Approaching Digital Economy from the Perspective of Political Economics

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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.

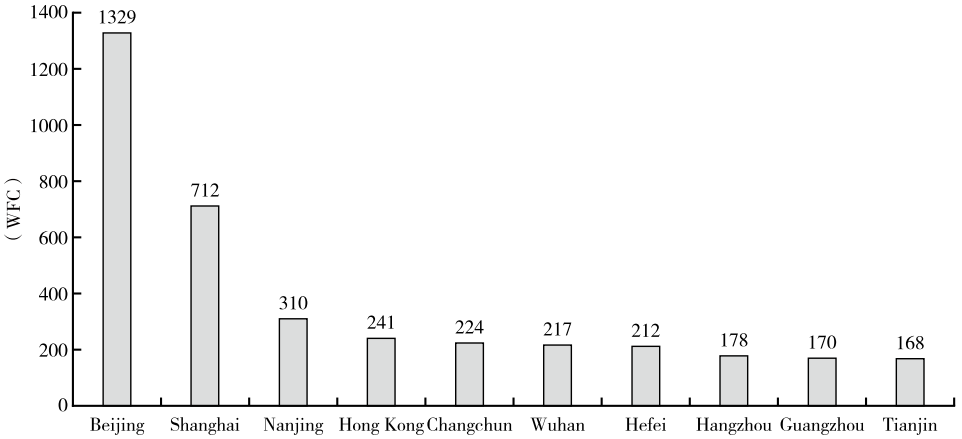

Figure 1. Evaluation of Scientific Research Achievements of the Top 10 Cities in China

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.

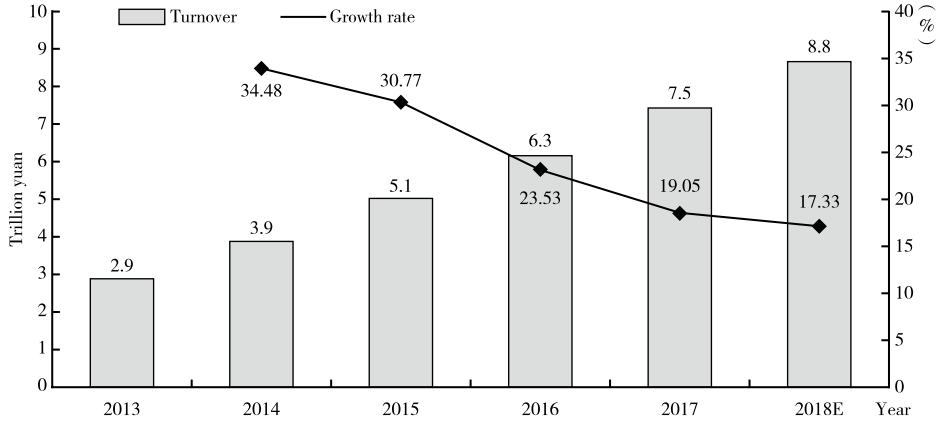

Figure 2. Scale of China's Cross-Border E-Commerce

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).

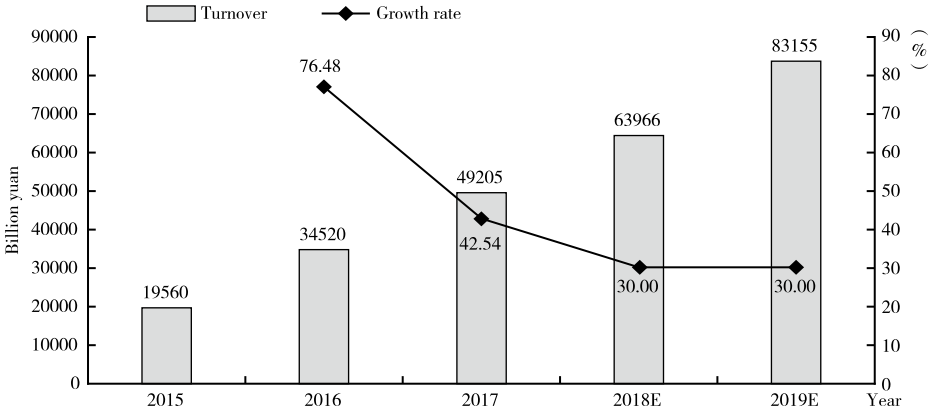

Figure 3. Market Size of China's Sharing Economy and Forecast in 2015-2019

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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