Journal of Economic Analysis 2023 2(4) 1-30

Journal of Economic Analysis

Homepage: https://www.anserpress.org/journal/jea

Ways to improve cross-regional resource allocation: Does the development of digitalization matter?

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ABSTRACT

The long-term extensive economic development has caused China's resource and environmental problems, especially the resource misallocation. The way China prioritises its limited resources is being significantly impacted by the rise of the digital economy and the interconnectedness of new technologies and the real economy. This paper quantitatively examines the linear and nonlinear impacts and mechanisms of digital development represented by internet development. With a series of empirical tests, we found that the internet development has significantly inhibited the resources misallocation, and the conclusion is still valid in the robustness test with internet popularization and internet infrastructure as the core explanatory variables. In addition to the marketization, internet development can further inhibit resource misallocation by promoting financial development, openness, urbanization and industrial structure. The findings of threshold regression suggest that the inhibitory effect of internet growth on resource misallocation becomes more visible as the degree of financial development and industrial structure increases; with the higher degree of urbanisation and marketization, although the internet development has always played an inhibitory role on resource mismatch, the inhibitory effect first increases and then decreases; with the improvement of openness, the hindering impact of internet growth on resource mismatch becomes more visible as the degree of financial development and industrial structure increases.

KEYWORDS

Internet development; Resource misallocation; IV estimation; DID; China

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ISSN 2811-0943
doi: 10.58567/jea02040001

Received 1 April 2023, Accepted 3 June 2023, Available online 9 June 2023, Version of Record 15 December 2023

1. Introduction

China's economy has taken a giant leap forwards and is now the second largest economy in the world after undergoing fast development for over 40 years as a result of the country's reform and opening-up policies. Despite this, the prior model of extensive growth cannot be applied to China's economy at its current level of development because it is no longer appropriate. To improve the effectiveness of resource distribution, it is necessary to change it into a new growth model. According to the report presented at the 19th National Congress of the Communist Party of China, the Chinese economy has transitioned from an era of rapid expansion to a rapid growth. This was one of the key takeaways from the report. The key challenge facing China's ongoing economic development is to foster high-quality economic growth.

Promoting development is the core issue of China's economic development. It is also a critical component of establishing a modern economic system. However, in the past, the long-term extensive economic growth model has not only placed multiple constraints on China's economy, such as resource and environmental constraints, but has also caused structural problems, such as resource misallocation between regions, industries, and departments and overcapacity (Wei and Li, 2017). The decrease in the efficiency with which resources are allocated will have an impact on both the immediate and distant output mode of the economy, which will provide a significant challenge to the long-term viability of the economy. If there is a misallocation of resources, it can have a large negative influence on the productivity and output of the entire economy (David and Venkateswaran, 2019). A misallocation of labor will aggravate the imbalance of labor mobility between regions, thereby expanding the imbalance of economic development among regions (Banerjee and Duflo, 2005). Therefore, in order for China to successfully shift its mode of economic development and achieve development, it is now necessary for the country to take effective action to address the issue of resource misallocation.

Research is thus focusing on how to restrain the misallocation of resources. Banerjee and Moll (2010) and Restuccia and Rogerson (2013) considered that under relatively closed conditions, a country could benefit from optimising the flow and allocated of production inputs like capital and labour in order to reduce resource misallocation. With the continuous opening of a country's economy to the outside world, it can partake in the international market by means of foreign direct investment and boost the optimal allocation of resources. The rapid development of the Internet has become intertwined with the real economy, leading the digital and real economies to support each other, which has profoundly affected China's resource allocation methods. In particular, the Internet has played a very significant role in the recent wave of technical and industrial shifts that have taken place around the world. The internet is also intertwined with society, the economics, and a variety of other disciplines. The Internet has an important and far-reaching impact on the processes of acquiring information, allocating resources, and doing international business. As an important form of infrastructure, the Internet not only directly but also indirectly affects the circulation and allocation of resource elements by affecting the overall market environment, financial market development, and international openness to improve China's resources. In accordance with the 45th Statistical Report on Internet Development in China, by March 2020, the number of Internet users in China had reached 904 million, placing it first in the world, and the Internet penetration rate had come to 64.5%. On the basis of this, it is an interesting question to consider whether the growth of the Internet can prevent China from misallocating its resources. In addition, what exactly is the process by which resource misallocation is affected by the use of the internet? Does China's resource distribution seem to be affected to a significant degree by the Internet? Given China's acute resource misallocation problem, it is crucial to analyse the relationship between the development of the Internet and resource misallocation at a time when the growth of the Internet is closely tied to China's social and economic growth. It is also essential to formulate rational and reasonable Internet and economic development policies that enhance the optimal allocation of resources. This is especially crucial at a time when the development of the Internet is closely tied to China's economic and social progress.

The main contributions of this paper are: i) It investigates the connection between the growth of the Internet and the misallocation of resources; ii) It builds a system of assessment for the level of Internet development based on four dimensions: internet popularisation, internet facilities information resources and applications. The next step is to measure and assess the level of development achieved by China's internet using the entropy method. Adopting the five perspectives of financial development, marketization, openness, urbanization and industrial structure, we test the transmission mechanism from Internet development to resource misallocation and further study their nonlinear relationship.

The remaining portions of the article are organised as shown below: In the second portion, we will go over the prior research, and in the third section, we will talk about the transmission mechanism that underlies how the development of the Internet effects resource misallocation. The techniques and the findings are discussed in the fourth part. The findings are presented in the fifth section, along with a discussion of them, and the conclusions of the research as well as some proposals for policy are presented in the last section. See figure 1 for details.

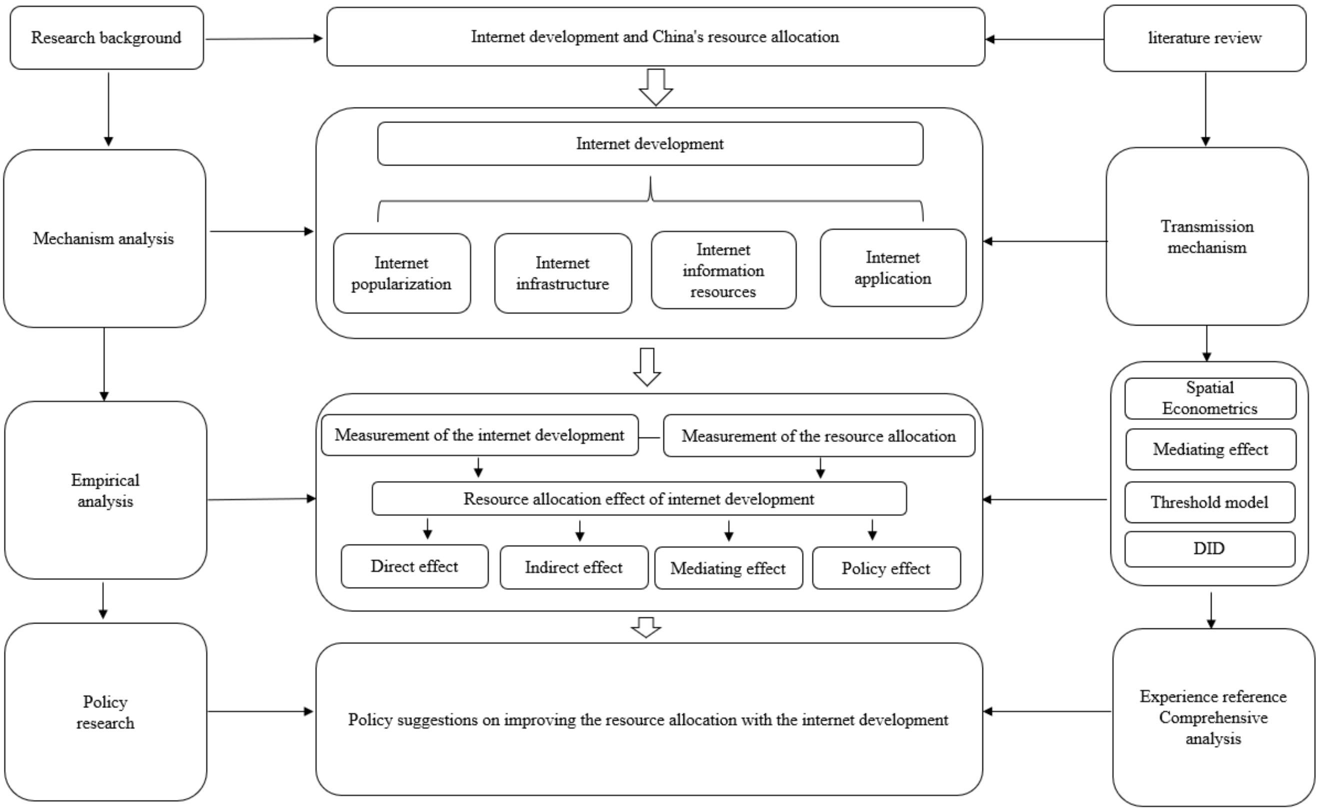

Figure 1. Research Framework.

2. Literature review

Resource misallocation is generally discussed relative to the efficient allocation of resources. According to economic theory, “effective allocation” refers to a state of allocation that maximizes output under the constraints of limited resources, while “misallocation’’ is a deviation from this ideal state. As found in the existing literature, scholars have conducted in-depth researches on the problem of resource allocation. In the research, it is only possible to observe the actual resource allocation status and not the “effective allocation” status, making it arduous to measure the degree of “misconfiguration’’ and the effects it has on TFP (TFP) by reducing operations and increasing the output gap. There are two main approaches to resource misallocation. The first sees some distortion in the economy as the main source of misallocation. By applying the heterogeneity model, the degree and influence of misallocation can be directly obtained, such as in Hopenhayn and Rogerson's (1993) measurement of the impact of misallocation caused by dismissal cost. The second approach expresses all possible distortions as a "tax wedge" added to the price. By comparing the balanced configuration with the twisted "wedge" and the balanced configuration without the "wedge", the size of the "misconfiguration" and its impact can be described. Based on this view, Hsieh and Klenow (2009) defined resource misallocation was first conceptualised and measured using the framework of the *Cobb-Douglas* production function with constant returns to scale, which defined output distortion and capital distortion.

Regarding the connection between resource misallocation and TFP, Jones (2011) proposed that on the micro level it typically results in a decrease in TFP on the macro level. Hsieh and Klenow (2009) used microdata of Chinese and Indian manufacturing companies and found that if capital and labor are redistributed so that the marginal product achieves the level observed in the United States, then China's manufacturing TFP gains will increase by 30-50%, and those of India will increase by 40-60%. Bartelsman et al. (2013) found that the output of China and Eastern European countries could increase by approximately 15% simply by correcting the misallocation of resources. Brandt et al. (2013) found that China's nonagricultural sector lost up to 20% in TFP due to the misallocation of capital and labor, and credit discrimination between state-owned enterprises and nonstate-owned enterprises led to an increase in capital misallocation. Calligaris (2015) found that the problem of resource misconfiguration in Italy has been alleviated, which can greatly improve TFP. Ryzhenkov (2016) studied a dataset of 47,497 unique enterprises in the Ukrainian manufacturing industry from 2002 to 2010 and found that the Ukrainian manufacturing industry experienced serious resource misallocation. If all market distortions could be eliminated, the productivity of its manufacturing industry would potentially see a threefold increase.

There are many causes of resource misallocation, but academics are more likely to believe that it is not the outcome of a single factor but rather stems from a combination of political processes, institutional arrangements, technological progress, and resource allocation. Although there are many causes of resource misallocation, scholars are more likely to believe that resource misallocation is not the result of a single factor(including the equilibrium result for the interaction of physical capital, human capital, technological innovation, and natural resources (Acemoglu et al., 2002)). Adamopoulos and Restuccia (2014) investigated the inequitable distribution of farms within the agricultural sector in order to better understand the factors that contribute to low agricultural output in less developed nations. They found that inheritance rules, agricultural subsidies and progressive taxes, land reforms and lease restrictions are all potential sources of distortions in the scale of agriculture in poor countries. Moll (2014) and Hirakata and Sunakawa (2019) found that financial frictions will affect capital misallocation and total productivity in the short term. Wu (2018) believed that financial friction would lead to an overall loss of 8.3% in TFP, which accounts for 30% of China's capital allocation errors. Piao et al. (2016) found that financial liquidity and financial pledges were the main factors affecting the misallocation of funds in listed companies. Bian et al. (2019) indicated that market segmentation seriously exacerbated the misallocation of labor and capital resources. Hao et al. (2020) believed that local corruption may exacerbate the suppression effect of the improper allocation of labor resources on GTFP. Jovanovic (2014) held the belief that the misallocation of labour is caused by information asymmetry in the labour market between employers and employees in regard to the capabilities of job candidates. The signalling mechanism is the only method by which employers may make an educated guess about the applicants' skill levels. In this instance, the quality of the signal will have a direct bearing not just on the efficiency with which talent is distributed but also on the degree to which output is really achieved.

Under the conditions of a closed economy, a country can reduce the barriers to factor flow through measures such as reducing financial friction (Greenwood et al., 2013) and labor market friction (Munshi and Rosenzweig, 2016) so that factors of production will be based on factor returns under the action of the price mechanism. The principle is that the value of the marginal product flows freely, thereby optimizing the allocation of resources. In the digital age, Meijers (2014) found that the Internet accelerated cross-regional resource integration ability. The cross-regional redistribution of talent, capital, and other resources is made possible by the multiplier effect of network link scores. Additionally, the effective integration of regional scientific and technological resources can be quickly completed in terms of both breadth and depth, which increases the level of collaborative innovation. The Internet development has played a positive part in promoting urbanization (Forman et al. 2005), technological innovation (Castiglione, 2012), economic growth (Salahuddin and Gow, 2016), production efficiency (Edquist and Henrekson, 2017) and industrial structure (Ivus and Boland, 2015). Bogoviz et al. (2019) found that it can significantly promote the development of human capital. The Internet can also reduce or even completely eliminate the communication and search costs in the trade process (Goldfarb and Tucker, 2017). The misallocation of capital may be caused by differences in corporate tax laws and marginal tax rates between companies (Kaymak and Schott, 2019). Regarding foreign direct investment (FDI), Burstein and Monge (2009) examined the influence of the international redistribution of professional management techniques on productivity from the perspective that FDI will bring advanced management experience and technology to increase productivity and found that if developing countries cancel FDI restrictions, the overall level of production will rise by an average of 12%, and the level of social welfare will also rise by 5%. Reforming the financial markets is also considered as a more effective strategy to enhance the distribution of available resources(Galindo et al., 2002; Bandyopadhyay et al., 2019).

In summary, at present, scholars have performed insightful analyses of the misallocation of resources from different perspectives. However, few studies have discussed the relationship between the Internet development and the misallocation of resources. In the measurement of Internet indicators, a single indicator, like the Internet penetration rate or mobile phone penetration rate, may be included in questionnaires, but a multi-index Internet development level system is rarely established. This study makes use of an empirical research methodology, creates a multi-index Internet development measurement system, and assesses the level of resource misallocation in a number of different provinces and cities in China. The authors employ China's level of economic development, industrial structure, openness, urbanisation, and marketization as intermediary variables. More specifically, we investigate the process that leads to the misallocation because of the growth of the Internet.

3. Mechanism analysis of the impact of Internet development on resource misallocation

Since its inception, the Internet has had a significant bearing on the progression of both society and the economy. The impact of the Internet is felt in every sector of society and at every level, and it has a considerable impact on the way economies function at every scale, from the global to the individual level. Harris (1998) believed that the Internet, as general purpose technology, significantly reduces transaction costs in economic activities and eliminates flow barriers for specific types of services, thus promoting the wide dissemination of information, knowledge and ideas. As a typical representative of information technology, the Internet has exerted a profound influence on the economic operation mode of countries and the lifestyles of their residents. With the widespread penetration of the Internet, its inherent advantages and essential features, like low-cost information acquisition, and the reinvention of economic and social forms, space, structure and governance (Salahuddin and Gow, 2016), have brought new utility to the integration and combination of resource elements. This paper will discuss the mechanism through which Internet development influences resource misallocation considering the direct and indirect effects. Fig. 2 is a diagram of the specific mechanism.

3.1. Direct impact of Internet development on resource misallocation

The Internet has improved and optimized the structure of social and economic resource allocation, resulting in a rapid increase in information resources within and between traditional industries. The conventional method of allocating resources within a region is unable to satisfy the requirements of the contemporary social and economic system. As a result, the foundation upon which interregional resource allocation is performed needs to be revised. This is necessary because the improvement of society and the advancement of technological innovation. As a new method of economic resource allocation, the Internet can act a vital part in future interregional economic resource allocation. With economic globalization, the Internet has changed the spatial transfer pattern of the original elements, making it a more fluid economic network and breaking the pattern of regional blocky connections, thereby promoting the formation of a new flow space and network-like economic development model. At present, the Internet which has a high degree of freedom and openness is establishing a combined virtual network market and real material market step by step, and the whole market economy will soon serve the information network and the real society, thus increasing the channel for economic resource allocation, expanding its scope, and forming a diverse state of interregional economic resource allocation.

First, the Internet has accelerated the ability of different regions to integrate resources. New structures will continue to appear in urban and regional areas as a result of the expansion of the Internet, and the aggregation and spread of space will become more agile and quick(Paunov and Rollo, 2016). The Internet's proliferation of connecting points has effectively eliminated the space-time barrier, which can quickly and efficiently link and reorganise the elements of different spaces according to various needs and can realise the redistribution of resources, accelerating the effectiveness of cross-regional resource integration. Second, as the Internet has evolved, it has allowed for more effective allocation of innovation resources during the integrating of markets. The use of information network technology increases the quality of collaborative creativity, accelerates the flow and aggregation of innovation elements, and facilitates the effective integration of regional scientific and technology resources in a short amount of time (Freund and Weinhold, 2004). Internet technology changes resources from being monopolized to being shared, integrates resources by changing the mode of production organization and supply chain circulation, and indirectly reconstructs the regional economic structure.In conclusion, the Internet primarily influences the distribution of regional economic resources as well as the economy of the region through the modification of information asymmetry and the scale effect of businesses. The technology behind the Internet lowers the costs associated with the transmission of information and the coordination of innovation agents, and it also makes it feasible to further increase the efficiency with which science and technology resources are allocated (Acharya, 2016). In particular, with the emergence of the virtual network market, economic resource allocation among regions is no longer limited to governments and enterprises; instead, all individuals are brought into the market through the transmission and replicability of network information. To the extent that all individuals have essentially the same information resources, this largely solves the problems brought about by information asymmetry in interregional economic transactions and development. In terms of the enterprise scale effect, the Internet realizes the reconstruction of the horizontal industrial chain and vertical value chain by means of information, which can help enhance the transparency of scientific and technological production activities and promote a change in the product production mode from linear innovation to parallel innovation. By increasing the speed of progress in knowledge, a positive feedback loop of increasing returns to scale can be realized.

3.2. Indirect impact of Internet development on resource misallocation.

3.2.1. Internet development, financial development and resource misallocation

The rapid expansion of the internet has also had a great and far-reaching influence on the business world of finance, particularly in recent years. Different from traditional methods in financing channels, a lot of innovation has been carried out. The capital supply side and the demand side are dynamically connected via the Internet. Both parties have the ability to make enquiries in a timely and accurate manner on the supply and demand of cash. This results in a significant increase in the speed of financing as well as the efficiency of allocating cash. The introduction of Internet-based financial services has given the financial sector access to a market environment that is both more stable and open to scrutiny. In this scenario, capital has the ability to overcome the limitations of both time and geography, to entice a greater amount of direct foreign investment, and to improve the efficiency of allocation by delivering both a supply of capital and a technology spillover. Second, the Internet can help micro-individuals and enterprises get timely and accurate capital supply and demand information, reducing transaction costs and information asymmetry (Choi et al., 2014), therefore, the effectiveness of capital allocation as well as the speed with which capital flows can be improved further. Improving the magnitude of supply and demand, as well as boosting efficiency in the financial market, can help reduce the amount of resources that are inappropriately allocated.

3.2.2. Internet development, marketization and resource misallocation

The advent of the Internet resulted in a significant drop in the price of many information resources (Spiezia, 2011) and promoted the scale effect of the transportation and logistics industries by increasing the mobility of regional economic resources and reducing transportation and logistics costs between regions. Many of the factors that hinder the realisation of factor endowment advantages have been eliminated due to the reduction in costs associated with information resource costs, transportation costs, and logistics costs. Economic growth in the region has been encouraged, and the efficiency with which resources are distributed has been improved. Second, the rapid growth of the web will help to improve the existing market mechanism for the allocation of science and technology resources. The quasi-public goods attribute of science and technology resources prevents the market mechanism from solving the externalities of innovation activities; since the imperfect market mechanism neglects the law of technology market development, the efficient matching of supply and demand remains unrealized for science and technology resources in the technology market. The rapid growth of the Internet has the potential to speed up the development of an energy-efficient resource allocation mechanism; it also has the potential to allow network technology to take an important function in the allocation of resources; to enhance the transformation of the market into an accurate allocation mechanism, and to accelerate the formation of an energy-efficient resource allocation mechanism.

3.2.3. Internet development, openness and resource misallocation

The Internet can influence the allocation of resources by opening markets to the outside world. First, in the digital economy, the Internet can optimize resource allocation by reducing the search costs for international trade (Levin, 2011). Through the Internet, suppliers involved in international trade can more easily and effectively obtain information on new markets, thus reducing the search cost when entering foreign markets. The usage of the internet also makes information transmission more efficient, particularly information transmission across vast distances. This makes planning more efficient and accurate, and it minimises the amount of uncertainty involved. Second, Anderson and Van Wincoop (2004) proven that the Internet improves the efficiency of resource allocation by lowering the costs associated with international trade. In today's digital economy, international business deals can be negotiated using cheaper mediums such as the telephone, telegraph, email, and video chat, rather than face-to-face meetings with representatives from many countries (Grossman and Rossi-Hansberg, 2008). Time and financial cost savings and online operations reduce the cost and through the use of the Internet, Businesses are more likely to engage in commercial exchanges on a regular basis, which boosts the effectiveness with which available resources are used. The Internet's ability to facilitate the development of a digital market has increased the breadth of international trade, and it has also provided the technical foundation for the growth of international trade in services. Small and medium-sized businesses are able to acquire economies of scope in international trade through the use of the virtual market generated by the Internet, which, in comparison to traditional trade, makes it easier for these businesses to engage in foreign markets and helps them obtain economies of scope. In the field of international trade, new market forces and business forms are reflected in the expansion of the trade market, as the Internet has expanded the market boundaries of international trade (Furman et al., 2002). The Internet centralizes the collection and processing of supply and demand data of the market and then diffuses it, transforming the traditional business model of the "bilateral market" into the new model of a "multilateral market" and a "two-way market" to achieve the synchronization and sharing of information and global resource integration and configuration.

3.2.4. Internet development, urbanization and resource misallocation

The Internet can influence resource misallocation through urbanization. The Internet development affects the allocation of resources through rural urbanization. To be more specific, in terms of employment, the growth of the Internet has made it possible for employment information in cities and towns to be communicated effortlessly to rural areas. As a result, residents of rural areas can then move to urban areas in search of employment opportunities. The promotion of rural employment can also promote the income level of rural residents and then the economic growth of the countryside. The growth of the Internet has the potential to increase farmers' awareness of information that can be useful to them in areas such as business and the sale of agricultural products. This is important from the standpoint of productivity (Forman et al., 2005). It has paved the way for rural modernization, which means that the traditional agricultural mode of production and structures have been optimized, and farmers' productivity has improved, accelerating rural economic growth. And the rapid growth of Internet technology can effectively promote the construction of a system of public services through urbanisation and raise the right of urban and rural residents to enjoy the same public services. This will ensure that regions with relatively less developed economies have timely access to public resources to respond to special circumstances and will prevent excessive disparities in the level of public services that are provided. The development of the internet can also allow urban innovation resources to flow to rural areas and promote the development of rural urbanization. The increased use of the internet among people living in rural areas leads to an improvement in their quality of life since it makes it easier for them to communicate with people living in areas that are not located inside their rural area. In addition, for rural managers, the spread of the Internet means the renewal of management methods, the more rapid construction of infrastructure and urbanization, and an optimized allocation of resources.

3.2.5. Internet development, industrial structure and resource misallocation

The growth of the Internet may cause a misallocation of resources due to the effect it has on the structure of industrial organisations. It has driven changes in their mode of production, organisation, and business processes, resulting in improved productivity, technology content, added value, optimisation, and upgrading. The widespread application of the new technology in various industries has greatly enhanced the technical support, production management, marketing services, and other capabilities of traditional industries (Hansen and SIA, 2015). In addition, the factors of production need to be optimised and integrated in order for economic progress to take place. The network effect and the industrial synergy effect can both be maximised thanks to the Internet's ability to reintegrate the markets, technologies, resources, and other aspects that are common to a variety of different businesses. The unrestricted and open character of the Internet not only encourages the sharing of information for the purpose of business innovation, but it also greatly lowers the cost that businesses incur when searching for information. This helps to increase the efficiency with which resources are allocated by leading the orderly upgrading of the industrial structure. Moreover, the Internet both complements and rearranges the available resources. We need to reallocate the original resources in order to increase the economic efficiency and enable the quality of economic growth. "Internet+" can supplement resource richness and transmit and exchange information more rapidly and more broadly thanks to technical advantages(Czernich et al., 2011) to steer the allocation of production elements in a reasonable manner and to maximise the effectiveness of economic regulation and management.

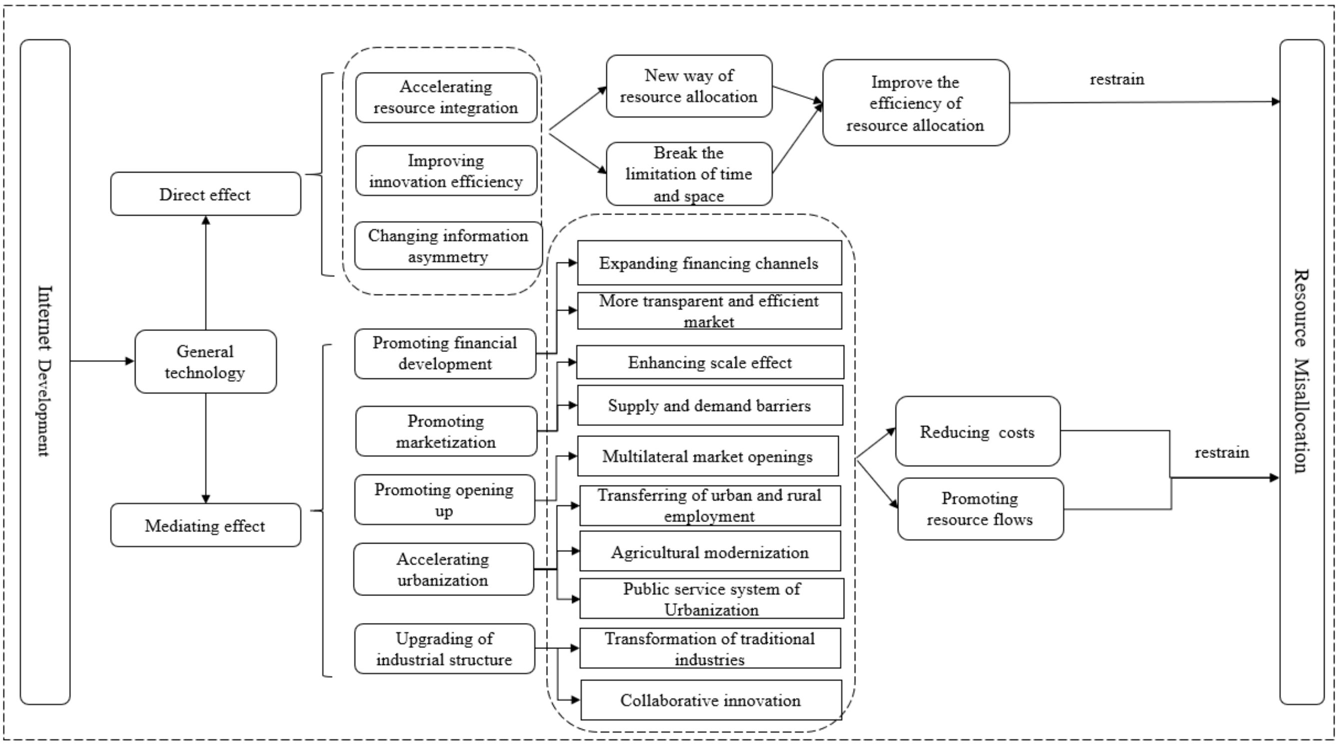

Figure 2. Mechanism diagram.

4. Models and data

4.1. Models

4.1.1. Benchmark regression model

In the light of the research framework of Hsieh and Klenow (2009), We offer a fundamental econometric model of the influence that the growth of the Internet has had on the inappropriate allocation of resources.

$$Ra_{it} = \alpha_0 + \alpha_1 Internet_{it} + \alpha_2 X_{it} + \alpha_i + \theta_t + \varepsilon_{it} \quad (1)$$

where Ra_{it} is the degree of resource misallocation, $Internet_{it}$ represents the level of Internet development, α_i represents individual fixed effects, θ_t is time fixed effects, and ε_{it} represents the random error term. In addition, resource allocation will also be affected by economic development, technological development and educational development. So we add per capita GDP, human capital and R&D investment intensity to model (1) to represent economic development, technological development, and educational development. X_{it}contains control variables.

4.1.2. Construction of the spatial econometric model

Because resource misallocation resembles geographical overflow in its manifestations, we decided to use a spatial econometric model to investigate the relationship between the expansion of the internet and resource misallocation (Hao et al., 2020). The fundamental model is put together in the following way:

$$Ra_{it} = \alpha_0 + \rho \sum_{j=1}^{N} W_{ij}\, Ra_{jt} + \alpha_1 Internet_{it} + \alpha_2 \sum_{j=1}^{N} W_{ij}\, Internet_{it} + \alpha_3 \sum_{j=1}^{N} W_{ij}\, X_{it} + \alpha_i + \theta_t + \varepsilon_{it} \quad (2)$$

where $W \cdot Internet_{it}$ represents the spatial spillover effect, ρ means the spatial correlation coefficient, and W means the spatial weight matrix. This article sets the selected spatial weight matrix w1 since the analysis that we conduct uses a geographical measurement model. This selected spatial weight matrix W_1 comprises both the geographic distance weight matrix and the economic weight matrix W_2. To avoid robust measurement error on the study results, which may occur owing to the distance between the full samples, the thresholds that are chosen to set the local space weight matrix in this paper are separate. This is done in order to prevent such a mistake, following the research of Combes (2000), Hao et al. (2020) and Wu et al. (2000). Using 600 km, 800 km, 1,000 km, 1,500 km, and 2,000 km as thresholds, we examine the effect of Internet development on resource misallocation under spatial weight matrices of different distances.

4.1.3. The test of nonlinear relationships

The impact that the growth of the Internet has had on the inappropriate distribution of resources may continue for a considerable amount of time notwithstanding the current acceleration of regional economic development, as shown through nonlinear or spatially heterogeneous characteristics. That is, the above factors are different for the different regions of China, which may cause the influence of Internet development to have a thresh old effect on the misallocation of resources in China. Therefore, this article uses the research of Hansen (1999) and establishes the following threshold regression model. The basic threshold model is:

$$Ra_{it} = \beta_0 + \beta_1 Internet_{it} \times I(q_{it} \leqq \gamma_1) + \beta_2 Internet_{it} \times I(q_{it} > \gamma_2) + \beta_3 X_{it} + \epsilon_{it} \quad (3)$$

Where q_{it} represents the threshold variable, γ is the specific threshold value, and $\mathrm{I}(\cdot)$ represents the index function. If there is a “multi-threshold effect” after threshold effect detection, the relevant model can be extended by the single-threshold model.

4.1.4. Test of policy effect

In order to further eliminate endogenous interference and identify the causal relationship beUtilising data collected at the city level and treating the "Broadband China" pilot policy as a natural experiment, this paper builds a DID model to assess the impact of Internet growth on resource mismatch. The State Council issued the "Notice of the State Council on Printing and Distributing the "Broadband China" Strategy and Implementation Plan" in August 2013 to meet the requirements national development strategy. Thus, China will steadily promote broadband and other network infrastructure construction. In 2014, 2015, and 2016, the Ministry of Industry and Information Technology and the National Development and Reform Commision chose 120 cities as "Broadband China" demonstration locations. After becoming a demonstration city (group), the local government will focus on growing broadband users, network speed, coverage, and cultural and economic growth. After three years of building, the selected cities must lead the nation in broadband access capabilities and user penetration. Thus, the "Broadband China" pilot policy offers a good technique. Model (4) is a DID model with "Broadband China" pilot policy as exogenous policy impact and resource mismatch as dependent variable:

$$RA_{it} = \beta_0 + \beta_1 broad_{it} + \sum \gamma_j X_{it-1} + \sum_{k=1}^{5} \vartheta_k X_{it} + \mu_i + \theta_t + \varepsilon_{it} \tag{4}$$

Board is the virtual variable that makes up the "Broadband China" policy grouping among these other factors. If a city is part of the pilot city programme and has participated in the "Broadband China" pilot, it will be classified as a processing group and given a value of 1; if not, it will be classified as a control group and given a value of 0, and its coefficient will indicate the impact that Internet development has had on the distribution of resources.

4.2. Variables

4.2.1. Calculation and analysis of resource misallocation

In accordance with the studies of Hsieh and Klenow (2009) and Hao et al. (2020), this article calculated the degree of capital resource misallocation in China's 30 provinces (data for Tibet, Hong Kong, Macau and Taiwan were not available) from 2006 to 2017.

Assuming that there is a distorted competitive market for factor input, the absolute distortion coefficient of capital factor and labor factor is calculated. γ_k and γ_L are defined as equation (5):

$$\gamma_K = \frac{1}{1+\tau_{Ki}}, \quad \gamma_L = \frac{1}{1+\tau_{Li}} \tag{5}$$

The coefficient represents the addition of factor input. Consider the role of capital, when there is no resource mismatch, namely $\tau_{Ki} = 0$, the absolute distortion coefficient of capital is 1, and there is no capital factor input plus distortion; When there is a resource mismatch, namely $\tau_{Ki} \neq 0$, the price of capital factor input is lower or higher, which will lead to the distortion of the capital factor input bonus level. The absolute factor distortion coefficient, on the other hand, is impossible to measure in practise. As a result, the relative factor distortion coefficient of capital and labour is established based on the premise that market competition equilibrium exists. Relative distortion coefficient of capital and labor factors $\hat{\gamma}_K$ and $\hat{\gamma}_L$ is defined as equation (6):

$$\hat{\gamma}_K = \frac{\frac{K_i}{K}}{\frac{s_i\beta_{Ki}}{\beta_K}}, \quad \hat{\gamma}_L = \frac{\frac{L_i}{L}}{\frac{s_i\beta_{Li}}{\beta_L}} \tag{6}$$

In the actual calculation, the absolute distortion coefficient can be approximately replaced by the relative distortion coefficient, and then the resource mismatch degree can be obtained. Where $K_i$represents the regional capital stock, and K represents the total capital stock of the whole country. $s_i = \frac{\gamma_i}{\gamma}$ is the output value of region *i*, s_i means the share of γ_i in the national total output value γ. β_{Ki} is the input-output elasticity of capital elements in region I; $\beta_K = \sum_i^N s_i\beta_{Ki}$ indicates the total input-output elasticity of regional capital after weighted sum; $\frac{s_i\beta_{Ki}}{\beta_K}$ calculates, in an ideal world, how much money Region I should spend on capital expenditures. From the expression of relative twist coefficient, we can see the following conclusion. If $\hat{\gamma}_K > 1$,the region's actual capital usage is higher than its theoretical value, suggesting that resources are being overcommitted; if $\hat{\gamma}_K < 1$, the actual use of capital is insufficient. The relative distortion coefficient of labor factors is the same. In order to calculate formulas (5) and (6), it is necessary to determine the input-output elasticity of capital and labor factors in each region β_K and β_L. Assume that, as stated in equation (7), each zone possesses a C-D production function with constant returns to scale:

$$Y_{it} = AK_{it}^{\beta_{Ki}} L_{it}^{\beta_{Li}} \tag{7}$$

Among them, the output variable Y_{it} is expressed by the real GDP in 2006, and the labor factor input variable L_{it} is expressed by the average annual employment, the capital factor input K_{it} is expressed by the fixed capital stock of each region. Following the research of Wu et al. (2020), the perpetual inventory method and the capital stock data provided by it are used to supplement and calculate the capital stock from 2006 to 2017 with constant price in 2006, which ensures the rationality and comparability of the data. Formula (7) is calculated by the Solow residual method. Logarithm is taken on both sides of the equation, and the influence of individual and time effect is controlled. The formula (8) is obtained：

$$ln(Y_{it}/L_{it}) = ln\,A + \beta_{Ki}\,ln(K_{it}/L_{it}) + \mu_i + \lambda_t + \varepsilon_{it} \tag{8}$$

Considering the great difference of development level between various regions in China, the input-output elasticity of capital and labor factors in different regions is different. Because of the practice of Hao et al. (2020), this paper introduces the interaction term of individual dummy variable and explanatory variable $ln(K_{it}/L_{it})$ into the regression equation, and constructs a variable coefficient panel model with variable intercept and slope to measure the elasticity of capital output β_{Ki} and β_{Li} is in formula (8). Incorporate the index data into formula (5) after estimating the factor output elasticity for each province, and the capital mismatch index τ_{Kit} and labor mismatch index τ_{Lit} of each province can be obtained.

To reflect regional differences and dynamic changes more intuitively, this article uses ArcGIS 10.8 software to display the calculation results for the misallocation of resources in China in various years in the form of geographic visualization. The specific results are manifested in Figure 3. This article only lists four years of calculation results for 2006, 2010, 2014 and 2017. In Figure 3, the red area indicates that the degree is positive, green indicates that the degree of is passive, and gray indicates that there is no data. On the whole, from 2006 to 2017, the red zone did not increase significantly, only increasing from 11 provinces in 2006 to 13 provinces in 2017. The degree of resource misallocation in China continued to decrease from the eastern coast to the central region and to the northwest, southwest and northeast regions. It tells the figure that China's northwest, southwest and northeast regions have a high degree of it and a lack of resources, and there is no significant improvement over the sample period; the Inner Mongolia area even shows a trend of regression. In the western region, only Chongqing and Sichuan show a deeper red color in the figure and produce a relatively obvious positive trend in the sample period, indicating that the resources allocated to the two regions are increasing and that the resource structure is continuously optimizing. This trend is related to the ongoing launch of large-scale projects and the active investment by the governments of the two regions in recent years. In the eastern region, Shanghai, Jiangsu, Zhejiang and Beijing have seen relatively significant increases in resources, while the remaining regions do not show obvious signs of optimization. The reason is that the profit-seeking nature of capital has concentrated capital resources in the eastern region, and those regions first developed continue to attract capital resources that are later developed, ultimately increasing the degree of resource misallocation between regions.

The reciprocal of resource mismatch is used in this article to represent the degree to which optimal resource allocation has been achieved with regard to the distribution of resources on the level of the city. The higher the number, the more efficiently the resources are being utilised. This research picked capital and labour to be the input variables at the city level, where the city level input indicators are concerned. The calculation of the capital input was performed using the perpetual inventory approach, 10.96% was the rate that was used for capital depreciation. The quantity of workers was evaluated based on the total number of employees.

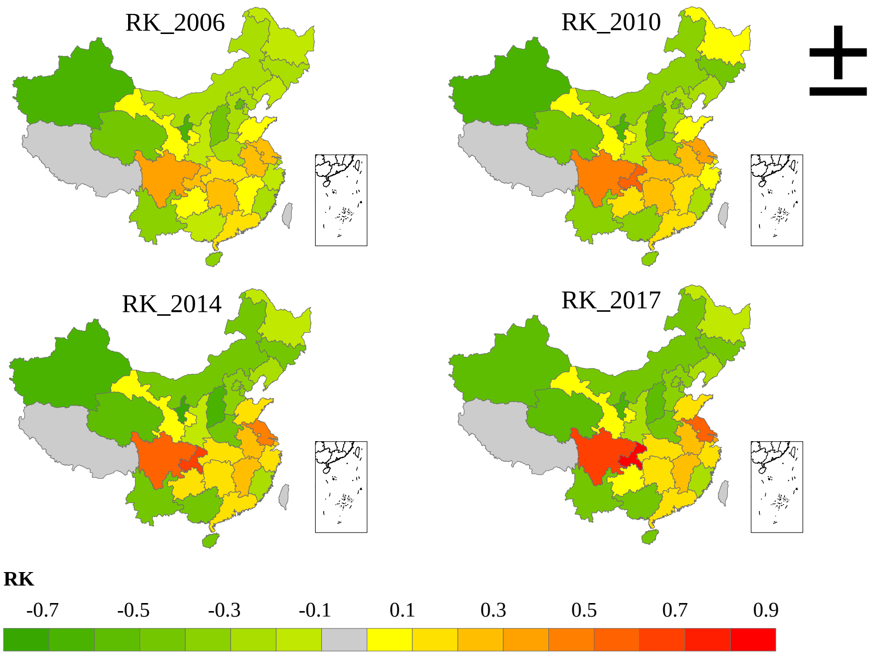

Figure 3. Degree of resource misallocation in 30 provinces of China.

4.2.2. Measurement and analysis of the Internet development level

Taking into account that Chinese officials have not disclosed a unified variable to measure the level of Internet development. Most traditional researches have selected a single indicator as a substitute variable, such as long-distance cable mileage (Koutroumpis, 2009), Internet penetration (Czernich and Falk, 2011), and the number of domain names (Roller and Waverman, 2001).In point of fact, the World Wide Web is a whole project that stands for technological advancement, and it is not possible for a single indicator to accurately depict the amount of growth that the Internet currently possesses. We constructed an evaluation system taking into consideration the following aspects: Internet popularisation, Internet facilities the web information resources and application, and we determined it using the technique of entropy (see Figure 4). This was based on the findings of Hao and Wu (2020), who conducted research on the topic. Table 1 displays the comprehensive approach that was created to measure the progress made by China in its Internet infrastructure.

4.2.3. Intermediary variables

On the basis of the mechanism analysis section, the variables financial development, marketization, urbanisation, and industrial structure are chosen as intermediary variables to assess the mechanism by which Internet development influences resource misallocation. For these variables, finance is reflected by the ratio of the balance of deposits and loans ; the level of marketization is measured by the proportion of employees in nonstate-owned enterprises in the various provinces and cities; the degree of trade openness is reflected by the ratio of the total import and export value expressed in RMB to GDP; and the level of urbanisation (urban) is reflected by the ratio of the urban population to the total population.

4.3. Control variables

There are also certain control variables that are included here. According to Wu et al. (2019), economic development is reflected by GDP per capita, education level (hum) is represented by the average number of years spent in school across all provinces, and scientific advancement is reflected by the fraction of money spent on research and development to total GDP. According to Elliott et al. (2017), the statistics at the city level show that economic growth, human capital, and technological progress could be represented by the GDP per capita, the amountes of patents per capita, and the number of regional college students respectively.

Table 1. Evaluation System of Internet Development Level.

Target level	Standard level	Index level	Interpretation of indicators	Unit
Internet development	Internet popularization	Popularity rate among Internet users	Reflecting the popularity of provincial Internet	%
		Number of Internet users	Measuring the demand capacity of interprovincial Internet services	10000 people
	Internet infrastructure	Proportion of IPv4	Reflecting provincial IP address resource allocation	%
		Number of domain names	Reflecting the configuration of provincial domain name resources	Unit/10000 people
		Length of long distance optical fiber	Reflecting the investment and construction of provincial optical cable infrastructure	10000 kilometers
		Number of Internet access ports	Reflecting the construction level of provincial Internet access equipment	10000 unit
	Internet information resources	The average number of bytes in a web page	Reflecting the richness of provincial Internet information resources	kb
		Average number of websites owned by enterprises	Measuring the allocation level of interprovincial Internet information resources	unit
	Internet application	Numbers of express delivery	Reflecting the development level of the provincial online shopping industry	10000 unit
		Total revenue of telecommunication business	Reflecting the development of the telecommunication industry	Billion yuan

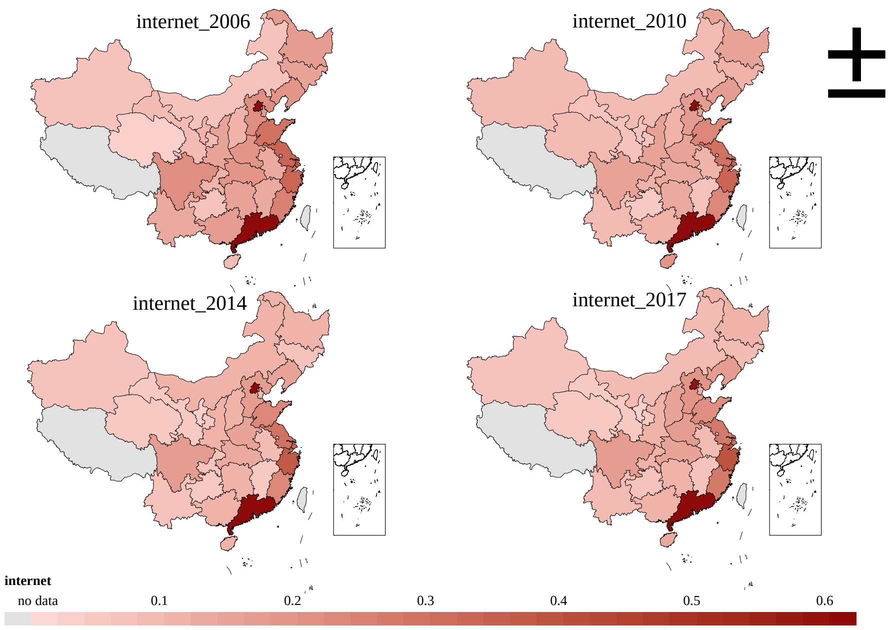

Figure 4. China's Internet development level.

4.4. Data

China's provincial panel data from 2006-2017 are selected as the research object in this paper. Hong Kong, Macau, Tibet and Taiwan, which have many missing data values, are excluded.Interpolation is used to fill in the pertinent missing data for samples that have a limited number of data gaps, and in the end, the study encompasses all of Canada's provinces and territorie (municipalities/autonomous regions) and a total of 12 years of balanced panel data. In order to eliminate the impact of price fluctuations, the price-related data in this article are deflated using 2006 as the base year. City-level data is the data of 196 cities from 2011 to 2018. The relevant data in this article come from the "*China Urban Statistics Yearbook*", "*China Ministry of Industry and Information Technology website*", "*China Statistical Yearbook*", "*Statistical Report on China's Internet Development Status*", "*China Environmental Statistics Yearbook*", "*China Financial Statistics Yearbook*", "*China Labor Statistics Yearbook*", "*China Science and Technology Statistical Yearbook*" and national statistics from the official website of the relevant bureau. The relevant statistical description is shown in Table 2.

Table 2. Statistical description of the sample.

Regional	Variable	Definition	Obs	Mean	Std. Dev.	Min	Max	Unit
Province level	Ra	Degree of resource misallocation	360	-0.068	0.305	-0.651	0.831	-
	internet	Internet development level	360	0.172	0.148	0.024	0.688	-
	poi	Internet population	360	0.289	0.196	0.024	0.958	-
	ioi	Internet infrastructure	360	0.178	0.156	0.015	0.825	-
	iri	Internet information resources	360	0.129	0.167	0.001	0.976	-
	aoi	Internet application	360	0.160	0.205	0.000	1.000	-
	pgdp	Economic development	360	5.136	4.698	0.634	32.640	1000 yuan per capita
	rd	Research input	360	1.452	1.065	0.200	6.010	%
	hum	Educational development	360	8.788	0.978	6.594	12.665	Year
	finance	Financial development	360	1.659	0.733	0.108	5.587	-
	market	Marketization	360	0.708	0.106	0.440	0.899	-
	openness	Degree of opening	360	0.312	0.375	0.009	1.721	-
	urban	urbanization	360	0.535	0.137	0.275	0.896	-
	ind	Industrial structure	360	0.423	0.091	0.286	0.806	-
City level	resource	Optimal allocation of resources	1,566	0.635	0.455	-0.358	2.957	-
	pgdp	Economic development	1,568	1.436	0.816	0.291	6.465	Ten thousand yuan
	innov	Technical progress	1,568	1.802	1.736	0.067	19.025	%
	edu	Educational development	1,568	11.726	18.261	0.093	108.641	Ten thousand people

5. Results and discussion

5.1. Benchmark regression analysis

In order to execute benchmark regression analysis and guarantee the accuracy of the results, we make use of a strategy that involves gradually increasing the number of control variables. According to Table 3, in the course of progressively adding control factors, the development of the Internet has considerably controlled the mismatch of resources and optimised the allocation of resources. This is demonstrated by the process of gradually adding control variables.

The reasons for the above conclusions in the benchmark regression are, first of all, because in the Internet era, social capital is mainly concentrated in state-owned enterprises, financial companies, and the heavy chemical industry. This is also a crucial cause of the problem of resource misallocation. After China's economic development entered the Internet 2.0 era, a new model represented by the Internet industry increasingly became the focus of social capital. Improvement in the Internet development level in this region absorbs the capital concentrated in traditional industries, and the original resource misallocation problem is naturally improved (Wu, 2018).

5.2. Results of spatial spillover regression

Table 3. Benchmark regression results.

Variables	Model (1)	Model (2)	Model (3)	Model (4)
internet	-0.356**	-0.306**	-0.275*	-0.305**
	(-2.226)	(-2.101)	(-1.828)	(-2.054)
rd		0.168***	0.165***	0.168***
		(8.111)	(7.798)	(8.062)
pgdp			0.002	0.001
			(0.825)	(0.663)
hum				0.074***
				(3.268)
_cons	-0.103	-1.048***	-1.061***	-1.867***
	(-0.954)	(-6.883)	(-6.927)	(-6.457)
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Adj R-squared	0.9453	0.9545	0.9545	0.9559
N	360	360	360	360

*Note: ***, ** and * are significant at the levels of 1%, 5% and 10%, respectively (the same below).*

This study calculates the geographical distance and the economic weight matrix, and the local spatial weight matrix, all of which are established according to five thresholds in order to determine whether or not there is a spatial link to calculate 30 provinces in China from 2006 to 2017. The specific consequences of the global Moran's index are shown in Table 3. Meanwhile, this paper also verifies the significance of the results through the Z test.

Table 4 illustrates that the global Moran's index coefficients produced by the seven spatial weight matrices are all positive, and the majority of them pass the Z test. This can be seen by the fact that all of the coefficients pass. This study demonstrates that there is a significant positive spatial correlation for the level of Internet development between regions; that is, the positive spillover impact of the level of Internet development in this region on the level of Internet development in neighbouring areas shows that there is a significant positive spatial correlation for the level of Internet development between regions. In addition to this, the findings of the spatial weight matrix that was generated based on the threshold value demonstrate the following three rules: i) Before 2010, the global Moran's index at the Internet level showed a trend of first falling, then rising, and then falling within different threshold ranges. The two inflection points were 800 km and 1000 km, which indicates that the positive spillover effect at the Internet level in China was different in strength in different ranges. ii) After 2010, this situation changed. The change in the global Moran's index shows a "w" trend with five thresholds, that is, it first fell, rose, and then fell and rose. iii) The vast majority of the global Moran's indexes calculated by the seven spatial weight matrices are significantly positive, which indicates that China's Internet level has a significant spatial autocorrelation.

To better and more intuitively judge whether the Internet development level has spatial agglomeration characteristics, this paper selects specific years to analyze the local Moran's index scatter diagram, as shown in Figure 5. This article analyzes China's 30 provinces in 2006 and 2010. The local Moran's index scatter chart shows four quadrants, with each quadrant having a different statistical meaning. The first quadrant is "high-high": the spatial relationship in which a regional unit with a high Internet development level is surrounded by regional units with a high Internet development level. The second quadrant represents the "low-high" spatial connection: Some provinces have a low level of Internet development, whereas others have a high level of Internet development. These provinces are surrounded by other provinces with a high level of Internet development. The observations in the third quadrant, labelled "low-low," show a pattern that is exactly opposite to that of the second quadrant. On the other hand, the observations in the fourth quadrant, labelled "high-low," show a pattern that is identical to that of the first quadrant. This indicates that the relative level of Internet development among neighbouring provinces is relatively low. In Figure 5, we can see that among the 30 provinces that were observed in 2006, there are more in

Table 4. Global Moran's Index Test.

Year	Moran's I	W1	W2	W600km	W800km	W1000km	W1500km	W2000km
2006	Moran's I	0.235**	0.036**	0.202**	0.149**	0.152**	0.121***	0.098***
	Z-value	(2.185)	(2.082)	(1.671)	(1.564)	(2.110)	(2.453)	(2.797)
2007	Moran's I	0.262***	0.043**	0.223**	0.165**	0.179***	0.122***	0.107***
	Z-value	(2.397)	(2.290)	(1.814)	(1.700)	(2.416)	(2.469)	(2.976)
2008	Moran's I	0.279***	0.049***	0.242	0.172**	0.200***	0.126***	0.112***
	Z-value	(2.534)	(2.451)	(1.945)	(1.755)	(2.648)	(2.523)	(3.080)
2009	Moran's I	0.270***	0.045***	0.239**	0.159*	0.195***	0.113**	0.106***
	Z-value	(2.457)	(2.349)	(1.922)	(1.642)	(2.591)	(2.318)	(2.963)
2010	Moran's I	0.236**	0.033**	0.205**	0.126*	0.173**	0.088**	0.091***
	Z-value	(2.180)	(1.989)	(1.683)	(1.361)	(2.339)	(1.919)	(2.632)
2011	Moran's I	0.202**	0.023**	0.174**	0.097	0.151**	0.069*	0.078***
	Z-value	(1.906)	(1.680)	(1.465)	(1.111)	(2.099)	(1.631)	(2.354)
2012	Moran's I	0.190**	0.017*	0.163**	0.086	0.143**	0.064*	0.074**
	Z-value	(1.813)	(1.528)	(1.387)	(1.023)	(2.003)	(1.544)	(2.272)
2013	Moran's I	0.191**	0.014*	0.158**	0.083	0.136**	0.060*	0.073**
	Z-value	(1.820)	(1.440)	(1.357)	(0.994)	(1.931)	(1.478)	(2.251)
2014	Moran's I	0.183**	0.009*	0.139	0.069	0.124**	0.054*	0.068**
	Z-value	(1.761)	(1.288)	(1.219)	(0.881)	(1.793)	(1.398)	(2.153)
2015	Moran's I	0.183**	0.007	0.129	0.063	0.118**	0.051*	0.065**
	Z-value	(1.763)	(1.224)	(1.154)	(0.832)	(1.729)	(1.341)	(2.104)
2016	Moran's I	0.182**	0.005	0.124	0.058	0.113**	0.049*	0.063**
	Z-value	(1.754)	(1.166)	(1.119)	(0.786)	(1.677)	(1.312)	(2.049)
2017	Moran's I	0.157*	0.001	0.112	0.042	0.106*	0.033	0.055**
	Z-value	(1.555)	(1.044)	(1.036)	(0.650)	(1.591)	(1.067)	(1.891)

the first and third quadrants, and there are less in the second and fourth quadrants. This is because there are more provinces in the first and third quadrants. This is similar to the trend for internet development. The trend of positive correlation between development level and space is consistent. Although the results in 2010 were not very different from those in 2006, the scatter plot was more dispersed, which to some extent reflects increasing differences in Internet development levels among different provinces. Meanwhile, the global Moran's index changed from 0.2349 in 2006 to 0.2356 in 2010. This means that spatial autocorrelation and the spatial agglomeration of China's Internet development level are both continuing to increase.

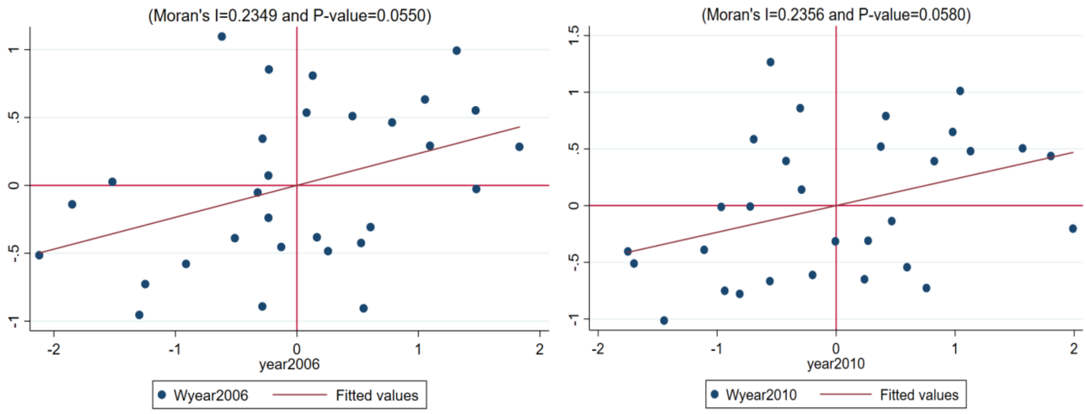

Figure 5. Local Moran's Index Diagram of Resource Misallocation.

After completing the analysis of spatial correlation, this work next examines various factors affecting resource misallocation, including the level of Internet development, based on the benchmark model. Table 5 displays that, i) the development level of the Internet significantly restrains the degree of resource mismatch. Although the coefficient is positive, it is not significant, which means that the level of it has no statistical impact on the degree of resource misallocation in this region. ii) The per capita GDP of this region is only significant in the spatial weight matrix constructed with the threshold values of 600 km, 800 km and 1000 km, while the coefficients under the other spatial weight matrices are all negative, which indicates that within this region, improvement in the economic development level can also reduce the problem of resource misallocation. However, the economic development level of neighboring areas has no significant influence on the resource misallocation of this region. iii) By contrast, the relationship between R&D investment and resource misallocation within this region may go hand in hand with the fact that the investment comes from other regions. Within this region, the increase of R & D investment will increase the mismatch of resources, while the increase of R & D investment in adjacent regions will inhibit the degree of resource mismatch. iv) Within this region, progress in the level of education development will increase the degree of resource misallocation, while the development of the education level in neighboring regions will cause a decline in the degree of resource misallocation in this region.

Table 5. Regression result of spatial spillover effect.

Variables	W1	W2	W600km	W800km	W1000km	W1500km	W2000km
internet	-0.326**	-0.276**	-0.316**	-0.313**	-0.318**	-0.283**	-0.266**
	(-2.451)	(-2.192)	(-2.320)	(-2.409)	(-2.333)	(-2.232)	(-1.990)
pgdp	-0.000	-0.000	-0.004**	-0.004**	-0.004*	-0.001	0.001
	(-0.151)	(-0.145)	(-2.285)	(-2.037)	(-1.914)	(-0.351)	(0.291)
rd	0.165***	0.163***	0.153***	0.163***	0.165***	0.163***	0.167***
	(8.043)	(8.991)	(7.369)	(8.252)	(8.174)	(8.721)	(8.517)
hum	0.066***	0.084***	0.026	0.051***	0.056***	0.091***	0.083***
	(3.344)	(4.272)	(1.302)	(2.632)	(2.734)	(4.527)	(4.028)
W×internet	0.281	0.413	0.193	0.239	0.225	0.443*	0.273
	(1.201)	(1.389)	(0.847)	(1.012)	(0.832)	(1.724)	(0.935)
W×pgdp	-0.003	-0.003	0.001	0.001	0.002	-0.002	-0.003
	(-1.285)	(-1.076)	(0.667)	(0.504)	(0.633)	(-0.782)	(-1.295)
W×rd	-0.001	-0.113**	-0.010	-0.030	-0.073*	-0.091**	-0.071
	(-0.031)	(-2.314)	(-0.278)	(-0.829)	(-1.740)	(-1.960)	(-1.423)
W×hum	-0.108***	-0.083***	-0.066***	-0.087***	-0.080***	-0.102***	-0.105***
	(-4.773)	(-3.097)	(-2.743)	(-3.670)	(-3.044)	(-3.949)	(-3.866)
Spatial rho	-0.232***	-1.337***	-0.153**	-0.404***	-0.211*	-0.698***	-0.475**
	(-2.863)	(-5.011)	(-2.050)	(-4.287)	(-1.924)	(-4.358)	(-2.523)
sigma2_e	0.004***	0.003***	0.004***	0.003***	0.004***	0.003***	0.004***
	(13.334)	(12.813)	(13.372)	(13.170)	(13.381)	(13.197)	(13.327)
N	360	360	360	360	360	360	360

The free social capital in the region will be shifted across regions for profit-seeking objectives when the level of internet development in neighbouring regions improves, which will make the problem of resource misallocation in the region even worse (Caggese and Perez-Orive, 2017). Second, in China, the growth of GDP per capita is closely related to the increase in the savings rate. Therefore, when the economic development level of the region improves, financial institutions have more capital for investment in other industries, which will also reverse the impact on the region's resources and the problem of misallocation (Chen and Lin, 2019), while the increase in the savings rate of neighboring regions does not have this effect. In addition, R&D investment and education development level both have an impact on the development of traditional industries. The increase in R&D investment will upgrade the technology of traditional industries in the region, greatly improving market competitiveness and attracting more capital; Moreover, the improvement in education level will increase the investment level of residents. Since traditional industries such as state-owned enterprises have a more stable return on investment, they will also attract a large number of investors in the stock market (Collard-Wexler et al., 2011). The problem of regional resource misallocation will worsen, and improvement in the technological level of neighboring regions will weaken the competitiveness of local enterprises, causing some of the capital used to support the development of local enterprises to flow into neighboring regions, which will alleviate regional resource misallocation (Song and Wu, 2015). In addition, R&D investment and the education development level both have an impact on the development of traditional industries. On the one hand, the increase in R&D investment will lead to the technological upgrading of traditional industries in this region, which will greatly improve market competitiveness and attract more capital. On the other hand, a rising education level will improve the investment level of residents, because the traditional industries such as state-owned enterprises have a stable return on investment and will also attract a large number of investors in the stock market (Collard - Wexler et al., 2011), so the resource misallocation problem in this area will diminish. The technology level of the neighborhood will weaken the competitiveness of the enterprises in this region, drawing the original capital used to support enterprise development in this region into the neighborhood and easing the region's resources misallocation problem (Song and Wu, 2015).

5.3. Robustness test

This part runs a series of robustness tests in order to check the robustness of the benchmark regression results and ensure that the research results are credible. Specifically, it is as follows.

5.3.1. Robustness test (1)

This article employs principal component analysis to re-measure China's Internet development in order to determine whether or not the results of the regression analysis shown above are reliable. After getting the level of Internet development in China, we use the method of gradually adding control variables for empirical test (See Table 6). The outcomes reveal that Internet development has significantly restrained the resource misallocation. At the same time, other control variables and significance did not change significantly. Therefore, the benchmark regression results are robust.

Table 6. Regression result of robustness test (1).

Variables	Model (1)	Model (2)	Model (3)	Model (4)
inter	-0.410**	-0.311*	-0.305*	-0.334**
	(-2.302)	(-1.700)	(-1.814)	(-2.017)
pgdp		0.005**	0.002	0.002
		(2.152)	(0.836)	(0.681)
rd			0.164***	0.167***
			(7.774)	(8.034)
hum				0.073***
				(3.252)
_cons	-0.099	-0.185*	-1.063***	-1.867***
	(-0.943)	(-1.650)	(-6.957)	(-6.449)
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Adj R-squared	0.9453	0.9460	0.9545	0.9558
N	360	360	360	360

5.3.2. Robustness test (2)

Choosing appropriate instrumental variable for core explanatory variables is the main method to solve endogenous problems. In a broad sense, the installation of Internet infrastructure has a close relationship with the geography of the surrounding area. As instrumental variables, the scale data of provinces and plains in China have been chosen for this particular piece of research. Note that the original data for the chosen instrumental variables are in the form of cross sections, which means that they cannot be utilised directly for the metrological analysis of panel data. This is something that should be kept in mind. In accordance with the findings of Nunn and Qian (2014), we employ a variable that is subject to change over the course of time in order to generate panel instrumental variables. Even when endogeneity is taken into account, the results of the first and second stages of the regression analysis presented in Table 7 demonstrate that the growth of the Internet can still prevent a mismatch between resources.

Table 7. IV estimation result.

Variables	First stage regression	Second stage regression
	internet	RA
land	-0.0042***(-2.71)	
internet		-2.1061*[-1.65]
_cons	0.0041(0.04)	1.9403***[5.73]
F value/ Wald Test	28.44***	68.87***
Control Variables	Yes	Yes
Year FE	Yes	Yes
Province FE	Yes	Yes
r2_a	0.5502	
N	360	360

Note: Figures in () and [] are the t-values and z-values of the coefficients, respectively (the same below).

5.3.4. Robustness test (3)

This article uses many computed measures of Internet development level as the primary explanatory variables in the benchmark regression analysis that it presents. Nevertheless, due to the fact that the growth level of the internet encompasses four dimensions, various dimensions can result in different outcomes. Therefore, in the robustness test, this study selects two sub-indicators to replace the core explanatory variables for analysis. Compared with the two sub-indexes of iri and aoi, poi and ioi can better measure the level of it and are also an important basis for future development. Therefore, the Internet penetration degree is selected for this analysis. A regression analysis is performed with ioi as the core explanatory variable, and the specific results are shown in Tables 8-9.

We can find from Table 8 that after replacing the core explanatory variables, the results of the remaining variables remain unchanged, and Internet popularity as a core explanatory variable has a big inhibitory influence on resource misallocation in this region. The change of neighbouring regions will exacerbate the problem, which is consistent with the finding obtained when utilising the level of Internet development as the primary explanatory variable. The consistency of the findings in Table 9 is maintained even if the Internet infrastructure level is substituted for it. Within this region, an increase in Internet infrastructure can significantly restrain resource misallocation, while an increase in Internet infrastructure in neighboring regions will promote resource misallocation in this region.

5.4. The test of transmission mechanism

To explore the mechanism through which Internet development influences resource misallocation, based on the mechanism analysis, the development level of finance, degree of marketization, degree of openness, level of urbanization and industrial structure are selected as intermediary variables for further verification. The phrase "mediation effects" refers to the indirect impact that explanatory variables have on the variables they are trying to explain through the use of intermediate variables. To be more specific, the following graphic (See FIG. 6) could be utilized to demonstrate the indirect effect that the explanatory variable (Internet) has on the explained variable (RA) through the medium of the intermediate variable.

Table 8. Robustness Test 3: Internet popularity as the core explanatory variable.

Variables	W1	W2	W600km	W800km	W1000km	W1500km	W2000km
poi	-0.351***	-0.285***	-0.413***	-0.366***	-0.373***	-0.274***	-0.313***
	(-4.186)	(-3.371)	(-4.797)	(-4.400)	(-4.291)	(-3.211)	(-3.531)
pgdp	-0.001	-0.000	-0.004**	-0.004**	-0.004*	-0.001	0.000
	(-0.290)	(-0.228)	(-2.195)	(-2.075)	(-1.957)	(-0.510)	(0.073)
rd	0.171***	0.165***	0.163***	0.170***	0.172***	0.165***	0.170***
	(8.303)	(9.174)	(7.963)	(8.699)	(8.618)	(8.842)	(8.798)
hum	0.069***	0.082***	0.037*	0.058***	0.059***	0.090***	0.082***
	(3.545)	(4.132)	(1.912)	(2.997)	(2.923)	(4.486)	(3.972)
W×poi	0.155	0.218	0.180	0.186	0.138	0.325*	0.191
	(1.164)	(0.882)	(1.276)	(1.251)	(0.795)	(1.858)	(0.865)
W×pgdp	-0.002	-0.002	0.002	0.002	0.002	-0.001	-0.003
	(-0.995)	(-0.906)	(0.752)	(0.656)	(0.875)	(-0.522)	(-1.013)
W×rd	-0.004	-0.112*	-0.007	-0.033	-0.075*	-0.109**	-0.068
	(-0.127)	(-1.659)	(-0.188)	(-0.887)	(-1.664)	(-2.070)	(-1.111)
W×hum	-0.105***	-0.081***	-0.072***	-0.088***	-0.076***	-0.101***	-0.102***
	(-4.646)	(-3.101)	(-3.097)	(-3.813)	(-2.971)	(-4.029)	(-3.868)
Spatial rho	-0.218***	-1.324***	-0.123*	-0.363***	-0.179	-0.630***	-0.497***
	(-2.657)	(-4.982)	(-1.645)	(-3.784)	(-1.626)	(-3.972)	(-2.638)
sigma2_e	0.003***	0.003***	0.004***	0.003***	0.004***	0.003***	0.003***
	(13.341)	(12.825)	(13.387)	(13.209)	(13.390)	(13.236)	(13.320)
N	360	360	360	360	360	360	360

Table 9. Robustness test 3: Internet infrastructure as the core explanatory variable.

Variables	W1	W2	W600km	W800km	W1000km	W1500km	W2000km
ioi	-0.193**	-0.188**	-0.186**	-0.182**	-0.211**	-0.174**	-0.181**
	(-2.304)	(-2.361)	(-2.167)	(-2.215)	(-2.497)	(-2.144)	(-2.143)
pgdp	-0.000	0.000	-0.004**	-0.004*	-0.004*	-0.001	0.001
	(-0.028)	(0.015)	(-2.144)	(-1.917)	(-1.860)	(-0.314)	(0.379)
rd	0.168***	0.163***	0.153***	0.163***	0.166***	0.166***	0.168***
	(8.172)	(9.037)	(7.351)	(8.246)	(8.228)	(8.854)	(8.572)
hum	0.067***	0.087***	0.027	0.054***	0.060***	0.095***	0.087***
	(3.358)	(4.394)	(1.391)	(2.731)	(2.918)	(4.690)	(4.177)
W×ioi	0.265**	0.367*	0.200	0.211	0.299*	0.183	0.210
	(1.981)	(1.956)	(1.347)	(1.384)	(1.705)	(1.041)	(1.092)
W×pgdp	-0.003	-0.003	0.001	0.001	0.002	-0.002	-0.003
	(-1.332)	(-1.137)	(0.524)	(0.440)	(0.631)	(-0.682)	(-1.314)
W×rd	-0.004	-0.109**	-0.016	-0.032	-0.081*	-0.095**	-0.079
	(-0.154)	(-2.229)	(-0.428)	(-0.868)	(-1.936)	(-2.037)	(-1.560)
W×hum	-0.109***	-0.090***	-0.065***	-0.089***	-0.082***	-0.110***	-0.108***
	(-4.833)	(-3.437)	(-2.721)	(-3.819)	(-3.158)	(-4.302)	(-4.013)
Spatial rho	-0.208**	-1.327***	-0.146*	-0.393***	-0.188*	-0.645***	-0.440**
	(-2.573)	(-4.974)	(-1.950)	(-4.155)	(-1.722)	(-4.052)	(-2.351)
sigma2_e	0.004***	0.003***	0.004***	0.003***	0.004***	0.003***	0.004***
	(13.349)	(12.820)	(13.376)	(13.182)	(13.388)	(13.227)	(13.338)
N	360	360	360	360	360	360	360

Table 10 is based on the intermediary effect estimation results of the OLS. We find that when finance and ind are used as intermediary variables, an intermediary effect of Internet development exists that promotes finance and ind upgrading to suppress the degree of resource misallocation. There are also direct impacts of Internet development on the impact of resource misallocation. With openness and urbanization as the intermediary variables, openness in equation (11) and urbanization have coefficients of 0.075 and 0.482, the coefficient of the

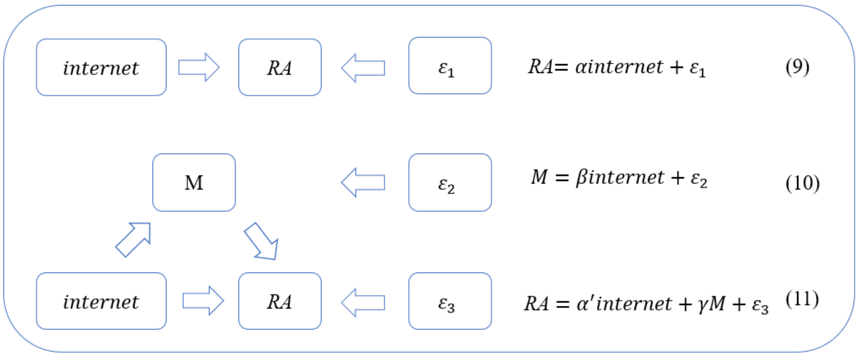

Figure 6. Schematic diagram of mediation effect test.

Internet was not significant, so Internet development influences resource misallocation through an indirect effect, but a direct effect does not exist, so Internet development can improve the openness and urbanization level to reduce the resource misallocation degree. However, when the degree of marketization is seen as the intermediary variable, the coefficient of marketization in equation (11) is not significant, indicating that the intermediary effect does not exist, and Internet development does not have an obvious effect on resource misallocation by influencing the degree of marketization.

In conclusion, the growth of the Internet has the potential to further decrease the extent to which resources are misallocated and to effectively advance the optimal allocation of resources. It does this by increasing the level of financial development, promoting the optimisation and facilitation of the industrial structure, and improving the degree to which openness and urbanisation are present. The development of the Internet will have a high impact on traditional finance, promote the reform of financial markets, effectively reduce financial transaction costs, and improve enterprise investment and financing channels. At the same time, Internet platforms will further improve the opening of the financial market, facilitate the continuous reduction of operating costs, promote the reasonable allocation of resources, and reduce money flowing to departments with low efficiency. In addition, the Internet is more than just a technology, it is the forerunner in the development of innovative strength; in the Internet age, multiple subjects can be involved in the transmission of information at almost zero cost, and the explosive growth in new technologies, new products, new models and so on led to mobile payments, shared economic value and a series of changes in industry development mode change, reducing wasted resources, and improving production efficiency. The Internet has promoted the circulation of talent and capital, enhanced the degree of openness to the outside world, and further optimized the allocation of resources on a global scale, utilizing the division of labor and cooperation to improve efficiency. A town is a meeting place for modern industry and the factors of production. In the development of the Internet, the town provides the hardware infrastructure and application scenarios and the Internet provide new investment and energy toward development and urbanization, having a relationship of mutual promotion and mutual cooperation (Forman, etc., 2005).TThe growth of the internet could make it easier for cities to collaborate with one another, make it easier for resources to flow between locations, and provide further support for the equitable allocation of resources. As a consequence of this, it has been shown that the expansion of the Internet has an impact on the transmission mechanism for resource misallocation. This takes place when the expansion of the Internet has an impact on the amount of openness, the level of urbanisation, and the industrial structure of a country. However, the method for changing resource misallocation by influencing the degree of marketization is not evident and may require further extensive investigation. This is something that needs to be looked into further.

5.5. Results of nonlinear relationship test

Table 10. Test results of mediation effect.

Variables	Equation (9)	Equation (10)					Equation (11)				
	RA	finance	market	openness	urban	ind	RA	RA	RA	RA	RA
internet	-0.356**	2.903***	0.259***	2.123***	0.598***	0.369***	0.662***	-0.295**	-0.209	-0.246	0.561***
	(-2.226)	(13.741)	(7.360)	(29.298)	(16.043)	(14.146)	(4.918)	(-1.981)	(-1.402)	(-1.463)	(3.838)
finance							-0.124***				
							(-4.403)				
market								-0.005			
								(-0.060)			
openness									-0.075**		
									(-2.338)		
urban										-0.482**	
										(-1.987)	
ind											-0.704***
											(-2.665)
_cons	-0.103	1.161***	0.663***	-0.052***	0.433***	0.360***	-0.020	-0.148	-0.110	0.208	0.095
	(-0.954)	(24.241)	(83.254)	(-3.170)	(51.247)	(60.827)	(-0.317)	(-1.217)	(-1.167)	(1.099)	(0.929)
R2	0.9453	0.3435	0.1290	0.7049	0.4166	0.3567	0.0384	0.9467	0.9475	0.9458	0.0050
N	360	360	360	360	360	360	360	360	360	360	360

The prior analysis was predicated on the premise that there is a linear link between the internet and the Ra. However, it is possible that there is also an undetected nonlinear relationship between the two, which is why the threshold regression approach will be used in this part to test for a nonlinear relationship. In this section, financial development, degree of marketization, degree of openness, urbanization and industrial structure, which are all closely related to the development of the Internet, are selected as the threshold variables for analysis. First, Table 11 shows the self-sampling test results to verify whether each threshold variable has a threshold effect. All five threshold variables reject the null hypothesis of no threshold impact, and all have a double threshold, that is, there are three change intervals. Next, Table 12 shows the specific analysis results of the thresholds of the five variables. Through the above steps, we prove that under different economic environmental conditions, there is a heterogeneous relationship among the Internet development level with resource misallocation in this region; that is, there is indeed a nonlinear relationship between the two.

To understand the specific nonlinear relationship, a threshold regression was conducted for the relevant variables in this paper. Table 13 reveals that the level of economic development is the only threshold variable for financial development that is significantly positive in the regression, and the other conditions do not have significance for the statistical resources misallocation degree; R&D and degree of resource misallocation also have a significant positive relationship, while the education level has a contrasting result, namely, in the five threshold regression, raising the level of regional educational development can significantly inhibit resource misallocation in the region.

Nevertheless, the Internet development level, which serves as the fundamental explanatory variable, has varying correlations with resource misallocation in the various threshold regressions. i) the level of financial development and industrial structure adjustment in the primary stage of Internet development show a significant positive relationship with the misallocation of resources, but at the intermediate and advanced stages, improvement in Internet development can significantly inhibit regional resource misallocation, as shown in the absolute value of the differences in the coefficients. ii) In the threshold regression with marketization level and urbanization level as threshold variables, the development level of the Internet always has a negative effect on resource misallocation, but the intensity with which it inhibits this problem shows an inverted "V" shape. In other words, the ability of the Internet development level to inhibit resource misallocation reaches its peak, and the absolute value of the coefficients in the initial stage is greater than that in the later stage. iii) However, in the threshold regression with the degree of openness as the threshold variable, the inhibition intensity of the Internet development level on resource misallocation shows a "V" shape, which is different from the previous results.

The development level of the Internet has a varying influence on the issue of resource misallocation at various stages and for various threshold variables, and the reasons for this are varied. During the beginning stages of the expansion of the financial sector, the level of economic development was relatively low, and the condition of the capital market was inadequate. The flow of cash into the market was controlled by the government through its various financial organisations. The market was dependent on this. At this time, improvement in the Internet development level depended more on traditional industry production. In the development process, it had not yet formed its own industrial chain, so improvement in the Internet development level at this time increased the local resource misallocation problem (Bower and Scheidell, 1970). As the level of financial development improved, the capital market became more complete, and the value of Internet technology was recognized by the market. Therefore, improvement in the Internet development level had a negative effect on resource misallocation (Marconi and Upper, 2017). The percentage of secondary and tertiary industries is also related to the overall industrial structure. In the early stage, secondary industry occupied a dominant position, capital was excessively concentrated in the heavy chemical industry, and resource misallocation was a prominent problem. As the proportion of tertiary industry continued to increase, capital became more focused on emerging industries, so the development of the Internet attracted the interest of investors (Kehrig and Vincent, 2017). The degree of marketization is closely related to the free flow of capital, and the technical characteristics of the Internet provide a solid foundation for market liberalization. Therefore, in the early and mid-stages of marketization, the level of Internet development continued to strengthen in its restraint of resource misallocation. However, in the late stage of marketization, since capital flow barriers had basically disappeared and capital could flow freely among various industries, the inhibitory effect of the Internet weakened (Misch and Saborowski, 2018). The level of urbanization was closely related to factors such as the number of residents and infrastructure. With the development of urbanization, residents' use of the Internet improved, and the construction of Internet infrastructure became more complete. The Internet development level had both positive and negative effects. The degree of restraint on resource allocation was fully brought into play. However, in the later stages of urbanization, urban infrastructure neared completion, urban residents became mainly engaged in tertiary industry, and the Internet's restraining effect on resource misallocation diminished (Miao and Wang, 2014). Internet technology originated with U.S. military and is an imported technology and industry for China. Therefore, in the early days of opening up, the Internet, as an emerging technology, naturally attracted the attention of governments and financial institutions. With the support of capital, it quickly took root in China (Benhima, 2013). Therefore, the local resource misallocation problem improved. However, the development of Internet technology is characterized by stages, and problems have been encountered in the localized development process. Therefore, in the middle stage, the Internet encountered a bottleneck, and its weakening effect on resource misallocation was reduced. With the establishment of the global Internet and the successful advancement in the localization and industrialization of Internet development, the Internet industry became an industry that attracted and concentrated capital. In this context, it has attracted a large amount of investment that had been concentrated in traditional industries. The problem of resource misallocation has also been weakened (Liao et al., 2020).

5.6. Test of policy effect

This study uses data at the city level, adopts the "Broadband China" pilot policy as a quasi-natural experiment, and constructs a DID model to examine the influence of Internet development on resource mismatch. This was done to further reduce endogenous interference and more correctly and gradually determine the causal relationship between Internet development and resource allocation.

Table 11. Self-sampling inspection of threshold effect.

Core explanatory variables	Threshold variable	Models	F-value	P-value	BS times	1%	5%	10%
Internet	Finance	Single threshold	28.132*	0.053	300	39.988	28.195	23.978
		Double threshold	23.832***	0.003	300	8.860	0.085	-7.729
	Marketization	Single threshold	7.204**	0.043	300	11.052	6.783	5.727
		Double threshold	32.430***	0.003	300	22.757	11.712	7.283
	Openness	Single threshold	18.535**	0.037	300	24.201	17.114	13.837
		Double threshold	59.080***	0.000	300	14.828	1.614	-4.986
	Urbanization	Single threshold	26.175**	0.037	300	44.783	20.851	14.008
		Double threshold	14.331***	0.007	300	14.154	7.985	3.410
	Industrial structure	Single threshold	19.088**	0.040	300	30.382	17.108	13.328
		Double threshold	34.115**	0.000	300	11.576	1.222	-3.436

Note: The P value and threshold value are obtained by bootstrap repeated sampling 1000 times.

Table 12. Threshold estimates and their confidence intervals.

Core explanatory variables	Threshold variable	Models	Threshold type	Threshold estimate	95% confidence interval
Internet	Finance	Double threshold	Single threshold	1.297	[1.267,1.953]
			Double threshold	1.920	[0.917,2.063]
	Marketization	Double threshold	Single threshold	0.731	[0.724,0.731]
			Double threshold	0.783	[0.655,0.799]
	Openness	Double threshold	Single threshold	0.781	[0.358,0.155]
			Double threshold	0.144	[0.144,0.156]
	Urbanization	Double threshold	Single threshold	0.562	[0.387,0.862]
			Double threshold	0.581	[0.387,0.862]
	Industrial structure	Double threshold	Single threshold	0.354	[0.346,0.362]
			Double threshold	0.558	[0.540,0.573]

Table 13. Threshold regression results.

Variables	Finance	Marketization	Openness	Urbanization	Industrial structure
$internet \cdot I\ (Regime \leq C_1)$	0.217	-0.558***	-1.567***	-0.606***	0.125
	(1.16)	(-4.34)	(-7.18)	(-3.48)	(0.80)
$internet \cdot I\ (C_1 < Regime \leq C_2)$	-0.422***	-1.097***	-0.404***	-1.021***	-0.555***
	(-2.65)	(-9.28)	(-3.43)	(-5.29)	(-7.21)
$internet \cdot I\ (C_2 < Regime)$	-0.756***	-0.635***	-0.726***	-0.423***	-1.154***
	(-5.96)	(-6.23)	(-7.84)	(-3.35)	(-10.12)
_cons	0.332**	1.040***	0.701***	0.476***	0.432***
	(2.49)	(6.13)	(4.64)	(3.14)	(3.62)
Control Variables	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes
R2	0.263	0.391	0.339	0.161	0.301
N	360	360	360	360	360

5.6.1. Parallel trend test

The visual technique is utilised in this paper to investigate whether or not there is a difference in resource mismatch before a city is selected as a demonstration city for "Broadband China." The estimated rise in resource mismatch is shown in figure 7, along with a confidence interval for its value of 95%. post1-post4 respectively represent the first 1-4 years after the policy has been impacted; current represents the period of the policy that is currently in effect; pre1-pre4 respectively represent the first 1-4 years before the policy is affected; and current represents the period of the policy that is currently in effect. It is clear from looking at FIG. 7 that the estimation coefficients for pre1 through pre4 move in a circle centred on ordinate 0. This demonstrates that there is not a discernible difference in the resource mismatch between pilot cities and non-pilot cities prior to the adoption of the policy, which satisfies the conditions of a balanced trend. On the other hand, it is crystal clear what the effect of this policy will be after it has been implemented. According to the findings presented above, the DID model that was utilised in this investigation is consistent with the parallel trend theory.

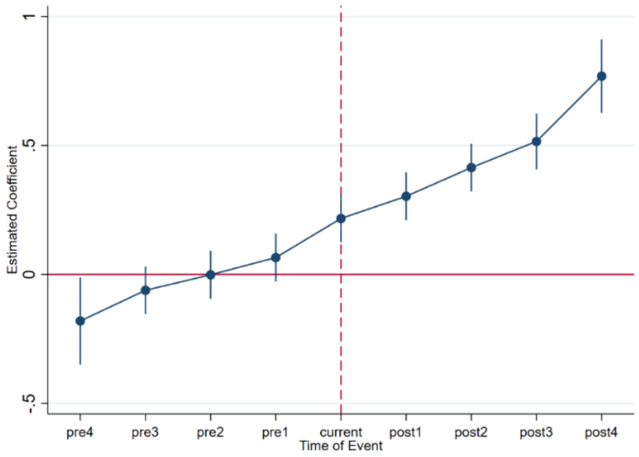

Figure 7. Parallel trend test.

5.6.2. Test results of policy effect

Column 1 of Table 14 does not include the regression results of control variables since those findings are omitted. According to the findings, the expansion of the Internet exerts an active and considerable influence on the promotion of resource allocation, and these results indicate that this influence is significant at the level of 1%. In column 2, add the control variable that will be used. Even though there has been a little reduction in the coefficient of the policy variable board, it has not lost its significantly positive sign. The robustness of the benchmark regression outcomes is demonstrated once more by the fact that all of the results of the regression show that the growth of the Internet has a direct influence on the facilitation of the promotion of optimal allocation of urban resources.

Table 14. Test results of policy effect.

Variables	Model (1)	Model (2)
broad	0.093***(7.126)	0.075***(5.864)
_cons	1.941***(40.438)	0.874***(7.349)
Control Variables	No	Yes
Year FE	Yes	Yes
City FE	Yes	Yes
Adj R-squared	0.9150	0.9213
N	1566	1566

6. Conclusions and policy recommendations

This article first measures resource misallocation among 30 provinces in China from 2006 to 2017. Since there is no spatial dependence in labor resource misallocation, the explained variable in this article is capital resource misallocation. In addition to this, it builds an Internet development level evaluation system that takes into account the poi, iri, aoi, and ioi components. In addition, the entropy method is applied to both the calculation and the analysis processes. Second, the global and local Moran's indexes are used to explore the effect of Internet development on the misallocation of resources in China through spatial measurement. This article investigates the transmission mechanism via which the growth of the Internet contributes to resource misallocation. The third variable in this transmission mechanism is the intermediary factors, which include financial development, industrial structure, degree of marketization, degree of openness, and urbanisation. In addition, we analyse the policy influence that the development of the Internet has on the most effective distribution of resources. In the final step of the analysis of the nonlinear connection, the intermediary variables serve the function of threshold variables.The following are the primary inferences to be drawn: i) Spatial analysis reveals that the proliferation of the Internet has had a significant dampening effect on resource misallocation, a finding that holds up to a robustness test in which the Internet's widespread use and widespread support serve as the primary explanatory variables. ii) The findings from the research that was conducted to verify the transmission mechanism demonstrate that, in addition to the degree of marketization, it can further promote resource misallocation through the promotion of financial growth, openness, industrial structure, and urbanisation, and upgrade the optimisation of resource allocation and improvement in efficiency. iii) Finally, the threshold regression results show that with a higher level of financial development and industrial structure, the inhibitory effect of Internet development on resource misallocations becomes more obvious, and degree of urbanization and marketization becomes higher; Internet development has always played a role in resource misallocation; although this role is inhibitory, the inhibition first increases and then decreases.The inhibiting effect that the development of the Internet has on resource misallocation is seen to first decrease and then increase in direct proportion to the degree of openness that exists. The policy of "Broadband China" has an active impact on the promotion of the best allocation of urban resources and is having an effect as a direct result of this. After that, the following suggestions for changes to the policy are provided:

First, China should continue to promote the "Internet +" strategy,improve resource allocation while bolstering the network's building and fostering Internet technology growth. As an important platform for the sharing of production and living elements, the Internet acts a pivotal part in resource allocation. The construction of Internet infrastructure is a fundamental cornerstone of the growth of the Internet. As a sub-indicator, it also has a significant inhibitory effect on resource misallocation. Considering that there is an obvious "digital divide", the level of Internet development between regions is not balanced, and the eastern region has apparent superiority over the central and western areas. Therefore, more money needs to be put into building out Internet infrastructure in the centre and west, and this work needs to be synchronised with the progress of those areas. In the process of commercialising 4G and 5G, it is necessary to consolidate advantages and maintain a leadership position in the eastern region while minimising disadvantages. China should appropriately favour central and western regions in determining Internet resources and supporting policies when formulating relevant policies,Consequently, the digital divide can be reduced, and regional cooperation can be fostered.

Second, China should further enhance the development of the financial market and increase the level of financial development. At present, the process of capital marketization in China is relatively slow. Most financial institutions focus on state-owned enterprise financing and provide limited services to small, medium and microenterprises, which has caused a misallocation of capital resources. Therefore, financial market reforms need to be further deepened. Financial institutions at all levels should reduce credit discrimination, encourage investment in small, medium-sized and micro businesses, and make it easier for them to raise funds. They should also lower the threshold for financial market access and use live funds to allow capital to flow into enterprises with high productivity to promote the standardization and ordering of the entire capital market. At the same time, China should actively improve the investment and financing system, promote capital circulation, fully utilize private capital and expand the direct financing market. The government should encourage and stimulate enterprises to increase independent investment, improve the capital market and realize the effective allocation of capital. China should make concerted efforts in market-oriented reform and raise financial development. It should steadily advance market-oriented reform, promote the development of the financial market, continue to open more widely to the outside world, and create favorable conditions for the greater use of the Internet in promoting the misallocation of resources.

In the end, but certainly not least, China needs to prioritise the modernisation of its industrial structure and the improvement of its resource utilisation efficiency. The optimisation of the industrial structure enables the elements of various departments to flow spontaneously to high-efficiency industries. This develops the process of reallocating elements in order to lessen the total resource misallocation that occurs in industry. China will facilitate the innovation efficiency of high-tech industries such as medicine and health, new energy and new materials, optimize the technological innovation system, stimulate organizational vitality, reshape business processes, and further upgrade the optimization of the industrial structure. The government should eliminate unreasonable industrial policies, accelerate supply-side structural reforms, and promote the formation of industrial clusters. The government should also actively support the transfer of "marginal industries" and industries with excess production capacity where China no longer has a comparative advantage over other countries with the same level or lower economic development. China has basically lost its comparative advantages in these “marginal industries”, but they still consume a large amount of resources and may have comparative advantages or potential comparative advantages in a host country, using their own advanced technology combined with local resource endowments and market scale. Other steps such as further reducing production costs, will in turn help release China's production factors, concentrate domestic resources to develop advantageous industries, and the improvement of resource allocation efficiency.

Funding Statement

This research received no external funding.

Acknowledgment

Acknowledgments to anonymous referees' comments and editor's effort.

Declaration of Competing Interest

The authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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