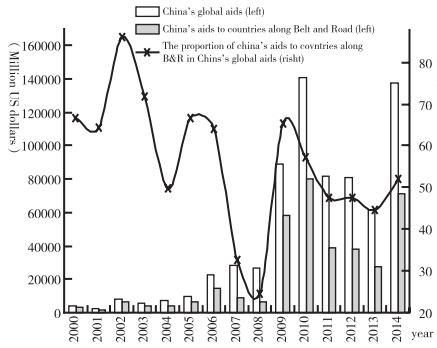

Figure 5. The amount of Chinese aids along the Belt and Road and in Global

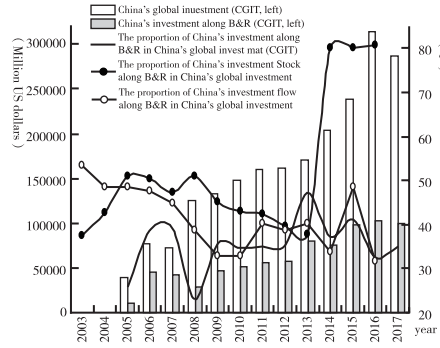

Figure 6. The amount of Chinese investmant along the Belt and Road and in Global

Source: The data of the proportion of China's investment stock and flow in countries along the Belt and Road in the global investment is from China's foreign direct investment statistics bulletin (2004–2017). To make it comparable with CGIT data, investments in Hong Kong, the Cayman Islands, the Virgin Islands and Bermuda were eliminated.

First, there are differences in the role of poverty alleviation among different types of aid. In addition to China, the international aid in the countries along the Belt and Road mainly comes from the official development aid (ODA) of the "North South aid" system. These aids are mostly concentrated in the fields of children's education, women's rights, environmental protection, medical and health care, while China's aid focuses on infrastructure, productive cooperation and other fields. The former's role in material capital accumulation and employment promotion is not very obvious and it mainly affects the economic growth through human capital and more long-term social

[1] To answer the question whether this phenomenon is caused by the multiple collinearity between variables and aid and investment, this paper uses the method of variance inflation factor (VIF) with the correlation coefficient of variables. The results show that the correlation coefficient between China's aid and global aid (except China) is 0.501 while the coefficient between China's investment and global investment (except China) is 0.329. VIF test found that VIF value of global aid (except China) was 4.63 (average), VIF value of global investment (except China) was 2.71 (average), and the overall VIF value of equation was 4.15 (average), which indicates that there is no serious multi-collinearity problem.

Table 1. Regression Results of Poverty Alleviation Effect of Chinese Aid and Investment

		Poverty rate(OLS)			Poverty rate(GMM)				Poverty rate (threshold regression)				
China's total aid	t	0.02		0.06				–0.07					
		(0.08)		(0.24)				(–0.31)					
	t-1	–0.07		–0.02				–0.18					
		(–0.34)		(–0.10)				(–0.79)					
	t-2	–0.40***		–0.38**		–0.41**		–0.40**		–0.39**			
		(–2.93)		(–1.94)		(–2.14)		(–2.22)		(–2.21)			
China's aid:ODA	t		2.28	3.05	2.42	2.41			2.65	3.23			
			(1.01)	(1.06)	(1.29)	(1.25)			(1.54)	(1.38)			
	t-1		–0.26	–0.22	–0.05	0.17			–0.18	0.23			
			(–0.16)	(–0.13)	(–0.03)	(0.10)			(–0.12)	(0.14)			
	t-2		2.09	1.68	3.12	2.71	2.19	2.11	0.54	1.43		0.71	1.42
			(0.49)	(0.40)	(0.99)	(0.85)	(0.70)	(0.67)	(0.17)	(0.46)		(0.23)	(0.46)
China's aid:OOF	t		–0.24	–0.33*	–0.20	–0.30*			–0.27	–0.26			
			(–1.15)	(–1.80)	(–0.71)	(–1.06)			(–1.01)	(–0.99)			
	t-1		0.05	–0.02	0.10	0.01			–0.03	–0.01			
			(0.18)	(–0.08)	(0.37)	(0.04)			(–0.12)	(–0.05)			
	t-2		–0.42***	–0.47***	–0.42**	–0.46**	–0.44**	–0.46**	–0.37*	–0.36*		–0.36*	–0.33*
			(–2.60)	(–2.77)	(–1.99)	(–2.14)	(–2.13)	(–2.18)	(–1.84)	(–1.77)		(–1.88)	(–1.69)
China's total investment	t	0.02		–0.21				–0.01					
		(0.09)		(–0.53)				(–0.04)					
	t-1	–0.40*		–0.56*		–0.57*		main variable rx		main variable rx			
		(–1.61)		(–1.58)		(–1.67)							
	t-2	–0.03		–0.20				–0.28					
		(–0.05)		(–0.46)				(–0.70)					
China's investment: Engineering contract	t		–0.08		–0.43				0.25				
			(–0.13)		(–0.62)				(0.36)				
	t-1		–0.81*		–1.03*		–0.92*		main variable rx		main variable rx		
			(–1.87)		(–1.70)		(–1.59)						
	t-2		–0.26		–0.54				–0.42				
			(–0.37)		(–0.96)				(–0.73)				
China's investment: Greenland	t		0.68		0.43				2.45				
			(0.34)		(0.24)				(1.34)				
	t-1		–1.97*		–2.43*		–2.04*		–2.15*		–1.35*		
			(–1.70)		(–1.53)		(–1.51)		(–1.63)		(–1.52)		
	t-2		–3.06		–3.39*				–1.38				
			(–1.23)		(–2.13)				(–0.87)				
China's investment: Direct investment	t		0.22		0.72				–1.54				
			(0.18)		(0.64)				(–1.33)				
	t-1		0.48		0.72		0.67		0.01		0.13		
			(0.46)		(0.75)		(0.71)		(0.01)		(0.14)		
	t-2		1.73		1.05				0.60				
			(0.84)		(1.06)				(0.60)				
China's investment: State-owned enterprise	t			–0.02		–0.26				–0.17			
				(–0.07)		(–0.68)				(–0.44)			
	t–1			–0.43*		–0.63*		–0.34*		main variable rx			main variable rx
				(–1.75)		(–1.76)		(–1.47)					
	t-2			–0.05		–0.31				–0.42			
				(–0.07)		(–0.69)				(–0.98)			

		Poverty rate(OLS)				Poverty rate(GMM)					Poverty rate (threshold regression)					
China's investment: Non state-owned enterprise	t			2.24			2.76						2.72			
				(1.13)			(1.30)						(1.44)			
	t-1			–0.94			–0.35			–0.86			0.05			–0.28
				(–0.81)			(–0.22)			(–0.55)			(0.03)			(–0.19)
	t-2			–1.50			–0.85						–0.24			
				(–1.20)			(–0.55)						(–0.17)			
Global total aid	t	0.02	–0.38	0.12	–0.07	0.09	0.00				0.06	0.31	0.17			
		(0.03)	(–0.34)	(0.20)	(–0.10)	(0.13)	(0.00)				(0.10)	(0.46)	(0.25)			
	t-1	0.51	0.17	0.32	0.43	0.22	0.25				0.89	0.67	0.60			
		(0.38)	(0.26)	(0.22)	(0.35)	(0.18)	(0.20)				(0.82)	(0.60)	(0.55)			
	t-2	–0.30	0.41	–0.23	–0.49	–0.42	–0.42	–0.22	0.22	0.16	–1.17	–1.43	–1.02	–0.54	–0.61	–0.46
		(–0.28)	(0.30)	(–0.21)	(–0.45)	(–0.39)	(–0.40)	(–0.45)	(0.43)	(0.32)	(–1.14)	(–1.37)	(–1.00)	(–0.74)	(–0.83)	(–0.62)
Global total investment	t	0.09	0.01	0.08	0.09	0.06	0.08				0.05	0.00	0.04			
		(1.09)	(0.26)	(1.14)	(1.13)	(0.80)	(0.97)				(0.69)	(0.05)	(0.46)			
	t-1	–0.04	–0.02	–0.02	–0.04	–0.02	–0.01	0.04	0.04	0.04	–0.05	–0.03	–0.03	–0.03	–0.03	–0.02
		(–0.82)	(–0.37)	(–0.31)	(–0.43)	(–0.23)	(–0.16)	(0.79)	(0.69)	(0.70)	(–0.62)	(–0.39)	(–0.38)	(–0.34)	(–0.37)	(–0.22)
	t-2	0.02	0.07	0.03	0.04	0.02	0.04				0.02	0.02	0.03			
		(0.46)	(1.42)	(0.70)	(0.49)	(0.30)	(0.57)				(0.30)	(0.24)	(0.44)			
Net export	t	0.08*	0.01	0.07	0.07*	0.08	0.08				0.06*	0.01	0.03			
		(1.39)	(1.15)	(1.20)	(1.44)	(0.77)	(0.90)				(1.53)	(0.02)	(0.65)			
	t-1	–0.04*	–0.02*	–0.01	–0.03	–0.02	–0.02	0.04*	0.03	0.03	–0.02*	–0.01	–0.01	–0.02*	–0.01	–0.01
		(–1.93)	(–1.39)	(–0.74)	(–1.31)	(–0.53)	(–0.36)	(1.76)	(1.07)	(0.99)	(–1.55)	(–0.43)	(–0.29)	(–1.44)	(–0.77)	(–0.62)
	t-2	0.01	0.02	0.01	0.03	0.02	0.03				0.02	0.02	0.03			
		(0.51)	(0.98)	(0.67)	(0.52)	(0.78)	(0.60)				(0.34)	(0.44)	(0.19)			
Per capita capital	t	0.26	0.21	0.23	0.08	0.01	0.09									
		(0.59)	(0.47)	(0.52)	(0.13)	(0.02)	(0.14)									
	t-1	–0.04*	–0.67*	–0.61*	–0.58*	–0.64*	–0.56	–0.42***	–0.30*	–0.29*						
		(–1.35)	(–1.50)	(–1.48)	(–1.91)	(–1.42)	(–1.35)	(–2.56)	(–1.85)	(–1.78)						
	t-2	–0.59	0.015	0.10	0.07	0.017	0.03									
		(–0.07)	(0.24)	(0.16)	(0.07)	(0.18)	(0.03)									
Unemployment rate	t	0.14*	0.10*	0.14*	0.14*	0.05	0.13*	0.14*	0.12*	0.14*	0.31*	0.30*	0.31	0.31*	0.30*	0.32*
		(1.79)	(1.39)	(1.48)	(1.41)	(1.32)	(1.37)	(1.33)	(1.32)	(1.39)	(1.68)	(1.62)	(1.35)	(1.68)	(1.66)	(1.41)
Proportion of agriculture population	t	3.48*	3.50*	2.42*	5.95*	6.66*	4.78*	5.92*	3.40*	2.85*	16.23*	15.14*	16.04*	15.38*	16.97*	21.23*
		(1.87)	(1.57)	(1.59)	(1.48)	(1.64)	(1.81)	(1.49)	(1.37)	(1.73)	(1.79)	(1.71)	(1.45)	(1.77)	(1.48)	(1.43)
Threshold effect（rx≤γ）											–2.23***	–2.84***	–2.30***	–2.24***	–2.94***	–2.30***
											(–3.00)	(–3.00)	(–3.10)	(–3.06)	(–3.17)	(–3.17)
Threshold effect（rx>γ）											–0.02	0.32	–0.09	–0.03	0.15	0.05
											(–0.05)	(0.44)	(–0.21)	(–0.08)	(0.22)	(0.13)
Other control variables		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant term		7.81***	7.90***	6.74***	7.67***	8.65***	7.48***	7.75***	9.23***	9.08***	2.33	2.92	2.02	2.72	2.30	0.64
		(3.29)	(3.31)	(2.83)	(2.99)	(3.38)	(2.93)	(3.11)	(3.78)	(3.71)	(0.37)	(0.45)	(0.31)	(0.46)	(0.38)	(0.10)
AR(1)					–1.16	–1.07	–1.43	–1.21	–1.65	–1.09						
					(0.91)	(0.15)	(0.68)	(0.32)	(0.81)	(0.27)						
AR(2)					–0.89	–0.09	–0.45	–0.31	–0.21	–0.14						
					(0.17)	(0.03)	(0.21)	(0.10)	(0.73)	(0.44)						
F		4.30***	3.61***	4.02***	1.99***	1.98***	1.88***	2.94***	3.43***	3.41***	5.02***	4.93***	4.96***	5.17***	5.04***	5.07***
R^2		0.14	0.16	0.15	0.18	0.14	0.13	0.11	0.14	0.13	0.15	0.17	0.16	0.14	0.15	0.14
Sargan					0.98	0.69	0.60	0.80	0.62	1.30						

Notes: ***, *** and * mean *t* value (OLS regression) or *Z* value (GMM regression) that estimates at the significant level of 1%, 5% and 10% respectively. Sargan test indicates the over-identification test of tool variables. Other control variables such as region, industrialization stage and year binary variables are omitted. The unit of aid and investment is billion US dollars.

and environmental construction channels. Therefore, the role of ODA in poverty alleviation needs a long time to be reflected. China's aid is more focused on infrastructure, energy development, product and service production, which may be more consistent with the actual needs and resource endowment characteristics of poor countries, and therefore has a more obvious role in the short-term wealth creation in poor countries. Secondly, investment by both China and other countries around the world is resource, which has the similar role in promoting economic growth in backward regions. However, the capital accumulation, employment increase and economic growth brought by different types of investments have different effects of poverty alleviation. The poor may not obtain the direct "trickle-effect" in the economic growth. The trickle effect of investment and economic growth is different in one country at different stages of development. According to the law of marginal decline of poverty alleviation effect, when the incidence of poverty drops to a certain extent, "trickle effect" would become weaker and weaker. The transnational investment of the developed countries to some countries along the Belt and Road is much earlier than that of China. The western Asian and ASEAN countries are relatively high developed, and among the countries along the Belt and Road, Central and Eastern European Countries that EU invests are also high developed, which leads to the marginal diminishing effects of investment and economic growth. The continued declining of poverty rate is limited. However, the countries that China aids and invests include Central Asia, South Asia and some developing countries in ASEAN, which are not the major recipients of international investment in a long time. It is due to the low level of economic development, large-scale infrastructure, energy and productive investment could produce a more significant poverty alleviation effect.

The threshold regression results show that threshold effect does not exist between aid and poverty rate, while exists between investment and poverty rate. For the countries along the Belt and Road with per capita GDP below the threshold value (US $1450), China's investment can significantly reduce the poverty rate, while in the countries above the threshold value, the poverty reduction effect is not significant. For the state-owned capital, the threshold value of per capita GDP is $1640. Similarly, for the countries along the Belt and Road with GDP per capita below the threshold value, there is a significant negative correlation between the investment in China's state-owned enterprises and the poverty rate.

In further, if different types of aid and investment were included in the regression equation, the results show that OOF has the poverty alleviation effect on countries along the Belt and Road, while ODA has no significant effect on the countries. On the one hand, the overall size of ODA is relatively small and concentrated in distribution with large volatility. On the other hand, the proportions of emergency relief, humanitarian supplies, and debt relief in the ODA funds are relatively high, which is conductive to reduce instantaneous poverty, but the role of sustained poverty

alleviation is relatively limited. At the same time, the alleviation effect of education, environmental protection, health and other funds need to be observed for a longer period of time. The proportion of OOF is relatively high, and with the expansion of the total amount of aid, some OOF projects begin to have the tendency of mix-style aid and investment development. Among the OOF aid in countries along the Belt and Road, the proportion of productive manufacturing, infrastructure, resources, energy, and Commerce and finance is relatively high. Since these OOF aid linked to production, trade and resource development, which is conductive to the continuous improvement of capital stock, job creation, as well as poverty alleviation.

In terms of investment type, the increase of green land investment and contract investment could reduce poverty rate. These two types of investment have the lag period of one-year, and the poverty alleviation of direct investment is not significant. The reason is that China's engineering investment and green investment are mainly based on infrastructure construction, which flows to countries with low social and economic development. However, other types of direct investment are relatively complex, which flows to developed countries that are the important destinations for China's direct investment, such as Singapore, Saudi Arabia, and the United Arab Emirates. Therefore, these investments have no significant effect of poverty alleviation. From the perspective of ownership of investment entities, the role of state-owned enterprises in reducing poverty rate is more significant with a lagging effect, while the non-state-owned enterprises has no significant effect, which is mainly due to the fact that the investment of state-owned enterprises is mainly concentrated in the field of infrastructure, and the investment demand of countries along the Belt and Road for infrastructure is mainly concentrated in developing countries. For private capital, there is a certain gap in the scale, duration, risk, return of infrastructure investment with the investment objectives and capabilities of enterprises. The scale in the field of private capital participation is usually small, while that in the field of business finance and manufacturing is larger. Investment prefer to the countries along the Belt and Road with better infrastructure and business environment, which contributes to the non-significant relationship between investment and poverty alleviation.

4. Empirical Study on Aid and Poverty Alleviation: Path Analysis of "Teaching How to Fish"

4.1. Mediation Effect Model

Regression analysis shows that despite the differences in the poverty reduction effects of different types of aid and investment, China's aid and investment in the less developed areas along the Belt and Road would help reduce the proportion of the poor population as a whole, and per capita capital formation, rise of the non-agricultural

sector population and the decline in unemployment rate would also help reduce the proportion of the poor population. Therefore, capital accumulation and employment creation may be the important channels for the independent poverty alleviation in backward areas. Whether China's aid and investment have the poverty alleviation effect through the above two ways needs to be analyzed by constructing corresponding mediation effect models. Based on the mediation effect test models and basic steps proposed by Bollen and Brand (2010) and Wen and Ye (2014), this paper constructs the following econometric equations:

$$POVR_{it} = \mu + \alpha_T AID_{it-T} + \beta_T OFDI_{it-T} + \theta X_{it} + \varepsilon_{it} \tag{4}$$

$$CAPIT_{it} = \lambda + \lambda_T^1 AID_{it-T} + \lambda_T^2 OFDI_{it-T} + \upsilon_{it} \tag{5}$$

$$EMPLO_{it} = \delta + \delta_T^1 AID_{it-T} + \delta_T^2 OFDI_{it-T} + \tau_{it} \tag{6}$$

$$POVR_{it} = \gamma + \gamma_T^1 AID_{it-T} + \gamma_T^2 OFDI_{it-T} + \gamma_T^3 CAPIT_{it-T} + \gamma_T^4 EMPLO_{it-T} + \gamma_T^5 X_{it} + \eta_{it} \tag{7}$$

The parameters of equation (4) have the same meanings as those in equation (1), λ、δ and γ in the equation (5) to equation (7) are the parameters to be estimated, υ、τ and η are residual terms. $CAPIT_{it}$ and $EMPLO_{it}$ represent the volume of per capita capital formation and employment respectively. Considering the lagging effect in regression of equation (1), as well as the lagging effect of aid and investment on capital formation and employment, the independent variables of 1-T period are still retained in the intermediary model.

The steps to test the mediation effect are as follows. Firstly, the regression analysis of poverty rate is made with China's aid and investment as the core explanatory variables. If the estimation results of parameters α and β in equation (4) were significant, it means there is a mediation effect at China's aid and investment in the poverty alleviation. Otherwise, there would be the concealment effect. Previous study shows that China's aid and investment have a lagging impact on the poverty alleviation, so mediction effect should be considered in the equation. Secondly, equation (5) and (6) with capital and employment as the dependent variable, and with aid and investment as the explanatory variable should be regressed to test whether the increase of China's aid and investment could contribute to the capital formation and employment growth in recipient and host countries. Thirdly, if the λ, δ,γ_T^3 and γ_T^4 were significant in equation (7), it means that the indirect effect would be significant. If γ_T^1 and γ_T^2 were not significant, it means that only mediation effect plays the role, and if significant, it means that both direct and indirect effect play the role of poverty alleviation, in which regression coefficients could be used to test the effect of complete or partial mediation effect. If the regression coefficients of

aid and investment in equation (7) are less than that of equation (4), it shows that capital formation and employment have partial mediation effect. If the regression coefficients of aid and investment in equation (7) were not significant, but those in equation (4) were significant, it shows that capital formation and employment have the function of complete mediation effect. Fourthly, if the regression coefficients of λ, δ, γ_T^3 and γ_T^4 are not all significant, Bootstrap method could be used to test hypothesis H_0: $\lambda_T^1\gamma_T^3=0$、$\lambda_T^2\gamma_T^3=0$、$\delta_T^1\gamma_T^4=0$、$\delta_T^2\gamma_T^4=0$. If the hull hypothesis is rejected, then the direct effect would also be significant, and the second half of the third step can be continued. Otherwise the indirect effect is not significant, and the test could be ended.

Since different types of aid and investment in China have different effects on poverty rate in the previous analysis, the mediation effect of aid and investment on capital and employment are analyzed by distinguishing different types of investment and aid funds. The specific equations are (8) and (9).

$$\begin{aligned} CAPIT_{it} &= \mu + \sum_{n=1}^{N}(\alpha_1 OFDI_{it}^n + ... + \alpha_2 OFDI_{it-T}^n) \\ &+ \sum_{m=1}^{M}(\beta_0 AID_{it}^m + ... + \alpha_T AID_{it-T}^m) + \theta' X_{it} + \varepsilon_{it} \end{aligned} \tag{8}$$

$$\begin{aligned} EMPLO_{it} &= \mu + \sum_{n=1}^{N}(\alpha_1 OFDI_{it}^n + ... + \alpha_2 OFDI_{it-T}^n) \\ &+ \sum_{m=1}^{M}(\beta_0 AID_{it}^m + ... + \alpha_T AID_{it-T}^m) + \theta' X_{it} + \varepsilon_{it} \end{aligned} \tag{9}$$

4.2. The Impact of Aid and Investment on Capital Formation and Employment

GMM regression analysis[1] shows that total amount of aid and investment of China in countries along the Belt and Road positively related to the total capital of these countries, and the efficient is significant with lagging period of one or two periods. The overall effect of investment on capital formation is higher than aids. Imvestment by other countries around the world have similar effects on poverty alleviation for countries along the Belt and Road, but the role of aid is not significant. The contributions of different types of aid and investment on total capital formation are different. China's OOF aid has a significant positive impact on total capital formation, while ODA has no obvious impact. The reason is that emergency relief, humanitarian supplies, and debt relief, as the most part of ODA are mainly consumed or used for

[1] Due to the limited space of the paper, the results of GMM regression are not listed in the paper, and the reserve claim is retained.

writing off debts, and they could not directly promote capital formation. There is a significant positive correlation between the total amount of capital formation and green land. The two-period lagging of project contract has the significant effect while direct investment has no significant effect, and the reason is that green land investment is a creative investment, which covers the whole process of financing, construction, and operation and results in a higher investment multiplier effect. Project contract investment also has a significant positive impact on the total capital formation. Since there is a long preparation period from the signing of the project contract to the real realization of investment, the impact of project contract on the total capital formation of the host country would be lagged. Other direct investments include the "brownfield investment" of existing enterprises in the host country. Since such investments generally only involve the transfer of property rights, it would not increase the scale of the capital formation in the host country.

From the perspective of employment, China's aid and investment have a significant positive effect on the employment of industry and service in the host country along the Belt and Road with varying degrees of lag. Investment has no significant impact on employment growth in the agricultural sector, but aid has a positive impact. The reason is related to the industrial structure of aid and investment that China's agricultural investment accounts for only 3% of the total investment in the country along the Belt and Road, and the rest investment is concentrated in the industrial and service sectors, while agricultural aid is relatively high with an annual average of over 6%, and the related projects in the agricultural and rural areas are related to poverty reduction. The employment promotion effect of Chinese investment in the countries along the Belt and Road is similar with that of other countries, but the aid of other countries in the world does not directly affect employment, which is different from China. Different types of aid and investment also have different impacts on employment in different sectors. OOF aid has a positive impact on employment growth in all sectors with lag period of one or two years. ODA aid has no significant effect. The poverty alleviation effect based on development aid has a better employment creation effect than that based on transfer payment. Green land investment has a positive impact on industrial sector employment with a lag period of one year. Engineering contract investment has a significant promotion effect on employment in industry, service industry, and agricultural sector. The reason is the wide distribution of Engineering investment that includes not only industrial sector projects, but also agricultural-related water conservancy and power supply projects, which plays a significant role in the development of agriculture and job creation.

4.3. Transmission Path of Poverty Reduction Effect of Aid and Investment

Regressing equation (4) with current data shows that the estimating results of α and

β are not significant, and mediation effect is not founded, while regression with lagging period of one or two years has the significant mediation effect. In the regression analysis of lagging one period, the total investment is significantly negative in equation (4) and (7), and the absolute value of the former is greater than that of the latter. The indirect effects of investment-capital formation, investment-industrial employment, and investment-service employment are all significantly negative, which indicates that China's investment has a significant mediation effect on one year lagged poverty rate reduction, and that capital formation and employment in industry and service industries bear part of the mediation effect. China's investment could promote capital formation and employment in industries and services in developing countries, which reduces the poverty rate. At the same time, investment has a direct impact on poverty alleviation with one lagged year. In the regression analysis of lagging two periods, the total amount of aid is significantly negative in equation (4) and (7), and the absolute value of the former is slightly larger. The three indirect effects of aid-employment, aid-industrial employment, and aid-service employment are all significantly negative, which indicates that China's aid has a significant mediation effect on the two period lagged poverty rate reduction, and that the total number of employed persons, the number of employed persons in industry and service industries bear part of the mediation effect function. Aid could promote employment of industry and service, which reduces poverty rates. At the same time, aid has a direct impact on poverty rates with lag period of two or more years.

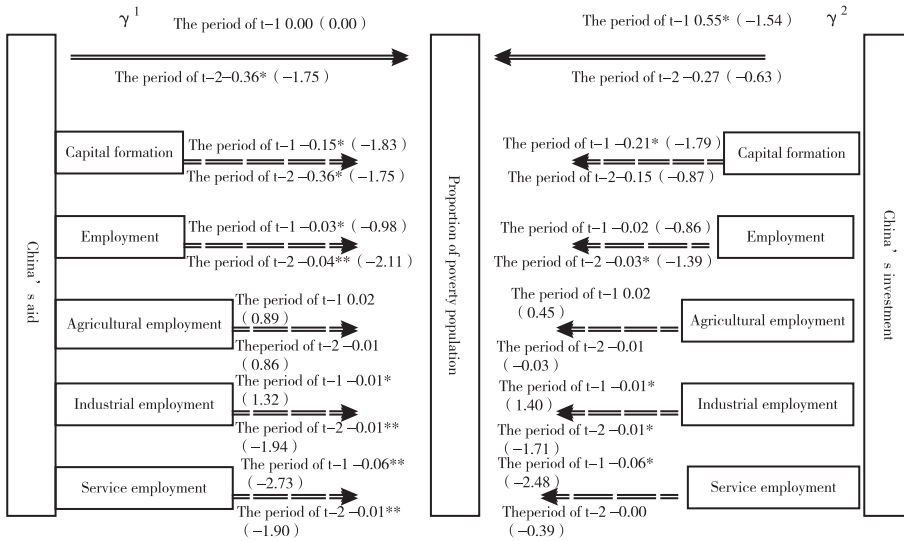

Figure 7. Investment Shares of Different Types of Chinese Enterprises in Different Regions

Notes: The figure is drawing with basis of regression results and mediation effect test. Due to the limited space of the paper, the regression results of complete mediation effect are not listed in the paper, which are retained on request. Solid arrows indicate the direct effects while dashed arrows indicate indirect effects.

5. Conclusion and Prospect

Since the 1980s, China has made a remarkable achievement in the field of anti-poverty, and the positive spillover effect of poverty reduction in China has become increasingly apparent. China contributes to poverty alleviation in developing countries along the Belt and Road by the way of aid and investment, taking infrastructure construction as a breakthrough and state-owned capital as the main force. Based on the sample data of countries along the Belt and Road from 2000 to 2017, this paper empirically tests the poverty alleviation effect of China's aid and investment on the countries along the Belt and Road by means of GMM and threshold regression method, and analyzes the influence path of aid and investment on poverty reduction by means of mediation model. The study finds that first, Chinese aid and OFDI help to reduce poverty rate, and there is a threshold effect between OFDI and poverty rate. When the per capita GDP level is below the threshold value, the poverty reduction effect of Chinese OFDI is more significant. Second, different types of aid and OFDI generate different poverty reduction effects, OOF, construction project investment, and green land investment have more significant effects, and poverty reduction mechanism based on infrastructure construction has better poverty reduction effect than transfer payment aid. Third, the correlation between state-owned enterprise OFDI and poverty rate is significant, state-owned capital plays an important role in poverty reduction in the B&R developing countries. Fourth, the research also finds that poverty reduction effect of Chinese aid and OFDI is realized mainly by capital formation and job creation in these countries, especially by improving the employment level in the industrial and service sectors. The conclusions of this study show that China should deepen the following aspects in order to better enhance the performance of poverty alleviation along the Belt and Road.

Firstly, aid and investment are the main ways to promote poverty alleviation in the countries along the Belt and Road. Since China's economic aid system for foreign countries and the development of enterprise's "going out" strategy are relatively immature, clear strategic planning and detailed system design is lacking, which makes the poverty alleviation of aid and investment overlap. In particular, the initiative of the Belt and Road adheres to the basic principles of "open cooperation, market operation, and mutual benefit", which could not be simply classified as the strategy of traditional foreign aid or foreign investment, but be related to the two strategies of development cooperation. It is more necessary to clarify the functional boundaries of aid and investment in different countries and regions, so as to help developing countries to achieve the goal of reducing poverty.

Secondly, infrastructure construction is the focus of China's development-oriented poverty alleviation in the countries along the Belt and Road, which plays an irreplaceable fundamental role in improving the basic livelihood of the developing

countries. However, water conservancy, transportation, energy, construction and other infrastructure projects often have the characteristics of large scale and long construction period, which has the greater impact on the ecological environment, as well as the risks of investment and international disputes. In this regard, the existing development models of China need to be improved. At the same time, it is important to appropriately adjust the increase of infrastructure aid and investment, and enhance the proportion of education and training, medical and health, women's rights and interests, cultural poverty alleviation and social organizations' aid and investment, so as to enhance China's "soft power" of poverty alleviation in the countries along the Belt and Road. On the other hand, the concept of "green poverty alleviation" should be implemented in infrastructure aid and investment construction, the eco-environmental protection services and support for major infrastructure projects in the countries along the Belt and Road should be strengthened, and principles of resource conservation and environmental friendliness should be integrated in investment.

Thirdly, China's state-owned capital has a very significant effect of poverty alleviation on the countries along the Belt and Road. However, promoting poverty alleviation of countries along the Belt and Road requires not only the role of "advance army" of state-owned capital, but also the actively participation of other capital, as well as the cooperation with donor countries, World Bank, the Asian Development Bank and other intergovernmental multilateral agencies and various non-governmental poverty alleviation organizations. Along with the establishment of new development bank of the BRICs, the Asian infrastructure investment bank, the Silk Road Fund and other organizations, the development concept in the countries along the Belt and Road is also showing a more diversified development trend. China needs to change its past thinking of poverty alleviation of "emphasizing bilateral and less multilateral", and to improve the compatibility between "China-style poverty alleviation" with the existing international development aid system, which could give full play to the positive spillover effect of poverty alleviation.

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Local Governments' Tax Competition, Industrial Structure Adjustment and Regional Green Development in China

Zihao Li, Jun Mao*

Based on the inter-provincial panel data from 2000 to 2014 in China, this paper applies the spatial panel simultaneousequations model to test the impact of local governments' tax competition and industrial structure adjustment on the regional green development in China. The conclusions are as follows. Local governments' tax competition and industrial development have a negative impact on green development. Tax competition and industrialization in the neighboring regions will also suppress local green development through the negative incentives of "race to the bottom". Evidently, regulating the tax competition behavior of the local government and rationally guiding the upgrading of local industrial structure have important policy implications for the high-quality growth of China's regional economy and the green, coordinated development between regions in the new era.

Keywords: local governments' tax competition, industrial structure adjustment, regional green development

1.Introduction

Since the reform and opening up, along with the reform of the fiscal and tax system involving the central and local relations, such as fiscal responsibility system and tax sharing, local governments have launched a fierce "competition for growth" among the regions in order to obtain more fiscal surplus rights and the economic performance of the promotion at the local officials level, which is considered to be an important driver of China's sustained and rapid economic development over the past 40 years (Zhang, 2005). However, in the local "competition for growth", tax competition policy and industrial structure adjustment, as an important means of local government competition

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(An and Wang, 2012), while actively guiding the cross-regional flow of resources, generate significant pressures on green development in various regions through the "race-to-the-bottom" effect of environmental regulation.[1] Moreover, with the strengthening of local tax competition and the migration of factors in different sectors and regions, the regional industrial structure and industrial policy will be adjusted (Kong *et al.*, 2017), which will also have a significant impact on the green development of local and neighboring regions (Han *et al.*, 2015). Therefore, the reality of China's rapid economic development and increasing environmental pollution for a long time has made the problem of regional green development approached from the perspective of local tax competition and industrial structure adjustment an academic focus (Yuan and Xie, 2014).

In the context of China's economic entry into the new normal, as local governments have more urgent needs to stabilize the demand for economic growth through tax competition and industrial restructuring, the impact of the two on the regional green development will be more significant. This has produced a series of questions worth thinking about: Do the intensified tax competition and industrial restructuring between local governments deviate from the concept of green development proposed by the 13th Five-Year Plan? Through what mechanism do inter-regional tax competition and industrial restructuring affect green development? Can we achieve the coordinated development of regional tax policy, industrial structure and green development through some kind of mechanism design? This paper intends to carry on the in-depth study into these problems. Under the background of the deepening reform of local fiscal and tax system, the urgent upgrading of domestic industrial structure and the comprehensive campaign of pollution prevention and control, it is of great significance to integrate local government tax competition, industrial structure adjustment and regional green development into a holistic framework study to realize high-quality economic growth and green coordinated development in China in the new era.

2. Literature Review

Welfare economics holds that the government, as the "night-watchman", can "internalize" the external cost of pollution by taxing sewage enterprises, and use the "Pigovian tax" to correct the damage to the environment caused by market failure, which can be regarded as the beginning of the study on the impact of tax policy on environmental pollution. Most research on the impact of local government tax

[1] The so-called "race-to-the-bottom" effect of environmental regulation refers to the behavior of local governments actively reducing regional environmental regulation via competitive fiscal and tax policies and industrial policy adjustments to attract more foreign liquidity factors by way of "race to the bottom" to maintain the rapid growth of the region's economy relative to the adjacent areas, and to stand out in the fiscal and even political competition. (Zhu *et al*., 2011).

competition on green development focuses on the impact of tax competition on local government environmental regulation. For example, Rauscher (2005) believes that local governments will gain an advantage in economic competition, broaden the tax base and increase tax revenue by adopting lax environmental control, thus giving up the maximization of regional social welfare. Fredriksson and Millimet (2002) point out that tax competition among local governments leads to lax standards of environmental regulation and governance, leading to damaging effect of "race to the bottom". Other scholars have discussed it from the perspective of fiscal decentralization, for example, Li and Zhou (2005) hold that under the fiscal decentralization system of central and local governments, local officials are more likely to gain a tax competitive advantage by investing more in infrastructure, and investment in public services will weaken, which aggravates local environmental pollution to a certain extent; Zhang *et al.* (2015) and He *et al*. (2016) further explore the impact of tax competition on local environmental quality through different fiscal decentralization channels. In addition, there are some studies analyzing the impact of tax competition on environmental pollution from other angles. For example, Chirinko and Wilson (2010) and Cui and Liu (2010) find that, because local governments usually implement the "riding seesaw" strategy in environmental governance, there are significant differences in the impact of local government tax competition on different pollutants. On the whole, the existing research has made some discussion, but also needs to be improved. For example, local government tax competition will have a significant impact on industrial policy, industrial structure, but the existing research does not include such impact in the scope of analysis. In the empirical study, most of them use different pollutant emission to measure the environmental quality, and the difference of physical properties and statistical sources of different pollutants will cause some errors in the estimation; meanwhile, in studies into the effect of local tax competition on environmental pollution, insufficient attention has been paid to the endogenous errors that the causal relationship between the two may produce.

In terms of the research on the relationship between industrial structure adjustment and green development, the classical studies of Grossman and Krueger (1995) break down the influence of economic development on environmental pollution into scale effect, structural effect and technical effect. Among them, the structural effect mainly refers to the impact of the economic structure and industrial structure adjustment changes on environmental pollution. Most scholars use the framework of the Environmental Kuznets Curve (EKC) by Grossman and Krueger (1995) to investigate the impact of industrial structure adjustment on environmental pollution. Jalil and Feridum (2011), find that the optimization and upgrading of industrial structure can promote the green development of the region to a certain extent, while studies by Bruvoll and Medin (2003) and Levinson (2009) show that industrial structure adjustment has not played a key role in the improvement of regional environmental

quality, and the improvement of technological progress on regional environmental quality is more prominent. Other scholars argue that the relationship between industrial restructuring and environmental quality is not a simple one-way link (Yuan and Xie, 2014), and that changes in regional environmental policies (or environmental quality) can also have a certain "inversion" impact on local industrial policies and industrial structures (Porter and Linde, 1995). On the whole, the existing research has been fruitful. However, the existing literatures mostly regard industrial structure and green development as one-way effects, and with little investigation into reciprocal causation, it is difficult to control the endogeneity between the two; the empirical investigation between the two is also limited to the direct impact of the local industrial structure, relatively little research has been done on the spillover effect of industrial restructuring in surrounding areas.

In view of this, taking the 30 provinces of China in 2000–2014 as the research object, this paper systematically investigates the complex impact of local tax competition and industrial structure adjustment on regional green development through the construction and estimation of spatial simultaneous equations. The main contribution of this paper is as follows. In terms of the research framework, this paper incorporates the local government tax competition, industrial structure adjustment, and regional green development into one integrated framework. Through the introduction of impact path of local tax competition–industrial structure adjustment–regional green development, this paper systematically examines the differences in the impacts of tax competition and industrial structure adjustment on regional green development through different channels.

3. Mechanism, Model and Data Description

3.1. A Brief Review of the Mechanism

The focus of this paper is to investigate the impact of local governments' tax competition and industrial structure adjustment on regional green development. Based on the brief review of the existing literatures, the impact of local governments' tax competition on the local green development is mainly reflected in two aspects. First, it is the impact of local tax competition on local green development. Under the competition model dominated by "competition for growth", local governments tend to compete for tax in two ways, such as directly lowering statutory tax rates and reducing the degree of tax enforcement, and the latter (reducing tax oversight) is more hidden and difficult to be supervised by higher governments and is often used by local governments (Fan and Tian, 2013). Local governments compete for the inflow of cross-regional capital (including environmentally backward production capacity factors) by means of tax competition (Li and Zhao, 2017). Although it may

be beneficial to the short-term stability of the local economy, it is not conducive to the transformation and upgrading of the local industrial structure, also it has a certain impact on local resource consumption patterns and actual pollution emissions. At the same time, local governments will be more keen on infrastructure investment to stimulate economic growth and obtain more local tax share (He *et al.*, 2016), which will lead to overlapping projects of fixed assets, excess capacity and other real economic problems, which will promote the development of the local heavy chemical industry through the industrial correlation effect but will also bring air pollution, environmental problems such as the destruction of water resources (Pi *et al.*, 2014). Moreover, the intensification of government tax competition will also bring about the lack of supply of public goods such as education and environmental protection (Zhang *et al.*, 2015), which is not conducive to promoting local environmental protection concepts and increasing investment in environmental governance (Li, 2016), nor to the local sustainable green development. Second, there is the impact of tax competition in neighboring areas on local green development. Under the background of economic development as the main competition target of local government, horizontal tax competition in neighboring areas will directly lead to the outflow of local liquidity factors to the surrounding areas, bringing about the pressure of local economic downturn, and under the "competition for growth" system of local governments, local governments will adopt the "race to the bottom" of tax and industrial structure as the countermeasure (Guo and Li, 2009; Huang *et al.*, 2012), that is, to increase attractiveness to liquidity factors through lower actual tax rates or the easing of tax administration, and to expand the scale of local "extensive" industrial production in order to stabilize local economic growth; and such tax competition will also curb local green development through increased environmentally backward production capacity, strengthened local infrastructure investment, and inadequate channels of public goods.

The impact of regional industrial structure adjustment on local green development is mainly realized through the following two aspects. First, there is the impact of local industrial restructuring on local green development. As mentioned above, different types of industry dominance models lead to significant differences in pollution emission intensity, pollution control patterns, and so on (Grossman and krueger,1995; Huang *et al.*, 2012), and local industrialization dominance development models usually lead to higher levels of pollution emissions in the region, which will also have a direct negative impact on local green development. Second, there is the impact of industrial restructuring in neighboring areas on local green development. First of all, under the background of local governments' tax competition, in the process of undertaking industrial transfer in various regions, the regional industrial structure tends to "imitate" the industrial structure of the adjacent areas, and there is a "race to the bottom" in the industrial structure (Huang *et al.*,

2012), and industrialization in neighboring areas will affect local green development by stimulating the development of local strategic industrialization. Next, due to the existence of regional industrial association and industrial agglomeration, the adjustment of industrial structure in neighboring areas will also have the same correlation influence on the process of advanced and rational local industrial structure. Therefore, if the neighboring areas neglect environmental governance to promote local industrial agglomeration, or slow down the optimization and upgrading of the industrial structure for short-term economic growth, this will adversely affect the inflow of local cleaner production factors and environmental technology spillover through industrial agglomeration and industrial linkages (Yan *et al.*, 2011; Han *et al.*, 2015), which is not conducive to local green development. Finally, the adjustment of industrial structure in neighboring areas will have a direct impact on the environmental quality of adjacent areas, and because of the externality of environmental protection and the existence of spatial spillover of environmental quality, there will also be a direct impact on the local green development level. Therefore, if the neighboring region adopts the "extensive" industrial development model, it will directly lead to the rise of local environmental pollution level, which will also reduce the local green development level through the negative externality of environmental pollution.

3.2. Models and Methods

On the basis of reviewing the theoretical mechanism and drawing on the research framework of Liu and Li (2013) and Li *et al.* (2014), this paper puts the local governments' tax competition, industrial structure adjustment and China's regional green development into a unified analysis framework, and establishes the spatial panel simultaneous equations model, which is set as follows.

$$sect_{it} = \psi_i + \pi_t + \alpha_1 \ln pgdp_{it} + \alpha_2 tax_{it} + \alpha_3 Wtax_{it} + \alpha_4 eco - eff_{it} + \alpha_5 X_{it} + \mu_{1it} \tag{1}$$

$$\mu_{1it} = \rho_1 \sum_{j=1}^{n} w_{ij}\mu_{1it} + \varepsilon_{1it}$$
$$\ln pgdp_{it} = \theta_i + \varphi_t + \beta_1 sect_{it} + \beta_2 Wsect_{it} + \beta_3 eco - eff_{it} + \beta_4 Z_{it} + \mu_{2it} \tag{2}$$

$$\mu_{2it} = \rho_2 \sum_{j=1}^{n} w_{ij}\mu_{2it} + \varepsilon_{2it}s$$
$$eco - eff_{it} = \delta_i + \gamma_t + \eta_1 pgdp_{it} + \eta_2 pgdp_{it}^{\ 2} + \eta_3 sect_{it} + \eta_4 Wsect_{it} + \eta_5 tax_{it} + \eta_6 C_{it} + \mu_{3it} \tag{3}$$

$$\mu_{3it} = \rho_3 \sum_{j=1}^{n} w_{ij}\mu_{3it} + \varepsilon_{3it}$$

$$\Phi = Var\begin{pmatrix}\varepsilon_{1it}\\ \varepsilon_{2it}\\ \varepsilon_{3it}\end{pmatrix} = E\begin{pmatrix}\varepsilon_{1it}^2 & \varepsilon_{1it}\varepsilon_{2it} & \varepsilon_{1it}\varepsilon_{3it}\\ \varepsilon_{2it}\varepsilon_{1it} & \varepsilon_{2it}^2 & \varepsilon_{2it}\varepsilon_{3it}\\ \varepsilon_{3it}\varepsilon_{1it} & \varepsilon_{3it}\varepsilon_{2it} & \varepsilon_{3it}^2\end{pmatrix} = \begin{pmatrix}\sigma_{11} & \sigma_{12} & \sigma_{13}\\ \sigma_{21} & \sigma_{22} & \sigma_{23}\\ \sigma_{31} & \sigma_{32} & \sigma_{33}\end{pmatrix} \quad (4)$$

where i represents the region, t represents the year, ψ_i and π_t, θ_i and φ_t, δ_i and γ_t, respectively, represent the individual effect and the time effect, and ε_{it} and μ_{it} are the random error item. *sect*, ln*pgdp*, *eco−eff*, and *tax* represent industrial structure adjustment, economic growth, green development and local governments' tax competition index respectively. W is the $N\times N$ dimensional spatial weighted matrix, contains three kinds of weight, such as geography, economy and mix. Geographical weight matrix $W_d=1/d_{ab}^2$, $a\neq b$, otherwise 0; economic weight $W_e=1/|gdp_a-gdp_b|$, $a\neq b$, otherwise 0; mixed spatial weight matrix $W_m=W_d\bullet W_e$. *Wtax* and *Wsect* are the spatial lag of local government tax and industrial structure respectively, and *X, Z*, and *C* are the control variables representing industrial structure equation, economic growth equation and green development equation respectively.

The interaction between industrial structure variables and green development variables leads to the endogeneity between variables and error items, and non-conformance or non-effective estimation of the estimation value of spatial panel simultaneous equation model (Zhang and Wang, 2014). In order to overcome the problems in the estimation of the spatial panel simultaneous equation model, the fixed effect estimation method in the general spatial three-stage least squares (GS3SLS) of the generalized space is used to measure and analyze the model.

3.3. Variables and Data Descriptions

In this paper, 30 provinces in China (not including Tibet and Hong Kong, Macao and Taiwan) were selected as samples of the study, and the data originated from *Procuratorial Yearbook of China*, *China City Statistical Yearbook*, *China Statistical Yearbook for Regional Economy*, *China Energy Statistical Yearbook, China's Environmental Yearbook, China Labor Statistical Yearbook*, and provincial statistical yearbooks, as well as the website of the National Bureau of Statistics and the official websites of the provincial People's Procuratorates. In order to eliminate the heterogeneity between the variables, all absolute amount variables were log-transformed, and all the indicators containing price factors were treated with the fixed-base price index of 2000 as the base period in order to remove the influence of price factors. Table 1 shows the index meaning and statistical description of the main variables.

Table 1. Statistical Description of Major Variables

Variable	Index meaning	Number of samples	Mean	Standard deviation	Minimum	Maximum
eco-eff	Green development (calculated index)	450	0.539	0.330	0.515	1.000
sect	Industrial structure (%)	450	0.403	0.082	0.131	0.565
pgdp	Economic development (log)	450	9.161	0.530	7.901	10.367
tax	Local governments' tax competition (%)	450	0.067	0.028	0.035	0.176
urban	Urbanization (%)	450	0.461	0.204	0.192	0.900
market	Marketization (%)	450	0.474	0.204	0.107	0.873
consume	Resident consumption (log)	450	8.581	0.531	7.530	10.070
decent	Fiscal decentralization (%)	450	0.764	0.089	0.541	0.933
capital	Fixed capital (log)	450	4.598	3.663	0.695	21.347
human	Human capital (calculated index)	450	0.927	0.165	0.491	1.312
poprate	Population growth rate (%)	450	5.432	2.921	−1.350	12.620
techno	Technological progress (1/100)	450	1.082	2.240	0.007	19.981
open	Openness (%)	450	0.388	0.493	0.041	2.145
cor	Rent-seeking corruption (cases/ million people)	450	29.780	11.747	9.180	139.020
reg	Environmental regulation (cases/ person)	450	0.529	0.589	0.010	4.080
popden	Population density (population/ area)	450	3.966	4.950	0.040	37.230

The explained variables include industrial structure (*sect*), economic development (*pgdp*) and green development (*eco-eff*). Since the reform and opening up, China's industrial structure has transited from the primary industry to the second industry, leading to the deterioration of environmental pollution; at present, China's industrial structure is undergoing the transition from the second industry to the tertiary sector, and with the decline in the proportion of the second industry and the rise in the proportion of the tertiary sector, the total environmental pollution emissions have declined. Therefore, this paper uses the proportion of output value of the second industry in each region in GDP to measure the industrial structure (*sect*). The level of economic development (*pgdp*) is expressed by GDP per capita. Green development (*eco-eff*) uses the ecological efficiency measured as the agent variable of regional green development in China. The main explanatory variable is local governments' tax competition (*tax*): the local governments have a direct impact on the environment

through tax competition of regulating tax burden and relaxing tax enforcement, and have an indirect impact on the environment by affecting industrial structure with tax policy. Based on the practice of Ren *et al.* (2014), the ratio of macro tax burden in the region to the average macroscopic tax burden in neighboring areas is used to describe the degree of local governments' tax competition.

Control variables (*X*) affecting industrial structure. (1) The level of urbanization *(urban)=*pop_{urban}/pop_{total}, pop_{urban} and pop_{total} represent the urban population and the local population in various regions respectively. (2) The level of marketization, (*market)=*$market_{domestic}/market_{total}$, $market_{domestic}$and $market_{total}$ represent respectively industrial output of state-owned enterprises and total industrial output in various regions. (3) Resident consumption (*consume*): expressed in the per capita consumption of regional residents in China. (4) Fiscal decentralization (*decent*): expressed in the decentralization of regional fiscal expenditure. (5) Industrial structure of the adjacent areas (*Wsect*), adding spatial lag *Wsect* to the industrial structure equation to study the impact of industrial structure adjustment in the neighboring areas on the industrial structure of the region. (6) Meanwhile, in order to measure the influence of tax competition in the neighboring areas on local industrial structure and green development, in this paper, spatial lag *Wtax* is added to the industrial structure equation(Shao *et al.*, 2015).

Control variables (*Z*) affecting economic growth. (1) Fixed capital (*capital*): expressed in the per capita fixed asset stock in all regions of China. (2) Human capital (*human*): expressed by the number of post-secondary level schooling years per capita in all areas of China. (3) Population growth rate (*poprate*): expressed in the year-end population growth rate in various regions of China. (4) Technological progress (*techno*): measured by the number of annual authorizations for three patents for inventions, utility models and designs. (5) Openness (*open*): expressed in the proportion of total import and export trade in GDP in various regions. (6) Output agglomeration effect (*Wpgdp*): this paper adds spatial lag *Wpgdp* to the output equation to study the effect of economic growth in neighboring areas on local economic growth, and to verify the agglomeration effect in spatial distribution of regional economic growth (Zhang and Wang, 2014).

Control variables (*C*) affecting green development. (1) Square of GDP per capita ($pgdp^2$): to verify the existence of EKC curves. (2) Rent-seeking corruption (*cor*): expressed by the number of cases of corruption and bribery in each million people in each region. (3) Environmental Regulation (*reg*): represented by the number of environmental administrative penalties enforced by each environmental worker in each region. (4) Population density (*popden*): expressed by dividing the total population of each region by the area of the region. (5) Green development cluster (*Weco-eff*): in this paper, the spatial lag *Weco-eff* is added to the green development equation to study the impact of green development in the adjacent areas on the local green development, and

to verify the agglomeration effect in spatial distribution of green development (Li *et al.,* 2014).

4. Empirical Results and Analysis

4.1. Estimation Analysis of Fundamental Panel Simultaneous Equation

In order to solve the problem of variable selection and heteroscedasticity of different equations in panel simultaneous equations, the parameter estimation is carried out by using three-stage least squares (3SLS) in this paper. Moreover, compared with 2SLS estimation, 3SLS estimation results are more effective when the metering equation is correct and the rank constraint is satisfied. Meanwhile, 2SLS is used to test the robustness of the model estimation (the results are shown in Table 2). The estimation results of 3SLS and 2SLS in Table 2 show that the regression coefficient of 3SLS in the model is slightly higher than that of 2SLS. Therefore, this paper mainly uses 3SLS to analyze the estimation results of the simultaneous equation.

Based on the estimated results of industrial structure equation in 3SLS estimation in Table 2, local governments' tax competition (*tax*) passed the test by the industrial structure at the significance level of 10%. This shows that in order to solidify existing tax revenues or expand the tax base, local governments tend to choose industrial enterprises with large output and high profits and taxes as the main pillar industries in the area (Afonso and Furceri, 2010). Green development (*eco-eff*) passed the test of industrial structure at the significance level of 1%, and the estimation coefficient is negative. This shows that in recent years, local governments have begun to pay attention to the coordinated development of environmental protection and economy, and the implementation of various environmental protection policies and measures has begun to promote the transformation and upgrading of regional industrial structure. The impact of green development (*eco-eff*) on economic growth has not passed the significance test at 10%. At present, regional economic development is still dominated by extensive growth, and rapid economic growth has brought more serious resource consumption and environmental degradation, which is the reason why regional green development has no obvious effect on economic growth (Wang *et al.*, 2014). Local industrial restructuring (*sect*) passed the test of green development at 5%, and the coefficient is negative. This shows that although industrial development is an important link between economic behavior and ecological environment, in order to compete for liquidity factors and economic advantages, the local governments are more inclined to adopt the "riding the seesaw" strategy and ignore the environmental costs of industrial policy, distorting the distribution of factors (Cui and Liu, 2014), and the externality of environmental pollution will

even lead to the "tragedy of the commons" of environmental pollution, thus bringing greater negative pressure to the local green development. Local governments' tax competition (*tax*) passed the test of green development at the level of 10%, and the coefficient is negative. This suggests that local governments, in order to gain a tax competitive advantage, adopt competitive strategies that reduce their tax burden and reduce the degree of tax enforcement in order to chase the scale of capital inflows, which directly increase emissions of industrial output and pollutants (Li and Zhao, 2017), while low tax burdens further lead to increased marginal external costs of environmental pollution, thus it is difficult to correct the negative externality of local governments' tax competition to environmental pollution (Shao *et al.*, 2015). On the other hand, the use of tax competition by local governments to reduce the inflow threshold of factors of production will inevitably lead to industrial policy "race to the bottom", indirectly reducing the level of green development in the region (Zeng and Zhao, 2009).

Table 2. Estimated Results of 2SLS and 3SLS

	2SLS						3SLS					
	sect		*pgdp*		*eco-eff*		*sect*		*pgdp*		*eco-eff*	
C	0.415***	*C*	0.713***	*C*	0.925*	*C*	0.674***	*C*	0.814***	*C*	0.973**	
	(4.62)		(9.12)		(1.77)		(4.20)		(12.44)		(2.03)	
pgdp	−0.850***	*sect*	0.820***	*pgdp*	0.807*	*pgdp*	−1.243***	*sect*	1.023***	*pgdp*	1.007*	
	(−3.20)		(4.80)		(−1.85)		(−3.01)		(8.06)		(−1.94)	
tax	0.652*	*eco-eff*	−0.110	*pgdp2*	0.035*	*tax*	0.534*	*eco-eff*	−0.094	*pgdp2*	0.039**	
	(1.72)		(−1.35)		(1.75)		(1.75)		(−1.41)		(2.21)	
eco-eff	−1.824**	*capital*	0.122***	*sect*	0.419**	*eco-eff*	−2.202***	*capital*	0.221***	*sect*	0.581**	
	(−2.19)		(13.72)		(−1.97)		(−3.34)		(15.70)		(−2.55)	
urban	0.003	*human*	1.044***	*tax*	−0.010*	*urban*	0.074	*human*	1.088***	*tax*	−0.013*	
	(0.09)		(12.06)		(−1.67)		(0.35)		(13.79)		(−1.69)	
market	−0.867	*poprate*	−0.012**	*cor*	−0.008***	*market*	−0.633	*poprate*	−0.075**	*cor*	−0.015***	
	(−1.28)		(−2.35)		(−5.14)		(−0.82)		(−2.44)		(−5.70)	
consume	0.651	*techno*	0.001***	*reg*	0.045*	*consume*	0.546	*techno*	0.004***	*reg*	0.053*	
	(1.49)		(5.81)		(1.69)		(1.05)		(6.16)		(1.87)	
decent	1.029*	*open*	0.254***	*popden*	−0.019***	*decent*	1.433**	*open*	0.314***	*popden*	−0.023***	
	(1.79)		(7.33)		(−3.91)		(2.31)		(8.13)		(−4.11)	
R^2	0.472	R2	0.736	R2	0.482	R2	0.493	R2	0.815	R2	0.543	

Note: ***, ** and * represent significance at levels 1%, 5% and 10%, respectively. In parentheses is *T* value. Similarly hereinafter.

4.2. Analysis of Measurement Estimation Considering Spatial Spillover Effect

Because of the spatial spillover of regional public policy and the"free-rider" in environmental protection between regions, inter-regional green development is bound to be affected by economic policy and green development in neighboring areas. In this paper, the model is estimated by GS3SLS (the results are shown in Table 3). According to Table 3, the tax competition in neighboring areas (*Wtax*) has passed the test of industrial structure at the significance level of 1%, and the influence coefficient of the estimated value relative to the local tax competition is more significant. Local governments, as coordinators of national economic development and social order, compete with each other for the pursuit of more economic resources, stimulating local governments to develop industry-led industries in exchange for short-term economic benefits (Brajer *et al.*, 2011). The influence coefficient of industrial structure adjustment in neighboring areas (*Wsect*) on local industrial structure is positive, that is, the enhancement of secondary industry in neighboring areas will improve the development of local secondary industries. Under the current performance appraisal system which mainly takes GDP as the core, the local governments can improve the spillover and diffusion of industrial structure through agglomeration or "gathering", and the industrial structure setting of each region often displays the characteristics of "imitating" the industrial development of the neighboring areas (Huang *et al.*, 2012). The coefficient of output agglomeration (*Wpgdp*) is significantly positive, that is, the increase in output in adjacent areas will increase the level of local output. The inter-regional game behavior of competition and dependence and the scale effect in space will lead to the cross-region flow of production factors, thus economic development has a strong spatial spillover effect (Yan *et al.*, 2011). The estimation coefficient of industrial structure adjustment in neighboring areas (*Wsect*) to green development is positive, but it has not passed the significance test, which shows that the "race to the bottom" of local governments' industry development is hardly effective for local environmental pollution control. The coefficient of green development cluster (*Weco-eff*) to local green development is significantly positive, that is, the increase of green development in neighboring areas will improve the local green development. The green development of neighboring areas will have diffusion effect and demonstration effect, the "positive externality" of environmental protection leads to the proximity of green development level to neighboring areas in the region, generating the incentive of regional green development, and the green development mode of "block" has a "positive" effect on regional environmental protection, as the adoption of "follower" behavior has promoted the local green development (Cui and Liu, 2010).

Table 3. GS3SLS Estimated Results

Geographical weigh						Economic weight						Mixed weight					
sect		*pgdp*		*eco-eff*		*sect*		*pgdp*		*eco-eff*		*sect*		*pgdp*		*eco-eff*	
C	5.568***	*C*	12.820***	*C*	4.709***	*C*	7.106***	*C*	11.255***	*C*	6.255***	*C*	6.106***	*C*	12.541***	*C*	6.106***
	(5.25)		(8.72)		(3.25)		(5.83)		(6.23)		(3.63)		(5.20)		(6.43)		(3.20)
pgdp	−0.415***	*sect*	1.228***	*pgdp*	1.181***	*pgdp*	−0.410***	*sect*	1.564***	*pgdp*	−1.438***	*pgdp*	−0.321***	*sect*	1.672***	*pgdp*	−1.624***
	(−3.86)		(3.21)		(−3.11)		(−4.03)		(3.40)		(−3.68)		(−3.11)		(3.87)		(−3.82)
tax	0.124**	*Wsect*	−1.827***	*pgdp2*	0.048***	*tax*	0.102*	*Wsect*	−2.152***	*pgdp2*	0.063***	*tax*	0.133**	*Wsect*	−2.335***	*pgdp2*	0.071***
	(2.18)		(−4.10)		(2.78)		(1.84)		(−4.32)		(2.93)		(2.24)		(−4.87)		(3.30)
Wtax	1.822***	*eco-eff*	−3.378***	*sect*	−0.126*	*Wtax*	2.029***	*eco-eff*	−2.665**	*sect*	−0.146**	*Wtax*	2.017***	*eco-eff*	−2.262**	*sect*	−0.265**
	(2.67)		(−3.32)		(−1.92)		(3.20)		(−2.21)		(−2.07)		(2.84)		(−2.07)		(−2.18)
eco-eff	−0.837*	*capital*	0.044***	*Wsect*	0.007	*eco-eff*	−0.829*	*capital*	0.155***	*Wsect*	0.065	*eco-eff*	−0.924*	*capital*	0.255**	*Wsect*	0.075
	(−1.70)		(3.24)		(0.21)		(−1.69)		(4.12)		(0.52)		(−1.72)		(5.01)		(0.96)
urban	0.432	*human*	0.198***	*tax*	−0.060*	*urban*	0.389	*human*	0.168***	*tax*	−0.072*	*urban*	0.552	*human*	1.770***	*tax*	−0.078*
	(0.55)		(4.07)		(−1.69)		(0.53)		(3.39)		(−1.78)		(0.66)		(3.58)		(−1.82)
market	−1.018	*poprate*	−0.322*	*cor*	−0.078**	*market*	−1.833	*poprate*	−0.751**	*cor*	−0.064*	*market*	−1.644	*poprate*	−0.574**	*cor*	−0.074*
	(−0.75)		(−1.94)		(−1.99)		(−0.94)		(−2.01)		(−1.91)		(−0.83)		(−1.98)		(−1.95)
consume	1.210	*techno*	0.040*	*reg*	0.032*	*consume*	0.855	*techno*	0.076*	*reg*	0.036*	*consume*	1.156	*techno*	0.166**	*reg*	0.047*
	(1.12)		(1.85)		(1.69)		(1.12)		(1.95)		(1.72)		(1.22)		(2.18)		(1.92)
decent	2.429**	*open*	0.052*	*popden*	−0.178*	*decent*	2.152*	*open*	0.094*	*popden*	−0.152*	*decent*	2.756**	*open*	0.097**	*popden*	−0.175*
	(2.13)		(1.74)		(−1.79)		(1.95)		(1.90)		(−1.69)		(2.42)		(2.06)		(−1.78)
Wsect	0.088*	*Wpgdp*	0.247***	*Weco-eff*	0.058*	*Wsect*	0.067*	*Wpgdp*	0.267***	*Weco-eff*	0.055*	*Wsect*	0.082*	*Wpgdp*	0.325***	*Weco-eff*	0.065*
	(1.93)		(9.10)		(1.89)		(1.85)		(10.65)		(1.68)		(1.93)		(10.94)		(1.91)
R^2	0.412	R^2	0.469	R^2	0.820	R^2	0.377	R^2	0.436	R^2	0.517	R^2	0.477	R^2	0.436	R^2	0.575

Among other variables affecting local green development (*eco-eff*), the per capita gross domestic product (GDP) coefficient is significantly negative, with a significantly positive quadratic term coefficient ($pgdp^2$). There is a positive U-shape relationship between economic growth and green development, that is, in the low level of economic development, the performance appraisal mechanism with economic growth as the core will "spur on"the local governments to pursue short-term economic benefits in investment, to support the production and operation of enterprises and lower factor prices, to intervene in the environmental assessment and approval of construction and projects, and to reduce entry threshold and neglect environmental protection, resulting in environmental pollution (Huang *et al.*, 2014). And when the economy develops to a certain critical point, the degree of green development increases with the growth of GDP per capita. With the expansion of economic scale and the maturity of industrial development, the structural and technological effects of economic growth play a role, and industrial structure and technological development will enhance the level of green development in the region. Rent-seeking corruption (*cor*) passed the test of green development at the level of 10%, and the coefficient is negative. The complicity between the enterprise and the government has an "anti-driving effect" on the green development by lowering environmental standards and relaxing environmental regulations (Li and Liu, 2013). The influence coefficient of environmental regulation (*reg*) to green development is positive and has passed the test at least at 10%. This shows that with the rising status of "energy saving and emission reduction" and other environmental indicators in the local assessment system and the popularity of "scientific outlook on development" and other concepts, the strengthening of local government environmental regulation has indeed brought about an increase in the level of green development. The population density (*popden*) has a negative impact on green development and has passed the significance test. In areas with high population density, the level of green development is relatively low; this shows that the environmental pollution pressure caused by population growth at the current stage exceeds its contribution to environmental protection.

4.3. Analysis of Differences in the Impact of Different Channels

This paper focuses on the impact tax competition and industrial structure adjustment on regional green development. Because of the significant spatial spillover effects of inter-regional tax competition and industrial restructuring, Table 4 gives the effect of local and adjacent tax competition and industrial restructuring on local green development based on the estimation results of Table 3. As can be seen from Table 4, (1) Local tax competition (*tax*) has a certain negative impact on the local green development directly or through the industrial structure adjustment; at the same time, local tax competition will also lead to local industrial structure focus

on the industrial sector, hindering the promotion of local green development; taken together, tax competition will lead to a significant decline in local green development. (2) Tax competition in neighboring areas (*Wtax*) will hinder the upgrading of local industrial structure through the "race to the bottom" of industrial structure, which inhibits the local green development to a certain extent, and the development of local industrial structure in favour of industrialization will pose more difficulties for the transformation of local production mode, further inhibiting the improvement of regional green development; overall, tax competition in neighboring areas has had a significant negative impact on local green development. (3) There is the impact of local industrial restructuring (*sect*). Local industrialization-oriented industrial development will directly bring about increased local pollution and increased pressure on green development; in addition, similar to the analysis of previous two channels, such a biased industrial structure will also increase environmental pressure by stimulating extensive growth; overall, the negative impact of the development of local industrialization on green development is quite significant. (4) There is the impact of industrial restructuring in neighboring areas (*Wsect*). Because the direct impact of industrial restructuring in neighboring areas on local green development of is not significant, the impact results are no longer shown in the table; however, the industrial restructuring of neighboring areas in favour of industrialization will inhibit the improvement of local green development level through the spillover effect and correlation effect of industrial structure, coupled with the negative impact of economic growth channels, The industrial structure of neighboring areas biased towards industrialization will result in a significant negative spillover to the local green development. Therefore, in addition to having a direct negative impact on local green development, local tax competition and industrial restructuring in favour of industrialization will also reduce the level of local green development through industrial structure or economic growth channels, and if the negative spillover impact of relevant tax competition and industrial policies on the green development of neighboring areas is taken into account, tax competition among local governments and industrial competition in favuor of industrialization are a kind of lose-lose competition in the aspect of regional green development, which is harmful to others as well as to oneself.

Table 4. Differences in the Impact of Tax Competition and Industrial Restructuring on Green Development through Different Channels

Factors	Channels	Geographical weight	Economic weight	Mixed weight
Local tax competition (*tax*)	Direct impact (*tax-eco*)	−0.060	−0.072	−0.078
	Industrial structure (*tax-sect-eco*)	−0.016	−0.015	−0.035
	Industrial structure-economic growth (*tax-sect-pgdp-eco*)	−0.046	−0.046	−0.072
	Comprehensive impact	−0.122	−0.133	−0.185

Factors	Channels	Geographical weight	Economic weight	Mixed weight
Tax competition in neighboring areas (*Wtax*)	Industrial structure (*wtax-sect-eco*)	−0.230	−0.296	−0.535
	Industrial structure-economic growth (*wtax-sect-pgdp-eco*)	−0.675	−0.900	−1.090
	Comprehensive impact	−0.905	−1.196	−1.625
Local industrial restructuring (*sect*)	Direct impact (*sect-eco*)	−0.126	−0.146	−0.265
	Industrial structure-economic growth (*sect-pgdp-eco*)	−0.303	−0.444	−0.540
	Comprehensive impact	−0.429	−0.590	−0.805
Industrial restructuring in neighboring areas (*Wsect*)	Industrial structure (*wsect-sect-eco*)	−0.011	−0.009	−0.022
	Industrial structure-economic growth (*wsect-sect-pgdp-eco*)	−0.026	0.029	0.044
	Comprehensive impact	−0.037	0.038	−0.066

Note: Estimations of impact in this table, the level of economic growth (ln*pgdp*) is assumed to be 9.161, the sample mean.

5. Conclusions and Policy Implications

Based on the provincial data from 2000 to 2014 in China, this paper constructs a spatial panel model which includes local governments' tax competition, industrial structure adjustment and regional green development equation. Analysis of the impact of local governments' tax competition and industrial structure adjustment shows that the tax competition of local governments and the industrialization of industrial structure will have a direct negative impact on the local green development, and the tax competition and industrialization development in the neighboring areas will also inhibit the local green development directly through the negative incentive of "race to the bottom".

Based on the conclusion of this paper, the policy implications are as follows. First, regions need to build green development policies based on regional functional characteristics. Because of the different regional ecological capacity in China, local governments need to consider their local ecological capacity in planning and construction, and formulate regional development strategy and environmental protection policy according to their regional positioning to promote the equilibrium of green development between regions. At the same time, the weight of green development evaluation in local performance assessment should be effectively increased, preventing local governments from ignoring ecological environmental protection and excessively pursuing economic growth, thus effectively promoting the new development model of coordinated regional economic growth and social and environmental protection. Second, local governments' tax competition behavior should be standardized. We should deepen the reform of local fiscal and tax system and strengthen the central government's supervision over the implementation of

local tax policies and tax collection and administration. At present, along with the unified legislation by the central government, in order to reflect regional differences, local governments are granted the initiative to formulate appropriate collection standards and management methods within the prescribed range, but it is necessary to strengthen supervision and carry out the filing approval system. At the same time, implementation of environmental tax collection should be strengthened and the environmental constraints of capital flow across regions should be increased to eliminate the possibility of local governments attracting backward production capacity through tax competition. Third, local governments should reasonably determine the appropriate industrial structure development strategy. With the help of the "anti-driving mechanism" of the industrial development strategy, we should give full play to the "innovation compensation" effect in the Porter hypothesis, weaken the negative effect of the protection barrier on the local governments' environmental function, change the "free-rider" behavior in local government environmental protection, develop the cross-regional collaboration between production factors and services, give full play to the benign competitive effect of local government and the positive spatial spillover effect of inter-regional industry, and promote the green transformation of regional industry.

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Research Review and Development of Circulation's Contribution to Consumption

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Basically speaking, scholars at home and abroad agree that circulation is conducive to the development of consumption. In terms of the research methods, equal importance is attached to both empirical research and normative research, which involve empirical analysis of econometric model and the deductive reasoning of circulation's contribution to consumption. Viewed from the research conclusion, circulation's contribution to consumption can be divided into direct and indirect ones, including circulation organization, circulation environment, and circulation revenue. Besides, rural consumption has aroused broad attention of Chinese scholars. Meanwhile, studying on the contribution of rural circulation development to countryside consumption is also a key research area concerned by Chinese scholars.

Keywords: circulation, consumption, research review, development

As the bridge linking production and consumption, on the one hand, circulation plays the role of helping products enter the market and achieving value. On the other hand, it has direct engagement with consumers and helps to meet their consumption demands and guide the consumption trend. Therefore, circulation is of great significance in relation to expanding domestic demands, releasing capacity, de-stocking, industrial restructuring and upgrading. As China's economy enters the new normal, consumption has become the basic factor which drives up economic growth. Researches concerning consumption are increasingly under the spotlights. Against the backdrop of expanding consumption and promoting the upgrading of consumption structure, it has been a hotspot topic to explore the relation between production and consumption and the circulation link of commodity exchange realization and consumption based on the Marx's four links of production relation theory. But till now, few studies summarise and review how circulation facilitates consumption. This paper is going to streamline and illustrate the circulation's contribution to consumption both in China and beyond on the basis of the economics theories.

This paper classifies the research results from Chinese and international scholars in this field accordins to the research perspective (whether it is from macro-perspective

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or micro-perspective). In terms of the macro-perspective, related papers view beyond enterprises or users and treat circulation as an entire industry or system or discipline (Xia, 2009). In terms of the micro perspective, organization is chosen as the research subject with the focus on the operation and management of individual or multiple circulation business organizations.

1. Development of Foreign Research

1.1. Macro Research of Circulation's Contribution to Consumption

1.1.1. Historical Review

As pointed out by Mun in the book of *England's Treasure by Foreign Trade* (Mun, 2006), circulation is a key pipeline for accumulating wealth for a country. Smith (2006) discussed the relationship between circulation and consumption growth from the perspective of division of labor and put forward the famous theory of dynamic productivity. Namely, circulation serves as a significant sign of the expansion of market scope, which restricts the degree of division of labor. And the development of the division of labor is the major factor which influences the long-term growth of productivity. Therefore, the expansion of circulation could facilitate the deepening of division of labor and the growth of productivity, and speed up the consumption demands.

Marxist economics classifies the social reproduction into four interrelated links: production, distribution, exchange and consumption. Among them, the theory of circulation is a significant part. According to Marx, circulation is "a factor of exchange or the exchange in the sense of overall exchange". Marx (1998) discussed consumption for many times and he thought the essential purpose was to satisfy various needs, which could be interpreted as that the goal of circulation was to meet the residents' consumption. Marx held that the professional labor division led to the contradiction between the simplification of production and the diversification of the consumption demands, which helped drive the development of circulation. In the book of *Manuscript of Economics*, he proposed that the final purpose of commodity exchange was to meet the demands for various qualities. Marx believed that the development of trade was to create conditions to promote the sale and buying from uncoordinated to coordinated status. During this process, sale needs to get used to buying, since buying reflects the consumption's demands. Mortimer, an economic historian, studied commodity circulation's role in consumption growth based on the analysis on commodity circulation's contribution to businessmen's wealth increase. He also put forward that "it is trade that makes some people rich among the merchants, and it is trade that creates the fashion of luxurious consumption in the upper class".

1.1.2. Contemporary Research

Nowadays, there are a limited number of researches abroad studying the circulation's contribution to consumption from macro perspective. Masaki (1999) discussed the circulation's contribution to consumption from the perspective of economic system. He held that as an intermediate process between production and consumption, circulation serves as a bridge between production and consumption, for the purpose of fueling economy and expanding consumption. Building on the study on consumer markets in rural areas, Krishnamoorty (2000) and Prahalad & Hammond (2002) thought that the rural circulation system was the hindrance which should be conquered to develop consumer markets in rural areas, and they also recognized the circulation's contribution to consumer markets in rural areas.

1.2. Micro Research of Circulation's Contribution to Consumption

Except for Japan, there is no systematic concept of circulation in the study of economics by European and American scholars. But the study on the influencing factors of consumption is a hotspot topic. Western scholars basically agree that the main element determining the consumption is the disposable income (Keynes, 1936). And they conclude that a stable and proportional relationship exists between consumer spending and disposable income (Duesenberry, 1949), the spending level of consumers is decided by their long-term disposable income (Friedman, 1957) and narrowing the income gap could improve the social consumption level (Blinder, 1975). The studies of circulation's influence on consumption are scattered in areas like business, retail, marketing and consumption, focusing on the micro perspective of business. And the related conclusions are mainly how circulation environment, circulation cost, and circulation organization influence consumption.

1.2.1. Circulation Environment Promotes Consumption

Contribution of circulation environment or shopping environment to consumption is mainly in the field of retail research. Many scholars find that the consumption environment offered by terminal retail enterprises as the carrier of circulation can affect consumer behavior. Donovan and Rossiter (1982) found out that a cozy shopping environment can exert a positive impact on consumers' shopping emotions and promote the consumption time and motivation through constructing the model of "environmental stimulation-emotion status-behavioral reaction". On such basis, relevant studies are detailed further. By analyzing a series of models, scholars have also discovered that the sense of joy brought by the store atmosphere (Sherman *et al.*, 1997), pleasing product display and aroma, especially orange flavor (Fiore

et al., 2000), and music background (Morrin *et al.,* 2005) with slow motion can promote the consumption spending of consumers. Moreover, scholars believe that intangible atmosphere such as music and vanilla can have a positive impact on stimulating spending of consumers, young shoppers in particular (Morrison *et al.,* 2011).

1.2.2. Circulation Cost Saving Promotes Consumption

The contribution of circulation cost saving to consumption is also another important area studied by foreign scholars, mainly based upon the research view of business marketing and consumer behavior, including searching cost, cost of goods return and replacement, cost of logistics and transportation, product purchasing cost, and time cost, etc.

First, searching cost. Based on the game theory, Stahl (1989) found that the searching cost incurred during the process of circulation is a key factor influencing consumer demands. The reduction of search cost can stimulate consumer demands. Shevchenko (2004) and Watannbe (2010) also discerned that circulation intermediary to maintain product inventory is conducive to saving consumers search costs during the research on the generation and evolvement of circulation intermediary. Cachon *et al.* (2008) and Cason and Mago (2010) and other scholars conducted further researches and found it out that lower market prices based on search cost savings can promote consumer demand and increase social welfare.

Second, cost of goods return and replacement. Anderson *et al.* (2009) found that the decline of the cost of goods return and replacement incurred during the process of circulation could increase product quantity and boost the consumption growth.

Third, cost of logistics and transportation. Thomas (2002) compared the agricultural product transportation, logistics, and consumption system from America and Argentina. It was detected that cost of logistics and transportation could affect the sale volume of agricultural products. Therefore, comparing with Argentina, America has the advantage of a lower logistics cost and thus higher agricultural product export.

Fourth, product purchasing cost. Hawkes (2009) held that merchants' flexible promotion strategy is helpful to stimulate consumers' purchasing points and expands consumption. Mhurchu *et al.* (2010) discovered that residents will expand their consumption in the supermarket given that the consumption purchasing cost is lowered due to the product discount offered by the supermarket.

Fifth, time cost. Rodriguez (2002) found out from the Argentina people's food purchasing behavior that as the consumer's shopping time shortened, the probability of consumers' consumption in supermarket and food purchasing would be improved.

1.2.3. Circulation Organization Improves Consumption

Western scholars have also found that the long-term and stable relationship between circulation organizations and consumers can stimulate consumers' purchasing motivation and drive consumption growth.

First, good brands shaped by retail and wholesale business and other circulation organizations could promote the consumption growth. Brashear *et al.* (2011) found that according to the research on wholesale brands' influence on consumer purchasing behavior, good wholesale brands could bring the signal of quality to consumers, and the high brand loyalty could help increase consumer buying frequency and enlarge consumption demands. Cacho and Loussaïef (2010) adopted the methods of questionnaire survey and interview to study the relation between French retail business brand image and consumption. They found that when consumers identify with the concept and brand of the retail enterprise, the emotional bond between the two sides can stimulate the purchase motivation of consumers.

Second, the circulation organizations' good service could encourage residents' consumption. Home (2002) found that the characteristics of retail stores and the service attitude of shopkeepers can influence the purchasing behavior of rural consumers based on the research on agricultural consumption.

Third, the great strategy of circulation organization could influence residents' consumption. Many scholars found out in case study of Walmart that the strategy of providing low-price and high-quality product to consumers by taking advantage of the supply chain management is good for stimulating residents to spend money on consumption and achieve the win-win results for enterprises themselves and consumers (Graff and Ashton, 2002; Hausman, 2005). Krishnamacharyulu (2010) conducted the case analysis on product strategy in rural markets based on four types of businesses and found that various strategies of product and service offerings in rural markets selected by circulation organizations could influence the consumption markets in rural areas.

2. Domestic Research Development

The concept of circulation in China derives from Marx's reproduction theory, which defines circulation as an intermediate process between production and consumption. In this case, circulation belongs to the domain of economics in the field of domestic economics and is included into industrial economics in the subject classification. *Commercial and Industrial Theory* (1995), *China's Circulation Industry and Its Operation (1998)*, *China's Circulation Industrial Policy Research (1999)*, *Commercial and Industrial Organization Theory (2001)* and other classics reflect the research fruits concerning circulation industry by scholars between the end of 19th century and the

beginning of 20th century. In comparison with foreign scholars, domestic scholars have more abundant and in-depth researches on circulation's contribution to consumption by conducting complete analyses from many dimensions such as macro and micro, direct and indirect ones. Under the background of China's severe condition of dual-system of urban and rural areas, segmentation of consumption markets in urban and rural areas and the urgent need of expanding the broad rural markets for 900 million farmers, there are a lot of studies concerning the contribution of circulation in rural area to consumption. Viewed from the research methods, domestic scholars mainly adopted deduction to analyze the mechanism of circulation's contribution to consumption at the beginning. Later on, conducting empirical analysis by building econometric model has become the popular trend.

2.1. Macro Perspective: Circulation System and Residents Consumption

The relationship between circulation and consumption has always been the focus of scholars. Back in the 1990s, Lin (1995) set forth that commodity trade could not only meet the needs of consumption, but also create conditions to improve consumption. Commodity trade does not play a negative role in production and consumption, setting up production and marketing links, promoting production and meeting consumption needs, but plays a leading role in guiding production and consumption. Li (2001) pointed out that the commodity circulation sector was in the forefront of the market operation. Such position would be increasingly obvious with the socio-economic development, frequent trade and close market relation, and would be more and more important in driving up consumption and addressing employment. Huang (2002) pointed out that the development of circulation sector is related with the form of consumption, lifestyle and quality of people. Only by circulation can the value of product be realized and people's material and cultural life demands be met. Wan (2003) put forward that circulation innovation could facilitate the consumption growth and the expansion of rural markets. The progress of modern circulation sector would benefit the expansion of domestic demands and the improvement of people's wellbeing. Besides, revitalizing circulation industry and commerce remained the key way for enlarging domestic demands (Wan, 2004). Zhao (2010) mentioned that the development level of circulation industry acted as an important force to promote the expansion of consumption market and consumption structure.

The modern circulation system is an integrated system consisting of seven horizontal systems as evidenced by the circulation of agricultural products, means of production, daily industrial products, and six vertical systems including the circulation organization system, the commodity market system, and the circulation management system and so on (Ding, 2007; Hong, 2010). Many scholars discussed the important role of circulation system in promoting residents' consumption from a

macro perspective, which involves the modern circulation system at multiple layers, the analysis on the agricultural circulation system in rural market as well as the urban-rural two-way circulation system's effect on expanding residents' consumption.

First, from the perspective of overall development of the circulation industry, a multi-level modern circulation system could promote consumption. Back in 1999, Ma (1999) proposed an idea that the promoting consumption requires strong circulation support. Under the institutional innovation of the retail industry, the development of the life service industry related to the consumption of residents and the structural adjustment of the wholesale trade, the construction of a multi-level "circulation platform" with high efficiency and fair competition is conducive to playing the role of circulation to expand domestic demand. In the context of accelerating economic globalization, Cheng (2007) thought that circulation modernization is the urgent task for expanding consumption at present. Song (2010) also put forward that an efficient circulation system can help to resolve structural supply contradictions and to maintain price stability.

Second, from the perspective of the subdivision of the rural market, a perfect rural circulation system could expand the consumption of rural residents. Song (2006) believed that the modern circulation service industry has many powerful influences: first, it can minimize all forms of "dornoant assets and waste of resources"; second, it can increase the proportion of social products that actually play a role in the industry; third, it can maximize the elimination of dormant assets, losses, and wastes. Therefore, a perfect rural circulation system is beneficial to optimize economic structure and processes as well as increase farmers' income and consumption. Wen (2007), He (2007), and Hao (2009), and other scholars believed that the modernization and improvement of the rural circulation system are the necessary conditions and important guarantees for the expansion of the rural consumer market and the exploration of consumption potential. Ran (2008) utilized the autoregressive distributed lag model and other related statistics methods to carry out a study on the relationship between circulation and consumption. The study found that the total retail sales of social consumer goods in the current period was positively correlated with consumption. The total retail sales of social consumer goods in the lagging period was negatively correlated with consumption. At the same time, the total retail sales of social consumer goods in the current period had the strongest effect on rural residents' consumption. That is to say, the development of the circulation industry has a promoting effect on consumption, and it has the greatest contribution effect on the consumption of rural residents. Wen (2011) made a study on the basis of the analysis of the internal relationship between rural modern circulation system and rural market, and he found that a perfect rural circulation system can increase the income of farmers and optimize the consumption environment, thus expanding the rural market. Besides, Lin (2011) proved it from the opposite side. Through analyzing the consumption market situation in rural areas in

Fujian province, she found that the backward rural circulation system was one of the constraints of the consumption of rural residents.

Third, from the perspective of urban and rural areas, the urban-rural interactive circulation system that breaks the division of urban and rural could expand consumption. This research stems from the facts that the problem of urban-rural dual structure is prominent in China and the constraints of expanding the rural consumer market. On the one hand, through the study of the coordinated development of urban and rural circulation, Liu (2012) and other researchers analyzed the mechanism of the dual structure of urban and rural circulation which restricts the expansion of rural consumption. On the other hand, Meng (2013) pointed out that the construction and improvement of the two-way trade circulation system between urban and rural areas is conducive to improving the circulation efficiency of agricultural products and the income of rural residents, thus promoting the growth of the rural consumer market. Wang (2015) proposed a two-way urban-rural circulation system for the rural areas to implement new industries or other means to expand rural consumption. Through empirical analysis, he concluded that the organizational structure and circulation efficiency of the two-way urban-rural circulation system directly affect rural consumption.

2.2. Micro Perspective: The Mechanism and Empirical Analysis of Circulation's Contribution to Consumption

The difference between the domestic scholars' analysis and foreign scholars' analysis of the micro-mechanism of circulation's contribution to consumption lies in the fact that foreign scholars focus on the single fractional perspective of consumer behavior and corporate marketing, while domestic scholars mainly focus on measuring the micro-factors that help circulation industry promote consumption on the basis of circulation organization, circulation facilities, and circulation environment. According to the dimension of mechanism, the domestic researches from micro perspective can be divided into direct effect and indirect effect. The direct effect means that the development of the circulation industry itself directly influences the development of consumption and the consumer market, such as the extension of circulation, the improvement of efficiency, and cost reduction. The indirect effect refers that the change of other intermediate variables caused by the development of circulation, influences the changes in consumption. For example, the development of circulation industry drives up the income level of residents and thus promotes consumption. Next two subsections review domestic scholars' research results in this field from the perspective of direct effect and indirect effect.

2.2.1. Research on the Direct Effect of Circulation on Promoting Consumption

The direct effect of circulation on consumption lies in the impact of the

development of the circulation industry on household consumption, which can be subdivided into the effect of the development of circulation organization, circulation facilities, and circulation environment on expanding the consumer market. According to the research methods, researches can be divided into non-empirical analysis methods such as case studies and normative research, and empirical analysis methods including the establishment of quantitative analysis model.

Among the literatures using non-empirical analysis methods (such as case studies and normative research), most of them select the individual circulation factor to study its promotion of consumption. In 2002, Song (2002) found that consumption environment was also an important factor that restricted the full release of the purchasing power of residents beside their income. Liu (2005) and other scholars applied the game analysis model to their studies and concluded that rural trade market can promote rural consumption. Qi (2008) argued that circulation's contribution to consumption is unquestionable, and a bad circulation environment is one of the factors that hinder the realization of some consumption. After the analysis of cases of rural power network reconstruction, Feng and Liu (2008) and other researchers have got a conclusion that the rural consumption environment has a restrictive function on rural residents' consumption and the improvement of the rural consumption environment is conducive to expanding the rural consumer market. Li (2011) and other scholars adopted the sampling survey method to investigate the consumption situation of rural residents, and found that there is much room to improve in the rural consumer markets. The markets for durable consumer goods and building materials products, such as refrigerators, air conditioners, microwave ovens, and other products, still have great potential. In addition to the conservative consumption concept of farmers, the lack of consumption in rural areas is also caused by the low-density circulation facilities which are not convenient for rural residents to consume.

The empirical analysis is widely used to study the comprehensive effects of micro-factors of circulation industries on consumption. Hao (2010) completed the questionnaire survey of 521 households in Henan Province, and established the Probit model. He found that the circulation mode, circulation format, circulation infrastructure, and circulation service can significantly affect the consumption of rural residents. Li *et al.* (2011) and other scholars selected the rural wholesale and retail township enterprises and the number of employed people, the amount of fixed assets investment and other factors to analyze the impact of circulation industry in rural areas on household consumption by establishing the PLS regression model, and concluded that the development of employment scale in the circulation industry, the increasing number of circulation organizations, and the investment in technical facilities are able to advance the consumption of rural residents. After studying the foreign studies, Zhang (2013) systematically established a micro-functional system that can promote consumption by saving search costs, solving adverse selection problems, and

optimizing the shopping environment. Wang (2015) and other researchers paid more attention on the role of circulation innovation in promoting consumption, and they choose some indicators including the technology efficiency of circulation industry, capital efficiency and network efficiency as independent variables to establish the DEA model. It is concluded that circulation innovation can significantly promote consumption expansion. Wang (2016) established the SD Model to study the impact of Jiangsu circulation industry on consumption, and thought that circulation factors such as the expansion of fixed investment in the industry, the growth of output value, and the improvement of industrial efficiency can all promote the growth of household consumption.

On the whole, the analysis of domestic scholars on circulation's direct contribution to consumption has utilized case studies, normative research, and empirical research methods, and basically agreed that the positive distribution industry infrastructure, circulation organizations, circulation services, and other factors can be used to expand consumption. At the same time, this point also coincides with the micro-study conclusions of foreign scholars. In addition to the basic research with extensive applicability, domestic scholars have also subdivided and deepened their studies in the field of consumption and have made some innovations.

First, in terms of the distinction between rural and urban areas, in the empirical study on the circulation development and consumption progress, Ran (2008) divided the consumption expenditure into rural and urban consumption, residents and government consumption, and analyzed the increase in the circulation scale represented by total retail sales of consumer goods. She concluded that the improvement of the modernization of circulation can promote the consumption of residents, especially the household consumption in rural areas. Luo (2011) got the opposite conclusion at this point. He selected the circulation industry and consumption expenditure data of Guangdong province, studied the impact of the circulation industry on urban residents and rural residents respectively, and concluded that the consumption of urban residents driven by the circulation industry is greater than that of rural residents. At the same time, he thought the reasons for this empirical conclusion include the low incomes of rural residents, few circulation facilities, and the unsound circulation network. Zhang and Li (2010) and other researchers divided the national circulation industry and consumption development data into three regions, namely, the eastern, central and western regions. They established the measurement model to study the degree of circulation's contribution on consumption in these three regions, and they found that the degree of circulation's contribution on consumption in the eastern, central and western regions was gradually decreased.

Second, in terms of the distinction among different types of consumption, Wu (2014) divided the residents' consumption expenditure into surviving-type and leisure-type. He established the measurement model to analyze the impact of marketization

and circulation facilities environment on consumption. It is found that in rural areas, circulation facilities have less impact on surviving-type consumption expenditures, while the impact on leisure-type consumption is greater. He concluded that improving the environment of the circulation facilities is conducive to promoting the upgrading of rural consumption structure. Chen *et al.* (2015) and other researchers also made similar researches. They analyzed the impact of agricultural product circulation efficiency on the total consumption, surviving-type consumption, and leisure-type consumption of rural residents by establishing a fixed effect model. They also found that the circulation efficiency of agricultural products has greater effect on the leisure-type consumption of rural residents than surviving-type consumption.

Third, in terms of the distinction in time, Wu and Li (2012) and other scholars analyzed the influence of the total amount of rural circulation, the trade market, and the circulation environment on rural consumption and take time factors into account. They found that in the rural areas, the effects of various segments of the circulation industry on the expansion of rural consumption are changeable from time to time, and the coefficient of elasticity of total circulation for rural consumption is increasingly rising. At the same time, the role of the rural market (as the main body of circulation) to expand rural consumption has experienced a process of rising to weakening, mainly because of factors such as the increase in income of rural residents and the abundance of emerging businesses.

Fourth, from the perspective of the interaction between circulation development and consumption growth, Wen and Liang (2010) and other researchers established the DEA model to analyze the degree of mutual support. They found that the role of circulation in promoting consumption is greater than the effect of consumption on circulation. Through empirical research, Ding (2012) found that the development of circulation industry and consumption expenditure of residents are interacting and influencing each other. The high-speed development of circulation industry can expand household consumption, and the low-degree development of low-level circulation industry can also restrain household consumption. At the same time, the growth of household consumption expenditure can counteract the circulation industry, and the upgrading of consumption structure can promote innovation of circulation organizations, and thus stimulate further development of circulation industry.

2.2.2. Research on the Indirect Effect of Circulation on Promoting Consumption

Dividing the direct effect and indirect effect of circulation on consumption and conducting differentiated research are another major innovation of domestic scholars in this field. At present, there are still few studies in this field. The direct effect of the circulation industry on the consumption of residents lies in the impact of the development of the circulation industry. At the same time, there are

other effects, such as the development of the circulation industry to achieve the improvement of the income level of rural residents, and the economic development of rural areas. The mechanisms that cause changes in intermediate variables and expand consumption can be regarded as the indirect effect of circulation on promoting consumption (Li, 2013).

One of the mechanisms of circulation's indirect contribution to consumption is that the development of the circulation industry can promote the improvement of the income level of residents, thereby realizing the growth of consumer demand. Through implementing various research, Zhao (2008) found that small and medium-sized retail enterprises can achieve the improvement of residents' income level through extensive absorption of social employment, thus promoting the expansion of consumption. Xia *et al.* (2009) and other scholars adopted case study methods to compare and analyze dandelion and sophamide, and concluded that the establishment of a dual-effect circulation system for urban-rural interaction can promote the branding and large-scale production of agricultural products, thus increasing the income of farmers. The second mechanism of circulation's indirect promotion to consumption is concluded from the perspective of the overall level of economic development. It is considered that the resource input of the circulation industry has a multiplier effect, and the development of the circulation industry promotes the improvement of the overall economic development level, thus realizing the improvement of the income level of the residents and the expansion of the consumer market.(Li, 2013)

3. The Future Research Direction

In general, there are lots of researches on circulation's contribution to consumption both from domestic and foreign scholars. It is recognized that the modern circulation system and industrial development can promote the expansion of the consumer market. From a macro perspective, the improvement of the level of the circulation industry and the continuous improvement of the circulation system can promote the expansion of consumer demand; from a micro perspective, the improvement of the circulation environment, the savings of circulation costs, and the enrichment of circulation formats can directly generate positive impact for the consumer market. At the same time, circulation can also indirectly expand the consumer market by increasing the income of residents by promoting the absorption of employment and the promotion of economic level by multiplier effect. However, on the whole, there are still many aspects that can be further explored such as research methods, research data and materials, and research objects.

First, we should enrich the research base of data and materials. Currently, most scholars obtain second-hand data from statistical yearbooks, government reports, and other sources. Many scholars have mentioned the lack of data in the circulation

industry in their research results and the need to improve the indicator system(Wu, 2014; Wang, 2015). Whether in empirical research or case studies, to some extent, the lack of data and materials affects the accuracy of research conclusions. At the same time, it is also difficult for these scholars to propose policy recommendations that are appropriate to China. Under the current background of the rapid development of Chinese e-commerce and the urgent need for transformation of physical retail, we should further improve the indicator system and quantitative methods of the circulation industry, make in-depth investigations to retail stores, e-commerce enterprises, and other circulation organizations, and collect first-hand data. Enhancing the originality and authenticity of research data and materials is one of the directions for further refinement in the future.

Second, we should enrich research methods. At present, most scholars use econometric models, case analysis, and other methods, and some econometric methods such as VEC, SVAR, and panel data are still widely used (Ding, 2014). However, there are other research methods which can be utilized such as state space models, variable parameters and non-parametric methods. At the same time, considering that the research of the circulation industry is a complex problem involving multiple subjects, multiple links, and multiple time periods, game theory and other methods can be applied to analyze the mechanism of action of all parties. Foreign scholars have applied game theory model to analyze and the relationship between consumer and the circulation industry subjects, and they have got a conclusion that circulation cost savings can promote consumption(Stahl,1987). In addition, in current studies, scholars are used to taking qualitative analysis or quantitative analysis methods. Maybe they can try to combine the case analysis and empirical analysis to analyze the internal mechanism of Chinese circulation and consumption, and propose actionable and practical policy suggestions and solutions to the current issues.

Third, we should segment the research object. At present, some Chinese scholars have begun to conduct sub-division studies according to the regional consumption differences between rural and urban areas, the nature differences between the surviving-type and the leisure type consumption, and the differences in time. This development trend is conducive to proposing differentiated policy recommendations to expand consumption. For example, the segmentation factors of circulation in rural and urban areas can have different impacts on consumption. Therefore, rural and urban areas should adopt different measures to improve the development level of the circulation industry and expand consumption. The policies recommendations proposed on this basis are more targeted. However, on the whole, there are still few studies about these sub-areas, and related research can still be further enriched. For example, researchers can subdivide the study according to the nature of goods such as service consumption and commodity consumption, consumer goods and bulk products, which is bound to have bright prospects.

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