Impact of the Digital Talent Supply on the Development of Digital Economy in China

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Abstract—Digital technologies such as big data and cloud computing are booming, so that new requirements have been put forward for the digital talent supply. However, China's digital talents, especially high-end digital talents, are in short supply. This study reviewed the current situation of the development of digital economy and digital talent environment in China. By analyzing the impact of the digital talent supply on the development of digital economy in China, this study concluded that digital talent is the driving force behind the growth of the future digital economy, and the creation of a digital workforce is central to the further development of China's digital economy.

Keywords— Digital economy in China, development of digital economy, digital environment, digital talent supply.

I. INTRODUCTION

In the past 40 years, China has developed from an unsolved problem of food and clothing to becoming the world's second largest economy, successfully entering the ranks of middle-income countries, and becoming a veritable economic power, which can be described as creating an economic miracle. However, due to deep and complex changes in the international business environment and domestic conditions, the problem of unbalanced and insufficient economic development is still relatively serious (Hu et al., 2018).

Luckily, digital technologies such as big data and cloud computing are booming, setting off a digital revolution around the world. The profound integration of digital technology with the actual economy has given rise to a new type of economy known as the digital economy, where digital knowledge and information are the main production factors, digital technology as a core force and a modern information network as an important carrier. (CAICT 2022b). Compared with traditional agricultural and industrial economies, the digital economy has been greatly improved compared with traditional agricultural and industrial economies in terms of resource allocation, penetration integration and coordinated development, and is a new economic paradigm for realizing industrial structure optimization and high-quality economic development (Pei and Fan, 2023). China has taken advantage of the new opportunities for the rapid development of its digital economy and achieved remarkable results. The digital economy is expected to expand in two main stages, according to China's 14th Five-Year Plan: the first is the connecting of digital technology and traditional industries, and the second is the deep integration of the digital economy with the real economy. The former depends on technological innovation, the latter depends on the economic environment.

In the early 90s of the 20th century, scholars represented by Moore gradually introduced the concept of ecosystem into the field of business research, believing that commercial ecosystem is an interactive consortium between multiple sectors in the market, which includes a variety of subjects in the market and the external environment (Moore, 1993). The external environment is composed of financial environment, market transaction environment, labor environment, government service environment, etc., reflecting the soft power of a region's economic development. A suitable business environment plays an important role in promoting a city's technological innovation ability and microeconomic vitality (Li, 2021). Similarly, when digital economy market entities engage in business activities, they are also in an ecosystem composed of various external environments such as government governance environment, legal and regulatory environment, macroeconomic environment, talent supply environment, market transaction environment and entrepreneurial innovation environment, which constitute the so-called digital business environment (Xu et al., 2022). Among these external environment, as digital technologies such as big data and cloud computing are booming, so that new requirements have been put forward for the digital talent supply.

II. CURRENT SITUATION

2.1 The development of China's digital economy

In recent years, China's digital economy has developed rapidly and made remarkable achievements, especially since the outbreak of the new crown pneumonia epidemic, In addition to helping to restore life and productivity, digital technology and the digital economy have been crucial in the fight against the current crown pneumonia pandemic.

China's digital economy has been booming in recent years, with new formats and new models emerging one after another, and emerging industries such as big data, 5G, artificial intelligence, and intelligent terminals growing rapidly, effectively promoting the accelerated development of the industrial Internet, enriching people's digital cultural life and consumption, and continuing to help improve the modernization level of national governance capabilities (Liu, 2022). As shown in Figure 1.1, in 2020, the scale of China's

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digital economy reached 39.2 trillion yuan, a year-on-year increase of 9.6%, ranking first in the world and second in scale, accounting for 38.6% of China's GDP, becoming a key driving force for stable economic growth (Liu, 2022). In 2021, China's digital economy has made a new breakthrough, with the scale of the digital economy reaching 45.5 trillion Chinese Yuan, more than doubling that of 2016, with a year-on-year nominal growth rate of 16.2%, higher than the nominal GDP growth rate of 3.4 percentage points, accounting for 39.8% of GDP, an increase of 9.6 percentage points over 2016.
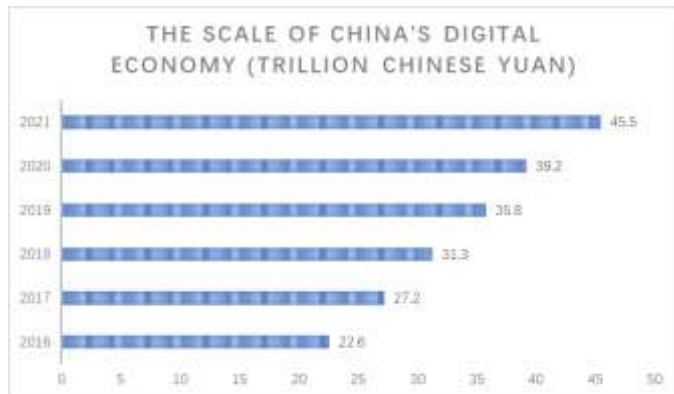

Figure1.1 The scale of China's digital economy in 2016-2011
Sources: CAICT, Report on the Development of China's Digital Economy (2022a)

With the innovative evolution of digital technology, the Internet, big data, artificial intelligence and the real economy are deeply integrated, and the dominant position of industrial digitalization continues to be consolidated. In 2021, the scale of digital industrialization in China will be 8.4 trillion yuan, an increase of 11.9% in nominal terms year-on-year, accounting for 18.3% of the digital economy and 7.3% of GDP. In 2021, the scale of industrial digitalization reached 37.2 trillion yuan, an increase of 17.2% year-on-year, accounting for 81.7% of the digital economy and 32.5% of GDP, and the digital transformation of the industry continued to accelerate in depth (As shown in Fig 1.2).
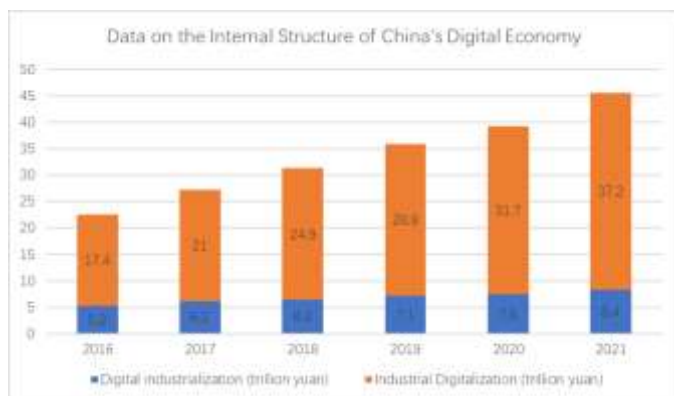

Figure 1.2 China's 2016-2021 digital economy internal structure data
Source: CAICT, Report on the Development of China's Digital Economy (2022a)

The scale of China's digital economy also ranks among the top in the world, It is mostly attributable to the nation's ardent support of the "decentralization and management of services" reform as well as the enhancement of the business environment. From 2017 to 2021, the government work reports of the China's State Council have made a series of deployments around the reform of "decentralization and management of services" to optimize the business environment. In accordance with the unified requirements of the China's State Council, local governments have introduced many reform measures around optimizing the business environment, and strive to simplify examination and approval, strengthen supervision, and better services. The trade in goods achieved through cross-border e-commerce has developed rapidly, the level of trade digitization has been continuously improved, and digital trade has become a new driving force and new force for China to promote economic growth and achieve high-quality trade development (Lin et al., 2022).

In the era of the digital economy, China's huge population has become the basis for the development of China's digital economy due to network effects, and it is also a digital economy development advantage that distinguishes China from other countries (Yu and Chen, 2021). Taking the new e-commerce platform PinDuoDuo as an example. PinDuoDuo has successfully stimulated domestic demand by targeting China's huge number of long-neglected cities and towns in the third and fourth tiers and below through low prices, and using Internet platforms such as WeChat to increase user stickiness. In 2020, there were 790 million active buyers on Pinduoduo, up 35% from the previous year. These buyers also used 2,115 yuan on average year, up 23% from the previous year1. The digital economy has also helped the government to digitize governance, driving China's consumption and economy to take the lead in recovering from the epidemic. In the post-epidemic era, in order to stimulate consumption, local governments in China have issued consumption coupons to the public through mobile payment platforms such as Alipay and life service platforms such as MeiTuan. Consumption vouchers have a multiplier effect, which can reduce the economic losses suffered by low- and middle-income people in the epidemic, stabilize the consumption of low- and middle-income people, and boost overall consumption in the short term (Yu and Chen, 2021).

At the same time, there are also a series of problems in the development of China's digital economy.

In its assessment on the state of the digital economy at the end of 2022, China's National Development and Reform Commission demonstrated that the country's digital industry still faces issues like big but weak, fast but not big. It is mainly manifested in the following aspects: First, the innovation ability in key areas is insufficient. In the fields of operating systems, industrial software, high-end chips, and basic materials, the level of technology research and development and process manufacturing lags the international advanced level (He and Tao, 2018). Second, China's digital economy presents the problem of unbalanced development of regions,

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1   Data source：https://pdf.dfcfw.com/pdf/H2_AN202103181473182686_1.pdf?1616060521000.pdf=

industries, as well as intergenerational imbalance (Yu and Chen, 2021), and the digital divide needs to be bridged urgently. Different industries, different regions, and different groups have different digital foundations, obvious differences in development, and even a trend of further expansion. Third, the management system of the digital economy must be improved. The system of rules and systems to adapt to the development of the digital economy needs to be improved, the basic institutional system of data elements is still under construction, the platform economy governance system that can stimulate vitality and ensure security needs to be improved, various implementation rules supporting relevant laws and regulations need to be promulgated urgently, and participation in international governance of the digital economy needs to be further improved. The governance mechanism of cross-departmental coordination and multi-party participation needs to be improved, and the governance capacity still needs to be continuously improved. At the same time, the vigorous development of the platform economy will also breed the phenomenon of enterprise monopoly (Yu and Chen, 2021).

2.2 Digital talent environment in China

Digital talent is the core driving force for China's comprehensive digital transformation, and the distribution of digital talent also determines the future development potential of the regional digital economy. In line with the development level of digital economy, the distribution of digital talents is also positively correlated with the level of regional economic development. The Beijing-Tianjin, Yangtze and Pearl Delta regions are major concentrations of digital talent, with 16.6% concentrated in Suzhou, 15.6% in Beijing, and 6.7% in Shenzhen from the third quarter of 2016 to the third trimester. from 2017 (Tsinghua SEM, 2017). At the same time, the flow of digital talent is also showing a trend of concentration in economically developed regions. From 2014 to 2016, the net inflow of digital talent to Shanghai, Shenzhen, Hangzhou, Beijing and Suzhou, and the net outflow of digital talent from cities such as Chengdu, Xi'an, Wuhan, Guangzhou and Nanjing. Shanghai and Shenzhen have attracted digital talent not only from first-tier cities (Beijing and Guangzhou), but also from second-tier cities (Hangzhou and Nanjing). The phenomenon of digital talents being distributed in economically developed regions and constantly agglomerating them has widened the imbalance in the development of the digital economy and the differences in economic growth in the region. In terms of the industry distribution of digital talents, 46.6% of China's digital talents come from basic industries such as information and communications technology (ICT), 20.9% from manufacturing, 6.8% from finance, 6.6% from consumer goods, and only 0.1% from agriculture (Yu and Chen, 2021).

However, China's digital talents, especially high-end digital talents, are in short supply. On the one hand, the shortage of digital talents is reflected in the insufficient total reserve of talents, and the supply of talents lags far behind the demand for the development of the digital economy. China's digital skills gap surpassed 11 million in 2020, according to a 2021 research report on job development in China's digital economy published by the China Academy of Information and Communication Technology (CAICT), including digital technology and digital R&D personnel required for digital industrialization, as well as digital skills talents needed for industrial digital transformation (CAICT,2021). On the other hand, the regional structure of digital talent is unbalanced (CAICT,2021). Beijing-Tianjin, Yangtze River Delta and Pearl River Delta regions are important concentrations of digital talent[2]. The phenomenon of digital talents being distributed in economically developed regions and accumulating them has widened the imbalance in the development of the digital economy and the difference in economic growth in regions (Yu and Chen, 2021).

China's education system focuses on cultivating professional talents, resulting in a serious shortage of compound talents who not only understand the technology, business processes and development needs of traditional industries, but also can master and apply digital technology, and high-quality talents with integrated practical experience are even more scarce. According to the White Paper on China's ICT Talent Ecosystem, by 2020, China's digital talent gap will be close to 11 million, and the talent demand gap will continue to widen as the digitalization of the whole industry requires a wider range of digital talents (Ernst and Huawei, 2022).

In the 2025 talent demand forecast in the top ten key areas of manufacturing, the total talent demand and gap of the new generation information technology industry such as the industrial internet is predicted to reach 9.5 million (iResearch, 2022). The satisfaction of this demand cannot only rely on limited external talent recruitment, but also requires enterprises to increase internal digital talent training, start from actual business needs, build a talent development system that adapts to the development strategy of the enterprise, and smooth the talent development and supply channel within the enterprise.

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[2] Data Source: Digital Transformation of China's Economy: Talent and Employment. http://www.199it.com/archives/675204.html.

[3] Data Source: Digital Transformation of China's Economy: Talent and Employment. http://www.199it.com/archives/675204.html.

economically developed regions and accumulating them has widened the imbalance in the development of the digital economy and the difference in economic growth in regions (Yu and Chen, 2021).

III. Effect of digital talent environment on the development of digital economy in China

Talent is the first resource for the development of the digital economy (Xu et al., 2022). Previous studies have shown that digital talent is an important factor in the development of the digital economy. Prasetyo and Kistanti (2020) use primary data on entrepreneurship and SMEs in the provinces of Central Java and Yogyakarta with correlational form of recursive model path analysis. Research results show a very strong role of human capital as the main key to economic growth, both directly and indirectly. The existence of human capital and social capital will further encourage new economic institutions, furthermore new economic institutions will encourage the competitiveness of productive entrepreneurship as well as high quality, and sustainable regional economic growth.

Trigler (2022) conducted an online questionnaire to survey enterprises with digital transformation experience and explore the influencing factors of digital transformation. The findings demonstrate that each observation variable has an effect on digital transformation and that digital strategy positively influences the digital transformation of small and medium-sized manufacturing firms: development strategy, digital talent construction, enterprise change culture, and organizational structure innovation.

Ma and Cai (2019) divide the ICT labour force into two parts, "professional ICT workforce" and "composite ICT workforce" in the digital economy, and use the official statistics and LinkedIn (LinkedIn) platform data of China and some OECD countries to conduct an empirical analysis of the supply and distribution characteristics of ICT labour in China. Studies show that the gap between supply and demand of ICT labour in China is widening, and there are structural imbalances such as excessive concentration of industries and regions, and lack of top talent. There are both objective reasons for the rapid development of the digital economy and subjective reasons for the government and workers. The structural imbalance in ICT labour supply will widen the regional digital divide, delay the digital transformation of traditional industries, and restrict disruptive innovation, thereby affecting the development potential of China's digital economy.

Based on the perspective of advanced human capital structure and digital economy development, Xie (2023) uses the spatial Dubbin model to explore the spatial spillover effect of advanced human capital structure on the development of digital economy and finds that the advanced human capital structure can significantly promote the development of digital economy, and at the same time have obvious spatial spillover effects on the development of digital economy in surrounding areas.

When evaluating the digital business environment, the talent environment is also an indicator for scholars and institutions to include in the evaluation (Zhao and Wang, 2022). Level of education, ICT skill mastery and the form of employment (Pan et al., 2023) are used to measure the talent environment for the development of the digital economy.

Pan et al. (2023) uses data from the World Bank's 2012 China Enterprise Survey to examine the impact of information and communication technology (ICT) applications on the productivity of firms in productive services from the perspective of the triple labour structure of skills acquisition, educational experience, and the form of employment. Studies have shown that ICT applications can help increase productivity in productive service enterprises, and a highly educated, skilled, and non-tenured workforce can complement ICTs to better exploit the productivity effects of ICTs.

IV. Conclusions and suggestions

Digital talent is the driving force for the growth of the digital economy in the future. Taking the United States as an example, while popularizing digital education, the U.S. government strongly supports the cultivation of digital talents. In 2011, the U.S. Department of Commerce's National Communications and Information Administration, in collaboration with other federal agencies, established the Digital Literacy Network Platform, which aims to create resources and tools for librarians, teachers, and other digital literacy educators to teach computer and network skills. The 2018 National Cyber Strategy clearly proposes to cultivate outstanding cybersecurity talents, including building and maintaining talent pipelines, strengthening the training of cybersecurity talents in the federal government, and highlighting and rewarding outstanding talents. The creation of digital talent has been the driving force behind the expansion of the digital economy in the United States over the last several decades. It has also provided a constant flow of energy for the industry's future growth.

The advancement of China's digital economy depends on developing a digital labor force. The digital economy is an integrated economy, so digital talents should not only be ICT talents, but also have business administration, language backgrounds, and cross-border collaboration capabilities. At present, the professional background of digital talents is mainly concentrated in technical disciplines such as computer science and software engineering, and more than 85% of digital talents are engaged in product research and development. Strengthen the construction of digital talent professionals to promote innovation and development in emerging industries. At the same time, we should promote the flow of digital talents, for example, provinces with less distribution of digital talents can provide talent subsidies and create a relaxed entrepreneurial and employment environment to attract digital talents from large digital provinces to areas with less developed digital economy.

Meanwhile, digital literacy is an important component of national quality and an important means to enhance comprehensive national strength. Digital literacy includes the ability and skills to use digital tools, the ability to critically understand digital media tools and content, and the ability to use digital technologies to create and communicate. The

United States is one of the earliest countries to research and practice digital citizenship literacy education. In 2007, the National Educational Technology Standards (Student Edition) released by the International Association for Educational Technology in the United States took "digital citizenship" as one of the six themes of the standard, which attracted the attention and attention of schools, teachers and parents to children's digital education. Since 2015, the "Digital Citizenship Literacy Summit", an academic conference held annually, is committed to promoting digital citizenship literacy education, and a number of influential research results such as "Digital Citizenship in Schools" and "Digital Child Parenting" have emerged.

Digital literacy education in China is not yet fully universal. To accelerate the improvement of digital literacy, it is necessary to raise awareness of the importance of digital literacy among all sectors of society. The implementation of digital literacy education requires the support and cooperation of education departments, schools, teachers, families, communities and other entities, such as public libraries providing information resources and a good digital service environment for the public. Second, basic education should be the starting point for the promotion of digital literacy education. In view of the connotation of digital literacy, primary and secondary schools should build a digital literacy education curriculum system to improve digital literacy ability, digital communication ability and digital connection ability.

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