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Development of Platform Economy and Urban–Rural Income Gap: Theoretical Deductions and Empirical Analyses

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Abstract: Against the historical background of the burgeoning platform economy and the promotion of common prosperity, this paper focuses on the impact of the development of the platform economy on the urban–rural income gap. Theoretical mechanism analyses are conducted from three aspects such as nonlinear action of the platform economy on the urban–rural income gap, the rural human capital level-based moderating effect, and the spatial spillover effect. Moreover, empirical analyses are carried out using the threshold model, interaction model, and spatial lag model in turn with panel data of 31 provinces in China from 2013 to 2020. The results of the study show that there is a significant double threshold effect of the development of the platform economy on the urban–rural income gap. The initial development of the platform economy can improve urban–rural income inequality, and the scale effect of the platform will further contribute to the reduction in the urban–rural income gap, but the expansion of market share and the deepening of monopoly will have a suppressive effect on the urban–rural equilibrium. There is a moderating effect of rural human capital in the platform economy in reducing urban–rural income inequality. The increase in the level of rural human capital will enhance the driving effect of the platform economy on the reduction in the rural–urban income gap. There are spatial spillover effects for the impacts of the platform economy on the urban–rural income gap and it positively promotes the coordinated development of urban and rural areas in neighboring provinces. Based on the above results, this paper makes policy proposals from three aspects such as perfecting the system and standard of the platform, improving the rural human capital level, and optimizing platform-based regional cooperation.

Keywords: platform economy; urban–rural income gap; monopoly; rural human capital; spatial spillover effect

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1. Introduction and Literature Review

As a new driver of global economic growth, the platform economy, with Internet platforms as the main carrier, data as the key productive factor, new-generation information technology as the core driving force, and network information infrastructure as a crucial support, is burgeoning. In 2020, the top ten companies in the global market capitalization ranking were dominated by platform companies. The rapid rise of digital platforms has optimized the traditional trade development model, created a rapid global spread of platforms [1], and become a core engine driving the growth of the world economy. The platform economy is the most important form of industrial organization in the new economic era [2]. Instead of directly participating in the manufacturing of products, the platform serves as an intermediary connecting the supply and demand sides of market transactions [3] to improve the speed and accuracy of information exchanges [4], reduce structural mismatches in the transactions of the two sides, and lower transaction costs and search costs, thereby facilitating the conclusion of transactions between the sides.

Common prosperity is the universal sharing of the fruits of development, which is an important part of people's aspirations for a better life. However, in developing countries, the problem of the urban–rural duality and unbalanced and inadequate urban–rural

development is widespread [5]. Exploring the causes of the urban–rural income gap and promoting common prosperity have become important issues for developing countries to achieve economic growth and sustainable development. It has been found that there are various reasons for the formation and fluctuation of the urban–rural income gap. For example, urban infrastructure construction in developing countries is relatively complete, raising urban housing prices and enabling urban residents to acquire more wealth. The urbanization process changes the direction of labor migration, and high-skilled labor gathers in cities [6] to promote urban capital accumulation and economic growth [7]. Some scholars believe that rapid urbanization has a positive effect on narrowing the income gap between urban and rural areas. Regions undergoing faster urbanization processes would have greater demand for consumption and investment, which can effectively lift low-income populations out of poverty [8]. The gap in human capital investment is an important factor contributing to urban–rural income inequality [9]. The difference of skill level causes the huge difference of urban and rural labor remuneration and hinders the development of urban and rural integration. In recent years, the decline and movement of surplus rural labor have narrowed the labor productivity gap between the agricultural and industrial sectors, increasing the income of rural residents. The implementation of a series of government policies that benefit farmers has effectively curbed a widened urban–rural income gap [10]. Technological advancements in agriculture have spatial spillover effects. They could not only directly improve the agricultural production efficiency and thus increase the agricultural income level, but also have a positive impact on narrowing the urban—rural income gaps in neighboring regions by giving play to the technology diffusion effect and learning and imitation effect [11]. However, emerging industries brought about by technological innovation are mostly concentrated in urban areas, thereby curbing the balanced urban–rural development [12]. The construction of telecommunications infrastructure promotes the optimization and upgrade of the industrial structure and creates more jobs, which has a positive effect on narrowing the urban–rural income gap between the locality and the neighboring regions [13]. Digital financial inclusion manages such segments as loan application, review, and issuance on a platform to cut the number of loan procedures, and reduce resource mismatch and waste, providing sufficient financial support for rural residents, promoting the industrialized development of agriculture, and narrowing the urban–rural income gap [14].

With the rapid development of the platform economy, there have been discussions in academia on how the platform economy affects the urban–rural income gap, but no consensus has yet been reached. One view is that the platform economy will help reduce the urban–rural income gap. Digital platforms reduce information costs, enhance the ability of rural individuals, enterprises, and other economic agents to participate in the global economy, improve market efficiency [15], and provide rural residents with a diversified way to escape poverty [16]. The vast majority of farmers in developing countries face challenges in marketing their products [17]. Platforms enhance the digitization of all links in the agricultural production chain, improve service quality, help rural specialty products reach the market [18], provide consumers with diversified product choices and cheaper alternatives [19], improve the market potential of rural products, and promote balanced urban–rural development. As distribution costs account for a large share of the price of agricultural products, many front-end platform enterprises have set up special zones for agricultural products to bring into play the brand effect, expand commodity distribution channels, and enhance the overall income of agricultural producers [18]. In addition, the popularity and application of Internet platforms can also enhance the region's ability to attract investment [20] and bring more opportunities for industrial transformation in rural areas. The knowledge spillover from foreign investment entry accelerates the spatial reconfiguration of local industrial layout [21] and enhances production efficiency. Technological innovation has spatial externalities, and the application of digital technology in the region will also bring demonstration effects to other regions, speeding up the diffusion of digital technology in neighboring areas [22], which in turn will indirectly improve the digital

technology literacy of rural residents in the surrounding areas [23] and raise their human capital levels. E-commerce policies would also promote the popularization and application of rural e-commerce, rationalize the industrial development and factor allocation, and bring investment and development opportunities, thereby bolstering the inclusiveness of rural development [24]. The platform lowers the threshold for public services by virtue of its online business and promotes fair access to more high-quality public services for different populations, which would be conducive to promoting the common prosperity [25].

Another view is that the platform economy will lead to a widening income gap between urban and rural areas. The uneven regional distribution of platform enterprises, which are mainly concentrated in developed cities, has a siphonic effect on the rural consumption, resulting in the flow of factors to cities, and accelerating the "hollowing out" of rural areas, which may affect the income distribution between urban and rural areas [26,27]. Digital infrastructure and related services are fundamental conditions for the platform economy to promote the spending power, and the uneven development thereof between urban and rural areas has become a key inhibitor to urban–rural consumption fairness [28]. There is clearly a high "threshold" for developing the e-commerce economy, but the imperfectly constructed information technology infrastructure in rural areas results in higher costs for developing platforms. In urban areas, however, due to more obvious advantages in infrastructure, residents benefit more from participating in the e-commerce economy, which ultimately leads to a wider income gap between rural and urban residents [29]. Digital finance has become an important way to obtain investment due to its advantage of low costs, but the long-standing financial exclusion in rural areas has exacerbated the financing difficulties of residents [30]. Low-skilled workers lack advantages with regard to the application of digital technology, so technological progress has a "crowding-out effect" on their employment, aggravating urban–rural income inequality on the whole [31]. Employment crowding out and lower incomes can change the consumption behavior of rural residents, discouraging them from adopting digital platform technologies and further widening urban–rural income inequalities [32]. The monopolistic agreements reached by platforms through algorithmic and technological means will have a serious impact on employment and labor protection systems [33] and reduce the welfare of the rural labor force. Platform monopolies will also increase the platform's price control over merchants selling agricultural products, forcing them to pay high commissions to obtain traffic and curbing the balanced development of urban and rural areas [34].

In recent years, the development of China's platform economy has also seen many great achievements. According to data from the National Bureau of Statistics, the scale of national platform-based transactions has increased year-on-year over the past five years, with e-commerce sales reaching 22.76 trillion by 2021, an increase of 20.22% year-on-year. New progress has also been made in the development of platform-based products, with the volume of China's express delivery services reaching 108.3 billion pieces in 2021, up 29.9% year-on-year. The capacity to build platform-based infrastructure has been improved. More than 98 percent of administrative villages and poor villages across the country have access to optical fiber and 4G, and 718,000 5G base stations have been built. With the deep integration of the platform economy and the real economy, there is an irresistible trend for industries to transform to platform-based operations. For example, provinces such as Jilin have vigorously developed information service platforms, smart agriculture platforms, etc. for agriculture, rural areas and farmers to promote "Internet plus" agricultural production and management. With e-commerce as the breakthrough point, Shijiazi Village in Liaoning Province has realized the transformation to intelligent and platform-based operations of the whole industry chain through the "Internet + planting base + cooperation + physical store" model to actively promote the improvement of the overall agricultural productivity, becoming an important pillar for the income increase in residents and rural revitalization. The Industrial Internet platform promotes the interaction and interconnectivity of market entities in all segments of the industry chain from multiple dimensions such as data, technology, and business to accelerate the transformation and upgrade of

traditional manufacturing towards intelligent and service directions, showing significant industry driving effects in many fields such as raw materials, equipment, electronics, and minerals. E-commerce platforms for wholesale and retail, shipment and delivery, take-out and content represented by Taobao, Jingdong, Meituan, and Douyin have spawned a batch of new service models for online shopping, payment, socializing, logistics, etc., resulting in improved user experience, stimulated consumer demands, and expedited transformation of production and lifestyle. Cities such as Beijing and Nantong have successively launched smart communities, digital traffic platforms, medical platforms, etc. to inject a powerful impetus into improving the urban management efficiency and promoting urban development. As of the beginning of April 2020, there had been nearly 800 smart city pilot projects cumulatively, and China is becoming the world's largest power in smart city construction and implementation. The development of the platform economy has brought about drastic changes in productivity and production relations.

Since the reform and opening-up, the urban–rural income gap has gone through two main stages, namely, continuous widening and remaining at a high level, and gradually tends to moderate in recent years [35]. In 2021, the per capita disposable income ratio of urban and rural residents in China remained as high as 2.50, with provinces such as Guizhou and Qinghai exceeding 2.70. An important path to common prosperity is keeping the living standard gap between urban and rural residents within a moderate range and forming a coordinated urban–rural development pattern. At present, the digitization and platform-based development of the economy has induced a myriad of changes in many areas such as mode of production, business model, and employment paradigm. It is still unknown whether the continuously expanded scale of rural e-commerce transactions and expedited deepening of the rural digital economy with tremendous potential would be conducive to reversing the pattern of urban–rural income inequality and promoting the realization of common prosperity, which is also the focus of this paper.

To sum up, the existing literature probes into urban–rural income inequality against the backdrop of the platform economy from such aspects as the platform as an intermediary for transactions, infrastructure, monopolies, and technology spillovers. However, the research angles are mainly on the theoretical level, with fewer empirical analyses where experience and reality are combined. The network effect and scale effect of the platform economy can easily lead to market monopoly, and the power of the platform economy to drive rural income growth has to be supported by the human capital level, all of which may affect the balanced urban–rural development. However, existing discussions are still somewhat insufficient. With panel data of 31 provinces (autonomous regions and municipalities directly under the Central Government, excluding Hong Kong, Macao, and Taiwan) in China from 2013 to 2020 as the research sample, and a fully elaborated theoretical mechanism from such three aspects as the monopoly threshold effect between the platform economy and the urban–rural income gap, the moderating effect of rural human capital level, and the spatial spillover effects as the basis, this paper applies the threshold regression model, interactive model, and spatial lag model for empirical analyses of the possible impacts of the platform economy on eliminating urban–rural income inequality.

This study finds that the development of the platform economy will initially help reduce the income gap between urban and rural areas, and as the platform network effect and scale effect come into play, it will further reduce urban–rural income inequality. However, the deepening level of monopoly in the platform market may eventually increase the degree of urban–rural income inequality. The interaction model regressions show that the role of the platform economy in reducing the urban–rural income gap has a significant rural human capital moderating effect. An increase in the level of rural human capital will enhance the driving effect of platforms in reducing rural–urban income inequality. The analysis based on the spatial lag model shows that the development of the platform economy has positive spatial spillover effects on the urban–rural income gap, as well as positive impacts on narrowing the urban–rural income gaps in neighboring regions.

The contributions of this paper are as follows: (1) Expand the research approaches of existing literature. The existing literature focuses on analyzing whether the platform economy has narrowed or widened the inequality in urban–rural income distribution, with insufficient attention to the possible nonlinear relationship between the two. This paper introduces the angle of monopoly in the platform-based market and examines through empirical analyses the possible nonlinear effect of the platform economy at different levels of development on the urban–rural income gap. (2) Enrich the research content of the existing literature. This paper not only theoretically sorts out the action mechanism of the platform economy on urban–rural income distribution, but also conducts further quantitative analyses using relevant econometric models and data to make up for the deficiency in the existing empirical research. (3) Deepen the academic understanding of the existing literature. The understanding, absorption, and application of the platform representing a technological change and an economic model transformation of the human capital have been taken into account to reveal the moderating effect of the rural human capital level in the platform economy on the urban–rural income gap. A quantitative analysis of the spatial spillover effects of the development of the platform economy on the urban–rural income gap is conducted using a spatial econometric model. The results of the study are of positive guiding significance in reasonably bringing out the growth potential of the platform economy and effectively promoting balanced urban–rural development.

2. Theoretical Mechanism and Research Hypotheses

2.1. Nonlinear Effect of the Platform Economy on the Urban–Rural Income Gap

The Internet platform integrates fragmented data and breaks down "isolated information islands" to realize efficient data aggregation, and further acts on urban–rural income inequality through such mechanisms as the breaking down of urban–rural barriers, the upgrading of dominant industries, and innovation resource acquisition. Firstly, intangible barriers caused by the information divide between urban and rural areas restrict the free flow of factors between them and hinder rural access to fair development opportunities, making them a key inhibitor for balanced urban–rural development. The Internet platform realizes data sharing and breaks down information barriers between rural and urban areas by relying on big data and intelligent technology and taking advantage of the replicability and shareability of data, and through the efficient management and timely transmission of data and information [36]. It provides rural entrepreneurs with easy access to information, technology, and knowledge, improving the efficiency and targeted orientation of business startups and enabling thrifty innovation [37]. The embedding of platform technology will also enhance the flow efficiency of productive factors and resources between urban and rural areas, becoming an important medium for urban–rural connectivity that will promote the introduction of quality factors, the export of featured products, and integrated urban–rural developments.

Secondly, the Internet platform promotes the connectivity of market entities in all aspects of the agricultural industry chain and supply chain from multiple dimensions such as data, technology, and business, drives the digital transformation and upgrading of the industry chain, facilitates the reform of supply chains and industry chains between regions [38], and boosts the rural economy relying on characteristic industries. Supported by platforms such as the Big Data Development Center, intelligent meteorology, and the National Agricultural Science and Technology Service Cloud, new progress has been made in the construction of "Internet plus" agriculture, the platform-based management of the whole industry chain of agricultural seeding, warehousing, logistics, and sales has been realized, the transformation of extensive agricultural production to the refined one has been promoted, and the overall efficiency of agricultural production has been enhanced. With the support of the platforms, regions with comparative advantages in tourism have upgraded the quality of the tourist industry and precisely matched tourist supply and demand resources. Consumers use travel platforms to select attractions and make scientific and efficient travel route planning. Relying on the platforms, rural tourism

enterprises realize low-cost publicity, enhance rural tourism flow with matching supply and demand, and promote the growth of non-agricultural income. The platform-based development of the tourist industry will also expand the agricultural value chain, revitalize various productive factors, drive the employment transformation of the rural labor through industrial transformation and upgrading, and accelerate the flow of the labor force to the high-yield sectors [39], raising the income level of workers.

Finally, the vast amount of data and information available on platforms facilitates access to innovation resources in rural areas, accelerating the transfer of quality factors to rural areas. The wealth of technological innovation resources available on platforms will further promote the digital and intelligent transformation of competitive industries in rural areas, which in turn will increase the demand for professional and skilled personnel in agricultural product design, marketing planning, Internet maintenance, etc. Relying on competitive industries, more quality personnel, technology and capital reflow will be attracted to inject new thinking and ideas into agricultural production, which will in turn promote the scientific and efficient development of agriculture [40]. Under the positive feedback effect of resource agglomeration, rural areas will gather numerous innovation resources to drive the economic growth, which will in turn alleviate urban–rural income inequality.

Different from traditional businesses, the inherent property and operation mode of the platform economy tend to induce platform-based market monopolies. Platforms, with data as the core element, are characterized by diminishing marginal costs. A large capital investment is required at the initial construction stage of a platform, but after the platform is built to a certain scale, its marginal cost of providing services to additional customers tends to zero with the support of cloud computing technology [41], presenting a scale effect that goes beyond time, space, and geographical limitations. With the expansion of platform enterprises, they can fully integrate upstream and downstream resources, give full play to the scale effect, and gradually grow into a super platform, achieving incremental returns on scale and cost savings by virtue of "network externalities" [42], reducing platform service fees for agricultural products sellers, and improving their welfare. At the same time, the increase in platform revenue will increase technological research and innovation, improve service efficiency and optimize data and information sharing capabilities, creating positive feedback on information interaction, industrial upgrading and access to resources, and enhancing the positive effect of the platform economy on narrowing the urban–rural income gap. At this stage, the role of the platform economy in narrowing the urban–rural income gap has strengthened. When the market share of the platform expands further, the monopolistic manifestations such as data monopoly, algorithmic control, and price manipulation brought about by its lock-in effect on users at both ends of the platform will have a curbing effect on the balanced development of urban and rural areas [43]. Some large platforms make use of their own data, technology, and traffic advantages to control over small- and medium-sized enterprises and producers in rural areas and continue to raise the price of platform services by selling traffic, charging fees for technical services, etc., causing the surplus value of rural producers to shift to large platforms, and profit margins to be depressed gradually. Large platforms have disguised themselves as traditional middlemen, gaining high profits through monopolies, and the unbalanced distribution of profits has led to a widened urban–rural income gap. The platform-based technological changes are stimulating new industries and patterns of division of labor and creating numerous new jobs and work paradigms. Platform-based gig employment, represented by food delivery, domestic services, transportation and distribution, provides diversified and flexible employment opportunities and models for surplus rural labor. However, as platform monopolies gradually deepen, there is an imbalance between labor supply and demand on large platforms. The dependence of workers on the platforms and the exploitation of labor by capital are further intensified by the platforms using massive amounts of data and powerful algorithms. Underneath the appearance of flexibility and independence at work, there are extended working hours, suppressed wage levels, and

a lack of social security, which inhibit the income growth of the rural labor. Based on the above analysis, the following hypotheses are proposed in this paper:

Hypothesis 1 (H1). *Platform economic development has a monopolistic threshold effect on urban–rural income gap. The initial stage of the platform economy development will help narrow the urban–rural income gap through urban–rural information sharing, upgrading of advantageous industries, and access to innovation resources. With the development of the scale effect of platform enterprises and the emergence of monopolies, they will further contribute to the narrowing of the urban–rural income gap through resource integration, returns on scale, and promotion of R&D, but will eventually hinder the balanced development of urban–rural areas due to data monopoly and price manipulation.*

2.2. Rural Human Capital-Based Moderating Effect

The human capital level in rural areas is a key factor that determines whether the platform economy can promote balanced urban–rural developments. The endogenous growth theory and relevant researches suggest that the focus of reducing urban–rural income inequality lies in increasing the rate of rural human capital accumulation [44]. The integration of agricultural industry chains, digital upgrading, and technological innovation through Internet platforms all require a certain level of human capital support, but the left-behind rural human capital level is relatively low, which hinders the diffusion of technology and the improvement of industrial efficiency [45]. As the digital rural construction gradually advances, rural–urban differences in the human capital level will lead to different levels of absorption and application of digital and intelligent technologies, which will in turn affect the income enhancement and economic growth effect of the platform economy. When the rural human capital level is low, the absence of key human capital factors [46] can lead to inadequate learning and utilization of technology and information resources related to the platforms. The under-utilization of platform resources has resulted in the inability to attract quality platform enterprises and to fully release the dividends of platform economic development. Compared to rural areas, urban areas have a higher human capital level and better Internet infrastructure, and their full utilization of platform resources will effectively improve production and life efficiency. Recent years have seen a gradual increase in the flow of personnel from urban to rural areas, with more migrant workers and college graduates returning home to work or start their own businesses. When the level of human capital in rural areas gradually rises, it will provide highly skilled personnel with expertise in Internet technology, online store construction and marketing to promote the efficiency of absorbing platform resources, publicize digital technology in agriculture, and enhance rural e-commerce innovation and coverage, further promoting the income growth of rural workers, and enhancing the positive effect of the platform economy on reducing urban–rural income inequality. Based on the above analysis, the following hypotheses are proposed in this paper:

Hypothesis 2 (H2). *There is a moderating effect of the platform economy on the rural–urban income gap in terms of rural human capital. As the level of rural human capital rises, the role of the platform economy in narrowing the urban–rural income gap gradually increases.*

2.3. Spatial Spillover Effect of the Platform Economy on the Urban–Rural Income Gap

Firstly, platform enterprises, as major subjects of scientific and technological innovations, have a strong spatial spillover effect in terms of their technology and knowledge. The spillover of technology and management experience from the platforms will promote the upgrading of the technological innovation level of enterprises in neighboring regions, accelerate the substitution of capital factors for labor factors [47], optimize the allocation of productive factors among regions, drive up the level of regional innovation [48], and enable the growth of neighboring regions. The economic prosperity of surrounding urban

areas will lead to investment and booming consumer demand, bringing new opportunities for rural economic growth and promoting integrated urban–rural development. Secondly, platform enterprises can create new jobs through flexible employment, directly providing employment opportunities for surplus rural labor in neighboring regions [49]. The rural labor is gradually shifting to the emerging service industry, promoting the resource agglomeration and scale expansion of the service industry, and taking in more labor transferred from rural areas [50]. The rural labor, which originally had a low human capital level, obtains re-employment, and earns a non-agricultural wage that is higher than agricultural income, narrowing the urban–rural gap. The labor mobility further contributes to the diffusion of knowledge and technology and enhances the technology spillover effect. Finally, the development of the platform economy will help open up supply chains in neighboring regions, bring quality productive factors and featured products from rural areas into neighboring markets. The platforms strengthen the interaction and cooperation among enterprises based on their data advantages, build industrial clusters with characteristics of neighboring regions, integrate production chains, and realize integrated production. They also play a synergistic effect based on their regional advantages, driving up the scale and efficiency of regional industries. Based on the above analysis, the following hypotheses are proposed in this paper:

Hypothesis 3 (H3). *The development of the platform economy has a spatial spillover effect, which has a positive effect on narrowing the urban–rural income gap in neighboring regions.*

3. Development Status and Characteristic Facts

The following is a description of the development level of China's platform economy from three dimensions, i.e., the level of e-commerce transactions, information technology infrastructure, and digital rural construction, and it also provides an analysis of the changes in the urban–rural income gap in the provinces in recent years, with a view to intuitively understanding the development status of the platform economy and the urban–rural income gap.

3.1. Development Level of the Platform Economy

3.1.1. Level of E-Commerce Transactions

Figure 1 shows the trends in e-commerce sales, e-commerce purchases, and the number of enterprises engaged in e-commerce transaction activities from 2013 to 2020. As can be seen, since 2013, the scale of e-commerce transactions has shown a rapid growth, with the e-commerce sales and purchases totaling RMB 29.85 trillion in 2020. Enterprises have made significant achievements in digital transformation, showing an overall upward trend. As of 2020, the number of enterprises engaged in e-commerce transaction activities has been close to 124,600, accounting for 11.1% of the total number of enterprises. All the above indicate the gradual rise in the level of platform-based development of China's economy, which has become an important support for stable growth and structural adjustment.

In terms of per capita network retail scale, the size of China's platform-based market continues to grow, but there are still significant differences among provinces. As shown in Figure 2, the overall per capita network retail sales is higher in the eastern region than those in the central and western regions. Relying on abundant factor resources, sound information technology infrastructure, and transportation conditions, the platform-based market in the eastern region is active, with Shanghai, Zhejiang, and Guangdong alone accounting for 52.81% of the total network retail in China in 2020. The year-on-year growth rate of per capita online retail sales of physical commodities in the western region is higher than those in the eastern and central regions. In recent years, the western region has made great efforts to promote the platform construction and boost the development of featured and branded agricultural products, contributing to rural revitalization. With the advancement of e-commerce programs targeted at the entire rural community, express delivery to rural areas and others, the western region has accelerated the online sales of

agricultural products in virtue of platforms, bringing lots of local featured and branded agricultural products to the markets nationwide. Platforms such as Suning and East Buy carry out live commerce directly at the origin of agricultural products, seek featured agricultural products from various regions, and integrate featured agricultural products with regional culture to enhance brand attractiveness and to accelerate the sales of rural commodities in the markets nationwide, achieving the rapid growth of retail sales.

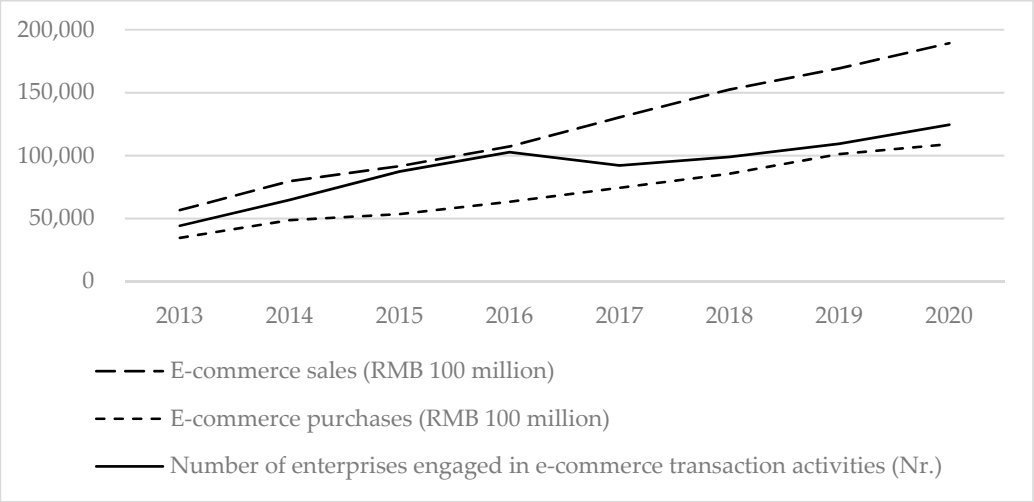

Figure 1. Level of E-commerce Development in China from 2013 to 2020. Note: Data for this and the following charts are from the China Statistical Yearbook and the EPS database.

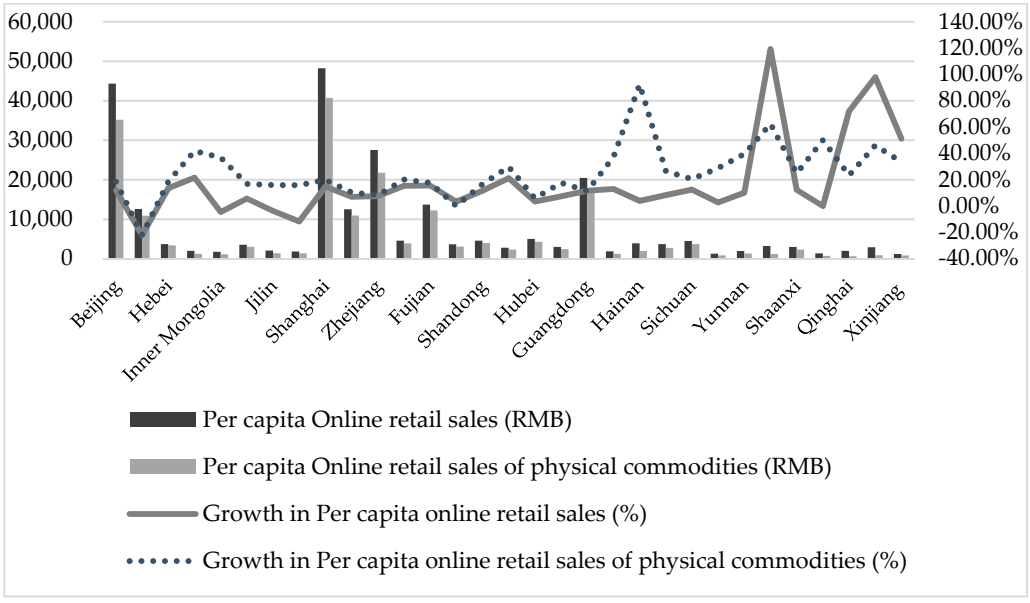

Figure 2. Per capita online Retail Sales, per capita online Retail Sales of Physical Commodities and Their Growth Rates by Province in 2020. Note: The eastern region of China includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central region includes Heilongjiang, Jilin, Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan; the western region includes Inner Mongolia, Guangxi, Chongqing, Sichuan, Tibet, Shaanxi, Guizhou, Yunnan, Gansu, Qinghai, Ningxia, and Xinjiang.

3.1.2. Construction of Information Technology Infrastructure

Figure 3 shows a comparison of the number of IPv4 addresses per capita and the number of Internet broadband ports per capita in China in 2013 and 2020, both of which show a growth trend. The level of infrastructure development in the eastern region is relatively high, with the number of Internet broadband ports per capita in areas such as Beijing, Shanghai, and Zhejiang being close to 1. A well-developed information technology infrastructure is an important foundation for the rapid growth of the platform economy in areas such as Beijing. Provinces such as Guizhou, Yunnan, and Gansu have a relatively weak information technology infrastructure and their Internet broadband ports per capita are at a relatively low level. Inadequate information technology infrastructure has affected the development of e-commerce, resulting in a level of platform development that lags behind those of the eastern and central regions.

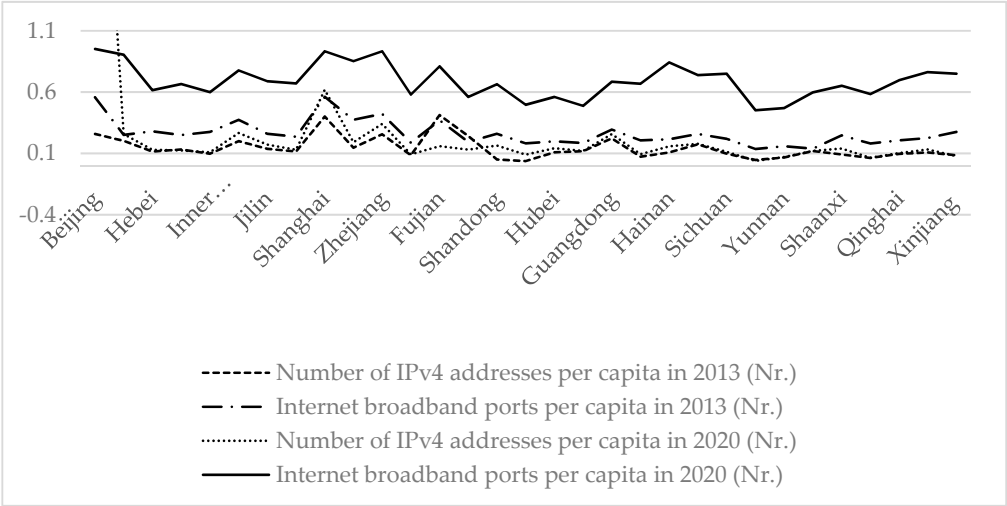

Figure 3. Level of Information Technology Infrastructure by Province in 2013 and 2020.

3.1.3. Digital Rural Construction

At present, China is advancing the e-commerce programs targeted at the entire rural community and promoting the integrated urban–rural development with the platform-based transformation as the focus. Figure 4 shows the rural network retail sales and the trend of year-on-year growth rate from 2014 to 2018. As can be seen, China's rural network retail sales has increased year by year, reaching RMB 1.79 trillion as of 2020, increasing from 6.45% in 2014 to 15.22% of the total. Table 1 further shows the number of netizens and the data on Internet broadband users in China in 2013 and 2020. The number of netizens and Internet users in rural areas exploded from 2013 to 2020, becoming an important factor in the popularization and application of rural e-commerce, which in turn promotes integrated urban–rural development.

Table 1. Number of Urban and Rural Netizens, Broadband Users, and Their Growth in China in 2013 and 2020.

	2013	2020	Growth Rate
Number of netizens (100 million)	6.18	9.89	60.03%
Wherein: Number of urban netizens (100 million)	4.41	6.8	54.20%
Wherein: Number of rural netizens (100 million)	1.77	3.09	74.58%
Internet broadband users (10,000)	18,890.9	48,355	155.97%
Wherein: Urban Internet broadband users (10,000)	14,153.61	34,165.3	141.39%
Wherein: Rural Internet broadband users (10,000)	4737.27	14,189.7	199.53%

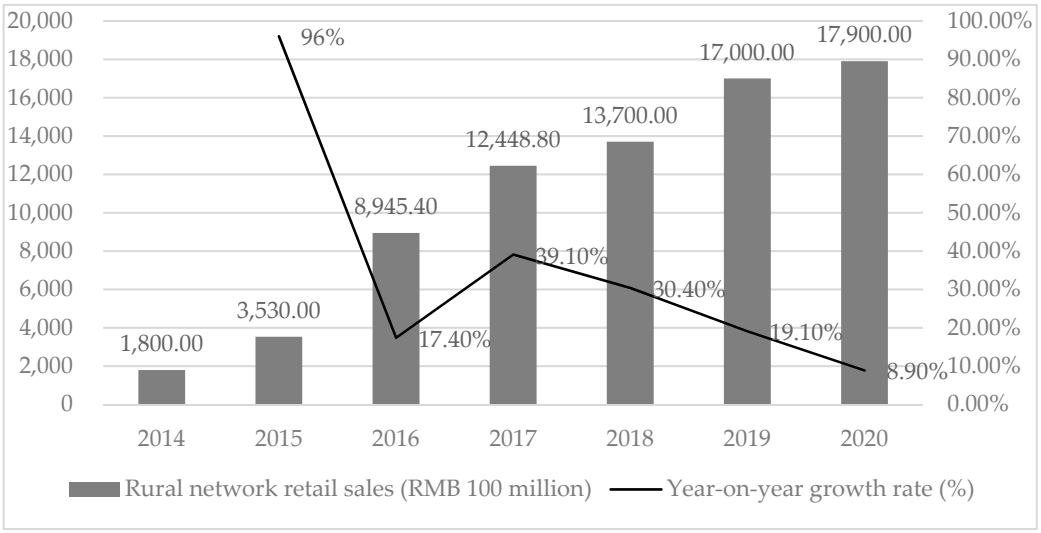

Figure 4. Rural Network Retail Sales and Its Growth Rate from 2014 to 2020.

3.2. Current Status of the Urban–Rural Income Gap

The urban–rural income gap is demonstrated with the urban–rural relative income ratio and the relative consumption ratio, with the trends since 2000 shown in Figure 5. As can be seen, the urban–rural income ratio first rises slowly, then remains high, and finally shows a downward trend, indicating that the urban–rural income gap tends to narrow and the pattern of integrated urban–rural development has been initially apparent. During the period from 2013 to 2020, the annual per capita disposable income of urban residents increased from RMB 26,467 to RMB 43,834, an increase of 65.62%. The annual per capita disposable income of rural residents increased from RMB 9430 to RMB 17,131, an increase of 81.66%, with a higher growth rate than that of urban residents. The urban–rural consumption ratio fell from 3.058 to 2.119, a decrease of 30.71%. At present, the penetration of online shopping in urban areas is close to saturation, while the demand for online shopping in rural areas continues to rise.

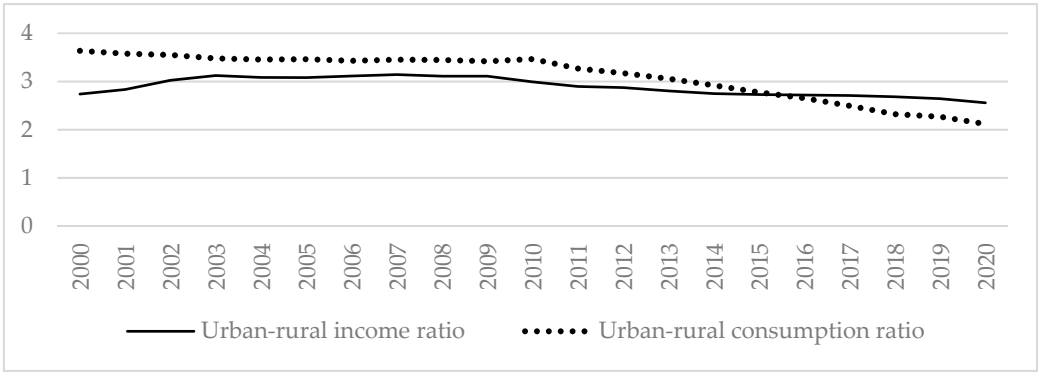

Figure 5. Urban–Rural Income Ratio and Consumption Ratio in China from 2000 to 2020.

Based on the urban–rural income gap in 2014, 2016, 2018, and 2020, respectively, in the provinces measured by the urban–rural relative income ratio in Figure 6, the urban–rural income ratio in the provinces has tended to narrow since 2014, converging with the trend of the overall urban–rural income ratio. The urban–rural income ratio is lower in the eastern region than that in the central and western regions.

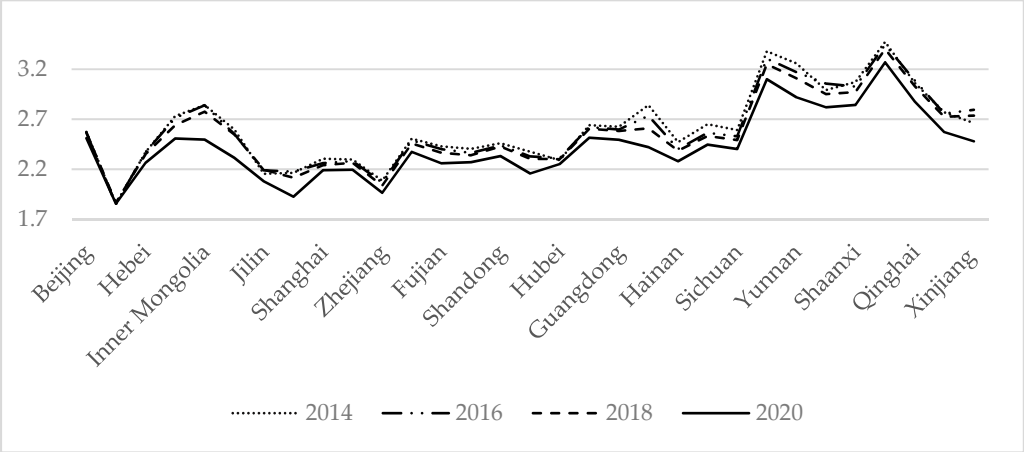

Figure 6. Level of Urban–Rural Income Gap by Province in China.

4. Study Design and Statistical Description

4.1. Model Setup

4.1.1. Baseline Regression Model

In order to analyze the possible nonlinear relationship between platform economy and urban–rural income gap, the following fixed effect model is constructed.

$$ig_{it} = \beta_0 + \beta_1 platel_{it} + \beta_2 platel_{it}^2 + \beta_3 x_{\mathrm{it}} + u_i + \varepsilon_{\mathrm{it}} \quad (1)$$

In Equation (1) i represents the province, t represents the year, the explained variable ig represents the urban–rural income gap, the core explanatory variable $platel$ represents the development level of the platform economy, and x_{it} is a set of control variables that may affect urban–rural income inequality, such as the opening up, government behavior, agricultural technology, infrastructure, and industrial structure. To examine the possible nonlinear effects of the development of the platform economy on urban–rural income inequality, a quadratic term for the platform economy is introduced into the model. u_i is the provincial fixed effect and ε_{it} is the stochastic disturbance term.

4.1.2. Threshold Regression Model

Based on the previous theoretical analysis and research hypothesis, this paper uses the level of monopoly as the threshold variable for the platform economy to influence the urban–rural income gap, and constructs the following panel threshold regression model with reference to the research method of Hansen [51]:

$$ig_{it} = \beta_0 + \beta_1 platel_{it} \cdot I(ml_{it} \le r_1) + \beta_2 platel_{it} \cdot I(r_1 < ml_{it} \le r_2) + \beta_3 platel_{it} \cdot I(ml_{it} > r_2) + \beta_4 x_{it} + u_i + \varepsilon_{it} \quad (2)$$

In Equation (2), r_1, r_2 is the threshold value to be estimated, $I(ml_{it} \le r_1)$,$I(r_1 < ml_{it} \le r_2)$ and $I(ml_{it} > r_2)$ are indicative functions, u_i is the provincial fixed effect, and ε_{it} is the stochastic disturbance term.

4.1.3. Interaction Model

The aforementioned theoretical analysis suggests that the impact of platform on the urban–rural income gap is influenced by the level of rural human capital, so this paper refers to the study of Brambor, Clark, Golder [52] to construct the following interaction model.

$$ig_{it} = \beta_0 + \beta_1 ig_{it-1} + \beta_2 platel_{it} + \beta_3 hr_{it} + \beta_4 platel_{it} \times hr_{it} + \beta_5 x_{it} + \varepsilon_{it} \quad (3)$$

In Equation (3), ig_{it-1} is the rural–urban income gap in the previous year, hr_{it} represents the level of rural human capital, and $platel_{it} \times hr_{it}$ is the interaction term between the platform economy and the level of rural human capital.

4.1.4. Spatial Lag Model

To further examine the spatial effect of the platform economy on the urban–rural income gap, the following spatial lag model is constructed to carry out the empirical analyses.

$$ig_{it} = \beta_0 + \rho W \times ig_{it} + \beta_1 platel_{it} + \beta_2 x_{it} + \varepsilon_{it} \quad (4)$$

In Equation (3), i represents the province, t represents the year, and ig represents the urban–rural income gap. $\rho W \times ig_{it}$ is used to examine the spatial correlation of the urban–rural income gap, ρ is the spatial correlation coefficient, and W is the spatial weight matrix. In this paper, a geographically binary proximity matrix is used, i.e., if two provinces are geographically adjacent, the value of 1 applies; otherwise, the value of 0 applies. x_{it} is the control variable. ε_{it} is the stochastic disturbance term.

4.2. Variable Selection

4.2.1. Explained Variable

Urban–rural income gap (ig). According to the existing indicators, the urban–rural income gap can be measured by such methods as the ratio of urban–rural per capita disposable income and the Theil Index [53]. The urban–rural per capita disposable income ratio is a widely used indicator by scholars studying urban–rural income disparity because of its rich data and its ability to visually reflect income change trends. The measurement of the Thiel index requires urban and rural population data. However, the urban and rural population data of some provinces in the current statistical yearbook are missing in some years. If the STATA linear interpolation method is used to complete all the data, it may cause estimation bias. In view of the above reasons, the ratio of per capita disposable income of urban residents to that of rural residents, i.e., the relative income, which is commonly used by scholars, is applied to represent the urban–rural income gap in this paper. The specific equation is as follows:

$$ig_{\mathrm{it}} = \frac{ui_{it}}{ri_{it}} \quad (5)$$

Wherein u_{it} represents the per capita disposable income of urban residents in i province in Year t, and r_{it} represents the per capita disposable income of rural residents in i province in Year t.

4.2.2. Core Explanatory Variable

Development level of the platform economy ($platel$). At present, the measures for the development level of the platform economy have not been unified. For example, in terms of the platform transaction scale, it is measured with the proportion of trade volume of industry e-commerce platforms in the total trade volume of e-commerce platforms [54]; alternatively, a comprehensive evaluation index of the platform economy is constructed from three aspects, i.e., platform infrastructure, platform network level, and platform product transactions [55]. In this paper, the development level of the platform economy is measured from three dimensions of platform-based infrastructure, platform-based transactions, and platform-based products, with reference to Ji Yuanyuan et al. (2022) [56]. The weights of the seven indicators are measured using the entropy method after eliminating dimensions of raw data in a standardized manner. The entropy method determines the weights of indicators based on the degree of variation in the values of the indicators, which is more objective and avoids errors brought about by human factors. The entropy method is also effective in identifying the intrinsic correlation between data, making it easier for decision makers to grasp the core objective information. The raw data are first standardized with the following equation: x_{it} represents the i th value of the indicator j.

$$T_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} + 0.000001 \quad (6)$$

In Step 2, calculate the entropy of indicator j:

$$h_i = -\frac{1}{\ln(n)} \sum_{i=1}^{n} \frac{T_{ij}}{\sum_{i=1}^{n} T_{ij}} \ln \frac{T_{ij}}{\sum_{i=1}^{n} T_{ij}} \tag{7}$$

In Step 3, calculate the variation coefficient λ_j of indicator j,

$$\lambda_{\mathrm{i}} = 1 - h_i \tag{8}$$

Finally, calculate the weight:

$$\omega_{\mathrm{i}} = \frac{\lambda_i}{\sum_{j=1}^{\mathrm{m}} \lambda_i} \tag{9}$$

According to the platform economy secondary index system to find the corresponding data, according to the above entropy value method formula to calculate the weight of each indicator, the weight calculation results are shown in Table 2, among which the per capita e-commerce transaction value, procurement value indicator, and Internet resources situation indicator occupy a larger weight, 18.54%, 19.52%, and 18.31%, respectively. The number of e-commerce platform enterprises and the Internet access situation have relatively low weights, at 9.04% and 3.84%, respectively.

Table 2. Weights of Platform Economy Indicators.

First-Level Indicators	Platform-Based Transactions			Platform-Based Infrastructures			Platform-Based Products
Second-Level Indicators	E-Commerce Transactions per Capita	E-Commerce Purchases per Capita	Number of e-Commerce Platform Enterprises	Internet Access	Internet Resources	Internet Number of Stations	Number of Express Packages per Capita for Internet Users
Weight	0.1854	0.1952	0.0904	0.0384	0.1831	0.1516	0.1559

Figure 7 shows the development level of the platform economy by province in 2014, 2016, 2018, and 2020. Since 2014, the development level of the platform economy in provinces has shown an upward trend in general.

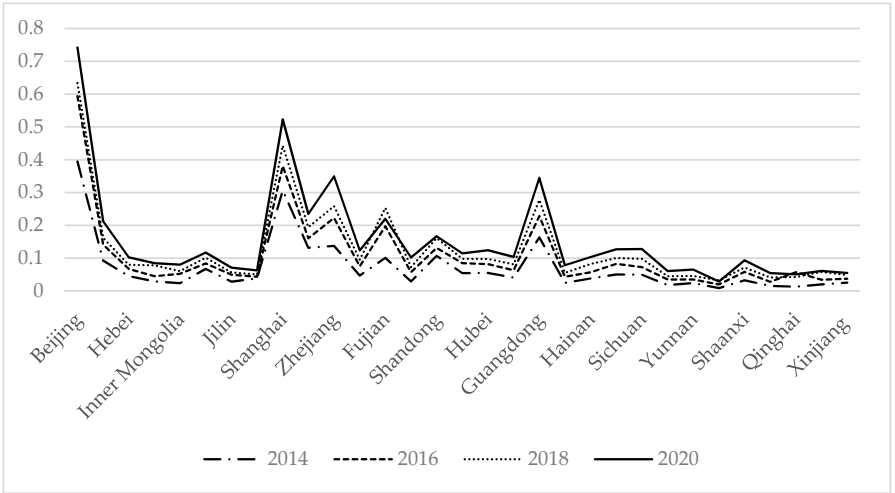

Figure 7. Development Level of the Platform Economy in Selected Years by Province.

4.2.3. Threshold Variable

Monopoly level (*ml*). The measurement of monopoly level mainly includes the state-owned economy share measure and the market concentration index measure. As this paper mainly uses provincial panel data, considering the uniformity of indicators and the availability of data, the proportion of the main business income of state-owned enterprises above the scale in each province to the main business income of industrial enterprises above the scale is used as a proxy variable for the level of monopoly by referring to the study of Peng Huan [57].

4.2.4. Interactive Variables

The level of rural human capital (*hr*), as measured by the number of rural junior high schools, is referred to in a study by Zhan Jing et al. (2022) [58]. A higher number of rural schools indicates that rural residents have more access to education and are more likely to acquire the basic skills needed for economic development on the platform.

4.2.5. Control Variable

Combined with existing researches, control variables such as openness, government behavior, agricultural technology level, infrastructure level, and industrial structure are incorporated. Among them, the openness (*open*) is measured with the proportion of total imports and exports to GDP. Government behavior (*gov*) is measured with the proportion of the total fiscal expenditure to GDP. The agricultural technology level (*ag*) is measured with the logarithmic value of the total power of agricultural machinery. Infrastructure level (bf) is measured with the proportion of the classified highway mileages to the population. The industrial structure (*ind*) is measured using the value added of the tertiary sector as a proportion of the value added of the secondary sector.

4.3. Data Sources and Statistical Description

Given that the statistics did not include information on enterprise informatization and e-commerce until 2013, the panel data of 31 provinces in China for the period from 2013 to 2020 are selected as the sample for this study. The data sources include the China Statistical Yearbook, the China Labour Economic Database, and the EPS Database. For the data with missing values, the STATA linear fit interpolation method is used to complete them uniformly. Table 3 provides a statistical description of the variables.

Table 3. Statistical Description of the Variables.

Variable Name	Variable Symbol	Sample Size	Mean Value	Standard Deviation	Minimum	Maximum
Urban–rural income gap	*ig*	248	2.568	0.364	1.845	3.556
Level of platform economy	*platel*	248	0.109	0.123	0.006	0.742
Monopoly level	*ml*	248	0.358	0.173	0.096	0.822
Rural human capital	*hr*	248	5.167	4.451	0.130	17.800
Industrial structure	*ind*	248	1.302	0.700	0.572	5.297
Openness	*open*	248	0.247	0.266	0.008	1.345
Agricultural technology level	*ag*	248	7.642	1.135	4.543	9.499
Infrastructure level	bf	248	0.004	0.004	0.001	0.027
Government behavior	*gov*	248	0.288	0.21	0.119	1.379

5. Empirical Results and Analysis

5.1. Preliminary Empirical Judgement

According to Figure 8, the effect of the platform economy on the urban–rural income gap forms a "U" shape, preliminarily verifying the nonlinear relationship between the platform economy and urban–rural income inequality. On the basis of the preliminary characterization of the relationship between the two, empirical analyses are carried out specifically through the econometric analysis.

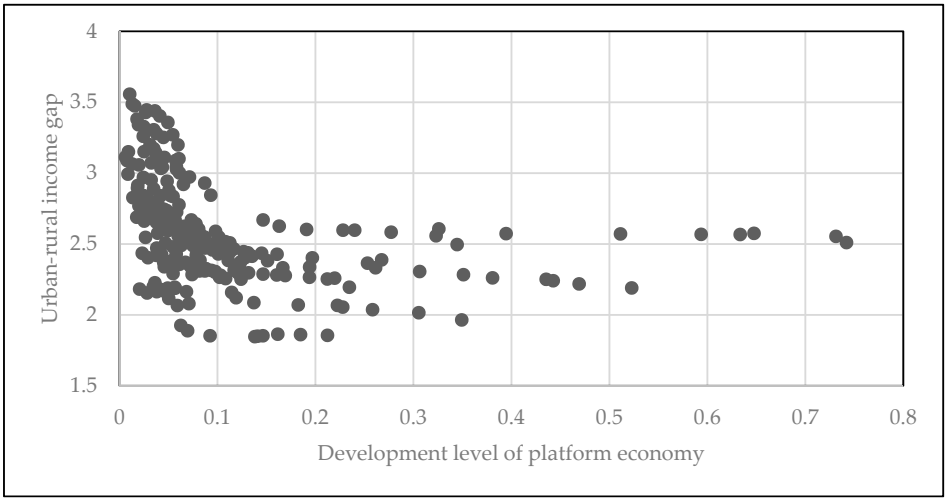

Figure 8. Preliminary Empirical Judgement on the Platform Economy and the Urban–Rural Income Gap.

5.2. Nonlinear Effect of the Platform Economy on the Urban–Rural Income Gap

Both the theoretical analysis and the scatter plot suggest that there may be a nonlinear relationship between the platform economy and the urban–rural income gap. Specifically, the driving effect of the platform economy at the initial stage of development on the balanced urban–rural development may shift with the expansion of platform size and the emergence of market monopolies. Table 4 shows the results of fixed effect regressions with the introduction of the quadratic term of the platform economy into the model. Model (1) is the regression result without control variables. Models (2) to (6) introduce openness, government behavior, agricultural technology level, infrastructure level, and industrial structure as control variables in sequence. The regression results show that the primary coefficient of the platform economy is significantly negative, and its quadratic coefficient is significantly positive, suggesting that there is a "U"-shaped relationship between the development of the platform economy and the urban–rural income gap. However, the introduction of quadratic regressions is strictly symmetric and cannot accurately portray the specific impact of changing levels of platform development on the urban–rural income gap, so this paper constructs a panel threshold model to carry out further analysis.

Table 4. Nonlinear Regression Results of the Platform Economy and the Urban–Rural Income Gap.

Model	(1)	(2)	(3)	(4)	(5)	(6)
platel	−2.227 ***	−2.264 ***	−2.252 ***	−2.282 ***	−1.883 ***	−1.274 ***
	(0.369)	(0.387)	(0.397)	(0.392)	(0.350)	(0.248)
$platel^2$	2.145 ***	2.060 ***	2.048 ***	1.963 ***	1.372 ***	1.336 ***
	(0.468)	(0.458)	(0.486)	(0.507)	(0.338)	(0.233)
open		−0.092	−0.0915	−0.115	−0.243 **	−0.163
		(0.136)	(0.136)	(0.134)	(0.109)	(0.104)
gov			−0.034	−0.012	−0.123	0.196
			(0.362)	(0.356)	(0.278)	(0.295)
ag				−0.066	−0.046	−0.029
				(0.062)	(0.056)	(0.052)
bf					−31.38 ***	−27.64 ***
					(10.37)	(6.121)
edu						−0.125 ***
						(0.038)
cons	2.753 ***	2.782 ***	2.791 ***	3.297 ***	3.313 ***	3.152 ***
	(0.029)	(0.060)	(0.126)	(0.501)	(0.444)	(0.417)
Provincial fixed	YES	YES	YES	YES	YES	YES
N	248	248	248	248	248	248
R^2	0.441	0.444	0.444	0.452	0.543	0.607

Note: *** represent significance at the 1% levels. The values in parentheses are the standard deviations of the regression. The same below.

5.3. Analysis of the Threshold Effect

Using the level of monopoly as the threshold variable, the test statistic *F*-value and the corresponding *p*-value were obtained by repeated sampling to further test the aforementioned theoretical Hypothesis 1.

5.3.1. Threshold Effect Test and Determination of the Threshold Value

The threshold effect was first tested under the triple threshold hypothesis and the results are shown in Table 5. The results of the triple threshold test were not significant when the monopoly level was used as the threshold, while the double threshold was significant at the 5% level, so the existence of a double threshold was determined. Table 6 shows the regression results for the double threshold, which shows that the first threshold is 0.411 and the second threshold is 0.515.

Table 5. Threshold Effect Test.

Threshold Variable	Model	*F*-Value	Prob	Number of BS Times	Critical Value		
					1%	5%	10%
Monopoly level	Single threshold	28.46	0.050	300	36.778	28.210	21.081
	Double threshold	27.38	0.013	300	29.530	20.686	18.850
	Triple Threshold	8.67	0.490	300	43.405	25.908	19.898

Table 6. Threshold Estimates and Confidence Intervals.

Threshold Variable	Model	Threshold Value	95% Confidence Interval
Monopoly level	Single threshold	0.411	[0.409, 0.422]
	Second threshold	0.515	[0.513, 0.526]

5.3.2. Analysis of Threshold Regression Results

The results of the threshold regression are shown in Table 7, which shows that the platform can significantly reduce the urban–rural income gap when the platform market monopoly level is below the first threshold value of 0.411. With the gradual advancement of the digital rural construction, platforms for e-commerce, logistics, technology services, intelligent agriculture, innovation, and entrepreneurship have been established one after another, bringing equitable development opportunities to the rural areas and promoting the digital transformation of industries and the enhancement of human capital. Laborers can find jobs quickly and at low cost through recruitment information platforms. Platforms such as Zhaopin.com and Zhipin.com break the restrictions of time and space based on digital intelligent technology, enabling online communication between workers and recruiters and precise matching of supply and demand, to address the employment of surplus rural labor. In addition, the development of the platform economy has given rise to new positions such as livestreaming marketing hosts, operators, trainers, and digital administrators, providing rural residents with more opportunities for innovation and entrepreneurship and boosting their income from wage and salary. Comprehensive platform-based supervision of the agricultural industry chain will improve the agricultural production efficiency, reduce the labor input required per unit of land, shift labor to non-agricultural employment to achieve diverse businesses, increase the overall income level of rural residents, and promote balanced urban–rural development.

Table 7. Threshold Regression Results.

Explanatory Variable	Coefficient	*t*-Value	95% Confidence Interval
$platel_{it} \cdot I(ml_{it} \leq r_1)$	−0.295 *	−1.87	[−0.616, 0.027]
$platel_{it} \cdot I(r_1 < ml_{it} \leq r_2)$	−1.435 ***	−4.48	[−2.089, −0.782]
$platel_{it} \cdot I(ml_{it} > r_2)$	0.398 *	1.76	[−0.064, 0.859]
cons	2.751 ***	26.63	[2.540, 2.962]

Note: *** and * represent significance at the 1% and 10% levels, respectively.

When the level of monopoly is between the first and second thresholds, the platform economy can still significantly reduce urban and rural income inequality, and the effect is stronger at this point. Platforms are characterized by diminishing marginal costs, and their large sizes and rich data can provide a better user experience. The super platform is able to achieve cost savings by integrating platform resources, improving the business chain and restructuring the internal structure of the enterprise to give full play to the scale effect by virtue of its monopoly position in the market. The platform will maintain its monopoly position by increasing technological innovation and research and development and optimising service effectiveness. It further enhances the platform's ability to break down information barriers, upgrade advantageous industries, and access innovation resources, thus making the platform's role in narrowing the income gap between urban and rural areas even stronger.

However, when the monopoly level crosses the second threshold of 0.515, the platform economy has an inhibiting effect on the balanced development of urban and rural areas, and the aforementioned hypothesis 1 holds. Large platforms continue to raise the prices of their services by virtue of their market power, gradually evolving into rent-collecting platforms [59]. They absorb the surplus value of platform enterprises in rural areas and cut down the profits of agricultural producers, causing a widening of the urban–rural income gap. Although the flexible forms of employment provided by platform enterprises have expanded the employment opportunities for a large number of migrant workers, their market and data monopoly continue to depress the salary of laborers, causing a widened capital–labor distribution gap. The share of labor in the income distribution has gradually decreased, causing a widened urban–rural income gap.

5.4. Analysis of Interaction Effects

Table 8, column (1) shows the results of the systematic GMM regression of the platform economy on the urban–rural income gap without the interaction term, which shows that the coefficient of the platform economy on the urban–rural income gap is −0.620, which is significant at the 1% level, indicating that the platform economy can reduce urban–rural income inequality. The regression results of the interaction effect in column (2), with the introduction of the lagged term of the explanatory variable to eliminate endogeneity, show that the regression coefficients of the interaction terms of the platform economy, the platform economy and rural human capital are all negatively significant, indicating that as the level of rural human capital increases, the role of the platform economy in narrowing the urban–rural income gap gradually increases, and the aforementioned Hypothesis 2 holds.

The different average education levels of urban and rural residents have led to differences in the degree of integration with the platforms between urban and rural areas. In the 2019 No. 1 Central Document, it was proposed to implement a digital rural construction strategy, promote the construction of big data in the agricultural industry chain, and push forward the progress of the "Internet plus" program of "delivering agricultural products to urban households from rural areas". In recent years, e-commerce programs targeted at the entire rural community have been accelerated, various types of information technology infrastructures have been improved, and platforms such as Big Data Development Center, Ministry of Agriculture and Rural Affairs of the People's Republic of China, intelligent meteorology, and entrepreneurial services have been established, promoting the digital transformation of rural characteristic industries. With the popularization and application of

e-commerce in rural areas, more rural residents have participated in e-commerce training to enhance their e-commerce application skills. With the continuously improved rural human capital level, rural residents could complete e-commerce activities such as agricultural product promotion, marketing and planning, and live commerce, which can reduce the circulation cost of agricultural products and create jobs for the surplus labor in rural areas. The human capital accumulation will increase the payments of rural laborers and improve urban–rural income inequality [60]. Platforms will lay a foundation for industry revitalization, talent development, and prosperity in rural areas and balanced urban–rural development.

Table 8. Regression results for interaction effects.

Variable	(1)	(2)
l.ig	1.045 ***	0.971 ***
	(0.165)	(0.023)
platel	−0.620 ***	−0.102 ***
	(0.174)	(0.026)
hr		0.006 ***
		(0.002)
platel × *hr*		−0.044 ***
		(0.012)
Constant	1.164 *	0.079
	(0.605)	(0.059)
AR (2)	0.592	0.416
Hansen Test	0.138	0.119
Control variable	YES	YES
Observations	186	186

Note: *** and * represent significance at the 1% and 10% levels, respectively.

5.5. Spatial Lag Model Analysis

5.5.1. Spatial Autocorrelation Test

Previous studies have shown that variables such as income have significant spatial spillover effects. Therefore, a global Moran test is made on urban–rural income gap indicators before the regression, and regression results are shown in Table 9. Moreover, 2013–2020 refers to the income gap indicator of the province in the corresponding year. Regression results show a significance for all *p*-values, indicating the existence of an influencing factor with spatial autocorrelation in the stochastic disturbance term of OLS regression and the necessity for a spatial econometric regression analysis.

Table 9. Moran Test Results.

Variable	I	E(I)	sd(I)	z	*p*-Value
2013	0.427	−0.033	0.118	3.893	0.000
2014	0.421	−0.033	0.118	3.841	0.000
2015	0.448	−0.033	0.119	4.057	0.000
2016	0.438	−0.033	0.119	3.975	0.000
2017	0.424	−0.033	0.118	3.863	0.000
2018	0.409	−0.033	0.118	3.740	0.000
2019	0.388	−0.033	0.118	3.579	0.000
2020	0.356	−0.033	0.118	3.309	0.001

5.5.2. Moran Scatter Plot

Figure 9 shows the partial Moran scatter plot of the urban–rural income gap in 2020 (b8 refers to the year 2020). The figure shows a relatively small urban–rural income gap in developed provinces and their neighbor provinces, indicating a positive spatial spillover effect of the urban–rural income gap.

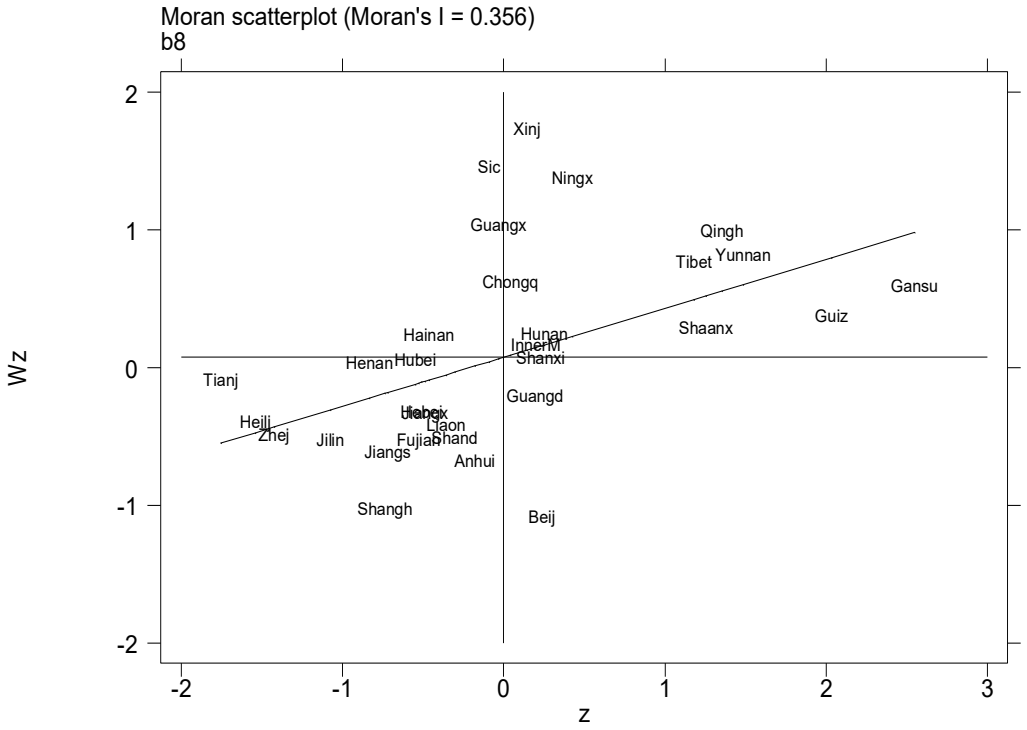

Figure 9. Moran Scatter Plot.

5.5.3. Selection of Spatial Econometric Model

In this paper, a spatial LM test and a robust LM test were conducted to further verify if the spatial econometric analysis is superior to the OLS regression and to select the spatial model, and the regression results are shown in Table 10. If the regression results show that the LM test for spatial lag and the robust LM test are significant, but the test for spatial error is not significant, then the spatial lag model is chosen; if the LM test for spatial error and the robust LM test are more significant than the spatial lag, then the spatial error model is chosen. If both tests are significant, then the spatial Durbin model is chosen. As can be seen from the table below, the LM test for spatial error is not significant, and the LM test for spatial lag and the robust LM test are both significant, so the spatial lag model is chosen for this paper. The Hausman Test was used in this paper to make a selection from fixed effect and random effect, and the latter is chosen based on the regression results.

Table 10. Spatial LM Test Results.

Test	Statistical Quantity	Degree of Freedom	*p*-Value
Space error:			
Moran's I	1.784	1	0.074
LM test	2.536	1	0.111
Robust LM test	31.789	1	0.000
Spatial lag:			
LM test	24.250	1	0.000
Robust LM test	53.503	1	0.000

5.5.4. Regression Analysis of the Spatial Lag Model

The random effect spatial lag model regression is carried out in this paper to check if the development of the platform economy could close the urban–rural income inequality, and the regression results are shown in Table 11. Column (1) shows that the coefficient of platform economy on urban–rural income gap is −0.263, with a significance at the 5% level. It indicates that as the platform economy develops, the urban–rural income gap gets narrower. The results include a significance at the 1% level of spatial correlation coefficient

rho, indicating a significant spatial spillover effect of the development of the platform economy on neighboring regions. To further analyze the spatial effect of platform economy on closing the urban–rural income gap, the effect decomposition is carried out on the spatial regression results in this paper, with the results shown in Columns (4), (5), and (6) in Table 11. The regression results reveal the direct influence of local platform economy and the indirect influence of platforms in neighboring regions on urban–rural income gap and validate the above-mentioned Hypothesis 3. Column (4) shows a direct effect, indicating that the development of the platform economy has significantly narrowed the urban–rural income inequality. Column (5) shows the indirect effect of the development of platform economies in neighboring regions on the local urban–rural income gap, with a coefficient of −0.811 indicating that it significantly contributes to the balanced development of local urban–rural areas. As technology and knowledge have strong spatial spillover, platform enterprises in neighboring regions provide opportunities for rural development through imitation and cooperation, data sharing, and collaborative research and development, which promote higher levels of technological innovation and industrial transformation. The platform economy provides flexible jobs for surplus rural labor in neighboring areas, easing the pressure on the job market and promoting income growth for residents. The platform also enables the spatial reconstruction of industrial chains in neighboring areas, realizes the integration of rural industries and complementary advantages, and develops synergistically to bring into play the scale effect and boost the rural economy.

Table 11. Regression Results of Spatial Lag Model.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	**Main**	**Spatial**	**Variance**	**Direct Effect**	**Indirect Effect**	**Total Effect**
platel	−0.263 ** (0.133)			−0.329 * (0.173)	−0.811 * (0.483)	−1.140 * (0.640)
rho		0.770 *** (0.048)				
lg*t_theta*			−3.135 *** (0.185)			
*sigma*2_*e*			0.001 *** (0.000)			
cons	0.758 *** (0.281)					
Control variable	YES	YES	YES	YES	YES	YES
N	248	248	248	248	248	248
$R-squared$	0.228	0.228	0.228	0.228	0.228	0.228

Note: ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

6. Conclusions and Suggestions

6.1. Conclusions

Based on emerging technologies such as big data, cloud computing, and the IoT, the platform economy has performed key functions in optimizing resource allocation and developing consumption potential and has become a major engine for economic growth and a balanced urban–rural development. Platform, a production and lifestyle changer, has become an important medium between rural and urban areas, the non-virtual and the virtual world, the brick-and-mortar world and the Internet, and also a key engine that innovatively leads the development of the real economy. Based on previous researches, the threshold regression model, interactive model and spatial lag model are built in this paper for the empirical analyses of the specific impact of the platform economy on the urban–rural income gap. The main conclusions of this paper are as follows: (1) There is a monopoly threshold effect of the platform economy and the urban–rural income gap. The initial development of the platform can improve urban–rural income inequality, and the

scale and network effects of the platform will further enhance its positive effect of reducing urban–rural income inequality. However, as the level of platform development gradually rises, the monopoly of large platforms based on technology, capital, and flow advantages will deepen, which will inhibit the balanced development of urban and rural areas. (2) The influence of platform economy on narrowing urban–rural income inequality is dependent on rural human capital. As the level of rural human capital rises, the positive effect of the platform economy on reducing the urban–rural income gap gradually strengthens. (3) The development of the platform economy has a spatial spillover effect on the urban–rural income gap and could also facilitate the narrowing of the gap in neighboring regions.

6.2. Suggestions

The following suggestions are made to fully leverage the growth-facilitating effect of the platforms and to narrow the urban–rural income inequality:

(1) Complete the system and norms of platforms to ensure sound development. The expansion of a platform will gradually add to its monopoly, which will reduce the share of labor and then affect the income distribution. Therefore, comprehensive supervision on platform-based market access, operation, and competition shall be strengthened to build a collaborative governance based on governmental leadership, self-inspection of enterprises, and the public supervision. A blacklist system shall be established to force fair competition among enterprises. The institutional mechanism shall support the platform economy to fully leverage its growth potential.

(2) Improve the rural human capital level to build an engine for economic growth. Efforts can be made to aggressively promote the e-commerce programs targeted at the entire rural community, organize micro-classes and Mooc and the like in e-commerce to improve the knowledge and skills of rural residents; increase investment in the platform economy to find a balance among the introduction of high-quality platform enterprises, information technology infrastructure improvement, and preferential policies; attract university graduates to start up their own businesses or work in their hometowns through talent introduction and other means to introduce new ideas and technologies to rural areas, support rural human capital level improvement, and promote a balanced urban–rural development.

(3) Optimize platform cooperation in neighboring regions to take full advantage of the spillover. The spatial spillover effect of the platform economy is becoming more and more obvious. Therefore, the trans-regional cooperation of the platform economy shall be strengthened with exchange platforms built for the platform operators and operators on the platform to interact and share information with each other. Practical cooperation shall be enhanced in industries such as production and manufacture, consumption and people's livelihood, and industrial clusters with regional characteristics shall be built based on platform cooperation to construct complexes for rural revitalization. Attention can be paid to speed up the flow of capital, talent, and other elements in neighboring regions to reasonably allocate the element and support regional technological innovation for common interests.

6.3. Limitations and Future Directions

There are two limitations to this paper. Firstly, the data in this study span a short period of time and the provincial panel data used are macro in nature. The platform economy in the digital era is exploding, and by far, limited statistics are available about enterprise informatization and e-commerce. As platforms develop rapidly, the dynamic studying of the impact of the platform economy on the urban–rural income gap based on more sample and data will catch on. Secondly, the system of urban–rural income gap indicators in this paper is not yet complete and could be enriched. The different costs for urban and rural residents to access to public services caused by the current gap in urban–rural public services and medical care, and the suppression of invisible welfare of

rural residents due to the same reason, shall be taken into consideration in future researches while defining the indicators of the urban–rural income gap.

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