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КЫТАЙДЫН МИСАЛЫНДА БИЛИМ БЕРҮҮГӨ ИНВЕСТИЦИЯНЫН ЭКОНОМИКАЛЫК ӨНҮГҮҮГӨ ТААСИРИН ТАЛДОО
АНАЛИЗ ВЛИЯНИЯ ИНВЕСТИЦИЙ В ОБРАЗОВАНИЕ НА ЭКОНОМИЧЕСКОЕ РАЗВИТИЕ НА ПРИМЕРЕ КИТАЯ
ANALYSIS OF THE IMPACT OF INVESTMENT IN EDUCATION ON ECONOMIC DEVELOPMENT USING THE EXAMPLE OF CHINA

Кыскача мүнөздөмө: Санариптик технологиялар экономиканын жана коомдун бардык тармактарына терең сиңип жаткандыктан, адам капиталын топтоонун негизги каражаты болгон билим берүүгө инвестиция салуу менен экономикалык өнүгүүнүн ортосундагы байланыш жаңы мүнөздөмөлөргө ээ болууда. Бул изилдөөдө Кытайдын мисалында билим берүүгө инвестиция салуу санариптик экономикадагы экономикалык өнүгүүгө тийгизген таасирин жана практикалык натыйжалуулугун талдоо жүргүзүлөт. Изилдөөдө билим берүүгө инвестиция салуу экономикалык өсүшкө үч негизги канал аркылуу салым кошору көрсөтүлгөн: жумушчу күчүнүн санариптик сабаттуулугун жогорулатуу, санариптик технологиялык инновацияларды трансформациялоону илгерилетүү жана санариптик тармактардын түзүмүн оптималдаштыруу. Бирок, жогорку жана кесиптик билим берүүгө инвестиция салуу аймактар боюнча ар кандай таасир этет. Изилдөөнүн жыйынтыктарына таянып, билим берүүгө инвестиция салуу түзүмүн оптималдаштыруу, санариптик көндүмдөрдү окутууну күчөтүү жана билим берүү ресурстарын аймактар боюнча тең салмактуу бөлүштүрүүнү илгерилетүү боюнча сунуштар берилет. Бул сунуштар санариптик экономика доорунда билим берүү аркылуу жогорку сапаттагы экономикалык өнүгүүнү камсыз кылуу үчүн колдонмо катары кызмат кыла алат.

Аннотация: В условиях глубокого проникновения цифровых технологий во все сферы экономики и общества взаимосвязь между инвестициями в образование как ключевым способом накопления человеческого капитала и экономическим развитием приобретает новые характеристики. Данное исследование анализирует пути влияния и практическую результативность инвестиций в образование на экономическое развитие в условиях цифровой экономики на примере Китая. Исследование показывает, что инвестиции в образование способствуют экономическому росту через три основных канала: повышение цифровой грамотности рабочей силы, содействие трансформации цифровых технологических инноваций и оптимизацию структуры цифровых отраслей промышленности. При этом инвестиции в высшее и профессиональное образование оказывают дифференцированное влияние в разных регионах. На основе выводов исследования предлагаются рекомендации по оптимизации структуры инвестиций в образование, укреплению подготовки цифровых навыков и содействию сбалансированному распределению образовательных ресурсов между регионами, что может служить ориентиром для обеспечения высококачественного экономического развития через образование в эпоху цифровой экономики.

Abstract: With digital technologies deeply penetrating all sectors of the economy and society, the relationship between investment in education, a key means of accumulating human capital, and economic development is acquiring new characteristics. This study analyzes the influence and practical effectiveness of investment in education on economic development in the digital economy, using China as an example. The

study demonstrates that investment in education contributes to economic growth through three main channels: improving the digital literacy of the workforce, promoting the transformation of digital technological innovation, and optimizing the structure of digital industries. Investment in higher and vocational education, however, has a differentiated impact across regions. Based on the study's findings, recommendations are offered for optimizing the structure of investment in education, strengthening digital skills training, and promoting a balanced distribution of educational resources across regions. These recommendations can serve as a guide for ensuring high-quality economic development through education in the era of the digital economy.

Негизги сөздөр: санариптик экономика; билим берүүгө инвестиция салуу; экономикалык өнүгүү; адам капиталы; өнөр жай түзүмү; аймактык өнүгүү.

Ключевые слова: цифровая экономика; инвестиции в образование; экономическое развитие; человеческий капитал; структура отраслей промышленности; региональное развитие.

Keywords: digital economy; investment in education; economic development; human capital; industrial structure; regional development.

Introduction. With the accelerated adoption of digital technologies such as 5G, artificial intelligence, and big data, the digital economy has become a new engine of global economic growth. The scale of China's digital economy in 2022 will reach 50.2 trillion yuan, accounting for 41.5% of GDP, and its contribution to economic growth exceeded 50%, making it a key force driving the optimization of the economic structure and the transformation of the development model [1]. In the era of the digital economy, investment in education, as the foundation of human capital formation, not only fulfills the traditional function of training basic personnel but also becomes a key link linking digital technologies and their application in the economy [2].

On the one hand, investment in education provides human capital support for the development of the digital industry, enhancing the digital literacy and operational skills of the workforce [3]; on the other hand, collaborative innovation between educational institutions and digital enterprises can accelerate the application of digital technologies to the real economy and promote the digital transformation of traditional industries [4]. Using macroeconomic data from the past decade, this paper systematically analyzes the internal logic and practical implications of investment in education for economic development in the digital economy using China as a case study. Compared with existing studies, this paper offers the following innovations: first, it clearly defines the special functions of investment in education in the digital economy and constructs an analytical framework across three dimensions: "digital literacy development," "technological innovation and transformation," and "industrial structure optimization." Second, it analyzes the regional heterogeneity of the impact of investment in education on economic development by considering differences between China's eastern, central, and western regions, providing a basis for developing differentiated regional policies.

Theoretical Paths of the Impact of Educational Investment on Digital Economic Development.

Path 1: Investment in education enhances the digital literacy of the workforce

Data and digital technology are key factors of production in the digital economy. As operators of digital technologies and creators of data value, the digital literacy of the workforce directly determines the effectiveness of the digital economy [5]. Investment in education enhances the digital literacy of the workforce in two ways: first, by popularizing digital skills at the basic education stage, for example, by offering information technology courses and popularizing programming education in primary and secondary schools. In 2022, the coverage of information technology courses in primary and secondary schools in China reached 100%, and more than 90% of schools were fully equipped with multimedia teaching equipment [6; 7]. This part of investment in education has laid the foundation for the basic digital cognitive abilities of the workforce. The other aspect is deepening digital skills at the higher and vocational education stages. For example, colleges and universities offer majors related to artificial intelligence, big data, and the digital economy, while vocational colleges provide training in digital technology application skills and industrial internet operations. In 2022, the number of students majoring in digital economy-related fields at regular colleges and universities in China reached 123,000, while the number of students majoring in digital technology at vocational colleges

exceeded 800,000, providing a significant workforce with professional digital skills for the digital industry [8; 9; 10].

From the broader perspective of human capital theory, "human capital" in the digital economy era has shifted from the traditional "knowledge reserve" type to the "digital skills" type [5]. By optimizing the structure of human capital, investment in education enables the workforce to better adapt to the requirements of the digital industry. For example, digital economy-related jobs (such as data analysts and artificial intelligence engineers) place significantly higher demands on the ability to use digital tools and process data than traditional positions [7]. By reforming the curriculum and strengthening practical training, investments in education can directly improve the workforce's adaptability to such positions, thereby reducing labor costs in the digital industry, increasing production efficiency, and ultimately promoting economic growth.

Path 2: Investment in education promotes innovation and digital transformation

Innovation and the application of digital technologies are the main driving forces behind the development of the digital economy. As the primary means of cultivating innovative talent, investment in education directly impacts R&D efficiency and the transformation effect of digital technologies. Investment in education supports talent for digital innovation. As important vehicles for educational investment, universities are not only key platforms for fundamental research but also foundations for cultivating innovative talent. In 2022, the number of academic researchers in digital-related fields at Chinese universities reached 187,000, accounting for more than 60% of national basic research projects in digital technologies [10]. Among these, research results in artificial intelligence algorithms and big data security have reached international advanced levels. Investment in education also promotes collaborative innovation among industry, universities, and academic research and accelerates technological transformation. In recent years, the number of joint laboratories and innovation centers established by Chinese universities and digital enterprises has exceeded 2,000 [6]. For example, Tsinghua University and Baidu jointly established the "Intelligent Driving Joint Laboratory," while Zhejiang University and Alibaba jointly established the "Digital Economy Research Institute." Such collaborations not only quickly transform university research achievements into enterprise products and services but also provide the training of specialists that meet the technical needs of enterprises through a "training-to-order" model, forming a closed-loop "innovation-transformation-application" and enabling the faster transfer of digital technology dividends to the economy [3; 5].

From the perspective of innovation theory, technological innovation in the digital economy is characterized by "high investment, high collaboration, and high iteration," and an individual entity cannot independently complete research and development and application of technologies [2]. By integrating the resources of universities, businesses, and the government, investment in education has created an "ecosystem" for digital innovation: universities provide fundamental research and talent, businesses provide application scenarios and funding, and the government directs resource allocation through education policy [10] The combined effect of these three actors has significantly shortened the digital innovation cycle and significantly increased the effectiveness of technological transformation, contributing to the expansion of the digital industry and economic growth.

Path 3: Investment in education optimizes the structure of the digital industry

The development of the digital economy is reflected not only in the expansion of the digital industry but also in the integration of digital technologies with traditional industries, i.e., the dual drive of "industrial digitalization" and "digital industrialization." Investment in education optimizes the structure of the digital industry in two ways: first, by promoting the upgrading of "digital industrialization," that is, the training of highly skilled digital industry professionals through investment in higher education; and second, by facilitating the transformation of the digital industry from "low-tech processing" to "high-tech research and development." For example, in its early stages, China's digital industry primarily focused on electronic equipment assembly and simple software development. Thanks to increased investment in computer science and electronic information science majors at colleges and universities, the output of high-tech R&D in China's digital industry reached 35% in 2022, and the export of high-tech digital products such as artificial intelligence and cloud computing increased by 28% year-on-year [6].

Another important aspect is promoting the implementation of "industrial digitalization"-that is, developing skilled personnel needed for the digital transformation of traditional industries-through investment in vocational education and promoting the integration of agriculture, manufacturing, and the service sector with digital technologies. For example, vocational colleges offer majors such as "smart agricultural technology," "industrial robot application," and "digital marketing," which have trained many technical professionals with digital skills for traditional industries. In 2022, the digital transformation rate of China's manufacturing industry reached 52%, while that of agriculture reached 25%, an increase of more than 30 percentage points compared with 2013. Industrial digitalization contributed 32% to economic growth [1].

From the perspective of industrial structure theory, the core of industrial structure optimization in the digital economy era lies in the "digital penetration rate" and the "industrial digitalization level"[2]. Investment in education, while meeting the digital needs of various industries, ensures the transformation of industrial structure toward high-tech, intelligent, and green. For the digital industry, investment in education provides highly qualified R&D professionals, promoting the industry's advancement up the value chain; for traditional industries, investment in education provides digital operations professionals, promoting industrial transformation toward digitalization and intelligentization, and ultimately ensuring the optimization and upgrading of the entire economic structure [11].

Promoting Role of Educational Investment in the Digital Economy Era. Optimizing the structure of investment in education and strengthening the development of digital skills depends on the following factors. First, increase investment in digital economy-related specialties in higher education, support colleges and universities in developing promising specialties such as artificial intelligence, big data, and the digital economy, build digital technology laboratories and practice bases, and enhance the capacity to cultivate highly qualified digital technology professionals. Second, strengthen the digital transformation of vocational education, create specialized specialties such as digital technology application and industrial internet work in response to the digital needs of traditional industries, and implement the school-enterprise cooperation and custom-made training model to cultivate qualified personnel for industrial digitalization. Third, promote the popularization of digital literacy at the basic education stage, integrate programming, digital security, and other topics into the curricula of primary and secondary schools, and improve the basic digital cognitive ability of the entire population.

Based on the above differences, efforts can be made in the following aspects to narrow the gaps in education and digital economic development between the eastern, central, and western regions of China. First, increase transfer payments for educational investment in the central and western regions, support colleges and universities in the central and western regions in creating specialties related to the digital economy, attract high-quality digital talent, and improve the digitalization level of education in the central and western regions. Second, accelerate the construction of digital infrastructure in the central and western regions, promote the expansion of new infrastructure such as 5G and big data centers to the central and western regions, and lay the foundation for the development of the digital economy. Third, establish a mechanism to promote education and the digital industry between the eastern, central, and western regions, encourage colleges and universities in the eastern region to cooperate in education with the central and western regions, and promote the transfer of technologies and industries of digital enterprises in the eastern region to the central and western regions, so as to promote the development of the digital economy in the central and western regions and further improve the economic efficiency of educational investment.

Conclusion. In the digital economy, investment in education contributes to economic development in three ways: (1) enhancing the digital literacy of the workforce, (2) promoting innovation and digital transformation, and (3) optimizing the digital industrial structure. These three areas are interconnected and work together to form a system of digital empowerment, within which investment in education influences economic development.

It is necessary to promote cooperation between industry, universities and research in the field of innovation and accelerate the transformation of digital technologies. First, establish a digital innovation mechanism in collaboration with the government, universities, and enterprises, establish special funds to

support the joint creation of joint laboratories and innovation centers by universities and digital enterprises, and encourage the participation of university researchers in enterprise digital R&D projects. Second, improve policies to encourage the transformation of digital technology achievements, provide university researchers with opportunities to participate in the distribution of dividends by enterprises in the form of technology shares, and increase the enthusiasm of researchers for transformation. Third, create a platform for the transformation of digital technology achievements, integrate university research achievements with information on enterprise needs, reduce the cost of technological transformation, and accelerate the conversion of technological dividends into economic value.

Narrowing the gap between regional education and the digital economy and promoting balanced development is also important. Currently, there are certain differences in education and digital economic development between the eastern, central, and western regions of China, with a general pattern characterized by the eastern region taking the lead, the central region accelerating, and the western region compensating for its shortcomings. The eastern region, with its developed economy and focus on high-tech industries, leverages its advantages in resources and technology to achieve a level of digital education significantly higher than that of the central and western regions. The central region, thanks to its geographical location, has an advantage in attracting industrial transfer, leading to the rapid spread of informatization in education and stable growth in digital economic development. The western region, limited by scarce resources, faces challenges in the overall development of the digital economy, mainly focusing on strengthening infrastructure.

In the future, it is necessary to leverage the positive role of investment in education in economic development, strengthen the collaboration between investment in education and digital technologies, and continuously stimulate economic growth.

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