The Internet reshapes China's economic geography: micromechanisms and macro effects

Chen Yang
Nanjing University of Finance and Economics, Nanjing, China, and
Tongliang An
School of Economics, Nanjing University, Nanjing, China

Received 18 October 2020
Revised 18 October 2020
Accepted 18 October 2020

Abstract

Purpose – By observing facts of the "reversal of agglomeration" of Chinese enterprises during the period of rapid Internet development and using a new economic geography model combined with the data of the real estate sector, this paper deduces the influence of the "reshaping mechanisms" of the Internet on China's economic geography based on the "gravitation mechanism" of the Internet that affects the enterprises and the "amplification mechanism" of the Internet that amplifies the dispersion force of house prices.

Design/methodology/approach – In the empirical aspect, the dynamic spatial panel data model is used to test the micromechanisms of the impact of the Internet on enterprises' choice of location and the instrumental variable method is used to verify the macro effects of the Internet in reshaping economic geography.

Findings – It is found that in the era of the network economy, the Internet has become a source of regional competitive advantage and is extremely attractive to enterprises. The rapidly rising house price has greatly increased the congestion cost and has become the force behind the dispersion of enterprises. China's infrastructure miracle has closed the access gap which gives full play to network externalities and promotes the movement of enterprises from areas with high house prices to areas with low house prices.

Originality/value – The Internet is amplifying the dispersion force of congestion costs manifested as house prices and is reshaping China's economic geography. This paper further proposes policy suggestions such as taking the Internet economy as the new momentum of China's economic development and implementing the strategy of regional coordinated development.

Keywords Internet, Network economy, Agglomeration, House price, Reshaping economic geography

Paper type Research paper

1. Introduction

The Internet [1] has changed the activities of production, circulation and consumption (OECD, 2012), is irreversibly becoming an important force affecting the global economic and social development and the source of competitive advantage of a country or a region (Porter, 1990). However, the explosive popularisation of the Internet is an extremely unbalanced

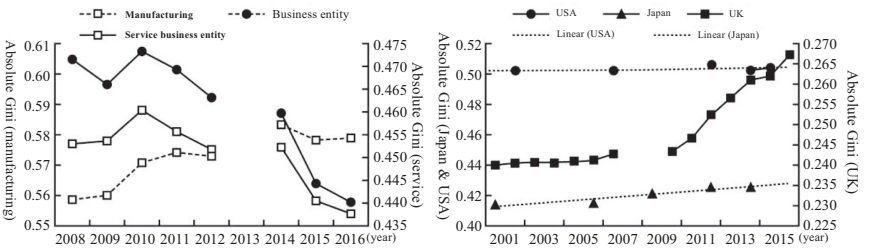
JEL Classification — D80, R13, R30

This research is supported by a major research special project of the National Social Science Fund of China (no. 18VXK002) and the "Ten Thousand Talents Program" of the Publicity Department of the Central Committee of the Communist Party of China. This paper was included in the conference proceedings of the 1st Forum for Internet and Digital Economy (2019). The authors thank Li Bin, Fu Lin and other attendees for their profound comments and sincerely thank the anonymous peer reviewers for their valuable opinions. The authors are solely responsible for all issues arising in connection with this paper.

China Political Economy
Vol. 3 No. 2, 2020
pp. 341-365
Emerald Publishing Limited
2516-1652
DOI 10.1108/CPE-10-2020-0014

expansion and economic subjects may form unbalanced economic geography in the process of chasing unevenly distributed information resources. Generally, economic geography is understood as the dynamic evolution of agglomeration and dispersion of economic subjects such as labour and enterprises in economic space. Then, whether the Internet strengthens the imbalance of spatial economic activities characterised by agglomeration and is a new source of widening the regional economic gap has become a question. Based on observation of the agglomeration characteristics of Chinese enterprises during the rapid development of the Internet, it is found that the concentration degree of China's most industries and particularly, service industry, began to decline in 2011, but an apparent upward trend was shown in the concentration degree of enterprises in developed countries such as the USA, Japan and Britain (see Figure 1). The development of the Internet has deepened the imbalance of economic activities in developed countries, but it seems to reverse the trend of further agglomeration of Chinese enterprises. The macro facts of the reversal of agglomeration of China's enterprises lead to the theoretical speculation of this paper: the Internet may be reshaping China's economic geography; however, the internal mechanisms are unclear.

In the era of the Internet of Things (IoT), a new geographical spatial structure is taking shape. On the one hand, the "access gap" [2] has widened the gap between regions and deepened the spatial imbalance. Due to the uneven distribution of information resources, the agglomeration economy of central cities has been continuously strengthened by the Internet . At the same time, the network effect allows the Internet to play a greater role after the Internet user scale reaches the critical point (Katz and Shapiro, 1985) and the spatial imbalance of economic activities has further expanded. In the era of the Internet economy, the pattern of economic geography may still tend to agglomerate. On the other hand, the Internet has increased the freedom in enterprises' site choices and reduced the importance of geographical factors (Goolsbee, 2000). In order to avoid the congestion cost, industries inevitably tend to



Note(s): As China Statistical Units Yearbooks before 2008 only provided the data of enterprises above the designated size, in order to ensure continuity and comprehensiveness, the research data of this paper starts from 2008, which happens to completely cover the period during which mobile Internet is integrated into people's daily life, creating the Internet economy era based on Internet of Things (from 2009 to present). Because of changes made during the third economic census, the statistical dimensions and scales of data collected in 2013 are inconsistent, resulting in the gap in the data. Under the consideration of the policy influences, after excluding the samples from the Beijing-Tianjin-Hebei region, the agglomeration index still shows a downward trend, and the concentration degree calculated by using the data of industrial enterprises above designated size in prefecture-level cities also shows a downward trend, which is omitted due to the limited space

Source(s): China Statistical Units Yearbook, China City Statistical Yearbook, the website of the US Census Bureau (https//www.census.gov/), the website of the UK Office for National Statistics (https//www.ons.gov.uk/), and the website of the Statistics Bureau of Japan (http//www.stat.go.jp/)

Figure 1.
Characteristics of enterprise agglomeration in China, the USA, Japan and the UK

disperse, creating new information geography, which is loosely linked with physical space (Choi *et al.*, 2006). However, the Internet does not completely eliminate the influence of geographical factors. Even for online products with no transportation costs, distance still plays a significant role (Blum and Goldfarb, 2006). Due to the existence of more complex and unmodifiable information generated by business processing and response time and economic development, the importance of geographical factors cannot be completely ignored (Leamer and Storper, 2014). The global agglomerating force remains strong, and whether information sharing is significant enough to change the geographical location of service providers remains to be discussed.

The shaping of economic geography is related to the Internet , but the shaping effect can be multifaceted. The new economic geography theory points out that when the interregional iceberg transport cost [3] is lower than the congestion cost in the region, it will result in a dispersed spatial equilibrium (Helpman, 1998). On the one hand, the development of China's Internet is at the forefront of the world, yet its Internet has not deepened spatial imbalance. The extraordinary infrastructure development has brought about the expansion of Internet access facilities and the convenience of using such facilities and quickly closed the "access gap" of the Internet in China (Qiu *et al.*, 2016; Ge and Cen, 2017); it has not only helped China to avoid a new "digital divide" but also effectively reduced the iceberg transport cost. On the other hand, as an important symbol of congestion cost, house price has a profound impact on China's economic development (Liu and Li, 2017). Since the housing system reform in 1998 and the land supply system reform in 2003, China's commercial real estate prices have maintained an average annual growth rate of more than 10%, and the prices in first-tier cities such as Beijing, Guangzhou and Shenzhen have even reached an average annual growth rate of more than 20% (Zhang *et al.*, 2017; Tong and Liu, 2018). The rise of house prices will increase production costs, and the rise of congestion costs directly affects enterprises' choices of location (Fan and Shao, 2011). The rapidly rising house price in Shenzhen even forced a large number of high-end manufacturing industries to move out. In China, there have been cases where the iceberg transport costs decrease and congestion costs rise at the same time and the Internet and house prices together create dispersed economic geography.

To confirm the above conjecture, the authors of this paper start from the logic of "the fact that the micro-location choice of enterprises leads to macro-agglomeration". Based on the "gravitation mechanism" of the Internet to attract enterprises and the "amplification mechanism" of the Internet that amplifies the dispersion force manifested as house price, the paper deduces the "internal mechanisms" of the Internet in shaping economic geography theoretically. In the empirical aspect, the spatial econometric technology is used to test the micromechanisms of the Internet in influencing enterprises' choice of location and verify the macro effects of the Internet on reshaping economic geography of China. In the era of the Internet , microeconomic theory is innovated (Zhang, 2016) and the behaviour and decision-making of economic subjects have changed (Wu, 1996; Shapiro and Varian, 1998). However, whether economic geography can be reshaped depends on whether the "access gap" is closed, the network externalities are brought into play, the congestion cost in the region is too high, enterprises are forced to relocate, the domestic market capacity is sufficient and there is room for enterprise migration. Therefore, exploring the internal mechanisms of the formation of China's dispersed economic geography is not only helpful in broadening the applicable boundary of microeconomic theory but also of great theoretical and practical significance to the sustained and stable development of China's economy and the evolution of its economic geography.

To the best of our knowledge, the possible contributions of this paper are as follows: (1) adhering to the concept of "explaining China's practice with Chinese theory", closely following the economic characteristics of China's vast territory and huge market scale and considering the double-factor background of the Internet access gap-bridging "infrastructure miracle" and the rapid rise of house price, this paper explores the internal mechanisms of the Internet reshaping China's economic geography. (2) The new economic geography theory

attaches importance to numerical simulation and pays less attention to the internal mechanisms of enterprises' choices of location. This paper delves deep into the micromechanisms behind the macro effects and discusses the "gravitation mechanism" and "amplification mechanism" of the Internet which influence the location choice of enterprises by modifying consumer budget constraints, producer profit function and heterogeneous iceberg transport costs. (3) This study has constructed an empirical analysis framework of "micromechanisms-macro effects", so that the conclusions can be mutually verified. The Internet condition is measured based on a global perspective, the dynamic spatial panel data model is used to consider the spatial-temporal correlation of enterprises' choice of location [4] and the house price distance matrix is introduced to simulate the dispersion force. The microscopic mechanism of the Internet in influencing enterprises' choice of location is then tested to verify its macroscopic effect on reshaping China's economic geography.

2. Internal mechanisms of the Internet in shaping economic geography

2.1 Mathematical model construction

Combining the models of Helpman (1998) and Pflüger and Tabuchi (2010), this paper constructs a 2*2*1 new economic geography model and brings the Internet , a key factor that can greatly reduce the iceberg transport cost, into the model, and manifests the dispersion force of congestion cost by using rapidly rising house price, thereby focussing on the micromechanisms behind the agglomeration characteristics and analysing the internal mechanisms of the Internet in shaping economic geography. It is assumed that in the economic system, there are two regions $i = 1, 2$, two production departments, namely the industrial department M and the real estate department H, one factor of production, i.e. labour L and the industrial products can be traded freely, while housing cannot be traded across regions.

2.1.1 Consumer behaviour. Let the utility function of representative consumers in region i be the constant elasticity of substitution (CES) utility function:

$$U_i = M_i^{\mu} H_i^{1-\mu},\ 0 \le \mu < 1;\ M_i = \int_0^{n_i} m_i(v)dv^{\frac{\sigma-1}{\sigma}},\ \sigma > 1;\ \text{S.t.} \int_0^{n_i} p_i(v)m_i(v)dv + r_i H_i = Y_i \tag{1}$$

where M_i is the number of industrial products consumed, $p_i(v)$ is the price of product v, r_i is the house price and σ is the elasticity of substitution between products.

$$Y_i = a_i w_i L_i \tag{2}$$

It is assumed that the land is owned by the government, the income Y_i comes entirely from wages w_i, L_i is the number of consumers and a_i is the influence of the Internet on income. In addition to effectively overcoming the asymmetry of information in the buyer's market and enhancing the purchasing power of consumers (Bakos, 1997; Rezabakhsh *et al.*, 2006), the Internet has dramatically reduced the commuting cost of consumers and the searching and commuting cost of labourers and the budget constraints have therefore been relaxed. First of all, e-commerce has reduced the difficulty of purchasing goods in remote areas, especially in rural areas (Zhu and Leng, 2017), and consumers can purchase goods nationwide and even globally without leaving their homes nowadays. Services in such forms as "Internet + O2O car rental" and "Internet + offline distribution" have solved the "last mile problem", and the commuting or time cost thereby reduced equals to income increased. Furthermore, the Internet increases information symmetry in the labour market and reduces the searching costs such as transportation, mailing and intermediary fees in job hunting and the commuting cost in work (Kuhn and Skuterud, 2004), which can also be considered as increasing the income of consumers.

2.1.2 Producer behaviour [5]. Let the production function of representative manufacturers in the region i be

$$\mathrm{TC}_i(v) = \frac{1}{b_i} w_i q_i(v) + \frac{1}{c_i} w_i^{1-\gamma} r_i^{\gamma} f \tag{3}$$

Given the product price p_i, the profit function of representative manufacturers is

$$\pi_i(v) = p_i(v) q_i(v) - \frac{1}{b_i} w_i q_i(v) - \frac{1}{c_i} w_i^{1-\gamma} r_i^{\gamma} f \tag{4}$$

where $q_i(v)$ is the output of industrial products v and f is the fixed cost other than salaries and house price. All regions are the same and the subscript can be discarded. $\frac{1}{b_i}$ and $\frac{1}{c_i}$ are the influence of the Internet on production costs. On the one hand, the Internet can reduce the fixed cost for enterprises in building or maintaining their procurement and distribution channels. First, the Internet improves the procurement–distribution channels and enterprises optimise the spatial organisation in the circulation field in time according to the market demands (Srinivasan *et al.*, 2002). Second, the virtual business environment caused by the information technology revolution has created a network platform that breaks the physical constraints of time and space, replacing the procurement–distribution channel to a certain extent (Yue and Li, 2018). Third, in the era of the Internet economy, a large number of new commercial activities, such as video, games and self-media, have completely broken through the constraints of time and space from production to sales and the network platform has directly replaced the procurement–distribution channels. On the other hand, the microscopic basis of the agglomeration economy is the matching, sharing and learning of labour force (Duranton and Puga, 2004). The Internet alleviates information asymmetry, reduces labour matching costs of enterprises and provides a platform that can reduce labour sharing and learning costs. From instant messaging to e-commerce and from search engines to online services, the Internet has fully permeated all aspects of economic and social development, creating a large number of flexible jobs and flexible employment methods and deriving new economic forms. The emergence of the agglomeration economy is no longer subject to time and space constraints.

2.1.3 Iceberg transport cost. There is an iceberg transport cost manifested as $\frac{\tau}{d_i}$, $\tau > d_i > 1$ in cross-regional sales of products. Let the difference be reflected by the Internet condition d_i and τ is the iceberg transport cost without the Internet . The subscript can be discarded. The actual supply quantity of products in the quantity of $\kappa_{12}(v)$ sold by enterprises in other regions is $\frac{\tau}{d_i}\kappa_{12}(v)$ and the sale price is $p_{12}(v) = \frac{\tau}{d_i} p_{11}(v)$. Let $\phi_{12} = \left(\frac{\tau}{d_1}\right)^{1-\sigma}$. The existence of geographical distance strengthens information asymmetry and leads to the imbalance of market allocation (Akerlof, 1970), but the Internet breaks down the barrier of information asymmetry and effectively alleviates this problem (Han *et al.*, 2014). On the one hand, searching and publishing information on online platforms can reduce iceberg transport costs such as information searching, bilateral matching and logistics (Anderson and Wincoop, 2004). On the other hand, the new commercial activities produced by the integration with the Internet are less or not restricted by geographical space in product trade, so that the iceberg transport cost is effectively reduced.

2.1.4 Calculation of equilibrium conditions [6]. To sum up, the equilibrium conditions are as follows:

$$F_1 = \frac{s_1}{1-s_1} = \frac{c_1 r_2^{\gamma} (b_1 b_2)^{\sigma-1} w_1^{\gamma-\sigma} w_2^{1-\sigma} (Y_1 + \phi_{12}\phi_{21} Y_2) - c_2 r_1^{\gamma} b_2^{2\sigma-2} w_2^{\gamma-\sigma} w_2^{1-\sigma} (\phi_{21} Y_1 + \phi_{21} Y_2)}{c_2 r_1^{\gamma} (b_1 b_2)^{\sigma-1} w_1^{1-\sigma} w_2^{\gamma-\sigma} (\phi_{12}\phi_{21} Y_1 + Y_2) - c_1 r_2^{\gamma} b_1^{2\sigma-2} w_1^{1-\sigma} w_1^{\gamma-\sigma} (\phi_{12} Y_1 + \phi_{12} Y_2)}, \; 0 < s_1 < 1 \tag{5}$$

2.2 Micromechanism of the impact of the Internet on enterprises' choice of location [7]

2.2.1 The gravitation mechanism of the Internet. The Internet not only reduces the cost of commuting and job hunting for consumers but also reduces the fixed and variable costs in the production of enterprises. It effectively alleviates the problem of information asymmetry in trade and profoundly impacts enterprises' choices of location. Firstly, $\frac{\partial F_1}{\partial b_1} = \frac{b_1^{2-2\sigma}B(C-D)+D(A-B)}{(C-D)^2} > 0$ and $\frac{\partial F_1}{\partial c_1} = \frac{[AC-BD]/c_1}{[C-D]^2} > 0$ can be obtained from formula (5) regarding equilibrium conditions. Through various channels, the Internet reduces the fixed costs that enterprises have to pay as well as the variable costs in the process of using labour, and the increase in profits attracts enterprises to move in. Secondly, with $\frac{\partial F_1}{\partial \phi_{12}} = \frac{\frac{C}{B}\frac{(\phi_{21}Y_1+\phi_{21}Y_2)}{(\phi_{12}\phi_{21}Y_1+Y_2)}\left[\frac{A}{(Y_1+\phi_{12}\phi_{21}Y_2)}-\frac{B\phi_{21}}{(\phi_{21}Y_1+\phi_{21}Y_2)}\right]^2[Y_1(Y_1+Y_2)]}{[C-D]^2} > 0$, the reduction of iceberg transport cost indicates that the Internet alleviates the information asymmetry faced by local products sold to other regions, reducing the sales price of products outside the region and further attracting enterprises seeking such competitive advantage to move in. Finally, focussing on the impact of the Internet on consumers' income, formula (5) can be changed to $F_1 = \frac{[1-\phi_{21}]Y_1+[\phi_{12}-1]\phi_{21}Y_2}{[\phi_{21}-1]\phi_{12}Y_1+[1-\phi_{12}]Y_2}$ and $\frac{\partial F_1}{\partial Y_1} > 0$. $\frac{\partial F_1}{\partial a_1} > 0$ can be obtained from $\phi_{12} < 1$. The Internet relaxes the budget constraints of consumers and attracts more labour, so enterprises tend to move in. The following can therefore be obtained:

P1. The Internet improves the profit of producers and increases the income of consumers by decreasing production and iceberg transport costs and further absorbs labour and attracts enterprises to settle in, thus forming a gravitation mechanism.

2.2.2 The amplification mechanism on the dispersion force. Considering the dispersion force of congestion cost manifested by house price. As $\frac{\partial F_1}{\partial r_1} = -\frac{\gamma r^{-1}[AC-BD]}{(C-D)^2} < 0$ can be obtained from formula (5), house price negatively correlates with the proportion of local enterprises and enterprises will spontaneously move from areas with high house prices to areas with low house prices. The amplification mechanism of the Internet in affecting house price dispersion force is as follows: (1) due to the gravitation mechanism, the development of the Internet in areas with low house prices reduces the opportunity cost of enterprise migration, so more enterprises migrate from areas with high house price to areas with low house price. Take the case where house price increases in region 1: $\Delta r_1 > 0$ and $F_1(r_1 + \Delta r_1) < F_1(r_1)$. According to the monotonicity of the function and the symmetry of the model, $\frac{\partial F_1(r_1+\Delta r_1)}{\partial a_2} < 0$, $\frac{\partial F_1(r_1+\Delta r_1)}{\partial b_2} < 0$, $\frac{\partial F_1(r_1+\Delta r_1)}{\partial c_2} < 0$ and $\frac{\partial F_1(r_1+\Delta r_1)}{\partial d_2} < 0$ can be obtained. The development of the Internet in region 2 (area with low house prices) increases the number of enterprises, which are reduced due to rising house price in region 1 (area with high house price). (2) The Internet enlarges the dispersion force of house price by alleviating interregional information asymmetry, which can be explained as a "signalling effect". The absolute marginal quantity of house price change in region 1 is $|\Delta F_1(r_1)| = F_1(r_1 + \Delta r_1) - F_1(r_1) = \frac{\gamma r_1^{-1}[AC-BD]}{(C-D)^2}$. Let the Internet development and other conditions in the regions be the same and homogenise the iceberg transport cost, $|\Delta F_1(r_1)| = \gamma r_1^{-1}\left[\frac{1+\phi}{1-\phi}\right]^2$, then $\partial|\Delta F_1(r_1)|/\partial\phi > 0$, i.e. $\partial|\Delta F_1(r_1)|/\partial d > 0$. For region 1, which has high house prices, the Internet transmits the signal of areas with low house prices, reduces the information search cost of enterprises in areas with high house prices and promotes the mobility of enterprises by alleviating information asymmetry. The following can therefore be obtained:

P2. The Internet facilitates enterprises' movement from areas with high house prices to areas with low house prices by reducing the cost of enterprise migration (gravitation mechanism) and alleviating information asymmetry (signalling effect), thus forming an amplification mechanism.

2.3 The internal mechanism of the Internet shaping economic geography

In practice, the attraction of the Internet for enterprises positively correlates with the network externality brought by the progress of information technology and negatively correlates with the regional access cost. Let $a_i = \frac{\alpha}{\lambda_i}$, $b_i = \frac{\beta}{\lambda_i}$, $c_i = \frac{\varphi}{\lambda_i}$ and $d_i = \frac{\delta}{\lambda_i}$, where the gap of regional Internet development is reflected by access cost λ_i, the influences of network externalities α, β, φ and δ are consistent and the subscript is dropped. Thus, formula (5) regarding equilibrium conditions becomes as follows:

$$F_1 = \frac{\lambda_2 r_2^{\gamma}(\lambda_1\lambda_2)^{\sigma-1} w_1^{\gamma-\sigma} w_2^{1-\sigma}(Y_1 + \phi_{12}\phi_{21}Y_2) - \lambda_1 r_1^{\gamma}\lambda_1^{2\sigma-2} w_2^{\gamma-\sigma} w_2^{1-\sigma}(\phi_{21}Y_1 + \phi_{21}Y_2)}{\lambda_1 r_1^{\gamma}(\lambda_1\lambda_2)^{\sigma-1} w_1^{1-\sigma} w_2^{\gamma-\sigma}(\phi_{12}\phi_{21}Y_1 + Y_2) - \lambda_2 r_2^{\gamma}\lambda_2^{2\sigma-2} w_1^{1-\sigma} w_1^{\gamma-\sigma}(\phi_{12}Y_1 + \phi_{12}Y_2)},$$
$$Y_1 = \frac{\alpha}{\lambda_1} w_1 L_1,\ \phi_{12} = \left(\frac{\lambda_1}{\delta}\tau\right)^{1-\sigma} \tag{6}$$

The micromechanism of enterprises' choice of location has shaped the macro-economic geography. (1) The shaping mechanism of gravitation mechanism: according to formula (6), $\partial a_1/\partial\lambda_1 < 0$, $\partial b_1/\partial\lambda_1 < 0$, $\partial c_1/\partial\lambda_1 < 0$, $\partial d_1/\partial\lambda_1 < 0$ and $\partial F_1/\partial\lambda_1 < 0$; the access cost increases the daily expenditure of consumers, the production cost of enterprises and the iceberg transport cost in sales, which may weaken the network externality of the Internet and is negatively correlated with the number of local enterprises. When $\lambda_i > \alpha$, $\lambda_i > \beta$, $\lambda_i > \varphi$ and $\lambda_i > \delta$, access to the Internet will increase consumer spending and enterprise costs, and the gravitation mechanism is manifested as the "repulsion mechanism", which indicates that reduced access cost helps to give full play to the role of the Internet 's gravitation mechanism. Let us relax the homogeneity assumption of network externalities. Let $\partial\alpha_1/\partial L_1 > 0$, $\partial\beta_1/\partial L_1 > 0$, $\partial\varphi_1/\partial L_1 > 0$ and $\partial\delta_1/\partial L_1 > 0$, and the network externality is positively correlated with the user scale in the access network (Shapiro and Varian, 1998). As mentioned earlier, the reduction of access cost increases the number of enterprises, and the increase of Internet users improves network externality, attracting more enterprises to settle in, thus forming the "positive feedback" effect of the Internet (Arthur, 1989). Considering that the region with more enterprises will develop a higher agglomeration economy, enterprises will further strengthen the gap between regions in the process of chasing the unbalanced distribution of Internet resources and the simple gravitation mechanism will deepen the imbalance of spatial economic activities and shape economic geography of agglomeration.

(2) Consideration of the reshaping mechanism of the amplification mechanism: when there are additional dispersion forces such as house prices, the Internet may create dispersed economic geography. On the one hand, the access cost is reduced and the externality of the Internet to reduce the migration cost of enterprises and alleviate information asymmetry is brought into full play, effectively enlarging the dispersion force brought by the rising house price in other regions, so that more enterprises will choose to move out of regions with high house prices. On the other hand, the settlement of new enterprises increases the size of local Internet users and enhances the network externalities of the Internet ; the improvement of network externality, in turn, attracts more enterprises to move in, resulting in the positive feedback effect of the Internet . Because areas with high house prices are generally areas with high concentration, it used to be difficult for local enterprises to decide on relocation due to the dilemma derived from the existence of an "agglomeration economy" and "congestion costs". However, the popularisation of the Internet has reduced the opportunity cost of enterprise

migration, so enterprises are opting to move from areas with high house prices (high degree of concentration) to areas with low house prices (low degree of concentration). In the meantime, as the positive feedback effect of the Internet amasses, the amplification mechanism affecting the dispersion force manifested by house price has been greatly enhanced and more enterprises have chosen to move, which may reshape the original economic geography of agglomeration (Figure 2).

P3. Under the combined effect of the Internet gravitation mechanism and its amplification mechanism on the dispersion force, more enterprises move from areas with high house prices (high degree of agglomeration) to areas with low house prices (low degree of agglomeration) and economic geography is thus reshaped.

3. The impact of the Internet on enterprises' choice of location: micromechanism testing

3.1 The metrological model

A benchmark measurement model is set according to the theoretical demonstration that the Internet impacts the micromechanisms of enterprises' choice of location:

$$\mathrm{Firm}_{it} = \alpha + \beta_0 \mathrm{Int}_{it} + \sum_{j=1}^{n} \beta_j X_{itj} + \varepsilon_{it},\ \varepsilon_{it} \sim N\left(0,\ \sigma^2 I\right) \tag{7}$$

where Firm is the proportion of enterprises for measuring the enterprises' choice of location, Int is the Internet index, including global Internet Oint and global mobile Internet Omint and X is the control variable that affects the location of enterprises. Considering that there may be a spatial correlation in enterprise site decision, spatial autoregressive (SAR) and spatial error models (SEM) are constructed for the empirical test. W is the spatial weight matrix, ρ and η are the variable coefficients and ε_{it} and μ_{it} are the disturbance terms.

$$\mathrm{Firm}_{it} = \alpha + \rho W \cdot \mathrm{Film}_{it} + \beta_0 \mathrm{Int}_{it} + \sum_{j=1}^{n} \beta_j X_{itj} + \varepsilon_{it},\ \varepsilon_{it} \sim N\left(0,\ \sigma^2 I\right) \tag{8}$$

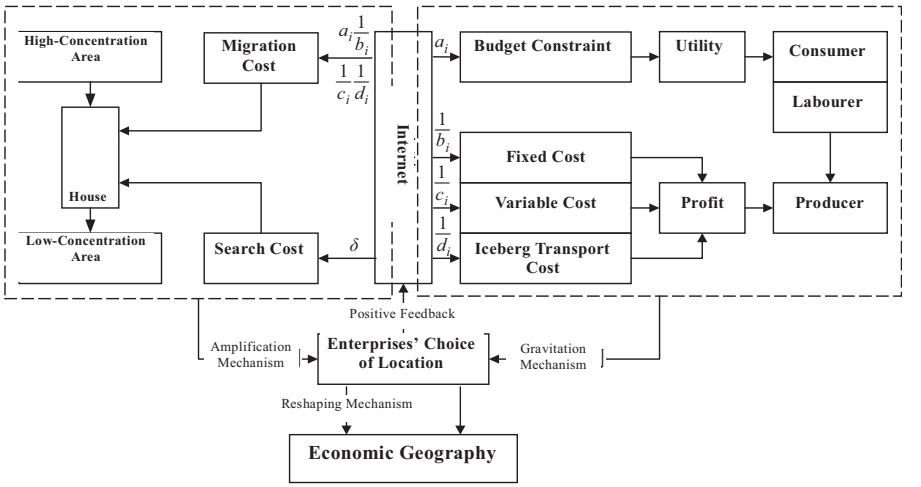


Figure 2.
Internal mechanisms of the Internet in reshaping economic geography

$$\mathrm{Firm}_{it} = \alpha + \beta_0 \mathrm{Int}_{it} + \sum_{j=1}^{n} \beta_j X_{itj} + \upsilon_{it},\ \upsilon_{it} = \delta W \cdot \mu_{it} + \varepsilon_{it},\ \varepsilon_{it} \sim N\left(0,\ \sigma^2 I\right) \tag{9}$$

There is a "dynamic continuity" in the enterprises' choice of location, that is, enterprises will refer to the location choice of other enterprises in previous years for deciding on locations. A dynamic spatial panel model that includes both temporal and spatial effects is constructed (Elhorst, 2012; Lee and Yu, 2014):

$$\mathrm{Firm}_{it} = \tau \mathrm{Firm}_{i,t-1} + \rho W \cdot \mathrm{Firm}_{it} + \eta W \cdot \mathrm{Firm}_{i,t-1} + \beta_0 \mathrm{Int}_{it} + \sum_{j=1}^{n} \beta_j X_{itj} + \mu_i + \omega_t + \varepsilon_{it},\ \varepsilon_{it} \sim N\left(0,\ \sigma^2 I\right) \tag{10}$$

where Firm_{it} and $\mathrm{Firm}_{i,t-1}$ represent the enterprises' choice of location in region i in years t and $t-1$, respectively, μ_i and ω_t represent the dummy variables of specific spatial and temporal effects, respectively, ε_{it} is a random error term satisfying independent and identical distribution and τ, ρ and η are coefficients of temporal, spatial and spatial-temporal lags, respectively.

In order to test the "amplification mechanism" of the Internet's dispersion force affecting congestion costs, this paper introduces house price distance and its interaction term with the Internet condition [8]:

$$\mathrm{Firm}_{it} = \tau \mathrm{Firm}_{i,t-1} + \rho W \cdot \mathrm{Firm}_{it} + \eta W \cdot \mathrm{Firm}_{i,t-1} + \beta_0 \mathrm{Int}_{it} + \beta_1 \mathrm{House} + \beta_2 \mathrm{Int}_{it} \cdot \mathrm{House} + \sum_{j=3}^{n} \beta_j X_{itj} + \mu_i + \omega_t + \varepsilon_{it},\ \varepsilon_{it} \sim N\left(0,\ \sigma^2 I\right) \tag{11}$$

In the model testing the "amplification mechanism", Int covers the local Internet (Internet) and the mobile Internet (Minternet). With the inclusion of the spatial-temporal lag of the dependent variable, the estimation parameters and standard errors of ordinary least squares (OLS) will be inconsistent. In this paper, maximum likelihood estimation (MLE) is used to estimate the static spatial model and bias-corrected quasi-maximum-likelihood estimation (BC-QMLE) is utilised to estimate the dynamic spatial model (Yu *et al.*, 2008). MATLAB is used for estimation.

3.2 Variables and data

3.2.1 The dependent variable: enterprises' choice of location (firm). Using the proportion of regional enterprises to all enterprises to represent the condition of enterprises' location choice is conducive to the partial avoidance of the limitation on dependent variables caused by the positive integer nature of the number of enterprises.

3.2.2 Core independent variables: the Internet condition (Int). It is generally measured by Internet resources or usage; considering the great influence of mobile Internet, this paper takes the Internet user scale and penetration rate of traditional Internet (Internet) (hereinafter referred to as the internet) and mobile Internet (Minternet) to reflect the regional Internet development. Because the network is a global spatial area and universally connected, the internet condition in a certain area cannot be observed separately. In the model for testing the gravitation mechanism, the spatial weight matrix W is introduced to construct the global network index and the calculation formulae are as follows: $\mathrm{Oint}_{it} = W^{*}\mathrm{Internet}_{it}$ and $\mathrm{Omint}_{it} = W^{*}\mathrm{Minternet}_{it}$ [9]. The Global index can not only examine the development of the Internet from a global perspective but also avoid the endogeneity of traditional indices and effectively solve the problem that the endogeneity of core explanatory variables cannot be dealt with within the framework of the spatial econometric model. In the model for testing the

amplification mechanism, local Internet conditions (Internet, Minternet) are used to meet the need of testing the amplification mechanism by using the interaction term of the Internet and house price distance. However, the critically focussed interaction term also factually follows the design idea of global indexes, which can also avoid endogeneity problems.

3.2.3 Control variables: economic development (Pgdp). The economic development is accompanied by a good institutional environment and high-quality labour market, and it can effectively expand the market size and is extremely attractive to enterprises. Population size (*Peo*): the number of individuals is positively related to the local labour market size. With more abundant labour resources, the labour cost of enterprises is lower and labour market matching is easier and enterprises are therefore more willing to settle in. Government expenditure (*Pgov*): local governments provide incentives to attract investment for enhancing political performance, which attracts enterprises through institutional arrangements in aspects such as land, employment, social security, administration and subsidies. The education level (*Edu*): education can effectively enhance the quality of human capital, promote enterprise innovation and improve total factor productivity. Areas with a high education level have a strong ability to attract enterprises to settle in.

3.2.4 The distance matrix. The spatial weight matrix is used to quantify the spatial adjacency of enterprises' choice of location, covering the spatial interaction effect. There are a large number of prefecture-level cities in China and much information will be lost if only whether cities are adjacent to each other is taken into account. Hence, the matrix (W) is set according to the geographical distance between spatial units and the elements in the matrix are defined as follows: $w_{i,j} = 1/d_{ij}$, where d_{ij} is the spherical distance between areas i and j. For house price distance (*House*), the element in the matrix $w_{i,j} = P_i - P_j$, where P represents the real estate price [10], which is calculated by dividing the transaction amount of the regional house price by area. "Making money from leasing land" is an investment and the financing model of urban construction with Chinese characteristics (Zheng *et al.*, 2014), which leads to a series of congestion costs such as rising house prices. It is reasonable to use house prices to simulate the dispersion force of congestion costs. The names, symbols and descriptions of variables are shown in Table 1.

Category	Name	Symbol	Description
Dependent variable	Enterprises' choice of location	Firm	Number/total number of regional enterprises
Core independent variables	Internet/mobile Internet condition (local)	Internet/ Minternet	User scale, penetration rate (user scale/ population size)
	Internet/mobile Internet condition (global)	Oint/Omint	W*Internet$_{it}$; W*Minternet$_{it}$
Control variable	Economic development	*Pgdp*	Per capita GDP
	Population size	*Peo*	Year-end population size
	Government expenditure	*Pgov*	Per capita government financial expenditure
	Education level	Edu	Number of students in colleges and universities per 100,000 people
Distance matrix	Geographical distance	W	Reciprocal of the spherical distance between areas i and j
	House price distance	House	The difference between real estate prices of areas i and j
Mechanism variable	Interaction term	Mechanism	Internet*House; Minternet*House

Table 1. Variable explanation

Considering data availability, the authors of this paper select the panel data of 285 prefecture-level cities in China from 2003 to 2016 as analysis samples. Amongst them, the number of industrial enterprises above the designated size is taken from the China City Statistical Yearbook, while data on the internet and other control variables are taken from both the China City Statistical Yearbook and the China Statistical Yearbook and the house prices are obtained from the China Development Yearbook for Regional Economy. Monetary variables such as per capita gross domestic product (GDP) are discounted to the monetary level in 2003 by GDP deflator and all indices are log-transformed. When data are unavailable, a linear interpolation method is used to supplement them. At present, there are comprehensive economic census data regarding the number of enterprises for three years only, so it is impossible to investigate the dynamic characteristics of enterprises' choice of location, and it is difficult to obtain the data from the State Administration for Industry and Commerce. Therefore, this paper selects data sources based on data openness and availability. Although the provincial data provide the number of business entities in all industries, much of the data of many years are missing, and therefore, time continuity is poor. In addition, as the provincial administrative area scale is too large, it is easy to miss much information, and the enterprises' selection of location cannot be accurately measured by the average house price of provincial-level regions because gaps between house prices of prefecture-level cities are relatively large. Although the data of prefecture-level cities only provide the number of industrial enterprises above the designated size, it has high completeness and continuity as well as an appropriate size for more accurately reflecting the enterprises' choices of location. Based on the above analysis, this paper selects prefecture-level city samples as its main data source.

3.3 Testing the gravitation mechanism of the internet

This paper first tests the relationship between the Internet condition and enterprises' choice of location based on the traditional data panel model, and the Hausman test supports the regression results of the fixed-effect model (Table 2). The estimated coefficient of the internet index is significantly negative at the significance level of 1%. The more popular the internet is in other regions, the lower the proportion of local enterprises. The popularity of the internet directly reflects the network externalities of the local Internet and the ability of the regional access to the network. Areas with good network conditions can effectively reduce the production costs of enterprises and the iceberg transport costs in product sales, improve the profits of enterprises, increase the consumer utility and attract enterprises to move in. In addition, the absolute value of the estimated coefficient of the mobile Internet index is larger than that of the internet. At present, smart mobile terminals have profoundly permeated all aspects of the economy and society and are playing a greater role than that of the traditional Internet. In terms of control variables, economic development and population size are significantly positive at the significance level of 1%, indicating that the degree of economic development and the labour force size are important factors to be considered in current enterprises' choice of location. Government expenditure is significantly positive in most models. For purposes such as obtaining agglomeration rent and improving political performance, local governments have the motivation to attract enterprises to settle in the region under their governance and government intervention affects the enterprises' choice of location. The education level shows no significant effect, which means that while enterprises may pay more attention to indicators such as the level of economic development and the labour market size, they care less about the quality of labour itself. At present, China, especially the industrial sector, is still dominated by labour-intensive enterprises and is in urgent need of industrial structure upgrade and cultivation of a new driving force.

Table 2.
Benchmark regression results of the gravitation mechanism of the internet

Model	FE	RE	FE	RE	FE	RE	FE	RE
Independent variable	Internet scale, Oint		Internet penetration rate, Oint		Mobile Internet scale, Omint		Mobile Internet penetration rate, Omint	
lnInt	−0.3582*** (0.0463)	−0.4938*** (0.0434)	−0.3624*** (0.0462)	−0.4988*** (0.0441)	−0.6590*** (0.0626)	−0.7802*** (0.0506)	−0.7251*** (0.0693)	−0.8551*** (0.0557)
ln*Pgdp*	0.2987*** (0.0645)	0.4076*** (0.0794)	0.2927*** (0.0631)	0.4008*** (0.0782)	0.3746*** (0.0784)	0.4700*** (0.0906)	0.3800*** (0.0795)	0.4758*** (0.0915)
ln*Peo*	0.6633*** (0.1708)	1.0022*** (0.0591)	0.6536*** (0.1698)	0.9972*** (0.0592)	0.8554*** (0.1724)	1.0677*** (0.0575)	0.8678*** (0.1725)	1.0766*** (0.0571)
ln*Pgov*	0.1071** (0.0427)	0.0965* (0.0562)	0.0995** (0.0421)	0.0839 (0.0559)	0.2218*** (0.0501)	0.2172*** (0.0589)	0.2305*** (0.0509)	0.2266*** (0.0595)
lnEdu	−0.0496 (0.0318)	−0.0014 (0.0299)	−0.0496 (0.0317)	−0.0001 (0.0299)	−0.0119 (0.0340)	0.0204 (0.0303)	−0.0078 (0.0345)	0.0237 (0.0305)
_cons	−7.0084*** (1.0174)	−7.7843*** (0.6975)	−14.3345*** (1.1421)	−17.9366*** (0.5835)	−3.2968*** (0.9610)	−3.1982*** (0.7363)	−17.3446*** (1.3194)	−19.7697*** (0.6763)
N	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990
R^2	0.139	0.133	0.138	0.132	0.196	0.193	0.199	0.197
Hausman	492.25	[0.0000]	645.05	[0.0000]	278.28	[0.0000]	277.35	[0.0000]

Note(s): ***, **, * denote that the variable is significant at the significance levels of 1% (0.01), 5% (0.05) and 10% (0.1), respectively, and the value within () is the standard error of heteroscedasticity robustness of the estimated coefficient. This note also applies to the table below

Considering the spatial adjacency and temporal dynamics of enterprises' choice of location, the authors of this paper construct static and dynamic spatial econometric models for the analysis [11]. The log-likelihood value supports the regression results of dynamic spatial econometric models, as shown in Table 3. First, after introducing spatial, temporal and spatial-temporal lags of the dependent variable, the internet index is still significantly negative at the significance level of 1% and the absolute value of the mobile Internet index is greater than that of the internet, which supports the previous estimation results. It shows that after considering the spatial-temporal correlation of enterprises' choice of location, the attraction of Internet development in other regions to enterprises' choice of location still exists. Second, the spatial lag is significantly positive at the significance level of 1%, which means that the number of enterprises in neighbouring areas is positively correlated with the number of local enterprises. Regional development has spatial correlation, and geographically adjacent areas have a similar influence on enterprises' choice of location. The temporal lag is significantly positive at the significance level of 1%, which indicates that the enterprises' choice of location is positively correlated in time and positively influenced by the previous enterprises. Furthermore, the spatial-temporal lag is significantly negative at the significance level of 1%, which indicates that the increase in the number of enterprises in neighbouring areas in the previous period attracts local enterprises and is negatively correlated with the number of local enterprises.

It should be noted that spatial, temporal and spatial-temporal lags are related organically. Amongst them, the positive correlation of spatial lag term originates from similar endowments of neighbouring regions, which poses similar attraction to enterprises. However, spatial proximity will also have a competitive effect, and the increase in the number of enterprises in the previous period in neighbouring regions will form an agglomeration economy, which has a strong attraction to local enterprises. The negatively correlated temporal-spatial lag depicts the internal relationship amongst them, thereby indicating the necessity of using the dynamic spatial model.

3.4 Testing the amplification mechanism on the dispersion force

This paper introduces house price distance and the interaction term of the internet and the house price distance matrix to test the amplification mechanism of the internet on the dispersion force (Table 4). Firstly, in the model where house price distance is positive (i.e. house price of which is lower than the local house price), the index of house price distance is significantly positive at the significance level of 1%, which indicates that the larger the difference between house prices of regions with low and local house prices, the higher the proportion of local enterprises. In the model where house price distance is negative (i.e. house price of which is higher than the local house price), the index of house price distance is significantly negative at the significance level of 1%, which indicates that the larger the difference between house prices of areas with high house price and local house prices, the lower the proportion of local enterprises. This result indicates that there is a high correlation between the number of enterprises in various regions of China and the housing price, which verifies the above judgement that "high house price areas are generally of high concentration" and China's economic geography has met the prerequisite for its reshaping. However, it is contrary to the theoretical derivation of the dispersion force of house price, which may be explained by the fact that although rising house price generates a force that disperses enterprises, high house price also actually implies advantages such as good economic conditions and more complete institutional arrangements, which are more attractive to enterprises, and the geographical concentration of enterprises will result in an agglomeration economy and offset the dispersion force brought by rising house price. Therefore, only when the congestion cost caused by rising house price is greater than that of

Table 3.
Spatial econometric regression results of the internet's gravitation mechanism

Model	SAR	SEM	SPDM	SAR	SEM	SPDM
Independent variable		Internet scale, Oint			Mobile Internet scale, Omint	
lnInt	−0.3898*** (0.0332)	−0.8930*** (0.1158)	−0.1150*** (0.0137)	−0.5413*** (0.0352)	−1.1536*** (0.1370)	−0.1849*** (0.0166)
$W\cdot$lnfirm/ $W\cdot$error	0.9860*** (0.0015)	0.9480*** (0.0097)	0.9287*** (0.0124)	0.9190*** (0.0079)	0.9540*** (0.0086)	0.9474*** (0.0097)
L.lnFirm			0.8373*** (0.0116)			0.8388*** (0.0114)
*W***L*.lnfirm			−0.6611*** (0.0536)			−0.8952*** (0.0547)
R^2	0.9652	0.9492	0.9885	0.9658	0.9281	0.9886
LogLike	552.47812	678.38594	2,508.2837	605.76172	689.46641	2,526.7828
Independent variable		Internet penetration rate, Oint			Mobile Internet penetration rate, Omint	
lnInt	−0.3854*** (0.0347)	−1.1949*** (0.1594)	−0.1125*** (0.0139)	−0.5871*** (0.0378)	−1.0930*** (0.1303)	−0.2057*** (0.0181)
$W\cdot$lnfirm/ $W\cdot$error	0.9440*** (0.0061)	0.9600*** (0.0074)	0.9249*** (0.0135)	0.9060*** (0.0092)	0.9460*** (0.0100)	0.9430*** (0.0109)
L.lnfirm			0.8397*** (0.0116)			0.8390*** (0.0114)
*W***L*.lnfirm			−0.6746*** (0.0550)			−0.9019*** (0.0562)
R^2	0.9649	0.9175	0.9885	0.9658	0.9467	0.9886
LogLike	544.3174	686.2527	2,506.1925	605.2010	682.3572	2,527.7324
N	3,990	3,990	3,705	3,990	3,990	3,705

Note(s): All models include control variables, and the selected model is a dynamic spatial econometric model with fixed individual and fixed spatial effect but no fixed time effect. This note applies to the following tables unless otherwise specified

Table 4. Regression results of the internet's amplification mechanism

Independent variable	Internet scale, Internet		Mobil Internet scale, Minternet		Internet penetration rate, Internet		Mobil Internet penetration rate, Minternet	
House price distance	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
lnInt	0.0011 (0.0154)	−0.0004 (0.0008)[a]	0.0378*** (0.0112)	0.0517*** (0.0132)	0.0049* (0.0025)	0.0017 (0.0016)	0.0513*** (0.0096)	0.0464*** (0.0103)
lnHouse	0.0132*** (0.0009)	−0.0482*** (0.0078)	0.0119*** (0.0039)	−0.0297*** (0.0055)	0.0336*** (0.0066)	−0.0233** (0.0094)	0.1091*** (0.0126)	−0.0059 (0.0158)
lnMechanism	−0.0073** (0.0044)	0.0121*** (0.0042)	−0.0060** (0.0025)	0.0027 (0.0018)	−0.0329*** (0.0069)	−0.0083 (0.0077)	−0.1068*** (0.0127)	−0.0312*** (0.0118)
*W** lnfirm	0.9282*** (0.0030)	0.9233*** (0.0155)	0.9234*** (0.0167)	0.9044*** (0.0156)	0.9264*** (0.0154)	0.9242*** (0.0153)	0.9293*** (0.0133)	0.9184*** (0.0155)
L.lnfirm	0.8616*** (0.0113)	0.8559*** (0.0113)	0.8652*** (0.0112)	0.8433*** (0.0111)	0.8544*** (0.0113)	0.8570*** (0.0113)	0.8567*** (0.0112)	0.8547*** (0.0112)
*W***L*.lnfirm	−0.7168*** (0.0468)	−0.7857*** (0.0513)	−0.7124*** (0.0472)	−0.3822*** (0.0252)	−0.6916*** (0.0478)	−0.7783*** (0.0520)	−0.8165*** (0.0519)	−0.6974*** (0.0458)
N	3,705	3,705	3,705	3,705	3,705	3,705	3,705	3,705
R^2	0.9882	0.9883	0.9882	0.9883	0.9883	0.9883	0.9884	0.9883
Log*L*	2454.0574	2474.8968	2457.6155	2430.2924	2464.7085	2470.7504	2496.3327	2479.2041

Note(s): [a]MATLAB provides asymptotic *t*-statistics, but this value is positive and the calculated standard error is negative, so the absolute value is taken

the agglomeration economy, housing price can produce a considerable dispersion force. In addition, the internet index is significantly positive in most models and the penetration rate of the internet can increase the proportion of local enterprises; therefore, the gravitation mechanism has been verified. The significance and symbolic direction of spatial, temporal and spatial-temporal lags are consistent with the previous ones, so here the elaboration thereon is omitted.

The focus of this paper is whether the internet can promote enterprises to move from areas with high house prices to areas with low house prices. As can be seen from Table 4, in the model with positive house price distance, the interaction term is significantly negative at the significance level of 1%, which indicates that the development of the internet in areas with low house prices increases the profits of enterprises and the consumer utility and by reducing opportunity costs of the migration of enterprises, it promotes more enterprises to move from areas with high house price to areas with low house prices or entrepreneurs to start a business in areas with low house prices, reducing the proportion of local enterprises (in areas with high houses prices). On the other hand, in the model with negative house price distance, the significance and signs of the estimated coefficients of the interaction term is undeterminable. Some of the estimated coefficients of the interaction terms are significantly negative, which may be explained that the development of Internet in areas with high house prices will reduce the proportion of local enterprises in areas with low house price due to the gravitation mechanism. Some of the estimated coefficients of interaction terms in other models are significantly positive, and this may be attributable to the signalling effect of the internet, where the development of the Internet in areas with high house price effectively alleviates the information asymmetry of enterprises in these areas and the internet provides more possibilities for enterprises in areas with high house prices to move out by reducing the search cost, thereby increasing the proportion of local enterprises in areas with low house prices. In fact, considering that the gravitation mechanism and the signalling effect act in opposite directions, the estimated coefficient of the interaction terms in the models is not significant. In general, both the gravitation mechanism of the internet that reduces the migration costs and the signalling effect that reduces information asymmetry can effectively facilitate enterprise movement from areas with high house prices to areas with low house prices.

3.5 Testing robustness

Variables adopted in this paper cover categories of both the traditional and the mobile Internet and involve the dual perspectives regarding user scale and penetration rate. The estimation methods used herein include fixed-effect, static spatial and dynamic spatial models, and the relative dependent variables and sample selection are comprehensive. Therefore, this paper first tests the use of the area of administrative regions and data of municipal districts for robustness in the selection of dependent variables. Furthermore, as the coordinated development of the Beijing–Tianjin–Hebei region relives Beijing of functions non-essential to its role as China's capital and requires some manufacturing enterprises to move out from Beijing, the sample data of Beijing, Tianjin and Hebei are deleted. The regression results support the previous conclusions [12].

4. The internet shapes economic geography: macro effects

The direction of economic geography shaped by the internet is the result of enterprises' choice of the location under the synergy of many conditions. Developed areas generally have better Internet conditions and more enterprises. Because of the unbalanced spatial distribution of Internet resources, the simple gravitation mechanism can make the internet further deepen

the spatial pattern of agglomeration. When there are extra congestion costs such as house prices, enterprises have the motivation to move out. However, due to the agglomeration effect, big market and knowledge spillover and the opportunity cost of migration, agglomeration remains the dominant spatial pattern. The emergence of the internet has increased the freedom of enterprises' choice of sites, which not only reduces the opportunity cost of relocation but also transmits signals of areas with low house prices, thereby facilitating more enterprise movement from areas with high house price to those with low house price and amplifying the dispersion force of house prices. The comprehensive action of gravitation and amplification mechanisms can shape dispersed economic geography, and the new economic geography model combined with the data of the real estate sector confirms this deduction result. A situation where $\phi_0 < \phi < \phi_1$ makes economic geography take an agglomeration form while dispersion is the only equilibrium state when $\phi > \phi_1$ (Fujita and Thisse, 2013). The spatial equilibrium shows a "dispersion-agglomeration-dispersion" pattern as the iceberg transport cost decreases [13].

In China, the "infrastructure miracle" has closed the "access gap" of the internet. It not only helped China to avoid a new "digital divide" and the imbalance of spatial economic activities but also reduced the iceberg transport cost. At the same time, the rapidly rising house price has increased the cost of land, labour and other factors and the congestion cost has been significantly increased. Moreover, to obtain agglomeration rent, local governments are tempted to attract enterprises to settle in, and enterprises also have the intention to cluster in developed areas for more desirable policies. Excessive agglomeration further leads to an increase in congestion costs. [14] In addition, China has a vast territory and its market scale is huge and there is plenty of room for enterprises to migrate. Therefore, China happens to meet the conditions of low iceberg transport cost and high congestion cost and the internet is very likely to be the key factor to cause China's dispersed economic geography. To verify whether the internet has reshaped China's economic geography, the authors set the econometric model as follows:

$$\text{Aggo\_Full}_t = \alpha + \beta_0 \text{Int}_t + \varepsilon_t, \varepsilon_t \sim N(0, \sigma^2 I) \tag{12}$$

$$\text{Aggo\_Ind}_{it} = \alpha + \beta_0 \text{Int}_{it} + \sum_{j=1}^{n} \beta_j X_{itj} + \varepsilon_{it},\ \varepsilon_{it} \sim N(0, \sigma^2 I) \tag{13}$$

where i and t represent the region and the year of observation, respectively. Aggo_Full is the degree of nationwide enterprise agglomeration calculated by using the number of enterprise entities in each province, and Aggo_Ind is the degree of enterprise agglomeration within each provincial-level administrative region calculated based on the number of industrial enterprises above designated size in prefecture-level cities, which is calculated using Gini coefficient based on the formula $G_i = \frac{1}{2n^2\mu}\sum_j\sum_k |s_{ij} - s_{ik}|$. Int is the index of the local Internet, including the internet (Internet) and the mobile Internet (Minternet). The verification of the macro effect is an analysis from a global perspective, and the selection of local Internet conditions matches the degree of local agglomeration. X is the control variable that influences economic geography, such as population size (*Peo*), transportation infrastructure (*Trans*), industrial structure (*Stru*) and degree of openness (*Open*). Considering the possible endogeneity problems, the authors of this paper use the two-stage least squares instrumental variable method (2SLS IV) for regression. STATA 12.0 is used for estimation.

Firstly, based on time series data, this paper verifies the relationship between the internet and macro agglomeration characteristics in China. Considering the lack of data at the national level [15], adding control variables may cause confusion in the regression results. In this paper, only the core explanatory variables are entered into regression, and the regression results are shown in Table 5. OLS estimates show that the estimated coefficient of the internet

Table 5.
Regression results of the internet and nationwide economic geography

Independent variable	All samples				All samples excluding Beijing, Tianjin and Hebei			
	Internet, Int		Mobile Internet, Mint		Internet, Int		Mobile Internet , Mint	
	Scale	Penetration rate	Scale	Penetration rate	Scale	Penetration rate	Scale	Penetration rate
lnInt	−0.0481*** (0.0157)	−0.0624*** (0.0125)	−0.0931*** (0.0203)	−0.0969*** (0.0214)	−0.0438** (0.0157)	−0.0573*** (0.0129)	−0.0857*** (0.0208)	−0.0891*** (0.0219)
N	14	14	14	14	14	14	14	14
R^2	0.591	0.670	0.722	0.716	0.547	0.631	0.682	0.677

Note(s): The intercept items are omitted in the table to conserve space

Table 6.
Regression results of the internet and provincial economic geography

Model	FE	2SLS-IV	FE	2SLS-IV	FE	2SLS-IV	FE	2SLS-IV
Independent variable	Internet scale, Internet		Internet penetration rate, Internet		Mobile Internet scale, Minternet		Mobile Internet penetration rate, Minternet	
lnInt	−0.0508*** (0.0148)	−0.0517*** (0.0120)	−0.0502*** (0.0151)	−0.0523*** (0.0121)	−0.0829*** (0.0203)	−0.0785*** (0.0181)	−0.0701*** (0.0193)	−0.0679*** (0.0190)
N	322	322	322	322	322	322	322	322
R^2	0.345	0.345	0.344	0.344	0.363	0.363	0.352	0.352
Hausman	12.28	[0.0311]	10.51	[0.0620]	12.73	[0.0261]	14.57	[0.0124]
Kleibergen-Paap rk LM statistic	43.465***	[0.0000]	42.578***	[0.0000]	45.199***	[0.0000]	24.861***	[0.0000]
Cragg-Donald Wald *F* statistic	72.368	{19.93}	70.393	{19.93}	62.440	{19.93}	69.891	{19.93}
Hansen *J* statistic	0.352	[0.5532]	0.338	[0.5609]	0.371	[0.5426]	0.708	[0.4002]

Note(s): the value in [ ] is the *p*-value corresponding to the test statistics in this paper, and the value in { } is the critical value of Stock–Yogo test at the significance level of 10%

index is significantly negative at the significance level of 1%. The development of the internet and mobile Internet has effectively reduced the degree of enterprise agglomeration nationwide and China's economic geography is characterised by dispersion. The absolute value of the estimated coefficient of the mobile Internet index is obviously higher than that of the internet, which indicates that the impact of mobile Internet on economic geography is greater than that of the traditional Internet.

As there are too few sample data at the national level, which is prone to estimation errors, this paper collects the data of industrial enterprises above designated size in prefecture-level cities and calculates the degree of agglomeration within various provincial administrative regions to ensure robustness. The results of the regression analysis are shown in Table 6. Considering that there is a strong correlation between the degree of enterprise agglomeration and the development of the internet, which brings serious endogeneity problems, [16] the authors of this paper use regional radio and television development as an instrumental variable for regional Internet development and collect the number of cable radio and television users (households) and cable television broadcast penetration rate (households/person) as instrumental variables for Internet indicators with reference to Czernich *et al.* (2011). The test shows that the model setting is reliable. The estimated coefficients of the internet and mobile Internet indicators are significantly negative at the significance level of 1%, respectively. The Internet reduces the degree of concentration within the region, and the reshaping effect of the mobile Internet is greater, which supports the previous conclusions.

5. Conclusion and implication

This paper attempts to give a theoretical explanation about China's decentralised economic geography from the perspective of the internet. The main conclusions are as follows: (1) the internet has a profound impact on the behaviour of consumers and producers and further attracts enterprises, forming a gravitation mechanism. In the era of the internet economy, the geographical space constraints are weakened, the freedom of enterprises' choice of location is enhanced and economic geography may be reshaped. (2) Housing price is the power to disperse enterprises. By transmitting the signal of low-price regions through alleviating information asymmetry, the internet reduces the opportunity cost of migration of enterprises in high-price areas and promotes enterprises to move from the high-price area to the low-price area. And as a result, the reshaping mechanism of China's economic geography forms. (3) The role of the internet is negatively related to access cost and positively related to user scale, and its "positive feedback" effect is superimposed on the amplification mechanism of the internet on decentralisation, which strengthens the reshaping mechanism. However, access costs will weaken the role of the internet, and some regions may fall into a vicious circle of interregional imbalance in Internet development, widening the regional gap.

In fact, most enterprises will fall into the deadlock between agglomeration economy and congestion cost, which will lead to efficiency loss. Decentralised economic geography indicates that the development of the internet in China not only does not strengthen the spatial imbalance of economic activities but also may solve the dilemma of enterprises' choice of location caused by rising house prices. Unbalanced spatial economic activities will widen regional disparities, and the widening of a series of regional disparities, including the income gap of residents, will bring severe challenges to the sustained and stable development of China's economy, especially to the innovation-driven transformation (An and Qian, 2014). Therefore, the internet provides an opportunity for rational allocation of space resources and coordinated development of the regional economy in China.

This paper does not deny agglomeration. Some scholars have noticed the characteristic fact of the decline of industrial geographical concentration in China (Wu and Zhu, 2015). However, their sample range is from 1999 to 2010, which is the initial mature stage of the

internet in China, in which the mobile Internet has not yet been fully popularised and the housing price has not risen sharply. We believe that industrial agglomeration in small geographical regions in China is necessary for economic growth, but at the same time, China's economy is also faced with the double problems of resolving overcapacity and cracking the paradox of the Hu Huanyong Line (a.k.a. Hu Line) (Wu and Duan, 2017). Therefore, preventing excessive agglomeration and optimising the economic geographical space are the meanings of this paper.

The reshaping of economic geography by the internet not only indicates that the growth of the internet in China has effectively weakened the time and space constraints on economic development and made enterprises and labour to choose locations more freely but also shows that the large-scale and positive feedback development effect of China's Internet industry are the concentrated expression of the market advantages of China as a big country. On the one hand, China's Internet industry has made a rapid transition based on the vast domestic market and deeply integrated into all aspects of economic and social development, and thus, the transport cost of "Iceberg" has dropped significantly. On the other hand, the acquisition of competitive advantage in China's industrial development is taking a leap-forward development path that relies on the internet to transform from geospace to cyberspace.

This paper puts forward the following suggestions: (1) the internet provides a new solution to the imbalance of regional development in China as it can be used as an opportunity to appropriately guide economic agglomeration to the central and western regions rationally while adhering to the principle of coordinated development across regions (Liu and Liu, 2019). (2) The internet provides new opportunities for the introduction of enterprises and economic development in underdeveloped areas. However, attracting enterprises is just the first step. Local governments should improve regional public services, build supporting industry facilities for enterprises, coordinate innovative ecological niches and realise a virtuous circle of regional development. (3) Take the internet as a new power and main engine for the sustained and stable development of the Chinese economy under the "new normal" while persisting in the policy of reform and opening-up.

Notes

1. In this paper, the term Internet generally refers to the communication Internet, energy Internet and logistics Internet. Amongst them, communication Internet includes traditional Internet and mobile Internet. Limited by data, the empirical part takes communication Internet as an example.
2. The "access gap" is the basic form of the "digital divide", and the "digital divide" was originally embodied as the distinction between "access or not". (Qiu *et al.*, 2016)
3. The iceberg transport cost refers to that the transportation of products between regions is iceberg-like, and some of them can "melt" on the way. In this paper, the iceberg transport cost generally refers to the costs incurred in a series of cross-regional product flow, including search cost, transportation cost and transaction cost.
4. The logit model is a common method to study enterprises' choices of location, but it requires that the enterprises making site selection decisions should meet the independent and irrelevant hypothesis, that is, each alternative space is similar and replaceable. However, when the number of candidate units is large and the geographical area is small, there is usually correlation amongst spatial units, which violates this assumption. This paper analyses enterprises' choice of location based on the data of prefecture-level cities, which do not satisfy this hypothesis. Therefore, the proportional data are used to weaken the limited influence of dependent variables caused by the positive integer nature of the number of enterprises, and the spatial correlation of each unit is considered by using the spatial econometric model.
5. Following the hypothesis proposed by Dixit and Stiglitz (1977), production department of industrial products are monopolistically competitive, and each product is only produced by a specialised

manufacturer in one region. According to Pflüger and Tabuchi (2010), fixed input is set as Cobb–Douglas production function $\gamma^{-\gamma}(1-\gamma)^{-1-\gamma}l_i^{1-\gamma}s_i^{\gamma}$. Similar to Fujita and Thisse (2013), land s_i only enters into fixed cost but not into variable cost, which is also consistent with economic reality.

6. The detailed derivation process is omitted to conserve space. Please contact the authors for the derivation process.

7. To simplify the analysis, in formula (5), let $A = c_1 r_2^{\gamma}(b_1 b_2)^{\sigma-1} w_1^{\gamma-\sigma} w_2^{1-\sigma}(Y_1 + \phi_{12}\phi_{21}Y_2)$, $B = c_2 r_1^{\gamma} b_2^{2\sigma-2} w_2^{\gamma-\sigma} w_2^{1-\sigma}(\phi_{21}Y_1 + \phi_{21}Y_2)$, $C = c_2 r_1^{\gamma}(b_1 b_2)^{\sigma-1} w_1^{1-\sigma} w_2^{\gamma-\sigma}(\phi_{12}\phi_{21}Y_1 + Y_2)$, $D = c_1 r_2^{\gamma} b_1^{2\sigma-2} w_1^{1-\sigma} w_1^{\gamma-\sigma}(\phi_{12}Y_1 + \phi_{12}Y_2)$ and $A > 0, B > 0, C > 0, D > 0$, and adopt the strategy of partial derivation before substitution. Then $AC - BD = (\phi_{12}\phi_{21} - 1)^2[c_1 c_2 (b_1 b_2)^{2\sigma-2} w_1^{1-\gamma-2\sigma} w_2^{1-\gamma-2\sigma} r_1^{\gamma} r_2^{\gamma}]Y_1 Y_2 > 0$ can be easily obtained.

8. According to the matrix calculation rules, the variable calculation formula is $\text{House} \cdot \text{Int}_{it}$, which is to facilitate readers' understanding of the regulation effect of the internet on house price.

9. Different from the traditional transportation network, the information transmission in the internet does not strictly depend on the geographical distance, so W is a square matrix with a diagonal of 0. The Internet index so calculated is actually the sum of Internet development conditions in other regions, and the expected coefficient sign of gravitation mechanism is negative.

10. Although enterprises may rent or use industrial land when choosing a site, land price is highly correlated with rent and even industrial land price, and real estate price is still a good proxy variable to measure the cost of regional congestion.

11. When choosing a model, the paper first estimates the non-spatial model, constructs statistics of Lagrange multiplier (LM) based on model residual and robust Lagrange multiplier, test the spatial autocorrelation and infer which model is suitable; the decision can also be based on comparing the log-likelihood values of the models.

12. The regression results regarding the robustness are omitted due to the length of this paper. Please contact the authors for the results if necessary.

13. Pflüger and Tabuchi (2010) have proved this point in detail, so it will not be detailed in this paper.

14. Some studies have pointed out that in order to attract foreign investment, the development zones along the Yangtze River are scrambling to adopt many policies and measures to reduce investment costs (Zheng *et al.*, 2008), and the main purpose of enterprises entering the development zones is to obtain "policy rent" (Wang and Zhang, 2016).

15. Even if the samples were selected from as early as 1978, the number of samples would only be 39, so it is reasonable not to add control variables.

16. Macro effect verifies the correlation between the internet and the aggregation degree of enterprises in the region and mainly investigates the influence of the internet on the economic geography formed by enterprise movement within each independent spatial unit, wherein the endogeneity problem of the mutual influence between the development of the Internet and the aggregation degree in the region is more important.

References

Akerlof, G.A. (1970), "The market for 'lemons': quality uncertainty and the market mechanism", *Quarterly Journal of Economics*, Vol. 84 No. 3, pp. 488-500.

An, T.L. and Qian, H.X. (2014), "Zhongguo jumin shouru chaju bianhua dui qiye chanpin chuangxin de yingxiang jizhi yanjiu" [Research on the acting mechanism of Chinese residents income gap change to firms' product innovation], *Jingji yanjiu [Economic Research Journal]*, Vol. 60 No. 9, pp. 62-76.

Anderson, J.E. and Van Wincoop, E. (2004), "Trade costs", *Journal of Economic Literature*, Vol. 42 No. 3, pp. 691-751.

Arthur, W.B. (1989), "Competing technologies, increasing returns, and lock-in by historical events", *Economic Journal*, Vol. 99 No. 394, pp. 116-131.

Bakos, J.Y. (1997), "Reducing buyer search costs: implications for electronic marketplaces", *Management Science*, Vol. 43 No. 12, pp. 1676-1692.

Blum, B.S. and Goldfarb, A. (2006), "Does the internet defy the law of gravity?", *Journal of International Economics*, Vol. 70 No. 2, pp. 384-405.

Choi, J.H., Barnett, G.A. and Bum-soo, C. (2006), "Comparing world city networks: a network analysis of internet backbone and air transport intercity linkages", *Global Networks*, Vol. 6 No. 1, pp. 81-99.

Czernich, N., Falck, O., Kretschmer, T. and Woessmann, L. (2011), "Broadband infrastructure and economic growth", *The Economic Journal*, Vol. 121 No. 552, pp. 505-532.

Dixit, A., K. and Stiglitz, J., E. (1977), "Monopolistic competition and optimum product diversity", *The American Economic Review*, Vol. 67 No. 3, pp. 297-308.

Duranton, G. and Puga, D. (2004), "Micro-foundations of urban agglomeration economies", in Henderson, J.V. and Thisse, J.F. (Eds), *Handbook of Regional and Urban Economics*, Elsevier, London, Vol. 4, pp. 2063-2117.

Elhorst, J.P. (2012), "Dynamic spatial panels: models, methods, and inferences", *Journal of Geographical Systems*, Vol. 14 No. 1, pp. 5-28.

Fan, J.Y. and Shao, T. (2011), "Fangjia shuiping, chayihua chanpin quwei fenbu yu chengshi tixi" [Housing price, location of diversified product and urban system], *Jingji yanjiu [Economic Research Journal]*, Vol. 57 No. 2, pp. 87-99.

Fujita, M. and Thisse, J.F. (2013), *Economics of Agglomeration: Cities, Industrial Location, and Globalization*, Cambridge University Press, Cambridge.

Ge, Y. and Cen, S.T. (2017), "Zhongguo jichu sheshi chaochanggui fazhan de tudi zhichi yanjiu" [Land contributions to the supernormal development of infrastructure in China], *Jingji yanjiu [Economic Research Journal]*, Vol. 63 No. 2, pp. 35-51.

Goolsbee, A. (2000), "In a world without borders: the impact of taxes on internet commerce", *Quarterly Journal of Economics*, Vol. 115 No. 2, pp. 561-576.

Han, X.F., Hui, N. and Song, W.F. (2014), "Xinxihua neng tigao zhongguo gongye bumen jishu chuangxin xiaolyu ma" [Can informatization improve the technology innovation efficiency of Chinese industrial sectors], *Zhongguo gongye jingji [China Industrial Economics]*, Vol. 31 No. 12, pp. 70-82.

Helpman, E. (1998), "The size of regions", in Pines, D., Sadka, E. and Zilcha, I. (Eds), *Topics in Public Economics: Theoretical and Applied Analysis*, Cambridge University Press, Cambridge, pp. 33-54.

Katz, M.L. and Shapiro, C. (1985), "Network externalities, competition, and compatibility", *The American Economic Review*, Vol. 75 No. 3, pp. 424-440.

Kuhn, P. and Skuterud, M. (2004), "Internet job search and unemployment durations", *The American Economic Review*, Vol. 94 No. 1, pp. 218-232.

Leamer, E.E. and Storper, M. (2014), "The economic geography of the internet Age", in Cantwell, J. (Ed.), *Location of International Business Activities*, Palgrave Macmillan, London, pp. 63-93.

Lee, L. and Yu, J. (2014), "Efficient GMM estimation of spatial dynamic panel data models with fixed effects", *Journal of Econometrics*, Vol. 180 No. 2, pp. 174-197.

Liu, X.Y. and Li, S.L. (2017), "Fangjia, qianyi moca yu Zhongguo chengsh de guimo fenbu—lilun moxing yu jiegoushi tongji" [Housing price, migration friction, and city-size distribution in China: theory model and structural estimation], *Jingji yanjiu [Economic Research Journal]*, Vol. 63 No. 7, pp. 65-78.

Liu, H.K. and Liu, X.H. (2019), "Goujian kaifangxing jingji xin kongjian buju: lilun jichu, lishi shijian yu kexing lujing" [The construction of new spatial agglomeration of open economy: theoretical foundation, historical practice and feasible path], *Gaige [Reform]*, Vol. 35 No. 1, pp. 30-42.

OECD (2012), *OECD Internet Economy Outlook 2012*, Chinese edition, 2013, Shanghai Far East Publishing House, Shanghai.

Pflüger, M. and Tabuchi, T. (2010), "The size of regions with land use for production", *Regional Science and Urban Economics*, Vol. 40 No. 6, pp. 481-489.

Porter, M.E. (1990), "The competitive advantage of nations", *Harvard Business Review*, Vol. 68 No. 2, pp. 73-93.

Qiu, Z.Q., Zhang, S.Q., Liu, S.D. and Xu, Y.K. (2016), "Cong shuzi honggou dao hongli chayi — jilianwang ziben de shijiao" [From the digital divide to the connectivity dividend difference: a connectivity capital perspective], *Zhongguo shehui kexue [Social Sciences in China]*, Vol. 37 No. 10, pp. 93-115.

Rezabakhsh, B., Bornemann, D., Hansen, U. and Schrader, U. (2006), "Consumer power: a comparison of the old economy and the internet economy", *Journal of Consumer Policy*, Vol. 29 No. 1, pp. 3-36.

Shapiro, C. and Varian, H.R. (1998), *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business Press, Boston.

Srinivasan, S.S., Anderson, R. and Ponnavolu, K. (2002), "Customer loyalty in E-commerce: an exploration of its antecedents and consequences", *Journal of Retailing*, Vol. 78 No. 1, pp. 41-50.

Tong, J.D. and Liu, Z.Q. (2018), "Fangjia shangzhang, jianzhuye kuozhang yu zhongguo zhizaoye de yonggong wenti" [Increasing housing prices, the expansion of the construction industry and China's manufacturing employment], *Jingji yanjiu [Economic Research Journal]*, Vol. 64 No. 7, pp. 59-74.

Wang, Y.J. and Zhang, G.F. (2016), "Kaifaqu shengchanlyu youshi de laiyuan: jiju xiaoying hai shi xuanze xiaoying?" [Sources of productivity advantages of special economic zones: agglomeration effect or selection effect?], *Jingji yanjiu [Economic Research Journal]*, Vol. 62 No. 7, pp. 58-71.

Wu, F.X. and Duan, W. (2017), "Guoji channeng hezuo yu chongsu zhongguo jingji dili" [International capacity cooperation and reshaping China's economic geography], *Zhongguo shehui kexue [Social Sciences in China]*, Vol. 38 No. 2, pp. 44-64.

Wu, Y.Y. and Zhu, X.W. (2015), "Zhongguo weihe guozao jinru zaifensan: chanye zhengce yu jingji dili" [Why China enters redistribution too early: industrial policy and economic geography], *Shijie jingji [The Journal of World Economy]*, Vol. 38 No. 2, pp. 140-166.

Wu, J.P. (1996), "Wangluo geming yu wangluo jingjixue" [Network revolution and network economics], *Jingjixue dongtai [Economic Perspectives]*, Vol. 3 No. 11, pp. 7-10.

Yu, J., De Jong, R. and Lee, L. (2008), "Quasi-maximum likelihood estimators for spatial dynamic panel data with fixed effects when both N and T are large", *Journal of Econometrics*, Vol. 146 No. 1, pp. 118-134.

Yue, Y.S. and Li, B. (2018), "Dianzi shangwu pingtai yingyong yu Zhongguo zhizhaoye qiye chukou jixiao—jiyu 'alibaba' dashuju de jingyan yanjiu" [E-commerce platform application and exports performance of Chinese manufacturing enterprises—empirical evidence based on big data from Alibaba], *Zhongguo gongye jingji [China Industrial Economics]*, Vol. 36 No. 8, pp. 97-115.

Zhang, L., He, J. and Ma, R.H. (2017), "Fangjia ruhe yingxiang laodongli liudong?" [How housing price affects labour migration?], *Jingji yanjiu [Economic Research Journal]*, Vol. 63 No. 8, pp. 155-170.

Zhang, Y.L. (2016), "Hulianwang, xinxiyuan yu pingmuhua shichang—xiandai wangluo jingji lilun moxing he yingyong" [Internet, information-elements and screening-market: a theoretical model of modern network economy and its application], *Jingji yanjiu [Economic Research Journal]*, Vol. 62 No. 9, pp. 147-161.

Zheng, J.H., Gao, Y.Y. and Hu, X.W. (2008), "Qiye 'zhadui', jishu shengji yu jingji jixiao—kaifaqu jiju xiaoying de shizheng fenxi" [Firm concentration, technology promotion and economic performance: an empirical study on the cluster effects in China], *Jingji yanjiu [Economic Research Journal]*, Vol. 54 No. 5, pp. 33-46.

Zheng, S.Q., Sun, W.Z., Wu, J. and Wu, Y. (2014), "'Yi di sheng cai, yi cai yang di'—zhongguo tese chengshi jianshe tourongzi moshi yanjiu" [Infrastructure investment, land leasing and real estate price: a unique financing and investment channel for urban development in Chinese cities], *Jingji yanjiu [Economic Research Journal]*, Vol. 60 No. 8, pp. 14-27.

Zhu, Z.K. and Leng, C.X. (2017), "Hulianwang yu nongcun xiaofei—laizi Zhongguo shehui zhuangkuang zonghe diaocha de zhengju" [Internet and rural consumption: evidence from a comprehensive survey of China's social situation], *Jingji kexue [Economic Science]*, Vol. 39 No. 6, pp. 115-128.

Corresponding author
Chen Yang can be contacted at: yc_summer1989@163.com