Examine The Impact of Digital Economy on Chinese FDI

디지털 경제가 중국 **FDI**에 미치는 영향에 관한 연구

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Graduate School of International Studies
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Abstract

This paper investigates the impact of the digital economy on Chinese Inward Foreign Direct Investment (FDI) and also examines whether the different levels of urban digital finance in each city group will change the impact of the digital economy on promotion, which means aforementioned relationship may be moderated by urban digital finance.

More precisely, this study starts by combining six variables based on dataset of 256 Chinese cities 2013- 2019 and using the principle components analysis to generate an index representing the digital economy. After that, run a complete sample regression to look at how the growth of FDI and the digital economy's development are linked. Then based on the aforementioned estimation, this study also splits all cities into three groups according to their average Digital Financial Inclusion Index from 2013 to 2014 and conducts the empirical test to identify whether the influences of digital economy on FDI in these groups are vary.

With several fixed-effect regressions, it came to the following findings: First, the city's ability to attract foreign direct investment is significantly impacted by the digital economy. Second, the positive effect of the digital economy is minimal or nonexistent for cities whose digital financial performance is below a lower level, but still remain significantly positive in the first group, indicating that the urban digital finance has a moderating effect on the relationship between the digital economy and Chinese Inward FDI.

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I. Introduction

1-1. Background

Nowadays, due to the high speed of the development of the digital economy, the growth of emerging market economies, the rapid changing of the industrial supply chain, and regional conflicts have all accelerated the historical process over the past ten years, which have significantly altered the foundation of the economy. And the Chinese government has made clear proposals to speed up the development of a modernized economic system, focus on increasing total factor productivity, concentrate on enhancing the resilience and safety of the industrial supply chain, and create a globally competitive collaborative innovation in the environment. Under the strategic goal of high-quality development, economic growth cannot rely on one specific factor to achieve, but needs to utilized multi-production factors to constructure new infrastructure, promote the development of strategic emerging industries, and upgrade those traditional established industries. As a new factor of production, data can add considerable value when combined with other factors and the multiplier effect of it also significantly increases the value produced by other factors (like land, labor, and capital) in terms of resource allocation.

In general, the digital productivity revolution has penetrated and rebuilt the whole economic system, which is driving the global transformation of social production systems to digitalization with extraordinary speed. As global demand for digital technology and information grows, the focus of international competition has shifted from competition among factors of production (like capital and labor) to competing for digital resources. The digital economy has gradually become a new engine for the economic development and growth of all countries. Therefore, this study attempts to gain insight into how the digital economy affects Chinese inward foreign direct investment.

1-2. Purpose and Significance of Research

It is undeniable that the digital economy is a rising force in achieving sustained, outstanding economic progress which also get many academic and governmental attentions. Until now, scholars have gradually expanded their research from the earliest definition of the connotation of digital economy and measuring methods to the economic effects it generates. But there is still no consensus economic paradigm to describe the influence taken by the digital economy, and most academics focus on quantifying the digital economy and how it impacts national economic growth, less empirical study has been done on the influence of the digital economy on inbound FDI, and against such a situation, the following questions are the primary objectives of this study:

(1) Whether the growth of the digital economy having a favorable impact on the inflow of FDI?

(2) Are cities with a high level of digital finance more likely to benefit from the promotion effects of the digital economy on attracting FDI, and are the findings more reliable in regions where digital finance is more developed overall?

The growth of the digital economy is receiving increased attention and support from many nations, and the digital economy is influencing new business and investment models as an emerging factor for regional and global economic growth. Based on previous findings and growing concerns, this paper offers a thorough examination of the effects of the digital economy on foreign direct investment by using data from 256 Chinese cities and serves as a guide to achieving a greater understanding of the factors influencing China's ability to attract inward FDI as well as to advance the field of research on digital economy.

1-3. Literature Review

1-3-1. The research of the digital economy

The capacity of the digital economy to achieve deep integration with all sectors of business and society as a whole depends in a major way on the development of high technologies like 5G, iCloud, AI, and so on. This assists in strengthening the traditional economy's structural foundation and contributes to it gradually emerging as the fastest-growing and most promising sector (Changhong 2018).

Modern information networks are quickly connecting digital knowledge and information, greatly enhancing the effectiveness of information and the efficiency of accurate matching of elements, lowering the cost of information communication between enterprises, promoting the digital transformation of industries, gradually forming a unique economic environment and resulting in new business models (Qunhui 2019).Additionally, according to the World Investment Report, the emergence of new business models in the context of the digital economy has sparked the digital and intelligent development of the global value chain, overturned the production and operation logic of conventional business models. Multinational companies have been forced to reconsider their global investment strategy as a result, which now include expanding the amount of digital assets. The digital economy is becoming a more significant regional factor influencing global investment flows than ever before (Yongfu 2018). Numerous notable findings from studies on the variables influencing the expansion of digital economy on Chinese OFDI indicate the unquestionable significance of the digital economy in influencing both regional economic growth and foreign direct investment. A few pieces of research that are connected to the previously mentioned issue are summarized in the section that follows.

1-3-2. The Role of the Digital Economy in enhancing the economic growth

An empirical model is made by (Fuzhong 2020) to examine the impact of the expansion of the digital economy and trade openness on economic growth using panel data from 53 countries along the Belt and Road 2007- 2016, which demonstrates that the expansion of the digital economy has a favorable impact on economic growth. (Zhao 2021) makes an analysis of the rise of the digital economy and its effects on value-added trade inequalities, which shows there has a significant influence between them. And their study also illustrates that the "trade cost effect" is amplified by the digital economy, which has an impact on value-

added commerce. The empirical findings of (Zheng and SUN 2022), who used panel data from 241 cities across China, show that the eastern region and large cities have a greater impact on the FDI of the digital economy. They also demonstrate how improvements in human capital levels and the development of information infrastructure can further the promotion effect of the digital economy. (Wang and Han 2023) based on data from 256 Chinese cities, shows that urban digital finance greatly affects FDI and may be a crucial new component in cities' capacity to absorb FDI under the new development pattern. Additionally, utilizing digital infrastructure indirectly affects FDI. (Zhao 2020) illustration of the influences brought from the digital economy and its mechanisms on high-speed regional development also compares the impacts in various places. This study also reveals that promoting widespread entrepreneurship is a crucial strategy for the digital economy to benefit from high-quality growth by using data from 222 cities between 2011 and 2016. (Lu 2021) considered the growth of the digital economy indirectly boosts logistical effectiveness by lowering the cost of market transactions. (Dong and Mi 2019) uses data from countries with high Chinese OFDI growth in recent years, and discover that Chinese foreign direct investment in the region is catalyzed by improvements in the host country's system, innovation environment, and information technology application and that the more digitally advanced the invested region is, the more Chinese OFDI there is in the area.

1-3-3. The Role of the Digital Economy in enhancing the foreign direct investment

Many recent study on the connections between the growth of the digital economy and FDI has concentrated on various aspects.

First, referring to how the digital economy is influencing global investment patterns and routes, traditional industries have been forced to undergo a complete digital transformation due to the innovation and potential productivity of digital technology. And the quality of data resources and infrastructure has become a crucial competitive advantage in attracting foreign investment (Xian-rong 2019). Additionally, the digitization of goods and services has honed in on consumer preferences.

Second, the development of the digital economy has resulted in the digitalization of all or parts of global value chains, which has prompted multinational corporations to use network information platforms to ease the restrictions of time, space distance, and information asymmetry on international investment (Zhang Hong and Wang Jian 2013). Additionally, the "creative destruction" of global value chains by the digital economy has resulted in value ch

ains being transferred and upgraded as a significant factor influencing the volume and scope of FDI (Zhen 2015).

Many studies focus on the development of the digital economy and Chinese OFDI has produced plenty of significant results. The majority of those studies concentrate on the host country's economic development level (Xinyi 2016), resource endowment, geographical distance (Ji Shengbao 2018), and institutional quality as well as its distance from China. However, fewer studies concentrated on the IFDI and the development of the digital economy and this paper will do more about this topic.

1-3-4. FDI Theory

According to (Dunning 1988), there are 3 concepts of foreign direct investment, which are Ownership advantages, Locational advantages, and Internalization in OLI frame work. And it explains how multinational companies prefer to invest and operate in different countries over the world, which is generally used in analyzing the foreign direct investment. Ownership advantages refer to some intangible assets that attract different inward FDI. Locational advantages are the key factor for investors to choose which country to invest Internationalization, along with the above advantages, a company's amount of involvement in and control over its international operations. And later, (Dunning, Sariannam 1993) adds four types of FDI motivation into the Eclectic theory.

According to (Kravis 1981) Labor cost was one of the primary factors in the research of multinational direct investment based on the data of the U.S. company. Furthermore, based on Kravis' research, some studies examined the effects of FDI location layout and discovered that market size has a major impact on FDI, which also discovered that a rise in labor costs will have a considerable impact on the decision of foreign investors to enter an economy. Some academics, though, have differing opinions. They hold that an increase in labor costs does not necessarily result in a decrease in FDI inflow because a rise in labor costs brought on by an increase in labor return indicates that a country or region's human capital level has improved, and boosting human capital level is essential for attracting foreign direct investment. Additionally, (Melville 2004) found that The level of utilization of FDI determines the effect of digital information technology on enterprise behavior. And (Georgios 2005) suggested that Foreign direct investment will be concentrated in areas that can provide highly skilled labor, thus information companies will be the new flow of foreign direct investment to drink high-tech enterprises.

1-4 Theoretical Mechanisms of Digital Economy Development Affecting Foreign Direct Investment

1) Reducing the transaction cost

Compared with the traditional way, the investment trading method under the digital economy increasingly lower transaction costs for investors. Specifically, due to the rapid growth and widespread use of digital technology, investors now have easier access to data on the countries and firms they invest in than that in the past. Traditional investment activities require investors to spend a significant amount of time and money on market research and risk evaluation. Additionally, at the same time, investors are able to significantly reduce information asymmetry by using digital platforms to establish relationships with compatible markets and partners. Furthermore, the advent of third-party online payment systems has increased transaction efficiency while maintaining transaction security, which helps to attract more inward FDI.

2) Enlarge the Market Size

As widely known, individual consumer requirements are difficult to effectively satisfy with traditional production techniques since they are primarily centered on high-volume and large-scale manufacturing. However. the New digital technologies' emergence together with the Internet's quick expansion has greatly increased the market mobility of goods that previously had low sales and low demand, creating new consumer demand. As a result, multinational corporations have a higher probability of profiting from overseas investments which are in the more digitally advanced region. And more FDI will consequently place into this area as the digital economy grows, information technology develops, and digital platforms are increasingly used.

3) Promote technological innovation

It is widely known that the digital economy depends largely on the continual development of information technology, and a host country with strong technological innovation capabilities may frequently create more chances for enterprises in the home country to use outbound FDI to further their technology. Consequently, as the need for knowledge and innovation increases in the global economy, the development of the digital economy has the potential to increase the effectiveness of companies' innovation efforts, establish a favorable environment for foreign investors to invest in, and ultimately encourage multinational corporations to expand FDI there.

4) Strengthen the quality of business environment

There is no doubt that the quality of government digital governance

is gradually rising in the context of the digital economy. It is widely known that a nation's political stability, government effectiveness, legal system soundness, etc. are all reflected in the system's quality and the risk of foreign direct investment is reduced as system quality rises, and multinational corporations will increasingly prefer a given country with an effective and stable system. Additionally, the integration of the digital economy with conventional industries results in the creation of new economic forms, as well as the modernization and transformation of those same classic sectors. All of these factors increase the appeal of FDI in the development of the digital economy.

5)   Establishment of Industrial Clusters
Industry cluster refers to the high concentration of the same industry in a specific geographical area, which, if economies of scale can be formed, may result in product differentiation and diversity. Competition within this region may benefit participants of industrial chain, and this, along with the continuously improved information system, the experienced labor force, the abundant resources developed, and the high-tech infrastructure used to build industrial cluster, all have a considerable attraction for foreign investors.

In total, the growth of an economy is being influenced in a multi-dimensional way by the digital economy..

Figure 1. Mechanisms of Influence

The development of the digital economy →

Reduce transaction cost	Weaken the geographic distance barrier and boost the effectiveness of trade communications
Enlarge the market size	Expand new channels for international businesses
Promote technological innovation	Develop industrial technology to improve production efficiency
Strengthen the quality of business environment	Boost the governance system's stability to create a stable environment for foreign investment

→ Rise in FDI

II. Overview of The Digital Economy and FDI

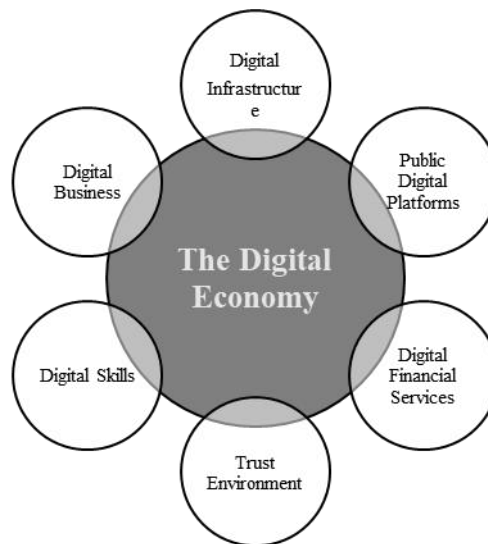## 2-1. The development of the digital economy in China

The digital economy is, in general, primarily a phased concept, as there is no precise and consistent definition, but its implications and extent are continuing to broaden. The China Academy of Information and Communication Research published "White Paper on the Development of China's Digital Economy" in July 2020, which provided a further definition of this term, which stated that the four main components of the digital economy are data value creation, industrial digitization, digital governance, and digital industrialization. The World Bank defines the digital economy as having six aspects, which are depicted in Figure 1 below. As there are several definitions of the term "digital economy," we attach it in this paper to digital information services, digital infrastructure, human capital, and digital transactions in order to make the following analysis.

Figure 2. A framework for the digital economy_6 Pillars

Source: The world Bank

And according to "The Plan for Development of the Digital Economy During the 14th Five-Year Period", the Chinese government places a high priority on the growth of the digital economy, and for the first time, the status of the digital economy was elevated to the national level in China, followed by the implementation of specific measures such as the "East Digital West Calculation", Therefore, a time of rapid progress has been brought on by the digital economy.

From 2015 to 2020, the growth rate of the digital economy is always about 10 percent higher than the GDP growth rate, with a CAGR of 17%, and the proportion

of GDP grows from 27% to 39%. Specifically, under the programmatic target of 10% of GDP by 2025, the value-added of the core industry of the digital economy will bring about a huge industrial scale of the digital economy in prediction. It is expected that the market size of the core industry value added of a digital economy is expected to increase by nearly 100% in 2025.

Figure 3. Scale of China's digital economy (Trillion RMB) (ICT 2022)
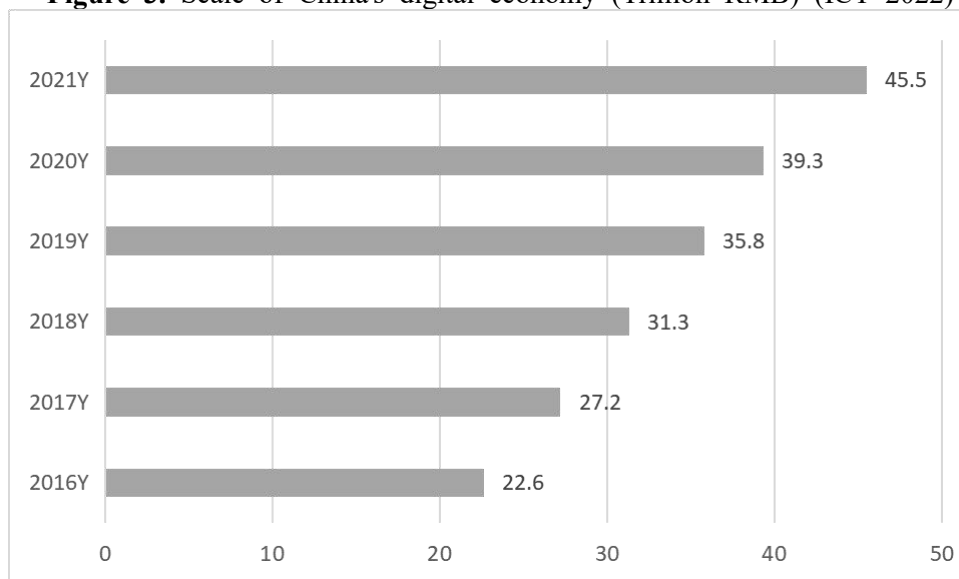
Source: China Academy of ICT

So far, as the variety of digital technology applications represented by IoT technology continues to expand and the integration of digital technology and industry continues to deepen, the digital economy has emerged as a fundamental driver of economic development. According to the figure above, the size of the digital economy has increased to 45.5 trillion yuan, more than doubling its size at the start of 2016. It has had nominal growth of 16.2% year over year, which is 3.4 percentage points greater than the nominal growth rate of GDP and accounts for 39.8% of GDP.

The value generated by digital industrialization in 2021 totaled 8.4 trillion yuan, an increase of 11.9% from the year before, and accounting for 7.3% of GDP, basically remaining flat from the year before. ICT services hold a significant position in the value-added of digital industrialization, with the software industry and the Internet industry continuing to increase slightly, respectively by 2.13 and 0.6 percentage points compared with last year, while the share of the telecommunications industry and electronic information manufacturing drops gently.

Figure 4. China Digital Industrialization Revenue, Value Added Scale and G rowth Rate, from 2014 to 2021
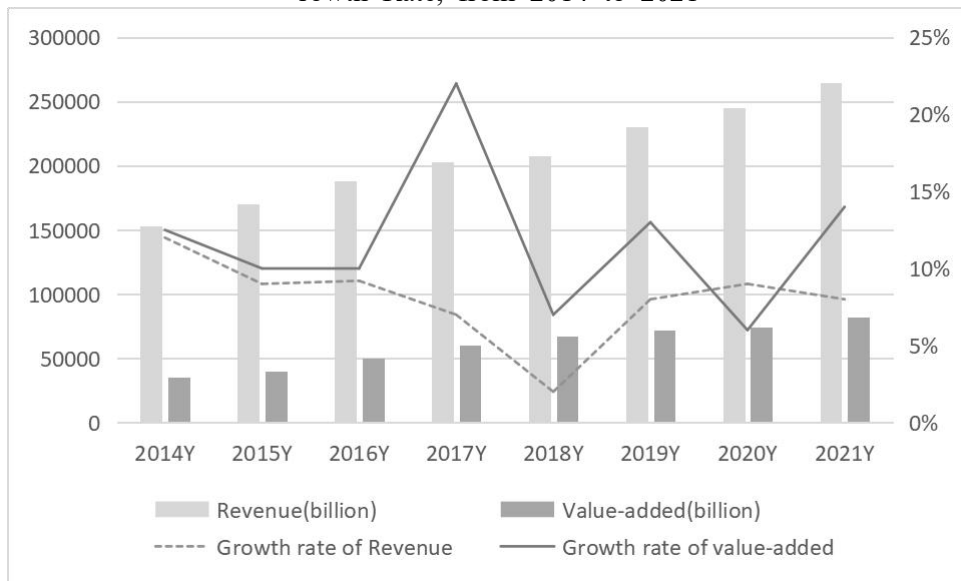
Source: National Bureau of Statistic of China, China Academy of ICT

More specifically, from a view of the internal sector of digital industrialization, first, the telecommunications industry maintains a steady and positive growth trend, which get steadily increased in 2021, reaching 1.47 trillion yuan, a rise of 8.0% over the same period last year and an increase in the growth rate of 4.1 percentage points year-on-year. Second, in 2021, the added value of the nation's electronic information manufacturing sector climbed by 15.7% over the year before, setting a new record for the preceding ten years and increasing by 8.0 percentage points from the year before. In addition, the total number of national software and information technology services enterprises in 2021 is greater than 40,000, with cumulative software revenue of 9.5 trillion yuan, an increase of 17.7%, and a two-year compound growth rate of 15.5%. This industry will continue to experience rapid growth. Furthermore, Chinese Internet and related services firms achieved an income of 1.55 trillion yuan, an increase of 21.2%, with the growth rate accelerating by 8.7 percentage points over the previous year. In total, the revenue and value added of sectors in digital industrialization has maintained an upward trend.

2-2. Different Types of Chinese Cities' Digital Economy Development

According to the "Annual Report about The Development of The Digital Economy" issued by the China Academy of ICT, there are three types of digital economy development in China: Comprehensive leading cities; Particularly

pioneering cities; Potential-boosting cities.

Figure 5. Ranking of cities' competitiveness index of digital economy (ICT, 2021)
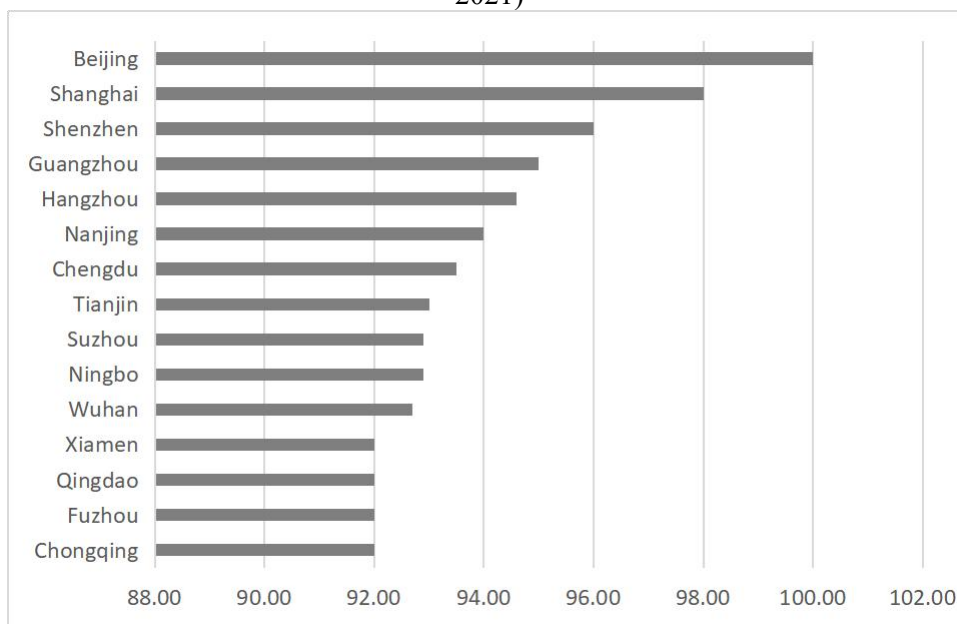
The first one, the comprehensive leading cities are Beijing, Shanghai, Shenzhen; Those Comprehensive leading cities are highly competitive in the digital economy and excel in areas including digital infrastructure, core digital industries, applications for digital convergence, demand in the digital economy, and the regulatory environment for technological innovation.

The second one, particularly pioneering cities, the competitiveness of these cities in the digital economy is high, and their unique comparative advantages contribute significantly to the overall growth of China's digital economy. The cities that stand out among them include Chengdu with its industrial cluster, Guangzhou with its digital-industrial integration, Hangzhou with its digital industry, Nanjing with its talent export, Tianjin with its location synergy, and Chongqing with its industrial digital.

Additionally, all other cities that are either actively attempting to take advantage of their geographic location and comparative advantages in the growth of China's digital economy, or have not yet fully explored their benefits, are considered potential-boosting cities.

Based on the various features of different cities, the growth of the digital economy in China is geographically varied meaning that each city has its own unique route of development. In the study that follows, the effects of the expansion

of the digital economy on foreign direct investment will be discussed in more detail with regional variations.

2-3. The Development of Digital Finance in China

Because of information technology's quick progress and widespread use in the sector of finance, urban digital finance is growing more and more essential for economic growth. such as easing financing constraints, reducing transaction costs, accelerating industrial transformation, narrowing regional differences and improving development quality, etc. Wang and Zhu (2023) based on data from 256 cities in China, shows that urban digital finance significantly influences FDI and may be a key new factor in cities' ability to absorb inward FDI under the new development pattern. Additionally, it influences FDI indirectly through the use of digital infrastructure.

Therefore, this study will concentrate on how, in the course of the subsequent investigation, the promoting impact of the digital economy may fluctuate depending on the degree of urban digital finance.

The term "inclusive finance" was first used by the UN in 2005, which defined "financial inclusion" as "universal access, at a reasonable cost, to a wide range of financial services, provided by a variety of sound and sustainable institutions." For the first time, the Chinese State Council stated explicitly in the notice of the Plan for Promoting the Development of Inclusive Finance (2016-2020) published at the end of 2015 that inclusive finance here refers to the provision of suitable and effective financial services for all socioeconomic groups and classes with financial service demands at an affordable price, by expanding governmental direction and support, bolstering the development of the financial system, and improvising,

Then, in regard to the Digital inclusive finance, it developed with many benefits, for example, it reduces the geographic restriction of financial services and essentially ensures that customers are able to utilize financial systems by relying on digital technologies like the Internet, communication services, and so on. More precisely, through digital trading platforms, users may transmit payments, receive transfers, and make investments in an easier way. Additionally, the transaction data generated from these actions can also serve as a credit basis for the appropriate credit agencies, enabling them to provide customers with improved financial services.

Accordingly, in this paper, the digital inclusion finance index issued by the Peking University will be used to represent the development of the digital finance.

2-4. The FDI situation in China

As shown in the graph above, the amount of realized FDI value has been rising steadily since 2000, achieving US$141.2 billion, an increase of 2.1% over 2018. Additionally, only 40910 new Foreign Invested Enterprises were founded in China in 2019, a decline of 32.4% from the previous year.

Figure 6. Foreign Direct Investment in China, 1979-2019 (China 2020)
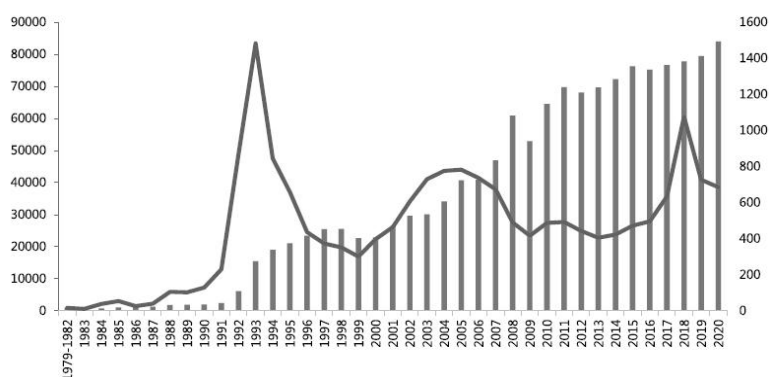
Source: Ministry of Commerce of China

China has established a cumulative total of 1001635 foreign-invested businesses as of December 2019, and the total amount of real foreign investment utilized was US$22904.7 billion. Among them, there were 586795 foreign-invested enterprises, representing 58.6% of all foreign direct investment enterprises, and US$ 14274.1 billion in actual foreign investment, representing 62.3% of all foreign direct investment used; 352,076 Sino-foreign joint ventures, representing 35.2%; US$5645.5 billion in foreign investment.

Then from the view of the sector that those inward FDI invest into, by compared with the following two tables issued by the Ministry of Commerce of China, it is clear to see that the top 4 sectors are different between 2013 and 2020. In 2013, they are Manufacturing, Real estate, Wholesale, Retailing and Finance; however, in 2020, they are Manufacturing, Leasing and business services, Finance and Scientific research and technology services. Among these changes, we may pay attention to a phenomenon that foreign investors are currently putting more money into the science sector which is able to be a new opportunity for economic development. Furthermore, the electronic information sector in China uses more foreign capital than any other industry, and over the past few years, the percentage of foreign capital used by the electronic information manufacturing industry in the total amount of foreign capital used by the manufacturing industry has been maintained at about 20%. Additionally, the amount of foreign investment that the information services sector has used has been gradually increasing since 2018. This

amount was USD 21.04 billion in 2017, decreased by 44.2% to USD 11.75 billion in 2018, and then increased steadily to USD 18.4 billion in 2021 with an increase of 16.5% year over year.

Table 1. Situation of FDI inflows be sector in 2020 (China 2020)

Unit: US$100 million

Sector	Number of New FIEs	Share%	Realized FDI Value	Share%
Total	38578	100	14,934	100
Agriculture, Forestry, Animal Husbandry & Fishery	493	1.3	5.8	0.4
Mining	46	0.1	6.6	0.4
Manufacturing	3732	9.7	310.0	20.8
Production and Supply of Electricity, Heat, Gas & Water	260	0.7	31.1	2.1
Construction	602	1.6	18.2	1.2
Wholesale and Retailing	10812	28.0	118.4	7.9
Transportation, Warehousing and Post	592	1.5	50.0	3.3
Accommodation and Restaurants	804	2.1	8.2	0.6
Information Transmission, Software and Information and Technology Services	3521	9.1	[64.3	11.0
Finance	364	0.9	114.6	7.7
Real Estate	1190	3.1	203.3	13.6
Leasing and Business Services	7513	19.5	265.6	17.8
Scientific Research and Technology Services	**6252**	**16.2**	**179.4**	**12.0**
Water Conservancy, Environment and Public Facilities Management	223	0.6	5.7	0.4
Resident Services, Repair and Other Services	447	1.2	3.1	0.2
Education	210	0.5	2.8	0.2
Health and Social Work	109	0.3	2.4	0.2
Culture, Sports and Entertainment	1407	3.6	4.0	0.3

Source: MOFCOM FDI Statistics.

Table 2. Situation of FDI inflows be sector in 2013 (China, 2013)

Unit:US$100million

Sector	Number of FIEs	Share %	Realized Value	Share%
Total	24934	100	1210.73	100
Agriculture, Forestry. Animal Husbandry Fishery	882	3.54	20.62	1.70
Mining	53	0.21	7.70	0.64
Manufacturing	8970	35.97	488.66	40.36
Production and Supply of Power, Gas and Water	187	0.75	16.39	1.35
Construction	209	0.84	11.82	0.98
Transportation, Warehousing and Post	397	1.59	34.74	2.87
Computer and Software	926	3.71	33.58	2.77
Wholesale, Retailing	7029	28.19	94.62	7.82
Hotel and Restaurant	505	2.03	7.02	0.58
Finance	291	1.17	114.76	9.48
Real Estate	472	1.89	241.25	19.93
Lease and Business Service	3229	12.95	82.11	6.78
Scientific Research, Technology Service and Geological Prospecting	**1287**	**5.16**	**30.96**	**2.56**
Management of Water Conservancy, Environment and Public Equipment	122	0.49	8.50	0.70
Resident Service and other Service	192	0.77	11.65	0.96
Education	11	0.04	0.34	0.03
Health Care, Social Security & Social Welfare	24	0.10	0.64	0.05
Culture and Entertainment	145	0.58	5.37	0.44

Source: MOFCOM FDI Statistics

Therefore, after discovering those changes, this study find that it is worthy to investigate the connection between the advancement of digital technology and the rise of inward FDI in China. Additionally, it is also crucial for studying how developments in digital technology impact foreign direct investment.

2-5. The FDI inflow of Technology Service and Electronic Information Industry

Figure 7. Growth Rate of Investment in Fixed Assets in Electronic Information Industry by Registration Type (China 2020)

	Total Investment	Domestic Investment	Investment From HK,Macao and Taiwan	Foreign Investment
2019Y	16.80%	23.30%	-8.50%	3.40%
2020Y	12.50%	12.90%	27.70%	4.50%
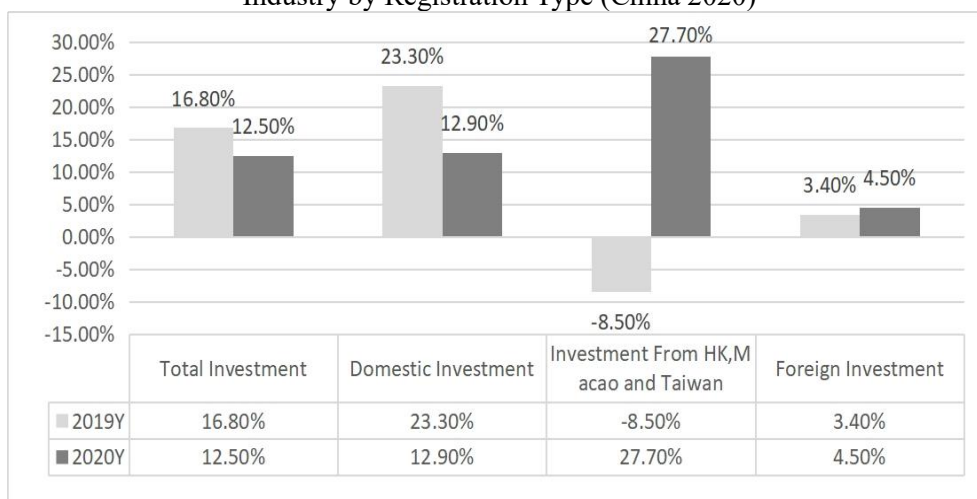
Source: National Bureau of Statistics

The growth rate of fixed asset investment across the board fell from 16.8% in 2019 to 12.5% in 2020, but it increased for businesses with foreign funding from 3.4% to 4.5% at the same time, according to data on the manufacturing of computers, communications, and other electronic equipment. This may indicate that the expansion of foreign-funded businesses in China's manufacturing sectors that produce computers, communications, and other electronic equipment has come to a rather steady stage in recent years.

Figure 8. Foreign Investment Actually Utilized by Information Service Industry during 2017-2021
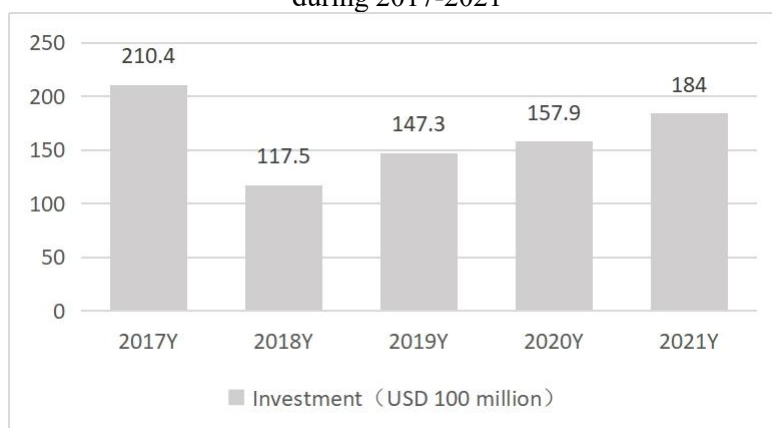
Source: Foreign investment statistics of the Ministry of Commerce

Since 2018, the amount of foreign investment that the information services

sector has actually used has been progressively climbing. The amount of foreign investment that the information services sector really used was USD 210.4 billion in 2017, dropped to USD 11.75 billion in 2018, grew steadily to USD 18.4 billion in 2021, a gain of 16.5% year over year, and then increased to USD 210.4 billion in 2017.

2-6. Promotion effect of New technology and the rise of FDI_Real case in Hangzhou

According to national data, 328 new foreign-invested firms were founded in Hangzhou in the first half of 2020, with actual use of foreign investment totaling USD 3.328 billion, accounting for 44.4% of Zhejiang Province. With a strong digital economy base and new manufacturing momentum on the rise, Hangzhou's urban industrial structure has been rapidly optimized and upgraded, and the agglomeration effect of high-end advantageous industries has become more and more prominent, which attracts many high-quality foreign investment projects to settle in Hangzhou.

In February 2020, Japan's Tokyo TV Trade Co. invested in the "Du Zhi Man" project at Hangzhou Digital Economy Industrial Park , with a total investment of 2 billion yen, demonstrating that overseas investors recognize the development of the digital economy of Hangzhou and have confidence on its future. At the same time, the "DuZhiMan" project is a project whose contracts were signed remotely by TV Tokyo and the Hangzhou government during the pandemic. Therefore, we can find from above case that the development of digital economy help Hangzhou for attracting more foreign direct investment.

Table 3. Ranking of the city's average digital financial inclusion index, from 2013-2019 (ICT, 中国城市数字经济发展报告 2021)

City	City code	Average digital finance index
Hangzhou	3301	240.592394
Shanghai	3100	230.8369785
Shenzhen	4403	229.7362541
Beijing	1100	228.4222273
Naning	3201	227.0806205
Xiamen	3502	226.4135846
Guangzhou	4401	222.7887635
Zhuhai	4404	220.5727683
Suzhou	3205	220.5414708
Wuhan	4201	219.9983629
Ningbo	3302	218.3553373
Wenzhou	3303	217.4677518
Changzhou	3204	216.283555
Fuzhou	3501	215.403148
Wuxi	3202	215.193422
Jiaxing	3304	213.6352621
Zhenghou	4101	211.3016702

Furthermore, it is clear from the aforementioned table that Hangzhou performs well in urban digital finance. The only World Bank Global Digital Financial Center in Asia has signed a contract to establish itself there, and Linktone (Hangzhou) Technology Co., the first Sino-foreign joint venture bank card clearing institution in China, has also chosen Hangzhou as its location. It is without a shadow of a doubt that Hangzhou's upgraded and incredibly efficient digital finance ecosystem helps the city draw in foreign direct investment. Therefore, the following section of this study will apply an empirical test to determine whether there is a statistically significant relationship between the digital economy, inward FDI, and urban digital finance based on prior research and real-life situation.

III. Data and Methodology

3-1. Evaluating the development of the digital economy

3-1-1. Data

According to earlier research, there are a variety of methodologies for measuring the digital economy, and because of problems with statistical quality and discrepancies in conceptual definitions, these approaches have not yet created a unified vision. Currently, there are two primary categories of calculation methods: the first type is the comprehensive evaluation method, which constructs an evaluation index system based on the connotation and characteristics of the development of the digital economy and the available data, and then determines the degree of the digital economy's development by using the principal component analysis approach. And the second type is the direct measurement approach, which intends to quantify the statistical range of the digital economy and evaluate its level of development.

And the evaluating way used in this study, developed by Zhao (2020), evaluates the digital economy by choosing six different types of indicators that describe it. Then, all indicators are merged to generate one index that reflects the digital economy, by using the Principal Component Analysis method.

In order to define the Digital economy(index), several factors were taken together to create indicators for measuring the growth of the digital economy, and it shows as followed. And a dataset comprising 256 Chinese cities during the period from 2013 to 2019 has been established in this study.

Table 4. Data in various areas for measuring the digital economy index

Primary indicators	Secondary indicators	Indicator calculation
Internet Development Indicators	• Number of Enterprises • Relative output • Number of Employees • Infrastructure penetration	• Internet users per 100 individuals as a percentage • Employees working in computer services and software as a percentage • Total telecom services per capita • Postal business per capita • Number of cell phone subscribers per 100 people
Digital financial indicators	• Digital transaction	• coverage breadth • usage depth • Payment business • Insurance business • Investment • Digitization level

The original data of the above variables are obtained from the Urban Statistical Yearbook of China and the Peking University Digital Finance Research Center and Ant Financial Services Group .

3-1-2. Methodology_ Principal component analysis

In this paper, as mentioned before, Principal component analysis was conducted to assign the weights for each secondary indicator by using SPSSAU, which has been widely used in pertinent studies.

Table 5. KMO and Barlett test

KMO and Bartlett test		
	KMO	0.775
Bartlett test	Approx. Chi-Square	4711.611
	df	15
	p value	0.000

Source: SPSSAU

As widely known, KMO and Barlett test are used to test whether each variable is independent of the other, which means whether it can be used in the PCA. Table 4. clearly displays that KMO value is larger than 0.7, which normally indicates that principal component analysis is helpful with the aforementioned data (if the value is less than 0.5, typically indicates that the outcome of PCA analysis is not acceptable). Then, the Bartlett's test is also used to test the hypothesis, and the table shows that the p value is less than 0.05, indicating that there are correlations between the variables and the data for the PCA analysis is available to use.

After conducting the principal component analysis, the weight of each indicator is shown in the Table 5. and according to the results, we can conclude that:

$$F_1=0.279*X_1+0.465*X_2+0.428*X_3+0.459*X_4+0.381*X_5+0.407*X_6$$

$$F_2=0.710*X_1+0.033*X_2+0.189*X_3-0.403*X_4-0.505*X_5+0.204*X_6$$

$$F_3=0.509*X_1-0.371*X_2+0.153*X_3+0.027*X_4+0.494*X_5-0.578*X_6$$

$$F_4=0.393*X_1+0.146*X_2-0.863*X_3+0.238*X_4+0.095*X_5+0.115*X_6$$

Finally, by generated those formula, the index of the digital economy can be expressed by:

$$DE = 0.568F_1+0.184F_2+0.146F_3+0.102F_4$$

Table 6. Results of each indicator's weight

X	Indicators	Com. Score	Weight
X_1	Employees working in computer services and software as a percentage (%)	0.4037	27.58%
X_2	Number of cell phone subscribers per 100 people	0.2312	15.79%
X_3	Postal business per capita	0.2126	14.53%
X_4	Internet users per 100 individuals as a percentage	0.2150	14.68%
X_5	The index of digital financial inclusion	0.2050	14.00%
X_6	Total telecom services per capita	0.1964	13.41%

Source: SPSSAU

Starting from now, this study can assess the level of the digital economy in each city every year. And the higher the index, the more advanced a city's digital economy is.

3-2. Evaluating the Correlation Between the Digital Economy and the Rise of Inward Foreign Direct Investment

3-2-1. Data

A dataset comprising 256 prefecture-level Chinese cities during the period from 2013 to 2019 has been established in this study. The following are detail information of those variables.

For the variables used in thie paper, such as Inward Foreign Direct Investment (FDI), total retail sales of consumer goods (CG), the number of people engaged in the mining industry (M), and the total number of the city's patent applications (EDU), Population (CITY), the average wage of employees (WAGE), the natural logarithm form is used to reduce heteroskedasticity and avoid the impact of interdependence between variables on the empirical results.

Table 7. Variables for Estimation

Variable	Definition	Unit
Dependent Variable		
FDI	(logged) The amount of Inward Foreign Direct Investment in China for city i in year t	USD 10000
Explanatory Variable		
DE	Index generated from various indicators that represents the development of the digital economy	Index
Control Variables		
CG	(logged) Retail sales of social consumer goods of city i in year t	RMB 10000
M	(logged) Number of workers in mining sector of city i in year t	Unit
EDU	(logged) Number of invention applications and patents issued of city i in year t	Unit
City	(logged) Total population of city i in year t	10 thousand
Wage	(logged) Average wage of employee of city i in year t	RMB
β_i	Province-fixed effects	
δ_t	Year-fixed effects	
ε_{it}	Random error term	

Regarding the control variables, according to previous research (Dunning, 2000; Dunning and Lundan, 2008) and related studies (Cao and Xu and Tian, 2022), this article selects the following control variables related to four motivations (market-seeking, resource-seeking, efficiency-seeking, and strategic asset-seeking) for FDI:

1.[Resource Seeking] The number of people engaged in the mining industry(m), which is chosen in this study as a resource endowment indicator because it not only measures the level of each city's natural resource endowment but also, to some extent, reflects the level of labor resources that are available to match the natural resources.

2.[Market Seeking] Total retail sales of consumer goods (cg). Instead of considering the region as a whole, this paper concentrates on the total retail sales of consumer goods in the municipality as the indicator of the consumption level of the city.

3.[Market Seeking] Population (city), this paper also takes each city's population into consideration, which, to some extent, reflects the potential of the market.

4.[Efficiency Seeking] The average wage of employees (wage). Based on the efficiency wage theory, companies must pay their employees high enough so that workers could stay productive and skillful.

5.[Strategic asset Seeking] The total number of the city's patent applications (edu). The knowledge and technology level of cities serves as a reflection of regional innovation capability. In this paper, the total number of patent applications in cities is selected as an indicator reflecting the level of knowledge and technology.

Table 8. Descriptive Statistics of All Cities

Variables	N	Mean	Max	Min	Std. Dev
FDI	1778	101241.2	2432909	104	221559.5
DE	1778	.2314232	18.85098	-1.869081	1.417982
CG	1778	8646206	1.58e+08	26703	1.54e+07
M	1778	17146.94	243900	0	31536.89
EDU	1778	15825.38	419387	84	36312.64
CITY	1778	475.5784	3358.014	38.00007	346.3715
WAGE	1778	59864.8	173205	24786.31	16591.8

3-2-2. Methodology

According to the Result of the Hausman test, this study will use fixed effects model to do the following analysis. As widely known, the Hausman test can be used to compare the estimates of the fixed effects and random effects models, which is useful for in panel data. And the result suggest that the following regressions should be done with fixed effects model, since P<0.05.

Table 9. The Hausman Test

Test: Ho: difference in coefficients not systematic
$$\text{chi2(3)} = (b\text{-}B)'[(V\_b\text{-}V\_B)^{\wedge}(\text{-}1)](b\text{-}B)$$
$$= \quad 69.40$$
$$\text{Prob>chi2} = \quad 0.0000$$

As seen below, the data were combined by integrating cities at yearly levels, using fixed effects to manage heterogeneity, and including a number of control factors. To completely exclude the economic impact of Covid-19, all the data utilized in this article stretch from 2013 to 2019. The basic model that follows is then built based on the research topics that this study is primarily concerned with.

Empirical function: $\ln (\text{Inward FDI})_{it} = \alpha_0 + \alpha_1 DE_{it} + \ln(M)_{it} + \ln (CG)_{it} + \ln (EDU)_{it} + \ln (CITY)_{it} + \ln (WAGE)_{it} + \beta_i + \delta_t + \varepsilon_{it}$

Based on the previous researches and the economic theory, this study make

2 4

the following hypothesis:

Hypothesis 1: The digital economy Index has a positive influence on FDI inflow.

3-3. Evaluating How the Correlation Changes under Different Level of Digital Finance

3-3-1. Data and Methodology

As widely known, the uneven urban development in China is quite obvious, for example, different regions have different levels of digital infrastructure and digital environment, etc. which may be served as significant determinants restricting the future growth and promotion effect of the entire digital economy in China. And the majority of earlier studies have concentrated on the disparities between the digital economy's promotion impacts in Eastern and Western of China, or between various categories of digital infrastructure, etc. According to (Yang 2021), there are notable geographic differences in the way the digital economy contributes to economic growth. Therefore, in the following analysis, this study will investigate the impact of the digital economy based on the differences among regional digital finance.

Figure 9. Rankings of cities' levels of digital financial inclusion in 2011, 2015, and 2020

- • Top group
- • High medium group
- • Low medium group
- • Low group
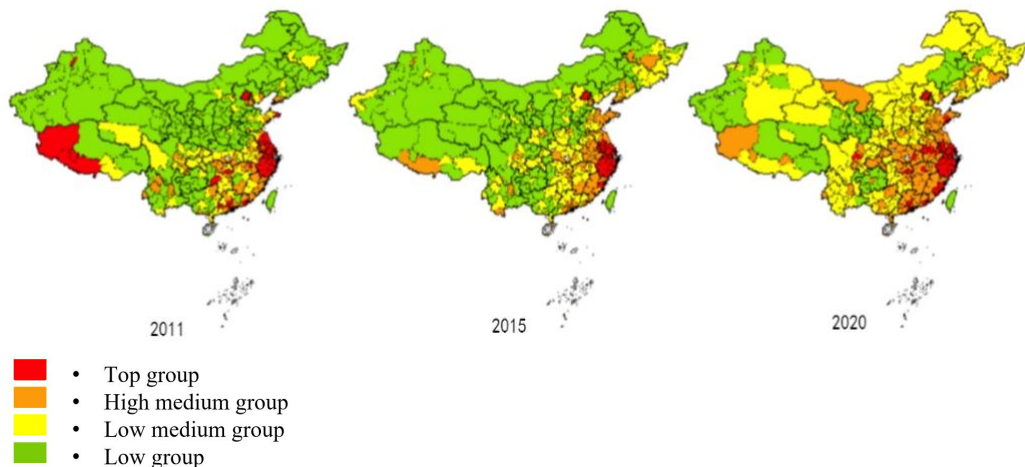
Source: Institute of Digital Finance Peking University

According to the previous studies, (Xinglan 2023) uses data from 31 cities, found that the development of Digital Inclusive Finance positively promotes the regional economic growth. And in the Figure 8, it can be found that there are large difference and variation of region's digital financial used level among last ten years

in China, which also shows that regional differences in China's adoption of digital finance have grown smaller over time, but they still present a significant divide. More specifically, In 2011, there was a large gap between cities, with the first tier concentrated in the neighboring areas of Shanghai and large cities, and the second and third tiers were very thin, with most areas in the fourth tier; then in 2015, the first tier expanded to the southeast coast and key cities at the regional level, while the second and third tier grew; and by 2020, the vast majority of cities are in the first and second tier, i.e., the digital financial inclusion index of most cities is within 70% of the highest areas in that year, and the gap between regions is further reduced.

At the same time, with the accelerated breakthrough of new generation information technology and its wide application in the financial field, urban digital finance plays an increasingly important role in easing financing constraints, reducing transaction costs, optimizing business environment, accelerating industrial transformation, narrowing regional differences and improving development quality and so on, which makes it possible to efficiently monitor and assess financial activities using digital technology while preventing the development of overcapacity, resource mismatch, and resource waste during production. Specifically, the way urban digital finance works to influence foreign direct investment by influencing the environment in which the digital economy operates. (Wang 2023) based on the panel data from 256 cities demonstrates that through digital infrastructure, urban digital finance can have a favorable impact on Foreign Direct Investment. And (YIPING HUANG, ZHUO HUANG 2018) illustrates that the digital finance influences the operation and typical characteristics of digital infrastructure by easing credit constraints, improving allocation efficiency, and enhancing risk control, and promotes the security of digital infrastructure construction and operation, thus influencing the operating environment of the entire digital economy.

As a result, this study will concentrate on how various degrees of urban digital finance affect the promotion effect of the digital economy on FDI in the analysis that follows.

Figure 10. Possible Moderating Effect of Urban Digital Finance
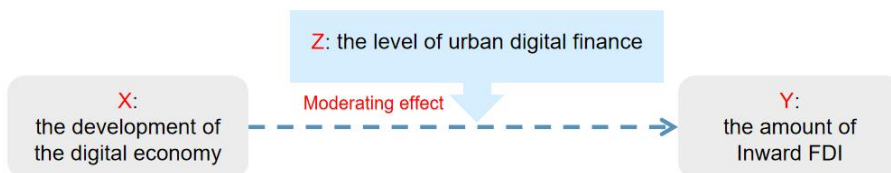
3-3-2. Data and Methodology

In order to define the development of the digital finance, in this study, the digital financial inclusion index will be used to represent it in the following analysis. Since the financial inclusion is more like a financial system whihc could serve all groups in society and based on some research and related materials, in China, the digital finance is becoming the engine of the development of financial inclusion, therefore, the digital financial inclusion index can be a good chocie for the following analysis.

This study will divide all 256 cities into three categories by ranking each city's average digital financial inclusion index from 2013 to 2019. And perform a regression analysis on these three groups separately, then compare the findings to see how differently the digital economy has influenced the FDI.

Grouping rules:

1) 1st Group: The first category comprises cities with values for the Digital Financial Inclusion Index of China that are at least 75% higher than the benchmark, which is the city with the highest average value for the index. After dividing all the cities into 3 group, the 1st group has 73 cities.

2) 2nd Group: The Second group consists of cities having index values that are 60%-75% of the benchmark, which is the city with the highest average digital finance index. After dividing all the cities into 3 group, the 2nd group has 114 cities.

3) 3rd Group: The Third group consists of cities having index values that are 60% less of the benchmark, which is the city with the highest average digital finance index. After dividing all the cities into 3 group, and the 3rd group has 69 cities.

Table 10. Descriptive Statistics of the 1st Group

Variables	N	Mean	Max	Min	Std. Dev
FDI	502	256015.6	2432909	135	363572.9
DE	502	1.519873	18.85098	-1.186659	1.942903
CG	502	2.02e+07	1.58e+08	535420	2.36e+07
M	502	9881.801	139000	0	21525.29
EDU	502	45886.68	419387	241	57499.78
CITY	502	596.6943	2426.007	38.00007	427.596
WAGE	502	71638.8	173205	33030.21	19037.07

Table 11. Descriptive Statistics of the 2nd Group

Variables	N	Mean	Max	Min	Std. Dev
FDI	798	49639.17	1031042	117	67819.34
DE	798	.1343054	6.090814	-1.289021	.675731
CG	798	4949354	1.16e+08	138800	7448236
M	798	20575	243900	0	37712.51
EDU	798	6594.03	109027	244	10135.59
CITY	798	426.4441	3358.014	90.35008	336.9388
WAGE	798	56005.15	110393	24786.31	13071.69

Table 12. Descriptive Statistics of the 3rd Group

Variables	N	Mean	Max	Min	Std. Dev
FDI	478	24843.04	136859	104	28943.28
DE	478	-.5111511	1.549059	-1.869081	.4904655
CG	478	2647946	2.08e+07	26703	2575716
M	478	19053.86	134200	0	27627.96
EDU	478	2793.912	15541	84	2631.639
CITY	478	440.8862	1170.979	78.15842	211.1031
WAGE	478	53943.14	94643	32336.66	12387.53

From Table 9 -Table 11, it shows that the average digital economy index in the 1st group is larger than those in 2nd and 3rd group. In order to further see the impact of the digital economy on FDI, this study will focus on more detail empirical test based on the above grouping of cities. And as Hausman test indicated before, this paper will still use fixed effect model in the following analysis.

Empirical function: $\ln (\text{Inward FDI})_{it} = \alpha_0 + \alpha_1 DE_{it} + \ln(M)_{it} + \ln (CG)_{it} + \ln (EDU)_{it} + \ln (CITY)_{it} + \ln (WAGE)_{it} + \beta_i + \delta_t + \varepsilon_{it}$

Based on the previous researches and the economic theory, this study makes the following hypothesis:

Hypothesis 2: The promotion effect of digital economy on FDI may vary under different financial conditions, implying that the level of digital finance has a moderating effect on above relationship

VI. Key Findings and Discussion

4-1. Assessing the Correlation Between the Digital Economy and the FDI _
Full Sample Regression Analysis

According to the regression results shown in the Table 12. Obviously, all regression coefficients of the digital economy are significantly positive, which means, in the general level, the development of digital economy actively affects city's ability to attract Inward Foreign Direct Investment across mainland China.

More particular, it is evident from model (1) that the digital economy index's coefficient is positive and satisfies the 1% statistical significance test in the absence of control variables and fixed effects. Additionally, from model 2 with control variables included, it demonstrates that there is a non-significant positive correlation between the population (ln_city) and FDI in each region, indicating that the total Inward FDI growth has not been accompanied by the higher population level. Additionally, there is a significantly negative correlation between each city's inward FDI and the average employee wage (ln_wage), showing that the rise of average wage in the local market will not trigger more Inward FDI. However, the inward FDI is positively correlated with total retail sales of consumer goods (ln_cg), the total number of the city's patent applications (ln_edu), and the number of people engaged in the mining industry(m), which statistically prove the validity of the FDI motivation theory. Particularly, these relationships are significant at the 1% level, indicating that the importance of high-technology, natural resources and high consumption market in attracting inward foreign direct investment across Mainland China.

From model (3), after combining with year and provincial fixed effects, the digital economy index is seen to have a positive regression coefficient and to have passed the 1% statistical significance test. However, it shows in the table that the increase of population may not contribute to attracting the Inward FDI, since the coefficient is negative.

As a result, the growth of inward foreign direct investment and the development of the digital economy are strongly positively correlated. In other words, this empirical assessment shows how the expansion of China's foreign direct investment benefits from the development of the digital economy.

Table 13. Estimate Result with Focus on all 256 cities

VARIABLES	(1) ln_fdi	(2) ln_fdi	(3) ln_fdi
de	0.510***	0.118***	0.138***
	(0.0271)	(0.0320)	(0.0287)
ln_cg		0.228***	0.201***
		(0.0517)	(0.0509)
ln_city		0.0429	-0.0426
		(0.0739)	(0.0673)
ln_edu		0.836***	0.631***
		(0.0449)	(0.0524)
ln_m		0.0684***	0.00715
		(0.0153)	(0.0147)
ln_wage		-1.907***	1.036***
		(0.159)	(0.247)
Constant	10.08***	19.62***	-9.464***
	(0.0390)	(1.688)	(2.599)
Observations	1,778	1,642	1,642
R-squared	0.166	0.528	0.714

Notes： This table reports estimation result from the total data from 256 cities, model (3) is done with fixed effects.

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

4-2. Assessing the whether the promotion effect of the Digital Economy may change

As presented in the first stage analysis, the digital economy has a promotion effect on attracting Inward Foreign Direct Investment across Mainland China. However, there has some differences happened as dividing all cities into three groups.

According to the model (1) ~ (3) on the table 12, in the 1st group, we can see that DE has a positive regression coefficient after combining with fixed effects and also passes the 1% statistically significant test, which demonstrate that the digital economy has a certain promotion effect on the rise of Inward Foreign Investment when cities have a high level of digital financial inclusion index.

Table 14. Estimate Result with Focus on 1st Group

VARIABLES	(1) ln_fdi	(2) ln_fdi	(3) ln_fdi
de	0.340***	0.0879**	0.167***
	(0.0335)	(0.0379)	(0.0348)
ln_cg		0.356***	0.190*
		(0.104)	(0.106)
ln_city		0.324*	0.0474
		(0.179)	(0.182)
ln_edu		0.597***	0.635***
		(0.0871)	(0.117)
ln_m		-0.0158	-0.0381
		(0.0236)	(0.0267)
ln_wage		-1.299***	-1.421***
		(0.269)	(0.250)
Constant	10.99***	12.14***	17.58***
	(0.0826)	(2.784)	(2.650)
Observations	502	431	430
R-squared	0.171	0.587	0.768

Notes：This table reports estimation result from the data of 73 cities, model 3 is with fixed effect.
Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

According to the model (1) ~ (3) on the Table 13, in the 2nd group, we can see that DE has a non-significantly negative regression coefficient after combining with fixed effects, which indicates that the digital economy may does not have a promotion effect on the rise of Inward Foreign Investment when cities in the middle level of digital financial inclusion. Furthermore, compared with the empirical results in 1st group, indicating that in cities with lower levels of digital finance development, the regression coefficients of the digital economy on FDI are not significant. In conclusion, the growth of digital inclusive finance supports the development of the digital economy and may enhance the influence of the digital economy's promotion of FDI. Additionally, for countries to fully benefit from the impact of the digital economy on FDI promotion, the urban digital finance sector needs to be strengthened.

Table 15. Estimate Result with Focus on the 2nd Group

VARIABLES	(1) ln_fdi	(2) ln_fdi	(3) ln_fdi
de	-0.170**	-0.0588	-0.00704
	(0.0756)	(0.0854)	(0.0755)
ln_cg		0.0617	0.0923
		(0.0813)	(0.0749)
ln_city		0.162	0.0989
		(0.126)	(0.112)
ln_edu		0.677***	0.495***
		(0.0795)	(0.0840)
ln_m		0.129***	0.0749***
		(0.0229)	(0.0211)
ln_wage		-1.022***	-0.785***
		(0.252)	(0.246)
Constant	9.973***	12.60***	11.88***
	(0.0520)	(2.617)	(2.431)
Observations	798	771	771
R-squared	0.006	0.295	0.588

Notes：This table reports estimation result from the total data of 114 cities, model 3 are with fixed effect.

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

According to the model (1) ~ (3), in the 3rd group, we can see that DE has a smaller positive regression coefficient than that in the 1st group after combining with fixed effects but does not pass the statistically significant test, which demonstrate that the digital economy may have a slight promotion effect on the rise of Inward Foreign Investment when cities are in the lowest level of digital financial inclusion index.

Table 16. Estimate Result with Focus on 3rd Group

VARIABLES	(1) ln_fdi	(2) ln_fdi	(3) ln_fdi
de	-0.270* (0.152)	0.0692 (0.167)	0.0733 (0.153)
ln_cg		0.167 (0.103)	0.0951 (0.0969)
ln_city		0.0389 (0.176)	-0.278* (0.162)
ln_edu		0.993*** (0.103)	0.355*** (0.119)
ln_m		0.0589* (0.0349)	0.0127 (0.0330)
ln_wage		-2.846*** (0.368)	-1.592*** (0.399)
Constant	9.038*** (0.107)	29.46*** (4.031)	23.95*** (4.182)
Observations	478	440	440
R-squared	0.007	0.387	0.627

Notes： This tale reports estimation result from the total data of 69 cities, model 3
are with fixed effects.
Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Based on the aforementioned estimation results, it is evident that the digital economy's coefficient is solely positive and meets the 1% statistical significance test in the first group. As was already said, this shows that when cities have a superior digital financial environment, the digital economy has a substantial promotion impact in attracting FDI. However, according to estimates from the second and third groups, there is no statistically significant correlation between the growth of FDI and the digital economy. Because the effects of the digital economy vary depending on the group, a sound digital financial environment may assist in the digital economy's ability to take in more inward foreign direct investment.

Table 17. Compared with the Estimate Result with Focus on different Group

VARIABLES	1st group. ln_fdi	2nd group. ln_fdi	3rd group. ln_fdi
de	0.167***	-0.00704	0.0733
	(0.0348)	(0.0755)	(0.153)
ln_cg	0.190*	0.0923	0.0951
	(0.106)	(0.0749)	(0.0969)
ln_city	0.0474	0.0989	-0.278*
	(0.182)	(0.112)	(0.162)
ln_edu	0.635***	0.495***	0.355***
	(0.117)	(0.0840)	(0.119)
ln_m	-0.0381	0.0749***	0.0127
	(0.0267)	(0.0211)	(0.0330)
ln_wage	-1.421***	-0.785***	-1.592***
	(0.250)	(0.246)	(0.399)
Constant	17.58***	11.88***	23.95***
	(2.650)	(2.431)	(4.182)
Observations	430	771	440
R-squared	0.768	0.588	0.627

Notes： This tale reports estimation result from the total data from 256 cities, model 3 are with fixed effects.
Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

In contrast to those three groupings, we are able to draw the conclusion that the existence of urban digital finance positively supports the development of the digital economy and may even strengthen the impact of that development on foreign direct investment. Furthermore, higher requirements for the digital financial environment have been imposed by the growth of the digital economy and strengthening the development of digital inclusive finance is necessary for maximizing the FDI amount.

4-3. Robustness Test

As widely known that changes in the environment may have a time lag effect on the actual growth of Economics, such as FDI. Therefore, this paper will examine the robustness by taking the lag effect into consideration for the purpose to confirm the reliability of the estimation results in the following empirical test. It replaces the current DE in the model with the corresponding lag 2 terms for regression. In other word, this paper will use data from $year_{t-2}$ will replace data of $year_{t0}$ for the regression of $year_{t0}$.

The final regression results are shown in the following tables, which shows the coefficients and significances in 1st group and 2nd group are consistent with

the benchmark model, only the test result in 3rd group is different from that in the original model, which may cause by the insufficient sample data and extreme values of some cities. However, by considering the lag effect, the estimation results are robust.

Table 18. Compared with the Estimate Result with Focus on different Groups

VARIABLES	Original 1st Group ln_fdi	Lag-2 1st Group ln_fdi.	Original 2nd Group ln_fdi	Lag-2 2nd Group ln_fdi	Original 3rd Group ln_fdi	Lag-2 3rd Group ln_fdi
de	0.167***	0.125***	-0.00704	-0.00841	0.0733	-0.230
	(0.0348)	(0.0340)	(0.0755)	(0.0959)	(0.153)	(0.173)
ln_cg	0.190*	0.301***	0.0923	0.0922	0.0951	0.120
	(0.106)	(0.103)	(0.0749)	(0.0748)	(0.0969)	(0.0980)
ln_city	0.0474	-0.236	0.0989	0.0989	-0.278*	-0.321**
	(0.182)	(0.170)	(0.112)	(0.113)	(0.162)	(0.163)
ln_edu	0.635***	0.749***	0.495***	0.495***	0.355***	0.357***
	(0.117)	(0.113)	(0.0840)	(0.0840)	(0.119)	(0.118)
ln_m	-0.0381	-0.0335	0.0749***	0.0750***	0.0127	0.0110
	(0.0267)	(0.0269)	(0.0211)	(0.0209)	(0.0330)	(0.0330)
ln_wage	-1.421***	-1.478***	-0.785***	-0.783***	-1.592***	-1.189***
	(0.250)	(0.260)	(0.246)	(0.254)	(0.399)	(0.402)
Constant	17.58***	17.13***	11.88***	11.87***	23.95***	19.28***
	(2.650)	(2.744)	(2.431)	(2.528)	(4.182)	(4.299)
Observations	430	430	771	771	440	440
R-squared	0.768	0.763	0.588	0.588	0.627	0.628

V. Conclusion

5-1. Conclusion

Digital platforms, technologies, and related products are becoming more prevalent in the global economy, and the influence of the digital economy on multinational business, trade, and investments is expanding. As the main way of international cooperations and countries to participate in the global business, FDI and how the digital economy effects it deserves to be investigated.

This paper outlines the deficiencies of earlier studies, which are related to the relationship between the development of the digital economy and the increase in inward FDI as well as whether the promotion effect of the digital economy varies depending on the circumstances. With greater precision, this study first describes the current state of FDI and the growth of the digital economy in China, then discusses how, theoretically, the digital economy influences FDI, based on the research of other scholars and traditional economic theories. After complete those literature reviews and background introduction, in the empirical test part, based on panel data from 256 spots between 2013 and 2019, this study employs principal component analysis to generate an accumulative index that depicts the various stages of the digital economy. The basic regression has been started using a fixed effects model for benchmark regression once all the variables have been collected. In order to determine if the promotion impact of the digital economy may differ when the cities are in varying stages of financial condition for digital inclusion, it is, therefore, necessary to further separate cities with various qualities of the digital finance environment as showed in the above analysis.

The following findings are gradually obtained from the previous information gathering and empirical examination in this paper.

1) The finding of the empirical test indicates that the growth of the digital economy does actively promote cities' ability to attract foreign direct investment. As mentioned before, the digital economy is constantly evolving with new opportunities and technological advancements for potential economic growth, and it also indirectly impacts the investment of inward FDI since those foreign investors may be attracted by that new environment and business model taken by the digital economy.

    Since the coefficient of DE was only significantly positive in the first group of cities (that is, those with the highest performance in digital finance), the regression results also suggest that the different levels of urban digital finance may have an impact on the promotion effect brought about by the digital economy. In other words, the link between the growth of the digital economy and the increase in inward foreign direct investment is moderated by the urban digital finance.

5-2. Implications

Based on the conclusions above, there are several implications can be proposed.

First, given the estimate results shows that the digital economy can become a fresh catalyst in attracting foreign investment, the country should increase its investment in the Internet and promote digital construction, particularly by speeding up the commercialization of 5G, the application of artificial intelligence, and so on to further consolidate the advantages of information technology.

Second, countries ought to support the growth of digital finance and enhance the spread of inclusive finance in urban areas. This study shows that FDI in the digital economy will be promoted in regions with better-developed digital finance, and the first group consists of first- and second-tier cities has a more strong and reliable promotion effect, which may be because those cities have higher resource inclination, stronger urban infrastructure, and superior development environment to promote the digital finance. As we already know, there are noticeable differences and inequities among regions in China. To make the digital economy a potent weapon for decreasing regional inequalities, the country has to adopt a fresh, innovative strategy for the growth of the digital economy.

5-3. Contribution

First, create a dataset with 256 Chinese prefecture-level data from 2013 to 2019, then get empirical evidence that the digital economy benefits the attraction of linward FDI. Since other research do not have the similar dataset, some papers also use the data of 2020, however, to lessen the effects of Covid-19, this study choose the data from 2013 to 2019.

Second, use the Digital Financial Inclusion Index to represent each city's digital financial level, and find that it has a moderating effect on the relationship between the digital economy and FDI by doing empirical test, which did not be used and examined by other scholars.

5-4. Limitations and Suggested Further Research

First, one of the goals of this study is to quantitatively assess how the growth of the digital economy and inward foreign direct investment are related. Although it should be noted that many of the approaches employed in recent research have certain limits in properly identifying the digital economy and the degree of digital finance, the methodology utilized in this paper for analyzing the growth of the digital economy also has some shortcomings. In other words, it is unavoidably incomplete since there is no defined method for evaluating the growth of the digital economy. More specifically, the approach utilized in this study does not measure

the absolute values that can best characterize the digital economy. And regarding to the challenge of data availability, the best option and eventually used in this article to gauge the extent of the digital economy is the principal component analysis, which was used to develop an assessment index system for analysis.

Second, the further analysis about how digital finance affect the promotion effect of the digital economy still has some imperfections. It is inevitable that there are various variables are able to affect the influence of the digital economy because of its broad definition, and as Figure10 demonstrates, there exists some correlations between digital finance and the Urbanization rate. The graph shows the correlation between the depth of digital financial usage at the city level and the rate of urbanization. The vertical axis is the depth of the digital financial usage index, the horizontal axis is the level of urbanization, and each scatter represents a city. It is clear from the figure that the depth of its usage is strongly positively connected with the level of urbanization, which shows that the more urbanized a region is, the deeper its use of digital finance is. Therefore, variations in digital finance have an impact on the promotion effect of the digital economy, but it's possible that changes in urbanization rates rather than differences in digital finance are what lead to changes in the impacts. And as this paper already investigated that the urban digital finance has a moderating effect on the relationship between the digital economy and FDI, maybe there still have other factors that have moderating effect or mediating effect on this relationship. Additionally, it may be the subject of further study.

Figure 10. Urbanization rate and the level of use of digital financial services
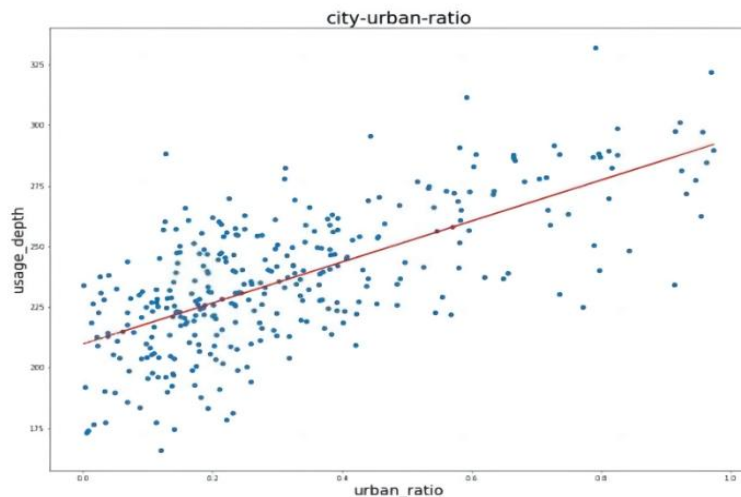
Source: Institute of Digital Finance Peking University

Third, since there are some cities with missing data, it is inevitable that the

database used in the empirical test has some inherent defects. And in order to minimize the error caused by incomplete data, this study eliminates the cities with significant missing samples and make sure the results are as accurate and comprehensive as possible.

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Abstract

본고는 디지털 경제가 중국 국내로 향하는 외국 직접 투자(Foreign Direct Investment, FDI)에 미치는 영향을 살펴 보고 각 도시 그룹에서 그 영향은 도시 디지털 금융 수준에 달려 있는지도 검토한다.

방법론상 2013년부터 2019년까지 중국 256개의 현급 도시 패널 데이터에 기반으로하고, 6가지 지표를 디지털 경제 지수로 축적하기 위해 먼저 주성분 분석을 활용한다. 다음으로 전체 표본 회귀 분석을 수행하여 디지털 경제 발전과 FDI 상승 간 관계를 살펴본다. 또한, 본 연구는 위의 작업을 바탕으로 하여 모든 도시를 디지털 금융포용지수를 기준으로 세 그룹으로 나누고, 디지털 경제가 대중국 FDI에 홍보 영향력을 미치고 있는지를 실증적으로 검증하기도 한다.

따라서 본고는 아래와 같이 2 가지 결론을 도출할 수 있다: 첫째, 디지털 경제는 대내 FDI를 유치하는 데 큰 영향을 미친다. 둘째, 디지털 경제는 디지털 금융 퍼포먼스가 상위 수준에 있는 도시에만 강력한 홍보 효과를 미치는 한편, 도시 디지털 금융 포함 지수가 하위 수준에 있는 경우 홍보 효과는 미미하며 심지어 존재하지도 않는 것으로 나타난다.

키워드: 디지털 경제; Foreign Direct Investment (FDI); 디지털 금융; 패널 데이터 분석; 지역별 차이
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