The Source of Momentum for Producer Services' Growth China: A Research from the Perspective of Driving Force Decomposition

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Under the background of growth driving force conversion, this paper examines the source of growth in the producer services sector in China with the stochastic frontier analysis (SFA) model, using provincial service sector data during 2005–2016. Research findings show that (1) the total factor productivity (TFP) of producer services in China is characterized by multi-stage changes, with technological progress being the primary driving force and industrial growth being "technology-led". (2) Innovation, represented by increased TFP, is the leading driving force of producer services' growth and the overall structure of driving forces is reasonable; (3) the driven structure of niche industries varies greatly, and the conversion of driving forces must take into account industry characteristics; (4) as developed regions are more capable of coping with external impacts and policy stimuli, innovation is the main driving force for them, while for other regions, where innovation as a driving force is weak and old driving forces has led to extensive growth, their structure way evolve to an irrational state. It is necessary to seize opportunities to promote innovation-driven model and take producer services sector as the main battlefield for the cultivation of new driving forces, giving full consideration to the heterogeneity of different industries and regions.

Keywords: producer services, replacing old growth drivers with new ones, stochastic frontier analysis (SFA), total factor productivity (TFP)

1. Introduction

The Report delivered at the 19th National Congress of the Communist Party of China (CPC) states that "China's economy has been transitioned from a stage of rapid growth to a stage of high-quality development. China now is at the key period of transforming growth model, improving economic structure, and fostering new growth driving forces". The Central Economic Work Conference in 2018 described this stage

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as that "socialism with Chinese characteristics has entered a new age, and so has the country's economic development." After the reform and opening up policy, the force that drove fast economic growth in China came from, economic globalization, massive cheap labor, a high savings rate, and technological catch-up (Yuan, 2017). However, with increasingly complicated global economic situations, disappearing demographic dividend, declining return on capital, and overcapacity on the domestic market, the extensive growth model that relied on massive labor, capital and natural resource input and importing of technology for capacity expansion has come to an end (Zheng *et al*., 2018). To cope with the inadequacies of traditional growth driving forces, President Xi Jinping pointed out that "in promoting high-quality development, we should place our focus on advancing the transformation and upgrading of the industrial structure", and Premier Li Keqiang also noted that "to promote the transformation and upgrading of the economic structure, we must accelerate the replacement of old growth driving forces with new ones" and in his Report on the Work of the Government 2018, he also stressed "speeding up the replacement of old growth driving forces." Therefore, a shift in growth driving forces will be crucial for high-quality development of the Chinese economy.

A growth driver may simply be understood as a force that drives economic growth. On the supply side, drivers of economic growth come from the input of capital, labor, land and other factors and the supply of technologies and systems that determine the efficiency of the use of such factors (Li *et al*., 2017). However, a model that relies simply on the input of factors for driving growth is not enough to sustain steady development of the economy, and is regarded as an old growth driver. High-quality development of the economy hinges on increased efficiency of the use of factors. Based on such a logic, and in light of what the General Office of the State Council described in its document *Opinions on Innovating in Management, Improving Services, Fostering New Drivers of Economic Growth and Accelerating the Replacement of Old Growth Drivers* (GBF [2017] No. 4), as "new growth drivers being in the making which are led by technological innovation, centered on new technologies, new industries and new business models, and bolstered by such new factors of production as knowledge, technology, information and data". this paper believes that new drivers of economic growth are derived from a driving model that relies on knowledge, system and other new factors, as well as on new technologies, new industries and new business models for more efficient use and allocation of factors.

The purpose of replacing old growth drivers with new ones is to boost industrial development. The Chinese producer services sector, with a growing share-close to one third of the national economy, not only boosted economic growth directly, but also helped accelerate the transformation of the manufacturing sector and the improvement of the development quality of the economy on the whole through effects of industrial relations, technological innovation, further division of labor, etc. (Francois and Woerz, 2008; Maine *et al*., 2010). As the main battlefield for fostering new growth drivers,

how to revitalize old growth drivers and foster new ones in the producer services sector is the key to achieving high-quality development. The State Council issued the *Guiding Opinions on Stepping up the Producer Services Sector Development and Promoting the Adjustment and Upgrading of the Industrial Structure* in July 2014, the Ministry of Agriculture, the National Development and Reform Commission and the Ministry of Finance promulgated the *Guiding Opinions on Strengthening the Agricultural Producer Services Sector* in August 2017, and provinces and municipalities across the country also introduced policies aimed to accelerate the development of producer services, suggesting the high attention that the Chinese government paid to the development of producer services as well as its resolve to replace old growth drivers with new ones. Under this background, this paper, beginning with an estimation of the change in total factor productivity (TFP) of China's producer services sector, examines old and new growth drivers for growth in producer services from the dimensions of factor contribution, industrial structure and regional allocation, with a view to providing new thoughts on high-quality development of the economy.

2. Literature Review

Many studies have evaluated the forces that drive China's economic growth, which provided empirical evidence for replacing old growth drivers with new ones. Above all, capital, labor and other traditional growth drivers still play important roles. Since 1978, capital has been the main growth driver (Lin and Ren, 2007). New growth drivers represented by TFP have kept growing in recent years, but at a slower pace, and their contribution to economic growth has been in decline (Yu, 2015). Traditional growth drivers can sustain economic growth, but with the changing economic supply and demand environment in China, the model of factors-driven extensive growth is unsustainable (Young, 2006). Currently, China's demographic dividend is diminishing, marginal return on capital is falling and the space for technological catch-up is also contracting, leading to a continued downward slide in output growth (RUC Research Group of Macroeconomic Analysis and Forecast, 2016). The slowdown in China's economic growth is closely associated with the feeble old growth drivers and an improper growth driver structure, which makes it imperative for China to foster new growth drivers (Zheng *et al*., 2018).

Industrial upgrading underpins the replacement of old growth drivers, and the service sector, especially producer services, provides unquestionable growth drivers. Inklaar *et al*. (2008) found that the difference in global economic growth comes from TFP of the service sector, and Mattoo and Hoekman (2013) noted that the service sector's TFP has an important role in driving up a country's TFP. Thanks to the high level of technology application and a high concentration of factors, the producer services sector has a higher TFP than the consumer services sector (Wang

and Hu, 2012), which can improve TFP of the economy as a whole, providing a new driver of high-quality growth (Li *et al*., 2017). While China's services sector's TFP changed drastically before taking on a trend of steady increase (Jiang and Gu, 2009), the producer services sector's TFP was growing rapidly in provincial capital cities (Wang *et al*., 2013) but has been in a general trend of negative growth (Yuan *et al*., 2009), making it imperative to foster new growth drivers. Moreover, it is widely believed that TFP's contribution to China's service sector is disproportionately low, with the sector's growth relying largely on the input of capital and other factors (Gu, 2005).

According to the growth theory, capital, labor and land are the forces that drives economic growth, but a growth model that relies on traditional factors as growth drivers is much constrained by resources and environment, and steady economic development must rely on more efficient use of factors (Saccone and Valli, 2009). The output efficiency of combined factor input as depicted by TFP may be used to measure the quality of economic growth objectively and accurately (Syverson, 2011), and is generally considered to be a new growth driver. Currently, such methods as the fixed effects mode (FEM), Olley-Pakes (OP), Levinsohn-Petrin (LP), data envelopment analysis (DEA) and stochastic frontier analysis (SFA) are most commonly used for TFP estimation. FEM generates big variances (Van Beveren, 2012); OP and LP, both of which can solve endogenous problems with the entry and exit of enterprises though, are more suitable for enterprise-level data; and DEA is quite sensitive to abnormal data and subject to stochastic disturbance. Yao (2009) made a comparison between DEA and SFA and considered it more justified to adopt SFA. Therefore, this paper adopted the SFA method, and the estimated results also showed that technological inefficiency can well explain the changes in production, suggesting that it was proper to choose the SFA method.

This paper is also helpful with respect to the following. (1) Given the period during which the RMB 4 trillion stimuli, the economic new normal, the supply-side structural reform and other policies are simultaneously in place, an analysis conducted with a prolonged sampling period may provide direct empirical evidence for high-quality development of the Chinese economy; (2) Since the producer services sector is the main battlefield for fostering new growth drivers, on which sector nevertheless there are few studies with respect to its growth drivers, an analysis of growth drivers for the sector from the perspective of TFP may broaden the boundaries of research at present into TFP of the entire or service economy; and (3) a "time-space-industry" growth drivers decomposition framework built based on heterogeneous features of industries and regions may make conclusions more practical, enrich the concept of replacing old growth drivers with new ones for the purpose of economic growth, and make evaluations of progress on the replacement of old growth drivers more comprehensive.

3. Model, Method and Data

3.1. Model Selection and Function Determination

A manufacturer cannot always achieve maximal profit, which drew attention to the problem of inefficiency of production (Kumbhakar and Lovell, 2003). Aigner *et al*. (1977) examined random and inefficient factors involved in production and developed the SFA method. Battese and Coelli (1992 and 1995) introduced the component of time into this method, making SFA capable of processing panel data; Battase and Coelli (1992) studied the change over time in production inefficiency and Battase and Coelli (1995) introduced factors affecting production inefficiency into the SFA model. Considering the subjectivity involved in selecting factors, this paper adopts a time-variant technological efficiency model to estimate the TFP of China's producer services sector. The model is:

$$Y_{it} = f(x_{it};\beta)\exp(v_{it} - u_{it}), v_{it} \sim N(0,\sigma^2) \tag{1}$$

where Y_{it} is the output of the producer i in the year t, $f(\cdot)$ is a production function, x_{it} is the output of factors, β is the parameter to be estimated, and technical efficiency is TE_{it} = exp ($-u_{it}$). The inefficiency item u_{it} follows the assumption by Battese & Coellli (1992), i.e. $u_{it}=\eta u_i=\exp[-\eta(t-T)]\ x\ u_i$, where η is the corresponding time-variant parameter and $u_{it}\sim N(\mu, \sigma^2)$ is a non-negative random variable that follows the truncated normal distribution. The Cobb-Douglas production function and the transcendental logarithmic (translog) production function are both widely used functional forms. The SFA model in the form of the Cobb-Douglas production function is $Y_{it} = A(t)K_{it}^{a}L_{it}^{\beta}\exp(v_{it} - u_{it})$, and that in the form of the translog production function is $\ln Y_{it} = \beta_0 + \beta_1\ln K_{it} + \beta_2\ln L_{it} + \beta_3 t = 0.5\beta_4\ln K_{it}^2 + 0.5\beta_5\ln L_{it}^2 + 0.5\ \beta_6 t^2 + \beta_7\ln K_{it}\ln L_{it} + \beta_8 t\ln K_{it} + \beta_9 t\ln L_{it} + v_{it} - u_{it}$; where $A(t)$ stands for TFP and K and L for capital and labor input respectively. This paper analyzes the two production functions and examined their desirability through the likelihood ratio test.

3.2. TFP and Growth Drivers Analysis Framework

3.2.1. TFP Analysis Framework

Based on the basic definition of TFP, and then converting it into the concept of growth rate, we can get:

$$\dot{TFP} = \dot{Y} - \sum\nolimits_j S_j\dot{x}_j \tag{2}$$

where x_j is the input of factors of the category j and S_j is the percentage of costs for inputting factors of the category j. TFP is broken down as the sum of technical change (TC), technical efficiency change (TEC) and scale efficiency change (SEC): [1]

$$\dot{TFP} = TC + TEC + SEC \tag{3}$$

3.2.2. Growth Drivers Breakdown

As Bosworth and Collins (2008) did to decompose growth, stochastic frontier items are introduced into the SFA framework to depict the contribution of capital, labor and TFP to growth, and growth drivers are then analyzed based on differential thinking (Yu, 2015).

$$df(K_{it}, L_{it}) = df_{K_i}(K_{it}) + df_{L_i}(L_{it}) + df_{TFP_i}(K_{it}, L_{it}) \tag{4}$$

Extending the above formula to cover the change from period t to period t+1, the percentage of contribution of factor input and TFP to economic growth is:

$$\frac{f(K_{i,t+1}, L_{i,t+1})_{t+1} - f(K_{it}, L_{it})_t}{f(K_{it}, L_{it})_t} \approx \frac{f(K_{i,t+1})_t - f(K_{i,t})_t}{f(K_{i,t})_t} + \frac{f(L_{i,t+1})_t - f(L_{i,t})_t}{f(L_{i,t})_t} + \frac{TFP_{t+1} - TFP_t}{TFP_t} \tag{5}$$

$$K_p = \left(\frac{f(K_{i,t+1})_{t+1} - f(K_{i,t})_t}{f(K_{i,t})_t} \right) \Bigg/ \left(\frac{f(K_{i,t+1}, L_{i,t+1})_{t+1} - f(K_{it}, L_{it})_t}{f(K_{it}, L_{it})_t} \right) \times 100 \tag{6}$$

$$L_p = \left(\frac{f(L_{i,t+1})_{t+1} - f(L_{i,t})_t}{f(L_{i,t})_t} \right) \Bigg/ \left(\frac{f(K_{i,t+1}, L_{i,t+1})_{t+1} - f(K_{it}, L_{it})_t}{f(K_{it}, L_{it})_t} \right) \times 100 \tag{7}$$

$$TFP_p = \frac{TFP_{t+1} - TFP_t}{TFP_t} \Bigg/ \left(\frac{f(K_{i,t+1}, L_{i,t+1})_{t+1} - f(K_{it}, L_{it})_t}{f(K_{it}, L_{it})_t} \right) \times 100 \tag{8}$$

3.3. Data Source and Processing

Because data of growth in the service sector at city level was unavailable, we use

[1] See Kumbhakar and Lovell (2003) for details.

data of 23 Chinese provinces during 2005–2016. This is based on three considerations: First, data aare not available for the provinces/autonomous regions of Gansu, Hebei, Heilongjiang, Shaanxi, Jiangxi, Sichuan, Tibet and Yunnan. Second, some provinces did not shift to the classification standards revised in 2002 until 2005, which made data before that incomparable. Third, provincial-level data on society-wide fixed asset investment in major industries was not available until 2005.

3.3.1. Economic Output (*Y*)

It is expressed by growth in the producer services sector. Because *China Statistical Yearbook* only contains growth data of some major industries and regions, and provincial statistical yearbooks do not contain data of different industrial segments, we gathered statistical yearbooks of 31 Chinese provinces for each year of the sample period and obtained growth data on major service industries in 23 provincial-level administrative regions for each of the years. The growth of the producer service sector are obtained by adding up the detailed service industries.

3.3.2. Capital Stock (*K*)

Calculation is done using the perpetual inventory method: $K_{it} = (1-\delta)K_{i(t-1)} + I_{it}$.[1] Society-wide fixed asset investment in producer services, I^{it}, comes from data of the tertiary industry in *China Statistical Yearbook* for corresponding years; the actual growth in fixed asset investment, g_{it}, is expressed by the geometric mean of the actual growth in fixed asset investment in producer services in the regions concerned during 2005–2016; the depreciation rate in the service sector, δ_{it} , can be 4%, 5% or 6% and we take 5% here for China's producer services sector.

3.3.3. Labor Input (*L*)

Data on society-wide labor input in major industries in regions is unavailable at present, and the use of employment data from urban and town entities would have TFP overestimated. This article, as did Wang *et al*. (2015), estimated the number of employees in each of the provinces' producer services sector, with data derived from provincial statistical yearbooks and the China Statistical Yearbooks of the Tertiary Industry for the corresponding years; the calculation formula is: Number of employees working in service industries = Total number of employees in the tertiary industry × (Number of employees in urban and town entities in detailed service industries / Total number of employees in urban and town entities in the all service sectors).

[1] See Harberger (1978) for details.

In addition, all value variables used in this article were converted into actual values in the base period of 2005 based on growth deflators of provincial tertiary sectors and price indices of fixed asset investment, with missing data remedied by the moving average method. Goodman and Steadman (2002) regarded service industries with over 50% of its outputs used as intermediate inputs in other sectors as producer services sector. Given the availability of data, the producer services sector in this article include five major industries-"transportation, warehousing, and post and telecommunication services", "information transmission, software, and information technology services", "financial services", "leasing and business services", and "scientific research, technical services, and geological exploration services".

4. Trends of Change in TFP of China's Producer Services Sector

4.1. Stochastic Frontier Production Function Estimations

Two types of production functions were selected and the assumption of non-neutral technological progress was considered. Estimations are given in Table 1 below. Model (1) is the translog production function; Model (2) is the Cobb-Douglas production function, namely the translog production function that meets certain constraints (H_0: $\beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$); Model (3) is the translog production function involving no neutral technology (H_0: $\beta_3 = \beta_6 = \beta_8 = \beta_9 = 0$); and Model (4) is obtained by removing insignificant variables from Model (1). The likelihood ratio test showed that Models (2) and (3) both rejected, at a level below 1%, the null hypothesis of the presence of constraints, while Model (4) accepted the null hypothesis of the presence of constraints. Models (4) and (1) had the biggest probability values, suggesting that it is feasible to use the translog production function in its complete form. Therefore, the next analysis is largely be based on results from Model (4).

All variables are significant at a level below 1%, and analytical indicators show the validity of the models selected. σ^2 reflects the fluctuation in production changes, with values smaller than 1, showing that error terms and inefficiency terms fluctuate relatively slightly; γ stands for the percentage of technical inefficiency among random error terms, which is close to 1 and significant at a level below 1%, suggesting that technical inefficiency has strong explanatory power with respect to the change in production nearly all of which results from the difference in technical inefficiency, and that it is appropriate to choose the SFA model; μ is the mean of inefficiency terms, at 1.557 and significant at a level below 1%, showing that inefficiency exists significantly in producer services development; η is a time-variant parameter, significantly positive at a level below 1%, suggesting that it is necessary to have selected a time-variant technical efficiency model.

Table 1. Estimated Results of the SFA Model

Variable	Model (1)	Model (2)	Model (3)	Model (4)
$\ln k$	0.3675 (0.3231)	0.1786*** (0.0244)	0.3120*** (0.1019)	
$\ln l$	0.8750** (0.3981)	0.0813 (0.0503)	–0.3002 (0.2122)	0.9419*** (0.1748)
t	–0.0551 (0.0665)			
$\ln^2 k$	0.0330 (0.0398)		–0.0219* (0.0126)	0.0497*** (0.0078)
$\ln^2 l$	0.0225 (0.0393)		0.0060 (0.0356)	
t^2	–0.0038*** (0.0009)			–0.0036*** (0.0004)
$\ln k \times \ln l$	–0.1419** (0.0718)		0.0440 (0.0295)	–0.1202*** (0.0234)
$t \times \ln k$	0.0036 (0.0108)			
$t \times \ln l$	0.0261** (0.0117)			0.0213*** (0.0015)
y-intercept	3.6904*** (1.3299)	1185.4588** (500.8529)	303.7957** (132.7677)	4.9210*** (0.5023)
LR test		51.65 (0.0000)	41.32 (0.0000)	3.88 (0.4224)
Loglike value	303.3632	277.5375	282.7028	301.4228
σ^2	0.6276*** (0.2934)	0.6391*** (0.2021)	0.6017*** (0.1910)	0.7020** (0.3204)
γ	0.9944*** (0.0027)	0.9934*** (0.0022)	0.9932*** (0.0022)	0.9950*** (0.0024)
μ	1.1547*** (0.2445)	1179.738** (500.8208)	297.7865** (132.7601)	1.1557*** (0.2613)
η	0.0073 (0.0045)	0.0001** (0.0000)	0.0002** (0.0001)	0.0067*** (0.0025)

Notes: *, ** and *** means significance at a level below 10%, 5% and 1%, respectively, where the sample size is 276; inside the brackets are standard errors.

4.2. Dynamic Characteristics of TFP of the Producer Services Sector

China has experienced complicated and volatile internal and external economic situations since 2005, and the producer services sector, with TFP down by 2.41% annually on average[1] and with no clear sign of new growth drivers taking shape, showed

[1] Calculated as the geometric mean of the weights of GDP of provincial administrative regions for different years (Wu, 2013).

complex characteristics from stage to stage (Figure. 1). Specifically, (1) In 2006–2009, the producer services sector's TFP growth was obviously in decline and, following the 2008 financial crisis in particular, plummeted due to the impact of increasingly grim external economic situations. (2) In 2010–2011, in response to the financial crisis, the Chinese government put in place an RMB 4 trillion stimulus policy, easing up the negative growth of TFP in the producer services sector and restoring TFP growth to the pre-crisis level. (3) In 2012–2015, as the Chinese economy entered the new normal where the country had to deal with an economic slowdown, make difficult structural adjustments, and absorb the effects of previous economic stimulus policies, TFP growth in the producer services sector once again slowed down, indicating that though the RMB 4 trillion plan in the previous stage gave a spur to the economy and helped maintain stable development, excessive capital input aggravated the loss of efficiency in the long run (Yu, 2015). (4) After 2016, the producer services sector's TFP growth tended slightly upwards, which might be the early result of the government's effort to advance the supply-side structural reform aimed to address structural problems with economic development in the previous stage, or related to the implementation in 2014 of the State Council's *Guiding Opinions on Accelerating the Development of the Producer Services Sector and Promoting Industrial Structure Adjustment and Upgrading* as well as of local government's supporting policies. However, more recent data is needed to see whether the above-mentioned policies' roles and growth trends are stable. Simply put, the TPF of China's producer services sector on the whole during the examined period showed a trend of negative growth, with no clear sign of new growth drivers emerging due to the impact of external environments and policy stimuli.

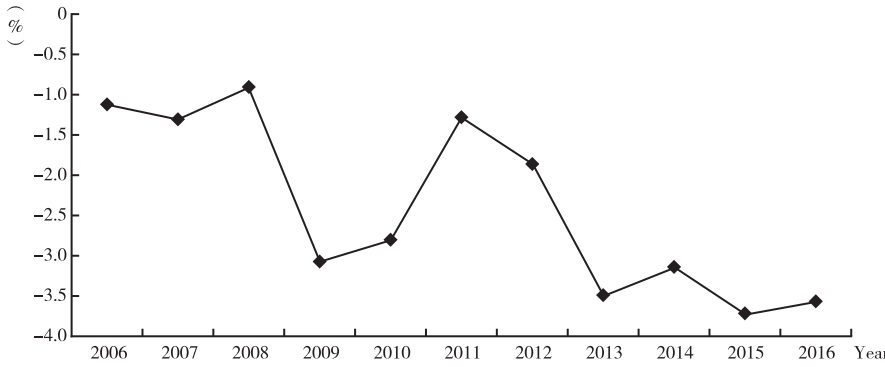

Figure 1. TFP Changes in China's Producer Services Sector (2005–2016)

4.3. Internal Composition of TFP of the Producer Services Sector

As shown in Table 2 below, China's producer services sector had an annual average TEC change rate of 0.63%, and the rates for TC and SEC were respectively

4.25% and –7.29%. The change of TFP mainly comes from TC and SEC with slight influence from TEC. TC is the main source of a positive change in TFP, with technological factors in producer services having considerable positive effects on TFP. With breakthroughs made in information technologies like big data, artificial intelligence and cloud computing, technological levels in such producer services industries as software and information services and scientific research and technical services have increased rapidly, and transportation, finance, leasing and business services among other service industries have seen a remarkable decrease in operating costs as a result of the application of information technologies. Information technology has become a crucial source of growth in the TFP of the producer services sector. On the contrary, SEC is a source of negative TFP changes in the producer services sector and also the main factor responsible for fluctuations in TFP, suggesting that the Chinese economy under the stimulation of the RMB 4 trillion plan experienced a typical "investment-led recovery," and that the extensive growth model, while guiding the economic recovery, might have caused a drastic fall in SE, leading to a heavy loss of efficiency. While this is also linked to the fact that input and output of the producer services sector are largely intangible services, its knowledge- and technology-intensive characteristic determines that growth in the sector relies more on human capital rather than non-material capital. Therefore, the deviation in the use of factors may lead to a downward trend in SE. Simply put, the new economy provided favorable external factors for fostering new growth drivers in the producer services sector, but the loss of efficiency caused by the RMB 4 trillion plan may not be ignored.

Table 2. Composition of TFP of China's Producer Services Sector, %

Time Span	TEC	TC	SEC	Time Span	TEC	TC	SEC
2005–2006	0.6504	6.3308	–8.1087	2011–2012	0.6244	3.7466	–6.2372
2006–2007	0.6460	5.9296	–7.9044	2012–2013	0.6202	3.4655	–7.5969
2007–2008	0.6416	5.5066	–7.0585	2013–2014	0.6160	3.0410	–6.8136
2008–2009	0.6372	5.0838	–8.8176	2014–2015	0.6118	2.6184	–6.9677
2009–2010	0.6329	4.6431	–8.1187	2015–2016	0.6077	2.1910	–6.4011
2010–2011	0.6287	4.1958	–6.1386	2005–2016	0.6288	4.2502	–7.2875

5. Breakdown of Growth Drivers for China's Producer Services Sector

5.1. Growth Drivers for the Sector as a Whole

Below we will examine the contribution of capital input and labor input among

other factors, as well as that of innovation represented by an increased TFP, to growth in China's producer services sector (Figure 2). First of all, TFP is the primary driver of growth in the producer services sector. TFP-induced growth, though with fluctuations, reached 5% on average, and in some years up to 10% or more in the producer services sector. As its characteristics of knowledge- and technology-intensive, the producer services sector, with widespread application of information technology, made technological progress and innovation-driven development an important driving force of growth, leading to a growth model different from the capital-driven model for the entire economy. Such an innovation-driven model, driven mostly by TFP, however, is unstable and vulnerable to external impact and policy stimuli. For instance, the drastic fall in TFP-driven producer services growth in 2009, which was resulted from the impact of the global financial crisis, and the 2013 downturn in the driving force of TFP, signaled that economic growth had been sliding into the new normal where the country had to deal with the slowdown in economic growth and to make difficult structural adjustments to absorb the effects of previous economic stimulus policies. However, such a innovation-driven growth model in the sector is good for high-quality development of the economy as a whole, and it is proper to take the producer services sector as a main arena where new growth drivers are fostered. Also, capital is the second source of driving force for the producer services sector. Capital-induced growth in 2005–2016 was relatively stable, roughly at 2%, and its ability to drive growth in producer services was rose slowly, signifying that massive capital input under the RMB 4 trillion plan worked also on the producer services sector and exacerbated the extensive growth in the country. Finally, labor contributes the least to growth in the producer services sector. Labor-induced growth in the sector remained below 0.5%, while was quite a low rate. This is in essence a deviation caused by adopting employment indicators so that the conclusion is constrained by the size of population and failing to obtain data needed to make quality adjustments to labor input in major service industries (Wang *et al*., 2015). But it also illustrates that demographic dividend is diminishing and that old growth drivers — most notably labor-is relatively weak in driving growth in the producer services sector.

The main driving force of growth in the producer services sector is TFP, followed by capital and labor, which is conspicuously different than the extensive growth model of the Chinese economy as a whole. That innovation-driven development represented by TFP boosted growth in China's producer services sector not only agrees with the development characteristics and trends of the sector, but also helps replace old growth drivers with new ones for the Chinese economy on the whole, illustrating that it is correct to take the producer services sector as the main area where new growth drivers are fostered. However, the innovation-driven growth model for the producer services sector was not stable, and TFP's ability to promote growth of the sector was very vulnerable to external impacts and policy stimulation; while capital and labor, as

growth drivers, were weak and constrained steady development of the sector. It is still imperative, therefore, to find effective ways to foster new growth drivers and invigorate old ones for the sector.

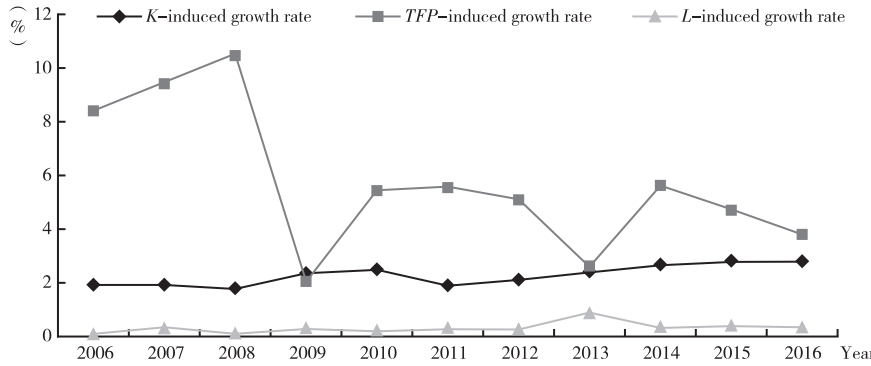

Figure 2. Growth Drivers for China's Producer Services Sector (2005–2016)

5.2. Growth Drivers for Major Service Industries

Figure 3 below shows growth drivers for major industries of China's producer services sector.

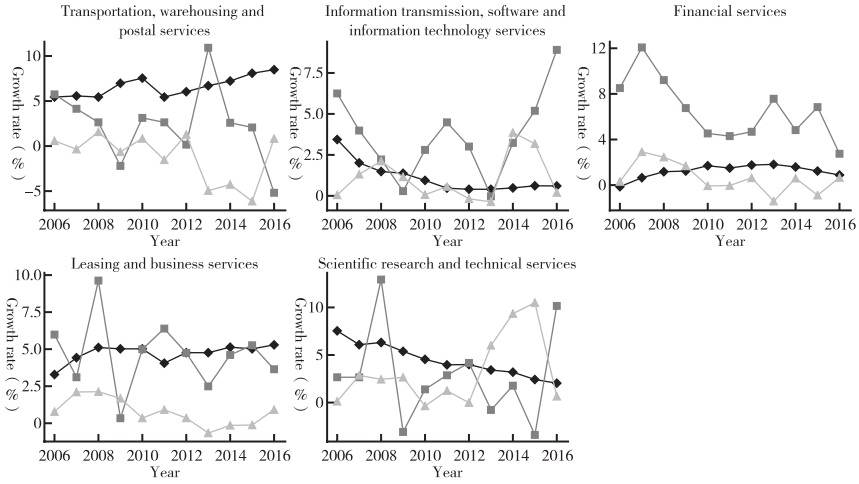

Figure 3. Growth Drivers for Major Industries of China's Producer Services Sector (2005–2016)

Notes: Legends are the same as those in Figure 2; the same below.

Specifically, (1) The driving force of growth in transportation, warehousing and postal services is capital, while innovation is not strong as a growth driver. First, capital was the main growth driver for the industry, with a contribution of generally more than 5%. Second, TFP played a relatively weak role in driving growth, showing

a trend of going up first and then down. This suggests an urgent need to stabilize new growth drivers. Finally, labor contributed 0% to growth, meaning that it did not have a significant role in driving growth, but its contribution rises in recent years. (2) Growth drivers for information transmission, software and information technology services improved, with innovation exerting its influence as the main growth driver. First, TFP-driven growth fluctuated drastically but tended to shoot up more recently. Second, capital-driven growth, though quite high in the early years, kept falling, showing that capital was no longer a major growth driver. Finally, labor's contribution to growth fluctuated quite wildly, and its role as a growth driver remained insignificant. (3) TFP was the main source of force driving growth in financial services, but its ability as a growth driver was in decline. First, TFP played a more conspicuous role than capital and labor, but due to the direct impact of the global financial crisis, TFP's contribution to growth in financial services decreased amid fluctuations. Second, labor's ability to drive growth fell first and tended to recover later. Finally, capital's role in pulling growth was quite stable before the decline when the driving force of the RMB4 trillion policy weakened. (4) Capital served as a stable driver of growth in leasing and business services, and innovation-driven growth fluctuated quite drastically. First, capital performed quite stably and gained strength as a growth driver. Second, TFP as a growth driver fluctuated quite considerably before edging down lately. Finally, labor's contribution to growth tended downward amid fluctuations before going up in recent years. (5) Labor's role in pulling growth in scientific research and technical services gained strength. First, capital was the main growth driver for the industry, but its ability to drive growth was in decline. Labor's contribution fluctuated but on the whole surged, playing a remarkable role in driving growth in the industry. TFP's contribution fluctuated wildly, which was largely related to the contingent nature of technological innovation, but its force of driving growth on the whole increased, signaling new growth drivers being in the making.

To sum up, growth drivers for China's producer services sector showed conspicuous industrial characteristics. Capital played a leading role in driving growth in transportation, warehousing and postal services and in leasing and business services, which was correlated with these industries' need for more capital investment. However, TFP's ability to drive growth didn't increase significantly also shows that it is necessary to adjust the growth drivers structure. To the information transformation, software and information technology services industry and the scientific research and technical services industry, traditional growth drivers were in decline and TFP become the main growth drivers for the industries; the growth drivers structure was adjusted in the two industries as a result of efforts made in respect of the Internet Plus initiatives and of building an innovation-oriented country, with old growth drivers being replaced by new ones. The financial services industry, which suffered more impact of the global financial crisis than other industries, was on the whole sluggish, and both old and new

growth drivers for the industry weakened to varying degrees, making it imperative to revitalize old growth drivers and foster new ones.

5.3. Growth Drivers for Four Major Regions

As big gaps exist between different regions across the vast territory of China, there is significant heterogeneity among regions in respect of producer services. This paper divides China four major regions in economic terms - East, Central, West and Northeast[1]-for the purpose of analyzing growth drivers for producer services according to regions.

5.3.1. Innovation Is the Main Driver of Producer Services Growth in East China

First, while TFP was on the whole in decline in terms of its role in pulling industrial growth in East China, it remained, except in some provinces, the main driver of industrial growth. TFP-induced growth in Beijing, Tianjin, Shanghai and Jiangsu, among other developed provinces, stood at about 10%. Second, capital's ability to drive industrial growth in most provinces in the region was modest, as these provinces, with good industrial foundation, had quite strong an ability to deal with the RMB 4 trillion policy stimuli and could sustain a proper growth driver structure. Of course, TFP-induced growth rates fell, making it still necessary to reinforce new growth drivers represented by TFP (Figure 4).

5.3.2. No clear sign seen for new growth drivers to replace ones for producer services in Central China

First, in most provinces in central China, TFP's ability to drive industrial growth moved downward amid fluctuations, and TFP, though being the main source of growth, saw its ability to drive growth moving closer to that of capital and labor, making it imperative to foster new growth drivers in the region. Second, capital's contribution to industrial growth in these provinces increased to varying degrees, and considering that such increases came after the RMB 4 trillion plan, they were probably not caused by revitalized old growth drivers, but by external policy stimuli. Therefore, Central China, where the industrial foundation is relatively weak, is more vulnerable to external impacts and policy stimuli. While old growth drivers were not substantively revitalized, new growth drivers need to be fostered and strengthened, and there is not yet any sign of replacement (Figure 5).

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[1] National Bureau of Statistics of China: Method for the Classification of East, West, Central and Northeast Parts of China, June 13, 2011.

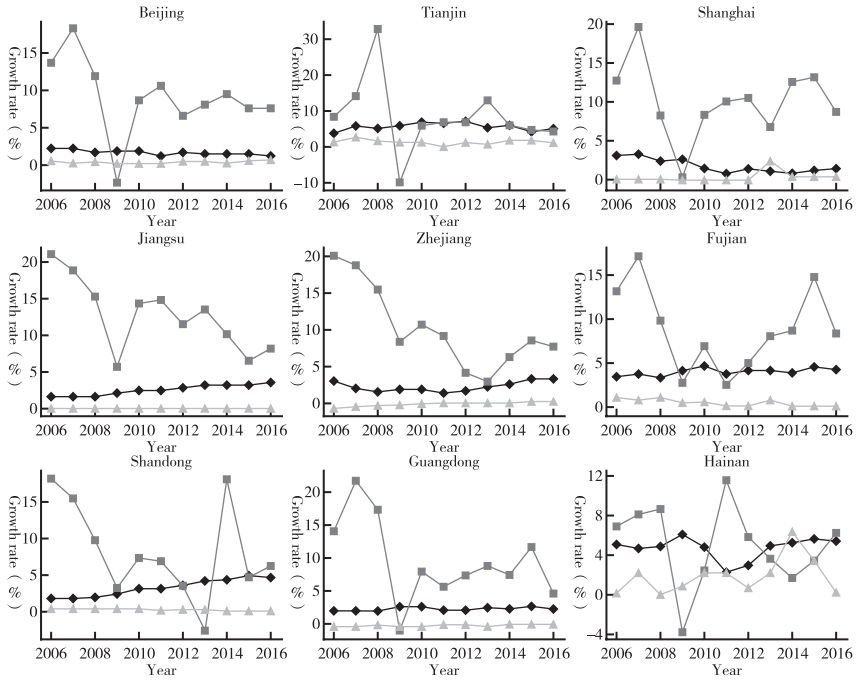

Figure 4. Growth Drivers for Producer Services in East China (2005–2016)

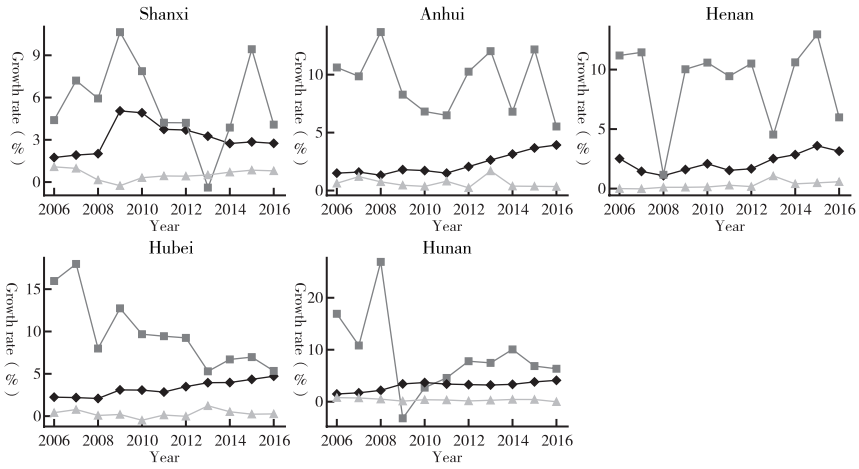

Figure 5. Growth Drivers for Producer Services in Central China (2005–2016)

5.3.3. It is challenging to replace old growth drivers with new ones in producer services in West and Northeast China

First, TFP as a growth driver was in a sharp decline in most of the provinces, especially Guangxi, Guizhou, Qinghai, Ningxia, Xinjiang and Liaoning. In Guangxi,

Guizhou, Xinjiang and Liaoning in particular, it is the trend that innovation was a weaker growth driver than factors. Second, capital as a growth driver for most of the provinces was on the rise, a characteristic more obvious upon the implementation of the RMB 4 trillion plan, which was probably resulted not from revitalized old growth drivers, but from policy stimuli, suggesting a need to further adjust the growth drivers structure in the regions. Without a firm industrial foundation, producer services growth in West and Northeast China are very likely to suffer from external impact and policy stimuli and lead to a distorted growth drivers structure where new growth drivers are weak and old ones grow extensively (Figure 6).

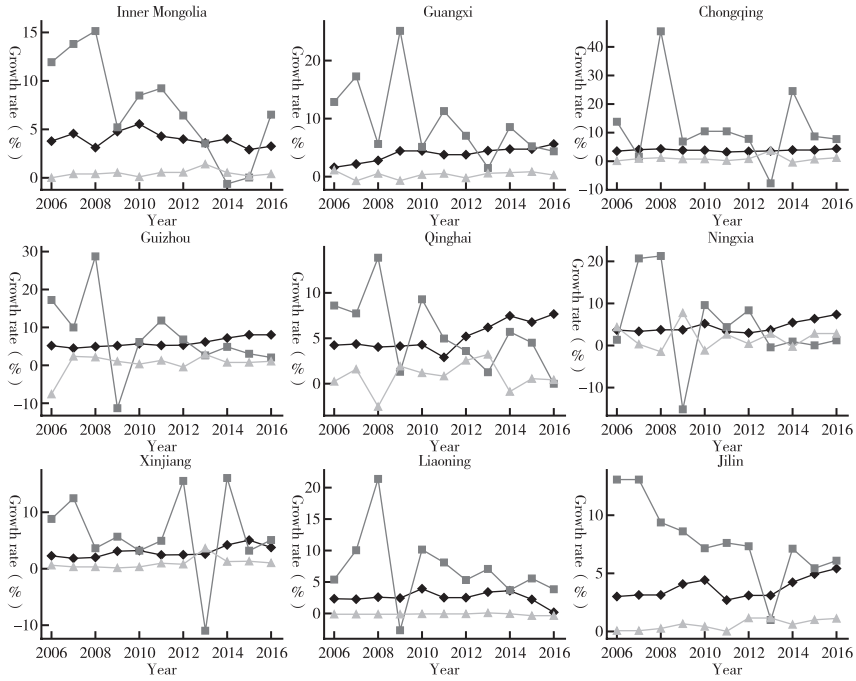

Figure 6. Growth Drivers for Producer Services in West and Northeast China (2005–2016)

To sum up, though East China saw a weakened TFP driving force due to the impact of the global financial crisis, extensive capital-driven growth as a result of the RMB 4 trillion plan, as well as challenges under the new normal, innovation remained the main source of driving force for growth there because of its good industrial foundation and a proper internal structure. TFP's ability to drive industrial growth in Central China declined conspicuously, with growth drivers performing sluggishly. Meanwhile, due to the impact of the RMB 4 trillion plan, traditional growth drivers represented by capital brought about extensive growth rather than industrial upgrading and transformation, with no clear sign of new growth drivers replacing old ones for the local industry. It is still a question whether there will be a proper growth drivers structure. Finally, TFP

was no longer a driving force for growth in some provinces in West and Northeast China and capital as a growth driver brought about extensive growth. Due to the dual effects of external impact and policy stimuli, the industry's capability of self-adjustment and recovery was quite weak, posing big challenges to our efforts to find new growth drivers to replace old ones. To West and Northeast China, a dominantly TFP-driven growth model is very unstable, with growth drivers derived probably from technological catch-up rather than independent innovation, and once the external environment changes, TFP would tumble as a driver of industrial growth.

6. Conclusions

This paper adopts the time-variant technical efficiency SFA model and the translog production function to estimate the TFP of China's producer services sector and to analyze growth drivers for the sector and particular industries therein, as well as heterogeneous characteristics of particular provinces, using producer services data of 23 provincial administrative regions of 2005–2016—a period when the Chinese economy was shifting from rapid growth to high-quality development with the pressing need to replace old growth drivers with new ones. Research findings are as follows:

Firstly, there were no clear trends as to fostering new growth drivers for China's producer services sector, but the new economy brought about favorable external factors. The change in TFP of the producer service sector shows complex and stage-specific characteristics, which is mainly, derived from TC and SEC and less from TEC, which was closely linked to the groundbreaking development and rapid application of new technology like big data, artificial intelligence and cloud computing and of the new economy.

Secondly, producer services growth was driven mainly by innovation represented by an improved TFP, followed by capital and then labor. In the transportation, warehousing and postal services and the leasing and business services industry, capital played the leading role in driving growth; in the information transmission, software and information technology services industry, TFP gradually became the main growth driver; impacted by the global financial crisis, the financial services industry remained relatively sluggish.

Finally, regions differ greatly in their industrial foundation and growth drivers structure. East China has a good foundation for producer services development, with innovation being the main growth driver; other regions have relatively weak ability for industrial self-adjustment and recovery, which, coupled with the external impact of policy stimuli, is likely to make new growth drivers weak and old ones extensive, resulting in an improper growth drivers structure.

This paper offers the following policy recommendations.

Firstly, seize opportunities of the time and take the producer services sector as the

main front where new growth drivers are fostered. Innovation is the most important new growth drivers, and development of new technology like information and communications helps improve efficiency of knowledge- and technology-intensive producer services sector (Zhang *et al.*, 2018). Innovating business models for producer services by means of Internet Plus initiatives, and building sharing economy, digital creative industries among other new industries and business models by integrating information technology such as the mobile Internet, big data and artificial intelligence, can foster new growth drivers for the sector.

Secondly, develop plans aimed to replace old growth drivers with new ones and build fast-growing areas in the producer services sector. The information transformation, software and information technology services industry and the scientific research and technical services industry may seize opportunities to foster new growth drivers by taking advantage of such information technology as big data; the transportation, warehousing and postal services industry and the leasing and business services industry should place focus on upgrading and transforming traditional growth drivers and tapping the economic potential of industrial stock (Tang *et al*., 2018); the financial services industry should, while guarding against financial risk, support financial innovation by, for example, improving the finance guaranteeing system and establishing compensation mechanisms against loan risks concerning small- and medium-sized enterprises (Xia, 2015).

Finally, consider development gaps between regions when developing plans to replace old growth drivers with new ones for the producer services sector. The east region should continue to pursue innovation-driven growth in producer services; other regions with a weak industrial foundation should, while deepening opening up and sustaining moderate external demand, pay more attention to building brands of their own and strengthening industrial core competitiveness, striving to achieve a transformation from technological catch-up to independent innovation.

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