Rural Internet Financial System Transformation and Development Based on Spatial Econometric Model: An Empirical Study

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Abstract

Internet Finances (ITFIN) is a financial system model based on the extensive development of online crowdfunding, P2P lending, third party payment, digital currency, big data finances and information financial institutions. Spurred by the development of network information technology, financial network in our country is unprecedentedly optimal in its overall development and expansion, which greatly pushed forward economic development. However, network communication technology limits the development of rural Internet financial system to a certain extent. Given that, this research, based on the theory of spatial econometric model, designs a rural Internet financial system evaluation model, after which carries out a research into rural online financial data information and analyses factors leading to differences in that between urban and rural areas, so as to provide theoretical references for rural Internet financial system transformation and development.

Keywords: Spatial Econometric Model, Rural Areas, Internet Financial System, Transformation and Development.

1. RESEARCH BACKGROUND

1.1 Literature review

ITFIN is not a simple combination of Internet and financial industry. Instead, it is a brand new financial industry brought about by secure and mobile online technology to meet new demands after being accepted by users, and also an effective combination of traditional financial industry and Internet technology (Chen et al., 2017). On October 13, 2016, General Office of the State Council issued Notice on the Implementation Plan about the Special Rectification of Internet Financial Risks, which symbolized the strong support of Chinese government about the development of Internet financial system. At present, however, ITFIN develops better in southeast and third-tier upper cities, yet hasn’t been totally integrated with rural financial system (Guo et al., 2017), which easily leads to unbalanced development of urban and rural financial systems and then enlarges the gap between urban and rural revenue. Some studies found out the way of introducing well-developed financial systems from the spatial econometric model based on which the integrity of rural financial systems can be evaluated. Therefore, it is practical and objective to study rural online financial market with spatial econometric model.

1.2 Research purpose

As is the case, the informatization of our financial institutions is at a high level, in that there are not only internationally advanced financial information technology platforms that support both the establishment of the three-dimensional electronic banking service system composed of self-service banking, telephone banking, mobile banking as well as online banking and the expansion of financial service through informatization (Dong and Shao, 2017), but also a financial e-commerce innovation service model where “portal” is combined with “online banking, financial products supermarket and e-commerce”. However, this financial model hasn’t been expanded to rural areas, which widens the gap between urban and rural revenues, thus affecting the healthy development of national economy and social stability (Liu et al., 2013). Therefore, to narrow the gap between urban and rural revenues, spatial econometric model can be adopted to gain data information to analyse how rural areas react when using ITFIN, and then based on Moran’I index and scatter plot, find out the spatial features and correlation of choices between urban and rural revenues. After that, verify the unfavourable factors affecting economic development in rural online financial system by establishing a spatial econometric model, so as to lead rural online finances onto normal and standard development route and provide theoretical references for narrowing the gap between urban and rural areas.
2. SPATIAL ECONOMETRIC THEORY AND ITS AUTOCORRELATION

2.1 An introduction to spatial econometric theory

As a branch of econometrics, spatial econometrics mainly studies how to deal with spatial interaction (spatial autocorrelation) and spatial structure (spatial inhomogeneity) analysis in the regression model of cross-section data and panel data (Xu and Zheng, 2017). Although similar to spatial statistics in research direction, the two differ from each other when it comes to financial researches, in that spatial econometrics focuses on the application of econometric model and demands for new coding database application, making it more suitable for online financial system study. According to spatial econometrics, the development of financial system is affected by spatial regions, which is indicated by the autocorrelation of spatial economic data in geographical distribution. Although ITFIN is highly correlated with network medium beyond the spatial limits of traditional financial system, rural financial system falls far behind that of urban areas in hardware and software facilities including status, technology, talents and infrastructure. Therefore, there are still relevant influence factors of ITFIN in spatial econometrics. Given that, the spatial econometric research direction of ITFIN can be divided into two dimensions: judgment on the autocorrelation of variable spaces and spatial econometric model choice and analysis.

2.2 Spatial autocorrelation judgment mechanism

Spatial autocorrelation refers to the spatial interactions among spatial geographic data, such as economic factors in financial development, innovative capability of financial products, fundamental conditions of technological index and the completion of computer network infrastructure, etc. Suppose the network construction of the region is at initial stage, with Internet and network communication technology meeting qualified technological index for supporting financial system, there will still be great obstacles in rural ITFIN development (Yu and Zhang, 2013). Therefore, spatial autocorrelation can be divided into global spatial autocorrelation (GSA) and local indicators of spatial association (LISA). Both Moran’I index and LISA figure represent the global spatial development in research, or research into the correlation of space efficiency. The operational model of global Moran’I index is as follows:

\[
M Moran' I = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} \omega_{ij} (y_j - \bar{Y})(y_i - \bar{Y})}{S^2 \sum_{i=1}^{n} \sum_{j=1}^{n} \omega_{ij}} \\
S^2 = \frac{1}{n} \sum_{i=1}^{n} (y_i - \bar{Y})
\]

As for the observed value of region i, n represents the total value and the weight of binary near space is taken as random element, and then restrict the relationship of financial system development between region i and j with near standard and represent nonadjacent regions with nonempty sets. So the threshold space of Moran’I index can be set within \([-1, 1]\) with positive correlation (Ye and Liu, 2016), which does not mean necessary negative correlation for negative values. The operation result of Moran’I index can be represented as random distribution through asymptotic normal distribution so as to test the empirical research result of the model. The operational model is as follows:

\[
Z(D) = \frac{\{M Moran’s I - E_{(M Moran’s I)}\}}{\sqrt{VAR_{(M Moran’s I)}}}
\]

\[
E_{(M Moran’s I)} = -\frac{1}{n-1}
\]

In this formula, unit parameter provides operational references for Moran’I index and indicates the activity space of observed value. When unit value does not match negative Moran’S I in spatial cluster, it means there is a spatial cluster of non-similarity values (Liu and Hao, 2016). Therefore, local Moran’S I can be adopted to study the
influence mechanism and formation factors of statistical data and scatter plot can be used to analyse the observed value of network finances in rural areas, so as to clarify the spatial distribution regulations and indicate the spatial autocorrelation of variables in various regions.

3. SPATIAL ECONOMETRIC MODEL

The spatial econometric model research represents the evolving regulations of econometric model with time sequence data and cross-sectional data, and takes the spatial static distribution of near region as basic analysis unit. However, rural online finances development falls far behind that of urban areas and thus has an obvious coupling effect in time and space dimensions. As a result, if static online finance is only represented by cross-sectional data and time sequence, there will be fuzzy spatial deviation in its evolving regulation and dynamic change analysis (Zhang and Du, 2016). Therefore, this research comprehensively reflects the presentation of spatial vector model with a combination of spatial lag model (SLM), spatial error model (SEM) and spatial Durbin model (SDM), so as to supplement the spatial efficiency of the empirical study of rural online finances.

3.1 Spatial lag model (SLM)

As the evaluation of variable Y usually leads to spatial lag, we can define the development conditions for the driving factors of variables, and the spatial lag model is as follows:

\[ Y = \partial + \lambda W Y + X \beta + \mu \]  

(5)

In this formula, \( W Y \) represents the variable forms of spatial lag factors, which are adopted to measure the overflow effect in the geographic spatial distribution and limit the influential mechanism for time T in geographic space (Chen and Zhang, 2016). Therefore, it can represent the financial environment of region i during this period and figure out its influences through weighted sum.

3.2 Spatial error model (SEM)

Suppose spatial variables are mutually restricted, relevant variables will be greatly interdependent in the space, thus resulting in certain error disturbance terms (Yang and Guo, 2016). If we choose variables from near region, there will be little disturbance from error shock. However, if the region under evaluation is too large, the operation result will see decrease in the degree of fitting. Therefore, spatial error model is suitable for location of errors in large research parameters in reducing errors of operation result in located section, so as to assure the authenticity and objectivity of operation result. The operational model is as follows:

\[ Y = \partial + X \beta + \eta \]  

(6)

\[ \eta = \lambda W \psi + \varepsilon \]  

(7)

3.3 Spatial Durbin model (SDM)

SDM can be adopted to assure operation accuracy when there is spatial autocorrelation lag term during the operation of spatial variable model:

\[ Y = \lambda W Y + X \beta_1 + W X \beta + \varepsilon \]  

(8)

In this formula, \( \lambda \) represents spatial lag coefficient and spatial autocorrelation can be strengthened through sample observation. When its autocorrelation is weak, SDM will deteriorate into SLM operation stage; on the contrary, when the autocorrelation of spatial vector model is strong, SDM will show similar operation environment as that of SEM (Wu and Zhu, 2015). Therefore, the spatial weight matrix of W is also a nonzero collection of non-diagonal blocks. The parameter index \( \varepsilon \) can be taken as the error term of the observed sample and meet the assumptions in spatial overflow.
4. THE DATA SAMPLE COLLECTION AND RESULT ANALYSIS OF RURAL INTERNET FINANCIAL SYSTEM DEVELOPMENT

4.1 research data collection

This research collected research data according to the operation demands of spatial vector model in combination of the online finance development scales of 31 provinces and municipalities during 2007 and 2016, so as to make a comparison of urban and rural data index coming from *Statistical Yearbook of the Chinese Investment in Fixed Assets*, basic data index of domestic loans, self-raised funds, foreign investment utilization, budget fund and microloan ratio, plus data information about the investment ratio, loan amount, capital holdings and utilization ratio of online finances comprehensively evaluated according to farmer investment and non-farmer investment data (Wang and Cheng, 2015). To weaken the influence of heteroscedasticity, we will take the logarithm of the above index and introduce cross terms into individual variables so as to weaken the centralization of relevant index after logarithmic process, thus avoiding restrictions of multicollinearity with average value of zero.

4.2 Analysis of spatial vector autocorrelation

By introducing collected samples into software Geada 095i we can comprehensively analyse the formation of Moran’s I index and summarizing testing result, so as to get the Moran’s I index result of the status quo of rural financial network development, as is shown in table 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Moran’s I</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0.5227</td>
<td>0.001</td>
</tr>
<tr>
<td>2008</td>
<td>0.5336</td>
<td>0.001</td>
</tr>
<tr>
<td>2009</td>
<td>0.5211</td>
<td>0.001</td>
</tr>
<tr>
<td>2010</td>
<td>0.5296</td>
<td>0.001</td>
</tr>
<tr>
<td>2011</td>
<td>0.5682</td>
<td>0.001</td>
</tr>
<tr>
<td>2012</td>
<td>0.5726</td>
<td>0.001</td>
</tr>
<tr>
<td>2013</td>
<td>0.5537</td>
<td>0.001</td>
</tr>
<tr>
<td>2014</td>
<td>0.5958</td>
<td>0.001</td>
</tr>
<tr>
<td>2015</td>
<td>0.5621</td>
<td>0.001</td>
</tr>
<tr>
<td>2016</td>
<td>0.5932</td>
<td>0.001</td>
</tr>
</tbody>
</table>

According to the analysis of the development of rural and urban online finances from 2007 to 2016, Moran’s I index of the gap between rural and urban revenues all passed 1% significance testing as positive numbers, indicating that the gap between rural and urban revenues during the investigated years demonstrated obviously positive spatial correlation. It is clear that the gap between rural and urban revenues is random distribution condition in spatial distribution as well as a presentation of the cluster state of spatial autocorrelation. Therefore, the regions with a smaller gap between rural and urban revenues tended to approach regions with smaller gap between rural and urban revenues, vice versa.

4.3 Moran’s scatter plot data analysis

To further find out the gap between rural online financial system and that of metropolis, this research took the gap between rural and urban revenues in different provinces and municipalities as comparison model to represent the similarity and value space of spatial cluster status, and also utilized Moran’s I scatter plot to describe the spatial vector distribution features in researched areas, as is shown in Figure 1.

Moran’s scatter plot reflects the gap between rural and urban ITFIN development, in which four-quadrant spatial units of various regions represent the correlation of relevant spatial vectors. If the cluster gathers in the first quadrant, it means the provinces with a small gap between rural and urban revenues are surrounded by provinces with large ones; if the cluster gathers in the second quadrant, it indicates the provinces with a large gap between rural and urban revenues are surrounded by other provinces with large ones; if the cluster gathers in the third quadrant, it indicates the provinces with a small gap between rural and urban revenues are surrounded by other provinces with small ones; if the cluster gathers in the fourth quadrant, it indicates the provinces with a large gap between rural and urban revenues are surrounded by provinces with small ones (Wang and Zhang, 2014). As can be seen through software Geada 095i and Figure 1, the gaps between rural and urban ITFIN revenues in most regions during 2007 and 2016 had positive spatial autocorrelation.
4.4 The estimation result analysis of spatial econometric model

With the help of spatial econometric toolkit in MATLAB written by Lesage, we can get the results of spatial lag model, spatial error model and spatial Durbin model, in which the fitting result of each kind of panel data could be divided into fixed effects model and random effects model, selected according to Lagrange multiplier statistics and fitting optimization coefficient. According to relevant results, when the estimation value significances of both spatial autocorrelation coefficient and spatial error regression coefficient reached 5%, it proved that there was a large gap in spatial factors in rural online financial system in China and both regular and irregular online financial systems play their roles in the gap between rural and urban revenues. If neglecting the spatial influence mechanism and adopting OIS to fit the operational model, there will be a significant result of assumed error (Wu and Xu, 2014). Considering the estimation results of all the three models, we can see that the fitting optimization coefficient and log likelihood of SDM fixed effects model are higher than those of other models. Therefore, testing analysis about this result can also be made when selecting SDM fixed effects model.

5. CONCLUSION

In a word, as can be seen from the analysis of Moran’s scatter plot data, the construction of rural online finances is still at a low level and fails to develop into equivalent scale with near cities or large and medium cities. Therefore, to narrow the gap between rural and urban areas, it is imperative to push forward the construction of rural online financial system by transforming the operation of online financial model in rural areas into more acceptable ones to contribute to the promotion of rural ITFIN, while at the same time, establish an all-data comprehensive network service platform based on network communications and computer technology so as to push forward the development and perfection of rural ITFIN through financial function expansion. Only in that way can the gap in ITFIN caused by technology index insufficiency be gradually narrowed and the sustainable development strategy be further implemented, so as to equip rural ITFIN with more driving forces and promote the rapid development of rural Internet financial markets in different regions through transformation.

REFERENCES


