The impact and spatial difference of agricultural producer services industry on agricultural development: an empirical analysis based on provincial panel data

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Abstract: The acting mechanisms of agricultural producer services industry on agricultural development remains much debated. This study applied provincial panel data in China to empirically research the influence of agricultural producer services on agricultural structure adjustment, income of farmers and agricultural production efficiency. Results indicate that agricultural information, science and technology promotion significantly promote agricultural development. But from regional perspective, results show that there are geographical differences in the roles of different types of agricultural production service industry playing. In major grain producing area, the agricultural production service industry is not a major role in optimising the agricultural structure, and financial and insurance services, agricultural technology extension services and agricultural sale services have play positive roles in increasing agricultural income and upgrading efficiency of agricultural production. However, the agricultural financial and insurance services and information services promote agricultural industrial structure optimisation, income and agricultural production efficiency in economic crops production areas.

Keywords: agricultural producer services industry; provincial panel data; agricultural industrial structure optimisation; agricultural income; efficiency of agricultural production.


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Yaokuang Li received his PhD in Management. He is currently a Full Professor at the School of Management of Hefei University of Technology. His research interests include entrepreneurial venture, financial management and national tax revenue and industry economic.

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1 Introduction

Producer services – new services can keep industrial processes consistency, promote technological progress, accelerate industrial upgrading and improve productivity – are more directly related to manufacturing. It has been widely recognised that producer services account for a large percentage of domestic production and labour employment in many economies of the world (Marrewijk et al., 1997). The growing importance of services in national economies is largely due to an increase in production of producer services. In order to gain cost advantages, manufacturing firms increasingly delegate intermediate-stage processing activities to specialise outside producers. By supplying producer services to several firms, outside producers are able to fully exploit scale economies to obtain cost advantages and produce efficiently. In effect, the service industry contributed 70.1% of the world GDP in 2012, according to data from the World Bank. If we focus on the most developed countries, the global importance of the service sector is accentuated, it represented 73.9% in the European Union and 77.7% in USA, even more surprising is reaching 86.1% in Luxembourg (Lanaspa et al., 2016). In fact, the relative importance of services in the GDP can be considered as an indicator to reflect the degree of a country’s development and economic level. Specially, the growth in India, China, and other economies in South-East can be attributed to growth in intermediate producer service activities at a certain extent (Bosworth and Collins, 2008; Tseng and Cowen, 2013). Marrewijk et al. (1997) also found the importance of services as intermediate inputs for manufacturing. An increasing number of firms have realised the tremendous value of providing intermediate services to other firms that engage in downstream production activities and outsource their service demands. These producer services cover broad areas, such as financial services for industrial clients, cargo shipping, research and development services (Enterprises, 1999). Because these firms provide differentiated services to customers, operation costs inevitably increase. Therefore, effective measures must adopt to maintain cost at a reasonable level such as expanding economic scale, which can help firms maintain an elegant balance between service differentiation and cost leadership.

The last decade has been seen the ‘global shift’ of industrial production, which has also given rise to lots of literature on flexible specialisation and the service economy (Beyers and Lindahl, 1996; Bryson et al., 2013; Coffey, 2000; Daniels, 2004; Illeris, 2005). Global economic forces have driven a new international division of labour, through which a complex spatial hierarchy is arranged. According to Sassen (1994), producer services are vital activities for organising the global flow of finance and information and for facilitating capital expansion in a global economy. In response to the switch in the production mode from mass production to flexible specialisation, producer services have undergone a dramatic expansion. The inter-firm linkages that are important for understanding the unequal distribution of producer services have been identified by some literatures. The producer services are involved in intensive forward and backward linkages with other economic sectors and firms by providing outputs to their clients and purchasing inputs from their suppliers. At the global scale, producer services are not limited to world cities or global cities, and office networks in a myriad of cities across the world have developed (Yinan et al., 2014; Taylor, 2001, 2004). Intra-firm flows are necessary for the production of producer services, but the process of production may involve intermediate inputs from other service suppliers in the same region or different regions. Producer services show a strong tendency to co-locate or cluster in space
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because of the agglomeration benefits shared with their forward and backward linkages (Keeble and Nachum, 2002; Moularet et al., 1995). The close relation in these activities is loosened as the demand for producer services becomes increasingly important from the service sector in response to the shift in the production system (Coe, 1998; Todtling and Traxler, 1995). Yi (2005) observed that most of the forward and backward linkages of producer services are local or region oriented. Starting from the 1990s, China has experienced a rapid growth of producer services and significant regional transformation (Yang and Yeh, 2013). Producer services are increasingly being considered to serve an important function in the regional economy by improving economic growth, increasing productivity and competitiveness, and promoting economic change and adaptation (Coffey, 2000; Tang et al., 2016). Zhang and Kloosterman (2016) think that producer services comprise a new and powerful dynamic that reshapes regional spatial structures and functional connections of Chinese mega-city regions. While interfacing with other firms, producer services provide intermediate inputs throughout the value chain, including activities of upstream, onstream, and downstream production (Daniels, 1997, 2013). All in all, the connections of producer services include intra-firm and inter-firm linkages. Under the context of different industrial structure and urban system arrangement, the producer services contribute a large share to the regional economy (Yang and Yeh, 2013).

Rural development is a persistent challenge everywhere, whether in advanced industrial and post-industrial economies or in less developed countries. While world attention has shifted back to agriculture out of concerns about how to feed its nine billion people by 2050, the precise role of agriculture in economic development remains very much debated. The principal reason for rural development’s special place is ‘the rural penalty’ within the broader sphere of economic development (Hite, 1997). Principal among the rural penalty are a low density of population and most markets, and greater distance to those markets as well as to most other resources (Hobbs and Blodgett, 1999). There are five challenges such as tapping new technology, leveraging the new agriculture, encouraging entrepreneurs, improving human capital, will be critical in shaping the rural economic outlook in developed and developing countries. Therefore, the new agriculture should exploit new technologies and other resources to optimise agricultural inputs and obtain more production. Among them, producer services industries have become an increasingly important source of new job in non-metropolitan regions and an important driver of agricultural development over the world. This importance has been heightened by the ongoing consolidation of farms and the automation of agricultural production. There are some perils cause the prosperity in rural areas:

1 farmers should not be taken in by the promise of the most recent technology

2 deregulation of telecommunications has diminished the likelihood of universal service

3 the internet as a tool for businesses to reach distant markets can cause business owners to neglect long-established ‘rules’ of successful business.

Traditional agriculture was rapidly transformed into a fast growing modern sector through the adoption of science-based technology, provided further confidence in agriculture as an engine of growth. The growth of rural producer services has been of
great interest to those concerned with the fate of rural economy. The new economic environment facing non-metro areas is characterised by enhanced competition, escalation of the role of services as sources of employment, rapid adoption of new technologies and production organisations. In sum, rural residents can benefit indirectly through the labour market and employment expansion in producer services (Anríquez and López, 2007; Maertens and Swinnen, 2009).

Agriculture is the foundation as well as an important sector of the Chinese national economy. Accompanied by the high growth of China’s economy, agricultural development has also experienced the fastest growth period in history since 1978. Since 2004 the state proposed a new round of ‘three rural issues’ policy, which implemented a proactive fiscal policy to increase preferential agricultural measures (Yu and Jensen, 2010; Long, 2014). A series of no. 1 policy documents issued by the Central Committee of the Chinese Communist Party from 2004 to 2013, reflects its continued commitment to strengthening farmer’s land-use rights and the use of market-oriented mechanisms, including emphasising the role of land rental markets in consolidating farmland and facilitating larger scale of farming operations. As a result, agricultural output has increased rapidly and agriculture industrial structure has been greatly improved. Though agricultural growth remained impressive for fishery, meat, vegetable, and fruit production in the period 1985–2005, the growth rate of grain production was low (Huang et al., 2010). Meanwhile, income and the living standard of rural populations have consistently lagged behind urban populations. As rural households worldwide increasingly participate in urban economies and global economies amid urbanisation and globalisation, researchers recognise an urgent need to examine individual farming systems within broader social, environmental, economic, and institutional contexts at multiple scales (Giller, 2013; Seto and Reenberg, 2014; Whitfield et al., 2015; Tian et al., 2015). Among them, having established that producer services in the Chinese economy have grown rapidly and profoundly affected the progress of rural economy. Because some rural populations are now employed in producer services industries and depend on such industries for their livelihood, it is important to understand more fully the social processes that contribute to the growth and development of economy in rural China.

This paper is divided into the following sections. Following this introductory section, Section 2 reveals the situation of case study region, selection of indexes and the basic model. Section 3 is the core of this paper and includes a comparative static analysis on the effects of agricultural producer services industry on agriculture development by the method of AHP. Finally, the paper ends with our conclusions and policy suggestions.

2 Method

2.1 Case study region

The case study area, Anhui, is a major agricultural production province of China located in the eastern region of the country. It covers about 139,400 km² with a cultivated area of 66,289 km² and agricultural population of 49.84 million. The climate here is temperate with four clearly distinct seasons. Loam, small mixed soil and brown mixed soil are the main soil types. Agriculture in Anhui varies according to the climate zones that the province crosses. To the North of the Huai River, wheat and sweet potatoes are grown, while to the south of the Huai River it is rice and wheat instead. In 2015, the annual GDP
per capita of Anhui Province was about 35,997 Yuan, 26.88% lower than the national average. As with other rural areas in China, rural livelihoods in Anhui Province are extensively integrated with the urban economy.

2.2 Selection of indexes

As noted above, the rural growth of producer services is an aspect of the spatial shift in the development of these industries. Concentrations of producer services firms in non-metropolitan locations would obviously be much smaller than those found in metropolitan growth centres, in terms of the absolute number of jobs involved, the volume of revenue from trade, and the density of forward and backward linkages in the rural local economy. Moreover, this industry concentration not only is increasing over time, but also represents an important source of employment growth, increasement of farmer’s income, crop growth within the area.

The existing research literatures identify several key factors that should influence where growth nodes in the effect of producer services industries on rural economy will develop in China. The structural attributes of firms in rural producer services industries affect the benefits of being located close to required labour, business expertise, and other needed inputs, as well as a larger number of customers (Scott, 1988; Goe, 2002; Irwin and Kasarda, 1991). Moreover, the success of firms in producer services industries required labour, information sources, and customers facilitates access and reduces costs in acquiring crucial resource inputs and serving customers, and thereby provides competitive advantage (Palmer, 1990). On the basis of the factors identified in the research literature discussed above, we hypothesise that the linkage between rural producer services industries and agricultural development reflect in:

1. agricultural materials distribution services
2. agricultural information service
3. agricultural product marketing services
4. agricultural finance and insurance services
5. agricultural technology extension services
6. rural labours’ shifting services
7. agricultural machinery operation services.

2.3 Model setting

In order to comprehensively analyse the promoting role of producer services industry on agricultural economic growth, the measuring and analysis model is shown as equations (1)–(3):

\[
NYCYJG_i = C_1 + \alpha_1NZPS_i + \beta_1NYXX_i + \gamma_1NCPYX_i + \theta_1NCJRBX_i + \varphi_1NJTG_i + \delta_1NDLZY_i + \lambda_1NJZY_i + \varepsilon_i
\]  

(1)

\[
NMSR_i = C_2 + \alpha_2NZPS_i + \beta_2NYXX_i + \gamma_2NCPYX_i + \theta_2NCJRBX_i + \varphi_2NJTG_i + \delta_2NDLZY_i + \lambda_2NJZY_i + \varepsilon_i
\]  

(2)
nyxl_i = C_3 + \alpha_i NZPS_i + \beta_i NYXX_i + \gamma_i NCPYX_i + \theta_i NCJRBX_i + \phi_i NJTG_i \\
+ \delta_i NDLZY_i + \lambda_i NJZY_i + \epsilon_i (3)

In this multiple linear regressive model, agricultural economic growth are measured by three explained variables NYCYJG, NMSR and NYXL, which represent the ratio of primary industry output to GDP, the annual income of rural populations and the agricultural input-output ratio. The independent variables NZPS, NYXX, NCPYX, NCJRBX, NJTG, NDLZY and NJZY represent agricultural materials distribution services, agricultural information service, agricultural product marketing services, agricultural finance and insurance services, agricultural technology extension services, rural labours’ shifting services and agricultural machinery operation service, respectively. \epsilon_i is a random disturbance term. Subscript i is the identification of each year (i = 2005, 2006, …, 2014). \alpha_i, \beta_i, \gamma_i, \theta_i, \phi_i, \delta_i and \lambda_i are the corresponding impact factors of NZPS, NYXX, NCPYX, NCJRBX, NJTG, NDLZY and NJZY, respectively. We use a recent data of economics development from Anhui Province Yearbook during the period of 2005–2014 for empirical study.

3 Empirical results

In the decade from 2005 to 2014 year, the agriculture of Anhui Province in China witnessed rapid development, and the industry structure is gradually optimised. We can comprehensively recognise overall development situation of producer services industry and agriculture by analysing the change trend of the panel data, and deeply reveal inherent relation between producer services industry and agricultural development based on empirical analysis on the test of root of unity and co-integration test of panel data.

3.1 Data sources

In previous studies, the factors to reflect the development of rural producer services industry and agriculture are used. Thus, in this article, we select NZPS, NYXX, NCPYX, NCJRBX, NJTG, NDLZY and NJZY as input variables and NYCYJG, NMSR and NYXL as output variables. Detailed data information about development of rural producer services industry and agriculture are obtained from Anhui Province Yearbook (2005–2014) and provided in Figures 1–2.

It can be seen from Figure 1, seven agricultural producer services industry indicators show growth trends on the whole. There are five variables, such as NZPS, NYXX, NCPYX, NJTG, NCJRBX present undulating growth trends during 2005–2014. The peak value of NCPYX appears in 2011, and other four variables peak in 2010. Before 2013, the value of NDLZY continue to increase year by year, then encountered sharp reduction in 2014, reflecting the backflow of residual working-age rural labour force from east coastal provinces and cities to the countryside. Due to the strong promotion of government on agricultural mechanised operation, the value of NJZY presents continued growth trend, showing that agricultural mechanisation level has increased in rural China.
The impact and spatial difference of agricultural producer services industry

**Figure 1** Change situation of agricultural producer services industry indicators during the period of 2005–2014 (see online version for colours)

**Figure 2** Change trend of agricultural development over 2005–2014 (see online version for colours)
For the three indicators for measuring agricultural development quality: farmers’ income, agricultural efficiency and agricultural industry structure, it is found from Figure 2 that farmers’ income shows fast growth, agricultural efficiency is increased gradually and agricultural industry structure presents undulating change during the decade from 2005 to 2014. From 2005 to 2010, agricultural industry structure marks time and makes no advances. The industrial structure is not optimised. Whereas, since 2010, the agricultural industry structure indicator has been rising fast, indicating the quality of agricultural industry structure of Anhui Province in China has been greatly improved.

3.2 Empirical analysis and discussion

3.2.1 Panel unit root test of variables

The thesis is based on the analytic hierarchy process method, and analysis the data with Eviews and Spss. In order to avoid occurrence of false regression phenomenon in estimation of dynamic panel data model, Levin, Lin and Chu $t^*$ test and ADF – Fisher Chi-square test are chosen to test the root of unity of the data. According to AIC principle, we choose lag period of one and obtain the results as shown in Table 1. The tests show that the original sequences of most of the variables have root of unity, but the first-order difference sequence passed the tests, indicating each variable is I(1) integration.

3.2.2 Co-integration test

The test of root of unity shows that the variables in three model are all process of I(1) root of unity. It indicates that there are a long-term balance relation between independent variables and dependent variables, and possibility of co-integration. Therefore, we tested co-integration of the model and the results are shown in Table 2.

The estimation results of model (1) show that $R^2 = 0.956$ and $F = 28.844$ after adjustment, indicating the explanation power of the model is relatively strong. Except that the coefficients of the two indicators – agricultural materials distribution services ($NZPS$) and agricultural finance and insurance services ($NCJRBX$) are not outstanding. The other five indicators – agricultural information service ($NYXX$), agricultural product marketing services ($NCPYX$), agricultural technology extension services ($NJTG$), rural labours’ shifting services ($NDLZY$), agricultural machinery operation service ($NJZY$) – are all salient. The coefficients of agricultural information service and promotion service of agricultural technology are positive, indicating that increasing investment of agricultural information service and agricultural technology extension services can effectively push on structural adjustment of agricultural industry. It is reflecting the fact that the growth mode of agricultural economy has been shifted from resource type to technology type. The dissemination of agricultural information and the energetic promotion of agricultural science and technology have improved farmers’ scientific and technological quality and also accelerated adjustment of agricultural industry structure.

The other two indicators – agricultural product marketing services ($NCPYX$) and rural labours’ shifting services ($NDLZY$) – have hindered structural adjustment of agricultural industry, showing the effect of the positioning of Chinese government on agricultural development of Anhui Province. As the main cereals production region of China, Anhui agriculture must guarantee production and supply of principal grains. The flow of rural working-age labour force from countryside to coastal cities directly influences agricultural production, and causes abandonment of a lot of farmland.
Table 1
Results of panel data unit root test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model (1)</th>
<th></th>
<th>Model (2)</th>
<th></th>
<th>Model (3)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t* ADF – Fisher</td>
<td>Chi-square</td>
<td>t* ADF – Fisher</td>
<td>Chi-square</td>
<td>t* ADF – Fisher</td>
<td>Chi-square</td>
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<td>NYCYJGi</td>
<td>-1.80091**</td>
<td>6.76329</td>
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<td></td>
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<tr>
<td>∆NYCYJGi</td>
<td>-3.78841***</td>
<td>26.9509**</td>
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<tr>
<td>NMSRi</td>
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<td>-0.53817</td>
<td>6.10445</td>
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<tr>
<td>∆NMSRi</td>
<td></td>
<td></td>
<td>-2.73071***</td>
<td>23.2745*</td>
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<tr>
<td>NYXLi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>∆NYXLi</td>
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<tr>
<td>NZPSi</td>
<td>1.83857</td>
<td>0.67854</td>
<td>1.99306</td>
<td>0.23158</td>
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<td>∆NZPSi</td>
<td>-2.24819**</td>
<td>5.83318*</td>
<td>-2.94621***</td>
<td>7.08912*</td>
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<tr>
<td>NYXXi</td>
<td>0.72371</td>
<td>0.87078</td>
<td>5.72824</td>
<td>0.21194</td>
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<td></td>
</tr>
<tr>
<td>∆NYXXi</td>
<td>-3.65520***</td>
<td>8.95817*</td>
<td>-1.49584*</td>
<td>5.28182**</td>
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<tr>
<td>NCPYXi</td>
<td>3.34313</td>
<td>0.66021</td>
<td>6.27792</td>
<td>0.00137</td>
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<tr>
<td>∆NCPYXi</td>
<td></td>
<td></td>
<td>2.45906*</td>
<td>0.56599*</td>
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<tr>
<td>NCJRBXi</td>
<td>0.07852</td>
<td>0.99980</td>
<td>5.33437</td>
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<td>∆NCJRBXi</td>
<td></td>
<td></td>
<td>2.45906*</td>
<td>0.56599*</td>
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<tr>
<td>NJTGi</td>
<td>3.39773</td>
<td>0.66024</td>
<td>6.03148</td>
<td>0.00140</td>
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<tr>
<td>∆NJTGi</td>
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<td>-2.17271**</td>
<td>7.18292*</td>
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<td>NDLZYi</td>
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<td>3.23193</td>
<td>4.17051</td>
<td>2.57309</td>
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<td>∆NDLZYi</td>
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<td></td>
<td>-1.95032**</td>
<td>7.99140*</td>
<td>-6.04106**</td>
<td>18.2902**</td>
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<td>NJZYi</td>
<td>-2.50376**</td>
<td>3.61502</td>
<td>-0.72037</td>
<td>2.95618</td>
<td>-2.53962**</td>
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<td>∆NJZYi</td>
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</tbody>
</table>
| Notes: *, ** and *** present statistics are significant at the 0.1, 0.05 and 0.01 level, respectively.
Table 2: Regression results of panel data in impact of agricultural producer services industry on agricultural development

<table>
<thead>
<tr>
<th></th>
<th>Model (1)</th>
<th>Model (2)</th>
<th>Model (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regression</td>
<td>T inspection</td>
<td>Probability</td>
</tr>
<tr>
<td>C</td>
<td>0.361*</td>
<td>4.178</td>
<td>0.053</td>
</tr>
<tr>
<td>NZPS,</td>
<td>0.000</td>
<td>-2.551</td>
<td>0.125</td>
</tr>
<tr>
<td>NYXX,</td>
<td>0.003*</td>
<td>6.368</td>
<td>0.024</td>
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<tr>
<td>NCPYX,</td>
<td>-0.001*</td>
<td>-3.810</td>
<td>0.063</td>
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<td>NCJRBX,</td>
<td>0.001</td>
<td>2.748</td>
<td>0.111</td>
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<tr>
<td>NJTG,</td>
<td>0.001**</td>
<td>8.200</td>
<td>0.015</td>
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<tr>
<td>NDLZY,</td>
<td>-0.001*</td>
<td>-4.208</td>
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<tr>
<td>NJZY,</td>
<td>0.000</td>
<td>3.896</td>
<td>0.060</td>
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Notes: *, ** and *** present statistics are significant at the 0.1, 0.05 and 0.01 level, respectively.
### Table 3
Regression results of panel data in impact of agricultural producer services industry on agricultural development in Huaibei Region

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model (1)</th>
<th>Model (2)</th>
<th>Model (3)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Regression coefficient</td>
<td>T inspection value</td>
<td>Probability</td>
</tr>
<tr>
<td>C</td>
<td>0.437***</td>
<td>5.371</td>
<td>0.005</td>
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<tr>
<td>NZPS_i</td>
<td>6.386E-5**</td>
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<td>0.050</td>
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<td>NYXX_i</td>
<td>0.001**</td>
<td>-1.046</td>
<td>0.047</td>
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<td>NCPYX_i</td>
<td>6.882E-5*</td>
<td>-0.504</td>
<td>0.090</td>
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<td>NCJRBX_i</td>
<td>0.002*</td>
<td>-0.848</td>
<td>0.060</td>
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<td>NJTG_i</td>
<td>0.000</td>
<td>-0.269</td>
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<td>NDLZY_i</td>
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<td>NJZY_i</td>
<td>2.244E-5</td>
<td>-0.253</td>
<td>0.115</td>
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Notes: *, ** and *** present statistics are significant at the 0.1, 0.05 and 0.01 level, respectively.
Table 4

Regression results of panel data on impact of agricultural producer services industry on agricultural development in Jianghuai Region

<table>
<thead>
<tr>
<th>Variable</th>
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<tr>
<td></td>
<td>Regression coefficient</td>
<td>T inspection value</td>
<td>Probability</td>
</tr>
<tr>
<td>C</td>
<td>0.437***</td>
<td>12.230</td>
<td>0.007</td>
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<td>NZPS$_i$</td>
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<td>0.584</td>
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<td>NYXX$_i$</td>
<td>0.000**</td>
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<td>0.036</td>
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<td>NCPYX$_i$</td>
<td>0.000**</td>
<td>3.088</td>
<td>0.015</td>
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<td>NCJRBX$_i$</td>
<td>0.001***</td>
<td>8.227</td>
<td>0.000</td>
</tr>
<tr>
<td>NJTG$_i$</td>
<td>0.000**</td>
<td>3.139</td>
<td>0.014</td>
</tr>
<tr>
<td>NDLZY$_i$</td>
<td>0.000</td>
<td>1.633</td>
<td>0.141</td>
</tr>
<tr>
<td>NJZY$_i$</td>
<td>4.572E-5***</td>
<td>5.385</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Notes: *, ** and *** present statistics are significant at the 0.1, 0.05 and 0.01 level, respectively.
Table 5  Regression results of panel data in impact of agricultural producer services industry on agricultural development in Jiangnan Region

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model (1)</th>
<th>Model (2)</th>
<th>Model (3)</th>
<th>Model (4)</th>
<th>Model (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regression coefficient</td>
<td>T inspection value</td>
<td>Probability</td>
<td>Regression coefficient</td>
<td>T inspection value</td>
</tr>
<tr>
<td>C</td>
<td>0.262**</td>
<td>1.793</td>
<td>0.031</td>
<td>0.262</td>
<td>1.793</td>
</tr>
<tr>
<td>NZPS</td>
<td>4.024E-5*</td>
<td>–0.508</td>
<td>0.089</td>
<td>4.024E-5</td>
<td>–0.508</td>
</tr>
<tr>
<td>NYXX</td>
<td>0.000*</td>
<td>–0.165</td>
<td>0.125</td>
<td>320.727***</td>
<td>4.835</td>
</tr>
<tr>
<td>NCPX</td>
<td>4.024E-5*</td>
<td>–0.541</td>
<td>0.086</td>
<td>43.689***</td>
<td>9.369</td>
</tr>
<tr>
<td>NCJRBX</td>
<td>0.001*</td>
<td>–0.970</td>
<td>0.052</td>
<td>623.515***</td>
<td>8.742</td>
</tr>
<tr>
<td>NJTG</td>
<td>0.000*</td>
<td>–0.566</td>
<td>0.084</td>
<td>158.291***</td>
<td>4.840</td>
</tr>
<tr>
<td>NDLZY</td>
<td>0.000*</td>
<td>–0.831</td>
<td>0.061</td>
<td>61.374***</td>
<td>6.164</td>
</tr>
<tr>
<td>NJZY</td>
<td>3.994E-5</td>
<td>–1.022</td>
<td>0.048</td>
<td>20.417***</td>
<td>9.639</td>
</tr>
</tbody>
</table>

Notes: *, ** and *** present statistics are significant at the 0.1, 0.05 and 0.01 level, respectively.
The results of model (2) show that $R^2 = 0.935$, and value of $F$ is 19.581 after adjustment, indicating the explanation power of the model is relatively strong. All the indicators show significant positive correlation, reflecting increasing investment of agricultural materials distribution services ($NZPS$), agricultural information services ($NYXX$), agricultural product marketing services ($NCPYX$), agricultural finance and insurance services ($NCJRBX$), agricultural technology extension services ($NJTG$), rural labours’ shifting services ($NDLZT$), and agricultural machinery operation services ($NJZY$) can effectively increase farmers’ income. Among them, the coefficients of agricultural information services ($NYXX$), agricultural finance and insurance services ($NCJRBX$) and agricultural technology extension services ($NJTG$) are relatively big, showing that farmers can sell out agricultural products in time via the internet. The agricultural finance and insurance services ($NCJRBX$) provide financial support for farmers to expand planting scale, and improve production level and extend sales channels so as to increase farmers’ income. The promotion in agricultural technology extension services ($NJTG$) effectively expands application of new technology for agriculture and reduces agricultural production cost and risk.

The estimation results of model (3) show that $R^2 = 0.991$, and value of $F$ is 135.946 after adjustment, indicating the explanation power of the model is very strong. All coefficients of indicators are significant and positive, indicating agricultural producer services industry can effectively increase agricultural production efficiency. Three indicators of them, agricultural information services, agricultural finance and insurance services and agricultural technology extension services, have a great effect on agricultural production efficiency. It indicates that grass-roots agricultural extension accelerate extensive application of new varieties, new fertilisers and new pesticides in agriculture when facing the demand of farmers on agricultural development. Meanwhile, agricultural information services improve the application of new agricultural technology, and agricultural finance and insurance services provides financial support for technological promotion.

### 3.3 Spatial difference of impact of agricultural producer services industry on agricultural development

According to the types of planted crops and the regional features, Anhui province is divided into three region such as ‘Huaibei Region’ including Huaibei, Bozhou, Suzhou, Bengbu, Fuyang and Huainan, ‘Jianghuai’ Region’ including Anqing, Chuzhou, Chaohu (cancelled in 2011 and incorporated into Hefei), Lu’an and Hefei, and ‘Jiangnan Region’ including the rest cities, in order to measure the spatial difference of impact of producer services industry on agricultural development. We test the root of unity of data panel of each region according to above method, each variable is $I(1)$ interaction, the following are the results of co-integration test.

Table 3 shows the empirical results of impact of producer services industry on agricultural industry structure, farmers’ income and agricultural efficiency in Huaibei region. $R^2$ of model (1), model (2) and model (3) is 0.491, 0.999 and 0.894, respectively. The goodness of fit in model (1) is not sufficient, indicating the explanatory variables cannot well explain the structural change of agricultural industry. However, the goodness of fit in model (2) and model (3) are relatively high. In model (2), agricultural product marketing services ($NCPYX$), agricultural finance and insurance services ($NCJRBX$), agricultural technology extension services ($NJTG$), rural labours’ shifting services
The impact and spatial difference of agricultural producer services industry

(NDLZY) and agricultural machinery operation service (NJZY) all pass t test and the coefficients of them are all positive, indicating these services effectively increase farmers’ income, whereas agricultural information service did not play a promotional role in farmers’ income. In model (3), all indicators show positive promotion role in improvement of agricultural efficiency, but the significance of agricultural information service and agricultural materials distribution services is not high. The coefficients of agricultural finance and insurance services (NJZY), agricultural technology extension services (NJTG) and agricultural product marketing services (NCPYX) are biggest and they play critical promotional role in increase farmers’ income and improvement of agricultural efficiency in model (2) and model (3).

Table 4 shows the results of empirical study about the impact of producer services industry of Jianghuai region on agricultural industry structure, farmers’ income and agricultural efficiency. The estimation results of Model (1) show that $R^2 = 0.981$, indicating higher fitting degree is obtained, and explanatory variables can relatively sufficiently explain change of the explained variables. The factors of agricultural finance and insurance services (NCJRBX) and agricultural machinery operation services (NJZY) pass t test of parameter estimation and their coefficients are positive. The coefficients of other variables are equal 0 or fail to pass t test. From the view of estimated results, agricultural finance and insurance services (NCJRBX) and agricultural machinery operation services (NJZY) play certain promotional role on the structural adjustment and optimisation of agricultural industry in Jianghuai region. The factors, such as agricultural information services (NYXX), agricultural finance and insurance services (NCPYX) and agricultural technology extension services (NJTG), play important role in increase of farmers’ income from the estimation results of coefficients of variables, whereas the coefficients of agricultural materials distribution and rural labours’ shifting services fail to pass t test. $R^2$ of model (3) is 0.903 with high goodness of fit, reflecting that the development of producer services industry can actively push on promotion of agricultural efficiency. But the coefficients of agricultural materials distribution, agricultural product marketing services and agricultural machinery operation services fail to t test. Agricultural information services (NYXX) and rural labours’ shifting services (NDLZY) play a biggest promotional role on the promotion of agricultural production efficiency of Jianghuai region with the analysis of estimated results.

As shown in Table 5, $R^2$ of model (1) is equal to 0.861, indicating higher fitting degree is obtained, and the explanatory variables can relatively sufficiently explain the change of explained variables. The coefficient of agricultural information services (NYXX) fails to pass t test, whereas the estimated coefficients of other explanatory variables all passed t test. The results show that agricultural information services (NYXX), agricultural technology extension services (NJTG) and rural labours’ shifting services (NDLZY) have no impact on the structural change of agricultural industry, because the coefficients of these factors are equal 0. By contrast, the effect of agricultural finance and insurance services on optimisation of industrial structure of agricultural industry of Jiangnan region is most significant. In model (2), the explanatory variables sufficiently explain the change in increase farmers’ income for the value of $R^2$ is equal to 0.999. The coefficients of agricultural finance and insurance services (NCJRBX), agricultural
information services (NYXX) and agricultural technology extension services (NJTG) are far bigger than the coefficients of other variables, indicating that the input in these three factors can significantly increase farmers’ income in Jiangnan region. The above changes are caused by the natural conditions of Jiangnan region in Anhui Province, where develop mountain forest economy. The $R^2$ of model (3) is 0.933, indicating that the independent variables in the model can better explain the change of dependent variables. From the viewpoint of estimated results, the explanatory variables all passed $t$ test except for agricultural technology extension services (NJTG). Among these factors, Agricultural finance and insurance services (NCJRBX) plays a biggest promotional role in agricultural efficiency, followed by rural labours’ shifting services (NDLZY) and agricultural information services (NYXX).

4 Conclusions

Based on the high correlation of agricultural producer services industry and agricultural development, we explored the impact of agricultural producer services industry on agricultural development by taking Anhui Province as study object. The spatial difference of impact of agricultural producer services industry on agricultural development is in-depth discussed in combination with agricultural diversity. As a new growing point of the agricultural economy, we have found agricultural producer services industry can support the development of modern agriculture, and structural adjustment of agricultural industry, increase of farmers’ income and promotion of agricultural efficiency in both the short run and the long run. The main conclusions are as follows:

1. The action modes of factors of agricultural producer services industry to promote agricultural development are different. From viewpoint of descriptive statistics, agricultural producer services industry and agricultural development in Anhui Province obtain rapid growth during the decade from 2005 to 2014. The empirical results show that the factors of agricultural producer services industry have their own respective different role in the optimisation of industrial structure of agricultural industry. The government-led variables, such as agricultural information services and agricultural technology extension services, have significant promotion role in industrial structure of agricultural industry. The roles of agricultural materials distribution, agricultural finance and insurance services and agricultural machinery operation services are not brought into full play. Whereas development of agricultural product marketing services and rural labours’ shifting services even exert negative impact on structural optimisation of agricultural industry. In the aspects of farmers’ income and agricultural efficiency, the empirical results show that agricultural producer services industry presents significant positive influence. Among them, agricultural information services, agricultural finance and insurance services and agricultural technology extension services have obvious effects in increasing farmers’ income and improving agricultural efficiency. The rural pillar industries and increase of farmers’ income are supported by timely market information, scientific and technical service, convenient logistics and sufficient fund provide support for farmers to change operation mode and expand operation scale. The perfection of agricultural finance and insurance services increase farmers’ opportunity to obtain investment and education and labour skills, promoting
The impact and spatial difference of agricultural producer services industry
devlopment of rural economy and transformation of agricultural development
mode. The impact of promotion service of agricultural technology on farmers’
income and agricultural efficiency originates from different roles of technological
progress and innovation in the structure of different industry. The new technology
that increases grain crop yield per unit area certainly leads to relative contraction of
the proportion of grain type traditional planting sector with smallest demand
flexibility in agricultural industry.

Significant spatial difference exists in impact of producer services industry on
agricultural development. Because of different endowment of natural resources in
different regions, significant spatial difference exists in the agricultural development
effect of producer services industry. The empirical results show that, the agricultural
producer services industry has no significant impact on industrial structure of
agricultural industry in Huaibei region, and has relatively complicated effect on
industrial structure of agricultural industry in Jianghuai region and Jiangnan region.
For having sufficient financial insurance support, high value cash crops are choosen
to plant, causing the emergence of outstanding effect of agricultural finance and
insurance services on structural adjustment of agricultural industry in Jianghuai
region and Jiangnan region. Agricultural machinery operation services is another
important factor that influencing industrial structure of agricultural industry in
Jianghuai region. The improvement of agricultural mechanisation level has promoted
the industrial development of agricultural industry in hilly areas. The factor of
agricultural materials distribution is considered as second major factor to industrial
structure adjustment of agricultural industry in Jiangnan region. There are important
influences of agricultural finance and insurance services and agricultural technology
extension services on increasing farmers’ income in Anhui province. However, the
effect of agricultural product marketing services on agricultural development only
appears in Huaibei region, and agricultural information services has promotional role
in increasing farmers’ income in both Jianghuai region and Jiangnan region. All of
which indicate that perfect agricultural finance and insurance services can increase
farmers’ opportunity to obtain investment and education, improve their labour skills,
change development mode of rural economy. Moreover, agricultural technology
extension services can improve the yield and quality of crops and increase farmers’
income. But for staple grain crops, good agricultural product marketing services can
raise grain price and increase farmers’ income. For the sale of economic crops,
perfect information network can expand sales channels of agricultural products and
raise price and increase income. In Huaibei region, agricultural finance and insurance
services and agricultural technology extension services have important impact on
agricultural production efficiency. The significant effects of agricultural information
services and rural labours’ shifting services on rural economy are observed in
Jianghuai region. Whereas, the factors with major promoting role on agricultural
development are agricultural finance and insurance services, rural labours’ shifting
services and agricultural information services in Jiangnan region. Empirical results
show that agricultural finance and insurance services increase farmers’ awareness in
avoiding natural risk, support promotion of agricultural technology and circulation of
agricultural products and improve agricultural production efficiency. In Huaibei
region, excellent variety research increase crop yields. However, the economic crops
are the main planting objects in Jianghuai region and Jiangnan region. In these areas,
the transition of labour from production of crops to processing of agricultural products and the value of agricultural products can be increased by deep processing of agricultural products and sell out the products in time.

The effects of agricultural producer services industry on agricultural structure adjustment, income of farmers and agricultural production efficiency are analysed by the empirical results. The different action modes and significant spatial difference existing in impact of agricultural producer services industry on agricultural development are observed. We have put forward a series of policy measures to increasing the influence of agricultural producer services industry as follows:

1 *The government-leading and private capital participating agricultural finance and insurance services industry should be build to intensify strength of support in agricultural development.* The empirical results indicate that the impact of agricultural finance and insurance services industry on agricultural development is significant in Anhui province. With the great change of rural economy and social development, the industrial structure of agricultural industry is under constant optimisation. The demand for financial services is increasingly diverse, with the industrialisation of agricultural industry, development of rural secondary and tertiary industries and ceaseless emerging of labours return to their home towns and entrepreneurship. In order to promote agricultural scale production and accelerate the transition to high-end industry, the government should increase the strength of financial to support farmers and share agricultural risk by perfecting agricultural insurance and improving expectation on return of investment. Therefore, the government should give policy support, such as increase credit support to agriculture through the rural branches of state-owned bank or agriculture-related policy bank, actively develop microfinance, carry out the exploration of the non-formal financial development in rural areas by introducing private capital, attempt mortgage loan guarantee among the farmers and rural enterprises. New insurance breeds are developed by combination with agricultural characteristics of different regions, which enrich agricultural insurance varieties, reduce the agricultural investment risk, and improve the anti-risk ability of agriculture.

2 *By introducing market competition mechanism, agricultural information service and agricultural technology extension services must be strengthened.* Agricultural information service provides convenience for farmers to grasp the trend of agricultural product market, expand sales channels of products, promote the promotion speed of science and technology, optimise the industrial structure of agriculture, and increases farmers’ income and improves agricultural production efficiency. But the current agricultural information service and agricultural technology extension services still have some defects, which resulting in poor operation of the information product market. If the information product market is provided by the government, this will in turn result in insufficient supply momentum of agricultural information products and low efficiency. As for agricultural technology extension services, it is mainly implemented by agricultural stations at various level. The staff internal structure is not reasonable and instable, because of aging of staff and the single knowledge structure. Therefore, in order to further improve the role of agricultural information service and agricultural technology extension services in optimising industrial structure of agriculture and increasing
fanners’ income and agricultural production efficiency, the government should introduce the market mechanism and establish scientific evaluation system of service efficiency. The threshold access to the service sector should be lowered to improve the marketisation plan and form the mode of government and market leading.

3 **Giving priority to the development of rural logistics and circulation service industry will be an efficient method to promote the overall transformation and upgrading of agriculture.** In order to realise the promotional role of agricultural materials distribution services and agricultural product marketing services, the development of rural logistics and circulation service industry should be accelerated to integrate with the link of high value at both ends of agricultural industry. It can facilitate farmers to purchase and sell agricultural products and reduce the corresponding cost through the distribution service of means of agricultural production and logistics related sales and circulation services of agricultural products. The government should regulate agricultural materials distribution services and establish the honest sales market of agricultural products. The scale of agricultural enterprises can be well controlled to prevent the emergence of monopolistic behaviour according to the inherent mechanism of the impact of agricultural materials distribution services and sales service of agricultural products on agricultural development. Related financial subsidies policies are established to promote the healthy development of agricultural materials distribution services and agricultural markets. The supporting role of agricultural producer services industry on agricultural development can achieve.

4 **The comprehensive quality and scientific and technological level of agricultural workers are improved by strengthening the investment in rural education.** The quality of science & culture of individuals within agricultural producer services industry have direct influence on the competitive power of agriculture, affecting the impartment and understanding of latest scientific and technological knowledge. With the flow of the talents from rural areas into cities, shortage of high-level agricultural producer service personnel is a very common phenomenon in rural areas. Therefore, internationalisation opportunity of economic development of agriculture is utilised to improve the efficiency of producer services industry and promote the development efficiency of agriculture. The practicable talent development plan should be set out to continuously improve the occupational skills and professional quality of agricultural producer service personnel, such as talent introduction, strengthen domestic education and talent development.

5 **The dislocation development of agricultural producer services industry should be established with relying on central town, by recognising the difference of demand in regions.** Because of different endowment of natural resources for agriculture development and different evolution trend of agriculture in different areas, the government should establish the job division system of producer services industry based on comparative advantage and industrial chain difference. We should fully recognise the differences in economic development stage and degree of marketisation. The construction of public service platform of agricultural producer services industry is strengthened through financial subsidies, tax incentives and substitution of subsidies with incentives. Relying on various types of cities, the production factors between urban and rural areas are should be accelerated, and give full play to cities in the agglomeration effect and outgoing radiation function of
factors in the aspects of finance, logistics, business service, information service, education and training. The complete agricultural industry chain and industrial clusters across different regions and sectors will form.

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