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# The Impact of Special Economic Zones on Producer Services Productivity: Evidence from China

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**Abstract:**

Do Special Economic Zones (SEZs) promote the productivity of producer services, and what are the channels of the effect? To shed light on these questions, we collect a dataset of 1.46 million producer service firms on the basis of the Second Economic Census of China. We then use the dataset to prove the productivity advantages of producer service industry in the SEZs. Guided by a “new” new economic geography model, we estimate these advantages using the IV model and unconditional distribution characteristic-parameter correspondence method. Results imply that agglomeration effect is the source of the productivity advantages of the producer services in the SEZs. This effect is positively correlated with the local manufacturing scale. A high industrial relevancy between the producer services and the leading manufacturing industry in the SEZs results in a strong agglomeration effect. The preferential policy in the SEZs reduces the entry barrier for firms and attracts a high proportion of inefficient firms entering with the selection effect. This result has a negative impact on promoting the productivity of producer services. The conclusions are robust in different circumstances.

**Keywords:** “New” New Economic Geography, Special Economic Zones, Producer Services, Selection Effect, Agglomeration Effect

**JEL:** R10, R52, L52

## 1. Introduction

Special Economic Zones (SEZs) are the most representative place-based programs in China. Essentially, the government uses tax incentives or subsidies to attract firms to gather in a special space. As a result, external economics emerges, and the government can provide more and more employment opportunities and economic output. However, the effectiveness of the SEZ program, which some scholars are skeptical of, is inconsistently established. These scholars argue that some firms and labors locate in the SEZs only because of the benefits of preferential policies; furthermore, these firms and labor do not substantially benefit the development of local areas and even generate crowding-out effects on the productivity and survival time of surrounding firms (Glaeser et al., 2010; Hanson and Rohlin, 2013; Bao and Tang, 2016). However, most studies have confirmed the positive effect of SEZs on economic development (Combes and Gobillon, 2015). According to the “*Audit Announcement Catalogue of China's Special Economic Zones* (2006)”, 1568 national-level and province-level SEZs are located in more than 270 cities at prefecture level or above in China; these SEZs contributed approximately 10% of the country's GDP and 1/3 of FDI with only 0.1% of the total land area in 2006 (Zheng et al., 2017). The land-use efficiency of SEZs is much higher than that of Non Special Economic Zones (NSEZs); some empirical studies have shown that the SEZ program promote the improvement of the total factor productivity (TFP) of firms (Wang, 2013; Alder et al., 2013; Lin et al., 2018); moreover, the productivity advantages of SEZs are caused by agglomeration and selection effects (Wang and Zhang, 2016). However, relevant literature has focused on the manufacturing industries and has used the productivity of manufacturing firms to characterize the productivity of the SEZs; in addition, the producer services in the SEZs are rarely involved in these studies. This study identifies producer service firms in SEZs on the basis of the "*Second Economic Census of China(2008)*" and the "*Classification of Producer Services (2015)*" by the National Bureau of Statistics of China. After eliminating the abnormal values, we conclude that more than 980,000 producer service firms are in the SEZs, which account for 50.4% of the total number of firms in the SEZs. The proportion of revenue and employees reaches 30.7% and 30%, respectively. With the evolution of the adjustment of urban industrial structure, the secondary industry weight of the urban economy is falling, whereas the tertiary industry weight is growing. The influence of the producer service industries on the development of the SEZs becomes increasingly strong. Producer service industries should be discussed when analyzing firm productivity in the SEZs.

With the improvement of specialized division of labor, the producer service industries gradually separate from the manufacturing industries. Furthermore, in the new industrial division system based on different links, processes, and modules of the value chain, the producer service industries are at the high end of the value chain. These industries are also the driving force and key development direction of economic growth in many countries and regions. The level of producer service industries in China is lagging behind that of developed countries. Nonetheless, the role of producer service in economic development is constantly rising. In 2015, the added value of producer service industries accounted for 58.8% of service industries and 29.6% of GDP, respectively[1]. According to the *"Second Economic Census of China(2008)"*, the number of producer service firms in the SEZs accounts for 66.2% of the total producer service firms in China; the proportion of the revenue and the employees are 67.6% and 22.4%, respectively. Thus, the SEZs are the cluster areas of producer service industries in China. The study on the productivity of producer service industries in SEZs can provide a decision-making reference for promoting the rapid development of China's producer service industries.

Theoretically, according to the framework of new economic geography (NEG) and the 'new' new economic geography (NNEG), the establishment of the SEZs will break the original spatial structure of urban industries, and the system will regain a new stable equilibrium under the agglomeration and selection effects. Compared with the NSEZs areas, the SEZs have two mechanisms that affect the productivity of firms in the SEZs. One mechanism is the agglomeration effect based on NEG theory. The SEZs attract a large number of firms to gather in the specific regions, thereby increasing market potential; then, the NEG model confirms that the regions with

[1] In 2015, the National Bureau of Statistics published the scope of statistical classification of producer services but not the corresponding statistical data. In accordance with the classification code of national economy, producer services are defined as transportation, warehousing and postal services, information transmission, software and information technology services, whole sale and retail services, finance, leasing and business services, and scientific research and technology services.

high market potential have productivity advantages and generally attributes the source of these advantages to the agglomeration effect. The agglomeration of similar industries can cause Marshall externality, which improves productivity by sharing intermediate inputs, labor pool, and knowledge spillovers. The Jacobs externality from diversified industries also promotes innovation through knowledge spillovers, thereby improving productivity (Jacobs, 1969). These two types of agglomeration economies generally improve the firm's productivity; thus, the distribution curve of the firm productivity in cluster areas shifts to the right altogether. In empirical research, Melo et al. (2009), Combes et al. (2010), Sun et al. (2013), and others have pointed out that agglomeration economies can generally improve the firm productivity due to Marshall and Jacobs externalities. Different from the productivity advantages brought by firm agglomeration in large market areas, the SEZs are government-formed cluster areas where a series of preferential policies and other policy rents are provided (Zheng et al., 2008). SEZs are not the result of the spontaneous effect of market forces (access to the market or suppliers).

The other mechanism is based on the selection effect of NNEG. By introducing micro-individual heterogeneity into NEG theory, NNEG theory suggests that productivity differences among regions are also due to the spatial location choice of heterogeneous firms. The forms of action vary among different models. Baldwin and Okubo (2006) proposed that the firms in cluster areas are competitive. Moreover, the market mechanism of survival of the fittest causes inefficient firms to withdraw from the market; only the efficient ones can survive in large market areas (Melitz, 2003; Melitz and Ottaviani, 2008). The selection effect increases the proportion of efficient firms in large market areas and reduces the proportion of inefficient firms. Ignoring the selection effect overestimates the promotion of agglomeration effect on the productivity of cluster areas. However, Okubo (2010) argued that the model of Baldwin and Okubo (2006) limits the labor mobility and cannot reflect the forward and backward linkage effects. By adding heterogeneity to the Footloose Entrepreneur Model (FE), Okubo (2010) proposed the adverse spatial selection effect, and then argued that the agglomeration of efficient firms would lead to serious competition and tend to decentralize, whereas inefficient firms are flexible in location choices. For producer service industries in the SEZs, this study argues that the mechanism of selection effect includes the market competitive effect (withdrawal of inefficient firms under the effect of survival of the fittest) and the location effect of heterogeneous firms (influence of entry threshold on the entry ratio of the inefficient firms). On the one hand, the market of producer services expands due to the agglomeration of manufacturing industries in the SEZs. This expansion then aggravates the market competition and causes difficulties for inefficient firms to obtain profits. Thus, the inefficient firms withdraw from the SEZs and promote the overall productivity of producer service industries in the SEZs. On the other hand, the existence of policy rent in the SEZs reduces the entry threshold of producer service industry firms. It increases the entry probability of inefficient firms and inhibits the productivity improvement among producer service industries in the SEZs. Both mechanisms determine the impact of selection effect on the productivity of producer service industries in the SEZs.

In empirical research, Combes et al. (2012) first used the method of unconditional distribution characteristic-parameter correspondence to identify the agglomeration and selection effects by measuring the right shift and left tail of the distribution of firm productivity in different regions. Since then, a large number of scholars have examined the existence of various industries in different regions on the basis of this method; however, their conclusions are different (Gaubert, 2018; Arimoto et al., 2014; Behrens and Duranton, 2014). Many studies have also discussed the issue on the basis of the data of Chinese firms. From the perspective of research object, most scholars have confirmed the selection effect mechanism of the sources of productivity advantages in big cities (Zhang et al., 2017), cluster counties or cities (Liu et al., 2015), and large market areas (Li et al., 2015). Only Wang and Zhang (2016) discussed the source of the productivity of SEZs; they found that the agglomeration and selection effects can considerably improve the productivity in the SEZs; in their study, the agglomeration effect plays a leading role. From the perspective of research scale, most documents can only reflect the source of productivity advantages of manufacturing firms in cluster areas in China. Furthermore, empirical research on service industries has not been performed. Besides, only a few studies have supported the mechanism of selection effect; some empirical studies have shown that the selection effect does not exist or has a weak effect (Combes et al., 2012; Yu and Yang, 2014). After considering the policy rent mechanism, Lin et al. (2018) further found that the productivity premium of firms in the SEZs is not due to the government's selection of efficient firms; moreover, the SEZs improve enterprise efficiency by providing a good policy environment (such as lower taxes). Therefore, no consistent conclusion on the selection effect is provided, and this subject should be studied further.

The present study aims to identify the productivity advantages of producer services in the SEZs. If an advantage exists, then this study will identify whether it derived from the agglomeration effect or the selection effect. This study also further explores the mechanism of agglomeration and selection effects. Compared with the existing literature, this article has a threefold contribution.

Most importantly, this study is the first to explore how agglomeration and selection effects influence the productivity of producer service industries in the SEZs completely. The analysis for identifying agglomeration and selection effects of the current studies are based on the unconditional distribution characteristic parameter correspondence method. However, this estimation method cannot identify whether the productivity advantages of the producer service industries in the SEZs is brought by the establishment of SEZs or already present prior to their establishment. Therefore, we test the impact of the establishment of SEZs on the productivity of the producer service industry before using this estimation method to identify the productivity advantages and sources of the producer service industry in the SEZs. The endogeneity of location choice of SEZs is overcome well, possibly promoting the accuracy of the estimates.

Furthermore, this study presents an empirical method to identify the agglomeration and selection effects and their mechanisms in SEZs from the perspective of manufacturing industry linkage and location choice of heterogeneous firms. On the one hand, on the basis of the industrial linkage between producer service industries and manufacturing industries, this study identifies the positive correlation between the agglomeration effect of producer service industries and the scale of local manufacturing industries. The agglomeration effect is strong when the producer service industries and the planned leading manufacturing industries in the SEZs have a high correlation. This study also verify the diversified development modes of various producer service industries in the SEZs have a strong agglomeration effect through Jacobs' externalities .On the other hand, from the perspective of the impact of policy rent on the entry ratio of inefficient firms in the SEZs, the mechanism of the selection effect is that preferential policies in the SEZs reduce the entry threshold of firms. Thus, a larger number of inefficient firms locate in the SEZs, thereby inhibiting the productivity improvement of producer service industries.

Finally, this study estimates the productivity advantages of the producer service industries in the SEZs on the basis of the firm data of the producer service industries. This study supplements the research on the producer service industries. At present, most of the discussions on the producer service industries in China have concentrated at the industry level, and discussion at the firm level is lacking. From the spatial perspective, studies at the level of province, metropolis (Xi and Li, 2015), city (Liu et al., 2017), or district inside a city (Qiu et al., 2008) have not discussed the micro-unit from the firm level. Additionally, unlike manufacturing firms, which often need a large area of land and incur high sunk costs of relocation, producer service firms mostly occupy a small area. Furthermore, for producer service firms, locations are flexible and the pursuit of preferential policies is obvious. Therefore, even if the current study on the agglomeration effect of the manufacturing industries is substantial, the existing conclusions are not necessarily suitable for the producer service industry. Policy misleading occur if industrial heterogeneity is ignored. This paper can provide micro-level evidence for policy making in the producer service industries of SEZs.

The rest of this paper is organized as follows. The next section introduces the institutional background and develops a theoretical framework. Data, variables and empirical strategy and results are reported in *Section 3*. *Section 4* empirically examines the existence and source of the advantages of producer service industries in the SEZs. *Section 5* further identifies the mechanism of agglomeration effect and selection effect on the productivity advantages of producer service firms in the SEZs. *Section 6* concludes.

# 2. Institutional background and theoretical framework

## 2.1 Institutional background

Since the establishment of the first SEZ in 1984, 552 national and 1991 provincial SEZs have been established in China until 2018. After more than 30 years of development, China's SEZs play a positive role in attracting foreign investment, promoting the development of modern manufacturing industry, and improving the investment environment. Simultaneously, to promote the integration of manufacturing and productive service industries and encourage the upgrading of industrial structures while developing modern manufacturing industries, the SEZs are also committed to developing producer services. In March 2005, the State Council promulgated "*Several Opinions on Promoting the Further Improvement of the Development Level of the National Economic and Technological Development Zones*(No. 15, 2005)", which includes "Becoming the agglomeration zone of modern services" as the development goal of national SEZs. Multinational corporations are encouraged to set up R&D, financial, technical service, training, procurement, logistics, and operation centers in national economic and technological development zones. The importance of producer services to the high-quality development of national SEZs is highlighted in the "*Innovative Development Documents Issued by the State Council(2014, 2017)*".

Producer services are also involved in a series of preferential policies given by the central government to SEZs (e.g., tax preferences, financial subsidies, credit facilities, land transfer preferences, and administrative approval convenience). For example, in terms of land supply, the state policy requires that the proportion of land used by producer services must be increased and that the use of industrial property in stock must be allowed to develop producer services. Lands must continue to be used in accordance with its original use and land right types within 5 years. If the relevant land use formalities must be handled at the end of 5 years or when a transfer is involved, then the land must be handled by an agreement in accordance with the new use, new right type, and market price[2]. In terms of fiscal and taxation policies, incubators that provide technical services for small and medium firms' entrepreneurship and independent innovation in national SEZs, as well as public infrastructure projects that provide technical services for service outsourcing and Internet of things firms, may apply for central financial discounts and various tax relief policies[3]. In addition to national policy support, the SEZs provide preferential policies to attract producer service firms. For example, within 5 years from the date of registration, the Beijing Economic and Technological Development Zone offers 40% of the total income tax to multinational corporations' headquarters, regional headquarters, R&D centers, marketing centers, settlement centers, logistics centers, and other producer service firms. The scientific and technological industrial parks on both sides of the Taiwan Straits of Nanjing will award 1.5 million yuan and 500,000 yuan one-time rewards to R&D institutions recognized by the state and provincial authorities and who promised that their research results will be transferred to the parks in priority.

## 2.2 Theoretical framework

This study aims to analyze the location choice of heterogeneous productive service firms between SEZs and NSEZs. To involve the location choice of these heterogeneous firms caused by the policies of SEZs, we propose a heterogeneous firm location choice model based on the nested model of Combes et al. (2012) and Wang & Zhang (2016).

The model is effective across two regions, two sectors, and manufacturing firms are consumers of producer service firms. The two regions are SEZ (denoted by *i*) and NSEZ (denoted by *j*), while the two sectors are manufacturing industry (good *I*) and producer service industry (good *S*). The populations of the two regions are denoted as $N_i$ and $N_j$, and the population is interregionally mobile. All differentiated good *S* in the two regions are symmetrical. Labor is the only factor of production and is inelastically supplied in a competitive market. The numeraire producer service goods are produced under constant returns to scale using one unit of labor per unit of output. Differentiated producer service products are produced under monopolistic competition. By incurring a sunk entry cost, that is, *s*, a producer service firm develops a new product using *h* units of labor per unit of output. Given that the cost of each unit of labor is the marginal cost, *1/h* is also the productivity of producer service firms. We also include the iceberg trading cost, $\tau$ ($\tau$>1). We do not make numerous assumptions on the model set up of manufacturing firms. For simplification, the number of manufacturing firms is denoted by $\theta(N)$ and $\theta' \geq 0$.

The utility function of the representative consumer (manufacturing firm) in each region is expressed as follows:

$$U = q^0 + \alpha \int_{k\in\Omega} q^k dk - \frac{1}{2}\gamma \int_{k\in\Omega} \left(q^k\right)^2 dk - \frac{1}{2}\eta \left(\int_{k\in\Omega} q^k dk\right)^2$$

(1)

where $q^0$ denotes the manufacturing firm's consumption of a homogenous numeraire good,

[2] See "*Some Opinions of the General Office of the State Council on Promoting the Reform and Innovative Development of Special Economic Zones*" (General Office of the State Council, No. 7, 2017)

[3] See Ministry of Finance "*Measures for the Management of Central Financial Discount Funds for Infrastructure Project Loans in State-level Economic and Technological Development Zones and State-level Border Economic Cooperation Zones*" (Finance Construction No. 94, 2012)

and $q^k$ denotes its consumption of variety *k* of a set Ω of differentiated producer service products. The three positive demand parameters (*α*, *γ*, and *η*) are such that a high *α* and a low *η* increase the demand for differentiated products relative to the numeraire, while a high *γ* reflects additional product differentiation between varieties. Utility maximization yields consumer inverse demand for differentiated producer service product *k* as follows:

$$p^k = \alpha - \gamma q^k - \eta \int_{j \in \Omega} q_j dj$$

(2)

where $p^k$ denotes the price of producer service product *k*. Here, $\bar{\Omega}$ denotes the set of producer service products with positive consumption levels in equilibrium, $\omega$ represents the measure of $\bar{\Omega}$, and $P \equiv \frac{1}{\omega}\int_{j \in \bar{\Omega}} p^j dj$ indicates the average price faced by the individual consumer for products with positive consumption. By integrating Equation (2), we can solve for an individual consumer's demand for product *k* as follows:

$$q^k = \begin{cases} \frac{1}{\gamma + \eta\omega}\left(\alpha + \frac{\eta}{\gamma}\omega P\right) - \frac{1}{\gamma} p^k, & if \quad p^k \le \bar{h}, \\ 0 & , \quad if \quad p^k > \bar{h}. \end{cases} \tag{3}$$

The price threshold $\bar{h}$ in equation (3) follows immediately from the restriction $q^k \ge 0$. Each producer service firm's *h* is randomly drawn after the sunk entry cost has been incurred from a distribution with known probability density function g(*h*) and cumulative *G(h)* common to all regions. According to Melitz and Ottaviano (2008), *1/h* follows a Pareto distribution, thereby indicating that *1/h* ~ P(*1/h<sub>max</sub>*, *k*), and *G(h)* = (*h/h<sub>max</sub>*). Producer service firms with a marginal cost higher than the price at which consumer demand becomes zero are unable to cover their marginal cost and exit. Therefore, the set of products that result in being produced in equilibrium is $\bar{\Omega} = \{k \in \Omega \mid h \le \bar{h}\}$. Using equation (3), the number of service products of NSEZs provided by the producer service firms in the SEZs is expressed as follows:

$$q_{ij}(h) = \frac{1}{\gamma + \eta\omega}\left(\alpha + \frac{\eta}{\gamma}\omega P\right) - \frac{1}{\gamma} p_{ij}(h) = \frac{1}{\gamma}\left[\bar{h}_j - p_{ij}(h)\right] \tag{4}$$

The mass of consumers in NSEZs, $\theta(N_j)$, yields the following expression for the demand faced in NSEZs by a producer service firm from SEZs as follows:

$$Q_{ij}(h) = \begin{cases} \frac{\theta(N_j)}{\gamma}\left[\bar{h}_j - p_{ij}(h)\right] & if \quad p_{ij}(h) \le \bar{h}_j \\ 0 & if \quad p_{ij}(h) > \bar{h}_j \end{cases} \tag{5}$$

A producer service firm from SEZs with unit requirement h operating in NSEZs sets its price as such to maximize operational profits in the SEZs as provided by $\pi_{ij}(h) = \left[p_{ij}(h) - \tau_{ij} h\right] Q_{ij}(h)$. This calculation yields $p_{ij}(h) = \left(\bar{h}_j + \tau_{ij} h\right)/2$, and we obtain equilibrium operational profits presented by $\pi_{ij}(h) = N_j\left(\bar{h}_j - \tau_{ij} h\right)^2 / 4\gamma$. Thus, the producer service firm's expected operational profits prior to entry for SEZs is formulated as follows:

$$\Pi(h)=\frac{\theta(N_i)}{4\gamma}\int_0^{\bar{h}_i}(\bar{h}_i-h)^2 g(h)dh+\frac{\theta(N_j)}{4\gamma}\int_0^{\bar{h}_j/\tau}(\bar{h}_j-\tau h)^2 g(h)dh \quad (6)$$

The first term on the right-hand side captures operational profits from operating in SEZs, and the second-term summation captures the operational profits from operating in NSEZs. According to the equilibrium condition of monopoly competition market, the determinant function of production cut-off productivity of producer service firms in SEZs can be obtained as follows:

$$\bar{h}_i=\left[\frac{\Delta}{\theta(N_i)}\left(s_i-\frac{s_j}{\tau^k}\right)\left(1-\frac{1}{\tau^{2k}}\right)^{-1}\right]^{\frac{1}{k+2}}$$

(7)

where $\Delta=2\gamma(k+1)(k+2)(h_{\max})^k$ .

Initially, the industrial development policies of SEZs aim to promote the development of the manufacturing industry. The SEZs are the main agglomeration regions of manufacturing firms in a city. Thus, the SEZs have higher manufacturing market size than NSEZs, where $\theta(N_i)$ of SEZs is large. Consequently, local producer service firms demonstrate low $\bar{h}_i$ and high cut-off productivity. The first result is expressed as follows:

**Hypothesis 1**: The SEZs have higher cut-off productivity of producer service firms. Thus, the SEZs have a higher level of producer service firms' productivity than the NSEZs.

In contrast to the general large market and central areas, SEZs are agglomeration areas established under the guidance of policies. Therefore, the changes in the location choice of producer service firms affected by the preferential policies of SEZs must be considered. The preferential policies of SEZs for producer service enterprises consist of tax concessions and industrial linkage between producer service industries and planned leading manufacturing industries.

Case 1: Tax concessions

Given that the effective tax rate provided to firms in SEZs is $t_i$, NSEZs is $t_j$, and $t_i<t_j$ because of the tax concession policies in SEZs. Thus, the operational profit in the SEZs is expressed as $\pi_{ij}^*(h)=\left[p_{ij}(h)(1-t_i)-\tau_{ij}h\right]Q_{ij}(h)$. Moreover, we obtain equilibrium operational price and profits defined as $p_{ij}^*(h)=\left[(1-t_i)\bar{h}_i+\tau h\right]/2(1-t_i)$ and $\pi_{ij}^*(h)=\theta(N_j)\left((1-t_i)\bar{h}_j-\tau_{ij}h\right)^2/4\gamma(1-t_i)$. Thus, producer service firms' operational profits under the expected tax concession policy prior to entry for SEZs are presented as follows:

$$\Pi^*(h)=\frac{\theta(N)_i}{4\gamma(1-t_i)}\int_0^{\bar{h}_i}\left((1-t_i)\bar{h}_i-h\right)^2 g(h)dh+\frac{\theta(N_j)}{4\gamma(1-t_i)}\int_0^{\bar{h}_j/\tau}\left((1-t_i)\bar{h}_j-\tau h\right)^2 g(h)dh \quad (8)$$

According to the equilibrium condition of monopoly competition market, the determinant function of production cut-off productivity of producer service firms under the tax concession policy in SEZs can be obtained as follows:

$$\bar{h}_i^*=\left[\frac{\Delta}{\theta(N_i)}\left(\frac{s_i}{(1-t_i)^{k+1}}-\frac{s_j}{\tau^k(1-t_j)^{k+1}}\right)\left(1-\frac{1}{\tau^{2k}}\right)^{-1}\right]^{\frac{1}{k+2}} \quad (9)$$

Based on equation (9), $\partial\bar{h}_i^*/\partial t_i$ is expressed as

$$\frac{\partial\bar{h}_i^*}{\partial t_i}=\Lambda\bullet\Gamma\bullet\left[\frac{s_i}{(1-t_i)^{k+1}}-\frac{s_j}{\tau^k(1-t_j)^{k+1}}\right]^{-(k+1)/(k+2)} \tag{10}$$

where $\Lambda=\left[\Delta\left(1-1/\tau^{2k}\right)^{-1}/\theta(N_i)\right]^{1/(k+2)}\geq 0$ , and $\Gamma=(k+1)s_i/(k+2)(1-t_i)^{k+2}\geq 0$ . Therefore, $\partial\bar{h}_i^*/\partial t_i$ depends on the s and τ of the two regions. $\partial\bar{h}_i^*/\partial t_i\leq 0$ is true when *s* and *τ* of SEZs are low-level; that is, the cut-off productivity is positively correlated with the effective tax rate of SEZs. By contrast, $\partial\bar{h}_i^*/\partial t_i\geq 0$ is true when *s* and *τ* of SEZs are high-level; that is, the cut-off productivity is negatively related to the effective tax rate of SEZs. In fact, the transaction cost of cross-regional services is lower than manufacturing products, and the preferential policies of land and tax are typically implemented in SEZs, thus significantly reducing the entry cost of firms in SEZs. Generally, the producer service firms face low entry and transaction costs, thereby indicating that $\partial\bar{h}_i^*/\partial t_i\leq 0$ is true. The second result is presented as follows:

**Hypothesis 2**: The implementation of preferential policies in SEZs will reduce the effective tax rate of producer service firms, thereby lowering the cut-off productivity for producer service firms to enter the SEZs. Thus, more inefficient producer service firms relocate to the SEZs.

Case 2: Industrial linkage

Each worker is made increasingly productive by interactions with other workers given Marshallian externalities, and these interactions are subject to a spatial decay. This practice implies that the effective labor supplied by an individual worker in SEZs is $a=f\left(\mathrm{N}_i+\sigma\,\mathrm{N}_j\right)$, where $f'\geq 0, 0\leq\sigma\leq 1$. Given the unit payment per effective unit of labor supplied, the total labor income of each worker in any occupation is a. Therefore, the worker demand function of producer service firms is expressed as

$$l_i(h)=hQ_{ij}(h)/a \tag{11}$$

According to Combes et al. (2012), the agglomeration effect of SEZs is defined as $A=\ln(a)$; thus, the natural logarithm of a firm's productivity is provided as follows:

$$\Psi_i(h)=\ln\left(Q_{ij}(h)/l_i(h)\right)=A-\ln(h)$$
(12)

The producer service industry is an independent sector given the continuous refinement of the division of production in the manufacturing industry. When the linkage between producer service industry and the leading manufacturing industry in the SEZs is high, the worker between the two sectors can be shared, and the effective labor supply ratio of producer service industry can be improved. Moreover, effective labor can be expanded by $a^*=\left[f\left(N_i+\sigma N_j\right)\right]^{\rho}$, where *ρ*>0 indicates the industrial linkage between the local producer service firms and the planned leading manufacturing industry. Evidently, *ρ* is exogenous. The natural logarithm of a firm's productivity while considering the industrial linkage is expressed as:

$$\Psi_i^*(h)=\ln\left(Q_{ij}(h)/l_i(h)\right)=\rho A-\ln(h) \tag{13}$$

Based on equation (13), the industrial linkage between producer service firms and manufacturing industry in SEZs is high, and the producer service firms' labor supply is effective. Thus, the producer service firms' productivity is high. The second result is presented as follows:

**Hypothesis 3**: The industrial linkage between producer services and manufacturing industry in SEZs is high, and the agglomeration effect will be enhanced; thus, producer service firms' productivity is high.

Based on the analysis of heterogeneous enterprise migration mechanism between SEZs and NSEZs, the efficiency level of the producer service industry in SEZ is the result of the combined influence of agglomeration and selection effects. However, quantitative analysis is still needed to identify accurately the key source of productive efficiency of the producer service industries in SEZs in China. Therefore, we use the firm data to empirically test the efficiency sources and mechanism of producer service industries of SEZs in China.

# 3. Data and measurement issues

## 3.1 Data

The database used in this study is the Second National Economic Census (SNEC) in 2008. This economic census includes all juridical entities, industrial activity units, and sole proprietorships that belong to the secondary or tertiary industries in China. The SNEC is the most comprehensive governmental database of the producer service industry in China that can be obtained at present.

### 3.1.1 Outlier processing

The SNEC database still has potential problems such as missing or wrong data. To improve the accuracy of the subsequent analysis, we adopt the methods used by Chen and Bao (2013) to optimize the initial data. We delete the samples contrary to statistical logic, such as the total business income less than zero or the negative number of employees. Furthermore, the samples that cannot operate normally are eliminated.

### 3.1.2 Definition of producer service industry

The National Bureau of Statistics in China published the producer service industry classification standard in 2015. This standard defined the statistical scope and classification of the producer service industry. The producer service industry includes R&D, logistics services, information services, financial services, energy-saving and environmental protection services, productive leasing services, business services, human resource services, wholesale brokerage agency services, and production support services. The industry consists of a total of 10 categories, 34 sub-categories, and 196 detail categories. The industry code of the database is based on the "*National Economic Industry Classification (GB/T4754-2002)*". Thereafter, we select the producer service firm data from the SNEC.

### 3.1.3 Identification of firms in SEZs

We use the method employed by Wang and Zhang (2016) to identify the firms in SEZs. Primarily, we extract longitude and latitude coordinates of each management committee of SEZs listed in the "*China's SEZ Audit Announcement (2006 edition)*". Then, we identify the districts where the SEZs are located. The official code of SEZ is used to match the district code of firms in the SNEC. If the codes match successfully, the firm that has the district code is identified as a firm in SEZ. Otherwise, it is identified as a firm in NSEZ. We identify 1,481,089 producer service industry firms in the SNEC database as a result of outlier processing. Among them, 980,208 and

500,881 firms are in SEZs and NSEZs, respectively.

## 3.2 Descriptive statistics

The firm data is a cross-sectional type of data and has no intermediate input index. The firm's entering and exiting state is impossible to identify. Accordingly, OP and LP models, which are commonly used to estimate the firm's total factor productivity(TFP), are not applicable. Similar to Li (2017), we use the production function model to evaluate the firm's TFP. The variables in this model include the firm's output capital stock and labor stock, but not the output capital stock in the SNEC database. Thus, we use the fixed assets original cost deducted depreciation instead. Heterogeneous firms are subject to different constraints. Consequently, the production technologies are different. The firm's production behavior with a unified production function is difficult to describe (Yang, 2015). Therefore, we focus on the industry difference, which determines firm heterogeneity. We calculate the capital stock and labor stock coefficients by industries while estimating the firm's TFP and control the province fixed effect in the basic regression model.

Additionally, we also use various methods to estimate the firm's productive efficiency for ensuring the robustness of the estimation. We include the TFP estimated by the entire sample and the sub-industry sample; the TFP is estimated by replacing the business income with the main business income, and the average labor productivity measured by per capita business income[4] (Ge and Luo, 2013). Table 1 shows the descriptive statistics results of firm's TFP of SEZ and NSEZ samples. The average TFP of the SEZ samples is larger than that of the NSEZ samples. Furthermore, the standard deviation of the SEZ samples is smaller than that of the NSEZ samples. Thus, the firms located in SEZs have a higher average productivity and a lower productivity heterogeneity than those in NSEZs.

**Table 1**
Descriptive statistics of producer service productivity by firm

| Productivity | Label | Sample | Number | Mean | S.D. | Min | Max |
|---|---|---|---|---|---|---|---|
| TFP by province & industry | *tfp0* | SEZ | 967,922 | 3.894 | 1.712 | -10.698 | 14.051 |
| | | NSEZ | 498,190 | 3.815 | 1.742 | -10.856 | 12.456 |
| TFP of total-sample | *tfp1* | SEZ | 967,124 | 4.183 | 1.656 | -9.6851 | 14.348 |
| | | NSEZ | 498,024 | 4.052 | 1.708 | -7.7850 | 13.023 |
| TFP by industry | *tfp2* | SEZ | 967,922 | 3.859 | 1.633 | -11.655 | 14.111 |
| | | NSEZ | 498,190 | 3.765 | 1.673 | -8.9103 | 12.806 |
| TFP with main business income | *tfp3* | SEZ | 967,124 | 3.897 | 1.718 | -10.656 | 14.071 |
| | | NSEZ | 498,024 | 3.816 | 1.752 | -10.166 | 12.472 |
| Average labor productivity | *tfp4* | SEZ | 967,922 | 5.296 | 1.648 | 0.000 | 15.812 |
| | | NSEZ | 498,190 | 5.167 | 1.688 | 0.000 | 14.903 |

We use the results to calculate the average efficiency of counties with the proportion of total business income as the weight. Table 2 shows the descriptive statistics results. Few districts have SEZs but have much more firms than others. Thus, a large number of producer service industry firms are concentrated in SEZs. Furthermore, the average productive efficiency of the districts of SEZs is obviously higher than that of others, as shown in Table 2.

[4] Per capita business income is the ratio of total business income to the number of employees.

**Table 2**
Descriptive statistics of producer service productivity by county

| Productivity | Label | Sample | Number | Mean | S.D. | Min | Max |
|---|---|---|---|---|---|---|---|
| TFP by province & industry | *ctfp0* | SEZ | 1179 | 5.512 | 1.078 | 1.966 | 12.470 |
| | | NSEZ | 1653 | 4.915 | 1.116 | 0.057 | 11.197 |
| TFP of total-sample | *ctfp1* | SEZ | 1179 | 5.819 | 1.087 | 2.535 | 12.296 |
| | | NSEZ | 1653 | 5.156 | 1.180 | 0.659 | 11.304 |
| TFP by industry | *ctfp2* | SEZ | 1179 | 5.256 | 1.027 | 2.264 | 11.929 |
| | | NSEZ | 1653 | 4.742 | 1.029 | 1.337 | 10.642 |
| TFP with main business income | *ctfp3* | SEZ | 1179 | 5.516 | 1.079 | 2.011 | 12.493 |
| | | NSEZ | 1653 | 4.916 | 1.119 | 0.621 | 11.196 |
| Average labor productivity | *ctfp4* | SEZ | 1179 | 7.192 | 1.058 | 3.872 | 14.107 |
| | | NSEZ | 1653 | 6.537 | 1.172 | 2.368 | 12.785 |

# 4. Productivity advantages and source identification of producer services in SEZs

Summary statistics show that the productivity of producer service industries in the SEZs is higher than that in NSEZs. However, these productivity advantages are not necessarily due to the establishment of the SEZs. Therefore, this section empirically explores whether the establishment of the SEZs can effectively promote the productivity of producer service industries in districts and counties. If we verify the existence of the productivity advantages of producer service industries in the SEZs, then we further explore its source.

## 4.1 Identification of productivity advantages of producer services in SEZs

To explore whether the establishment of the SEZs promotes the productivity of producer service firms, we construct the following econometric model:

$$ctfp_i = \beta_0 + \beta_1 zone_i + \beta_X X_i + \varepsilon_i \tag{14}$$

We use *ctfp0* as the dependent variable of baseline regression and *ctfp1*-*ctfp4* as the dependent variable of robustness tests. The core explanatory variable is a dummy variable (*zone*) to measure whether a county has an SEZ. $X_i$ is a series of control variables, such as the average wage of producer service industries in a district or county (*lncwage*), which measures the labor cost of districts and counties; the degree of local marketization in a district and county (*stapec*), which is measured by the proportion of the revenue of state-owned enterprises (*SOE*s) to the revenue of all firms; the degree of openness in districts and counties (*forepec*), which is measured by the proportion of the revenue of foreign-funded enterprises to the revenue of all firms; the tax rate of a district or county (*taxrate*), which is measured by the average tax rate, that is, the ratio of the tax payable to the total revenue. At the same time, given the heterogeneity of cities, the dummy variables of municipalities (*lev1*) and sub-provincial or provincial capitals (*lev2*) are introduced.

Considering that the SEZs are typically set up in areas with high productivity of producer services, endogenous problems of reverse causality are observed in our empirical research. The establishment of the SEZs is a specific implementation of a country's development strategy. Rather than a result of random selection, a decision is made after comprehensive consideration of geographical location, economic development level, and many other factors. The factors that affect the establishment of the SEZs often directly affect the variables that researchers are interested in, so the existing literature does not provide an ideal instrumental variable (Li and Shen, 2015).

To overcome the estimation error caused by the reverse causality, we construct a fitting variable as the IV of the dummy variable zone to get around the endogenous problems. The reason is that the endogenous variable zone is a dummy variable, and many factors influence whether a district or a county can establish a SEZ. The variables directly using these influencing factors may cause a problem of weak instruments. To overcome the behavioral self-selection problem of the process, Woodridge (2002) uses the estimated fit value of the binomial selection model as the IV of the binary explanatory variable. We then set up a probit model with reference to the method of Woodridge (2002)_to fit a new IV for our key explanatory variable zone. Specially, the probit model is expressed as follows:

$$prob\left\{zone=1\right\}=\delta_0+\Theta X_i \tag{15}$$

where $X_i$ indicates a set of variables that may influence the district to establish a SEZ, and denotes a coefficient vector. Overall, we consider two types of factors that may affect the possibilities of setting up SEZs. One is the geographical condition of the district or county itself, and the other is the economic and social characteristics of the districts or counties. Under the former, we consider two variables, namely, average slope (*slope*) and market center degree (*mc*). Generally, areas with relatively flat terrain may be suitable for the construction of manufacturing plants and establishment of development zones. The market center degree refers to the distance between the market center and the national market center of the administrative center of a region. This variable can determine fit via the degree of access to market resources in various places, so it has strong correlation with the selection of SEZs. We calculate the market center degree with reference to Yang (2017)[5]. The economic and social characteristics include the scale of manufacturing market in districts and counties, the potential of manufacturing market around cities, and the administrative level of cities. We use probit model to regress and predict the probability value (*fitz*) of the dummy variable zone, as our IV of zone, to regress with the average productivity of the district or county using equation (14).

The basic estimation results of 2SLS are reported in column 1 of Table 3. They show that the IV (*fitz*) satisfies the under identification and weak identification tests, thus meeting the statistical requirements. The regression results of the first stage show a substantial negative correlation between the *zone* and *fitz*. The second-stage regression reveals that the key variable zone has a substantial positive effect on the productivity of producer services. Furthermore, we report the

[5] China's market center is determined to be the center of the east of the Hu-Huanyong line, the market center is the European distance between the administrative centers of a district and the market center. 43% of the land east of the Hu-Huanyong line has a population of 94% and 96% of GDP of the country, is the most concentrated area in China's economy. The distance between the geographic center of this land and the administrative centers of each region can basically match the degree of access to market resources, and among the 222 national-level SEZs, 143 are located in the eastern region, while only 32 in the western region.(Li and shen, 2015), so this variable has a strong correlation with the selection of SEZs.

results of using *ctfp1–ctfp4* as the dependent variables in columns 2–5 of Table 3, which are considerably positive at the 1% significance level. The SEZs can bring the productivity advantages of producer service industries, and this result is robust. [6]

**Table 3**
The impact of the establishment of the SEZs on the productivity of producer service industries

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| *The 1st stage* | *zone* | *zone* | *zone* | *zone* | *zone* |
| *fitz* | 0.921*** | 0.921*** | 0.921*** | 0.921*** | 0.921*** |
| | (0.040) | (0.040) | (0.040) | (0.040) | (0.040) |
| *observations* | 2,723 | 2,723 | 2,723 | 2,723 | 2,723 |
| *F statistics* | 541.390 | 541.39 | 541.390 | 541.39 | 541.390 |
| | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| *The 2nd stage* | *ctfp0* | *ctfp1* | *ctfp2* | *ctfp3* | *ctfp4* |
| *zone* | 1.251*** | 1.551*** | 1.251*** | 1.266*** | 1.305*** |
| | (0.109) | (0.112) | (0.101) | (0.109) | (0.105) |
| *lncwage* | 0.233*** | 0.307*** | 0.209*** | [illegible].227*** | 0.527*** |
| | (0.068) | (0.070) | (0.063) | (0.068) | (0.065) |
| *stapec* | -0.512*** | -0.504*** | -0.708** | [illegible]0.517*** | -0.211** |
| | (0.097) | (0.100) | (0.[illegible]90) | (0.098) | (0.094) |
| *forepec* | -1.758*** | -0.736** | -1.3[illegible]*** | -1.777*** | -0.195 |
| | (0.293) | (0.302) | ([illegible].272) | (0.294) | (0.282) |
| *taxrate* | -17.94*** | -24.28*** | [illegible]8.9[illegible]*** | -17.90*** | -23.38*** |
| | (1.292) | (1.332) | (1.[illegible]201) | (1.298) | (1.246) |
| *lev1* | -0.0383 | 0.563*** | [illegible]50*** | -0.0300 | 0.552*** |
| | (0.118) | (0.121) | (0.109) | (0.118) | (0.113) |
| *lev2* | 0.323*** | 0.38[illegible]*** | 0.353*** | 0.328*** | 0.384*** |
| | (0.065) | (0.0[illegible]) | (0.060) | (0.065) | (0.062) |
| *Constant* | 4.498*** | 4.4[illegible]3*** | 4.386*** | 4.512*** | 5.200*** |
| | (0.178) | (0.183) | (0.165) | (0.179) | (0.172) |
| *Underidentification test (LM statistics)* | 452.712 | 452.712 | 452.712 | 452.712 | 452.712 |
| *P-value* | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| *Weak identification test (F stattistics)* | 541.390 | 541.390 | 541.390 | 541.390 | 541.390 |
| *10% critical value* | 16.380 | 16.380 | 16.380 | 16.380 | 16.380 |
| *Observations* | 2,723 | 2,723 | 2,723 | 2,723 | 2,723 |
| $R^2$ | 0.959 | 0.961 | 0.962 | 0.959 | 0.978 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

## 4.2 Identification of sources of productivity advantages

[6] We supplement the control variable of market potential based on the benchmark model, namely, *mp*, considering the impact of the potential market size of the surrounding manufacturing industry on the productivity of producer services. According to the study of Harris (1954), we measure the market potential of producer service industry in the SEZs based on the output scale of the manufacturing industry, that is, $mp = \sum_{j \neq i} y_j / dij$ . In this equation, y represents the output value of manufacturing of each city, $d_{ij}$ represents the European straight-line distance between two city centers, i represents the cities where the SEZs are located, and j represents another city. The total sample estimates show that the *mp* of the manufacturing industry insignificantly impacts the productivity of producer service firms. Moreover, all total samples are divided into two sub-samples based on the city level, namely, regional and non-regional central city samples. The former includes provincial capitals and municipalities directly under the Central Government. The results show that the impact of *mp* on the non-regional central cities is a significantly negative correlation. The regression coefficients of the *mp* of the regional central cities on the productivity of producer service firms are insignificant, and the impact is negative. These results show that the impact of the market potential of the peripheral manufacturing industry on the productivity of producer service firms is mainly reflected in the regional central cities, but the positive correlation is insignificant. The potential market demand has not been effectively converted into the real demand of producer service firms. Moreover, to a certain extent, the results also confirm that the producer service industry has a strong local grounding effect.

The preceding empirical results show that the establishment of the SEZs promotes the productivity of producer services. We further explore the source of the productivity advantages in this section[7]. Compared with the productivity distribution curve of the NSEZ firms, that of the producer service firms in the SEZs shifts slightly to the right. Consequently, the average productivity of the producer service firms in the SEZs is relatively high. However, no obvious left-truncated feature is observed. Thus, the selection effect, through which the inefficient firms are eliminated because of market competition in the SEZs, is not serious.

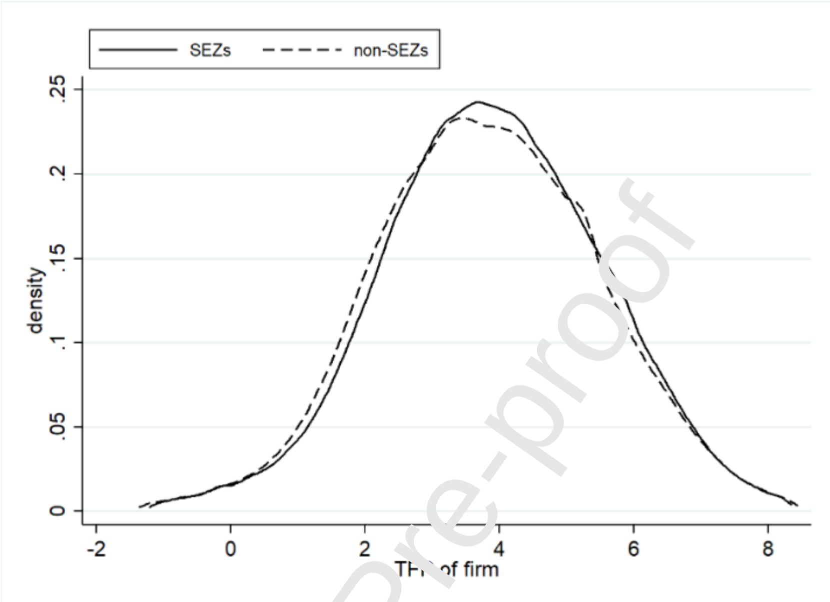


**Fig.1.** Distribution of firm productivity of producer services in the SEZs and NSEZs

Note: the observations of 0.5% before and after were eliminated.

In accordance with the estimation method of Combes et al. (2012), we build the logarithmic productivity cumulative distribution function of firms in region *i* as follows:

$$F_i(\phi) = \max\{0, \frac{\tilde{F}(\frac{\phi - A_i}{D_i}) - S_i}{1 - S_i}\} \tag{16}$$

where $A_i$ and $D_i$ represent the agglomeration effect by right shift and dilation of the distribution curve of productivity, respectively. The elimination rate $S_i$ can reflect the selection effect, thereby showing the characteristic of the left truncation of the curve. The cumulative distribution function $\tilde{F}(\phi)$ is unknown. The three parameters cannot be directly estimated quantitatively, but the relative values of two regions can be estimated. For an SEZ region *i* and a NSEZ region *j*, we define $D = D_i / D_j$ as the dilation ratio of logarithmic productivity curve of *i* to *j*; $A = A_i - DA_j$ is the right shift of the productivity distribution curve of *i* relative to that of *j*; and $S = (S_i - S_j)/(1 - S_j)$ is the left truncation of the productivity distribution curve of *i* relative to that of *j*. By transforming the productivity distribution and calculating the quantile by linear

[7] Only the TFP distribution curve used for regression calculation of baseline estimates is reported due to space limitation. Other TFP distribution features are similar.

interpolation, we can derive the estimable objective function. Then, we can estimate the values of parameters *A*, *D* and *S*, which represent the aggregation and selection effects of the sources of productivity advantages, respectively. $A>0$ indicates that producer service industries in SEZs have a stronger agglomeration effect than those in NSEZs; *D* reflects the heterogeneity of firms in agglomeration effect; and $D>1$ indicates that the productivity distribution curve of producer services in the SEZs has a greater dilation than that in NSEZs. *S* denotes the selection effect; and $S>0$ implies an elimination rate for inefficient productive service firms in SEZs higher than that in NSEZs.

Using this method, we estimate the constrained parameters *A* and *D*, as well as the unconstrained parameters *A*, *D* and *S*. The estimation is shown in Table 4. The agglomeration effect parameter *A* is considerably positive. Thus, compared with NSEZs, the productive service firms in the SEZs experience the agglomeration effect; this effect is the most important source of their productivity advantages. The parameter *D* representing the heterogeneity of agglomeration effect is considerably less than 1. Thus, the inefficient firms in the SEZs benefit more from the agglomeration economy than those in the NSEZs. Furthermore, the productivity distribution shifts to the right more obviously. Thus, the productivity distribution is centralized. The selection effect parameter *S* is considerably negative. Consequently, the proportion of inefficient producer service firms in the SEZs is relatively higher than that in the NSEZs. The policy rent of the SEZs attracts additional inefficient firms to locate there. This finding proves our second theoretical hypothesis. Dynamically, the current inefficient firms benefit more from the agglomeration than efficient firms, thereby increasing the proportion of inefficient firms entering the next stage; that is, the heterogeneity of the agglomeration effect will strengthen the selection effect.

**Table 4**
Source identification of productivity advantages in the SEZs: Baseline estimation

| | (1) | (2) | (3) |
|---|---|---|---|
| *Shift A* | 0.080*** | 0.144*** | 0.172*** |
| | (0.003) | (0.005) | (0.005) |
| *Dilation D* | - | 0.983*** | 0.978*** |
| | | (0.001) | (0.001) |
| *Truncation S* | - | - | -0.001*** |
| | | | (0.0002) |
| *Observations* | 1,451,453 | 1,451,453 | 1,451,453 |
| $R^2$ | 0.826 | 0.927 | 0.951 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Furthermore, this study aims to quantify the degree to which the productivity advantages of producer services in the SEZs originate from the agglomeration effect and the selection effect, respectively. On this basis, the contributions of agglomeration and selection effects are calculated at different quantiles to the productivity advantages of the SEZs. Moreover, $\lambda_i(u)$ is the productivity of the SEZ firms at the quantile *u*, and $\lambda_j(u)$ is the productivity of the NSEZ firms at the quantile *u*. Thus, the contribution of productivity advantages due to agglomeration and selection effects, can be expressed as follows:

$$diftfp = \lambda_i(u) / \lambda_j(u) - 1 \tag{17}$$

Given no agglomeration effect, that is, $A=0, D=1$, we can fit the productivity of the SEZs as

$\lambda_j'(u)$. Then, the productivity advantages of the SEZs are as follows:

$$\lambda_i(u)/\lambda_j'(u)-1 \tag{18}$$

The difference between Equations (16) and (17) is the contribution of agglomeration effect to the productivity advantages of producer service firms in the SEZs in equation (19):

$$diftfpa = \lambda_i(u)(1/\lambda_j(u)-1/\lambda_j'(u)) \tag{19}$$

Similarly, we can calculate the contribution of the selection effect to the productivity advantages of the SEZs. In accordance with the estimation results of *A*, *D* and *S* in column (3) of Table 4, we calculate the contributions of agglomeration, selection, and total effects to the productivity advantages of the SEZs at 10 quorum points, as shown in Fig.2.

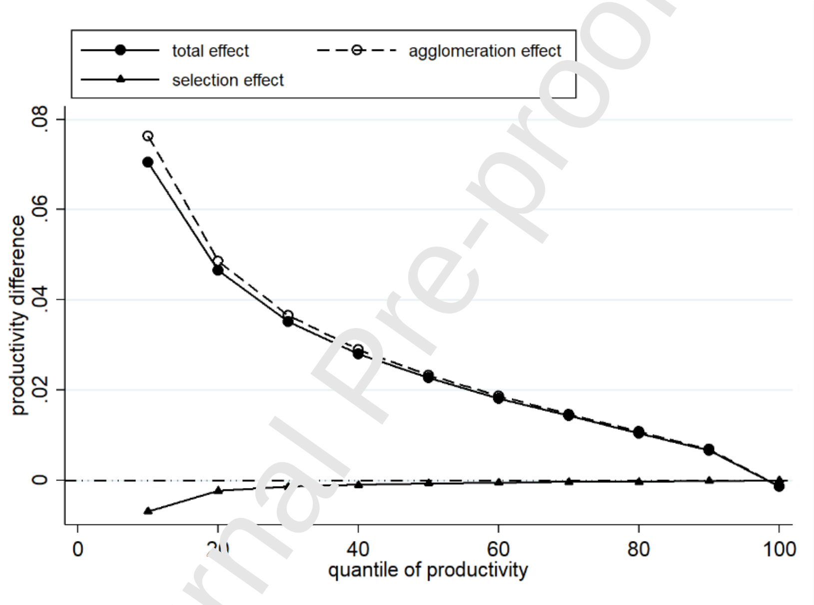


**Fig.2.** Contribution of different effects to productivity gaps between the SEZs firms and the NSEZs firms

As shown in Fig.2, the productivity advantages of the SEZ firms are more than those of NSEZs firms. Furthermore, the advantages are due to the contribution of agglomeration effect. The contribution of selection effect is negative, thereby offsetting the influence of the agglomeration effect to a certain extent. Dynamically, with the continuous improvement of productivity, the contribution of agglomeration effect to productivity advantages is decreasing. Thus, the agglomeration effect is important to the inefficient firms. The efficient firms earn less profit from the agglomeration externality.

## 4.3 Robustness

We use three methods to test the robustness of the aforementioned baseline estimates. The results are reported in Table 5. First, we change the method of calculating firm productivity. In this manner, we use industry-wide data to estimate the productivity, and then we estimate by industry, replace the total revenue with the main business revenue, and use the per capita revenue as the productivity. The results are reported in lines (1)–(4) of Table 5, which show that the estimates of the preceding replacement efficiency indicators are all robust.

Second, we change the sample size. (1) Some cities do not have development zones. Adding these cities to the sample may have an impact on the estimation of the difference in the productivity of producer services between the SEZs and NSEZs. Therefore, to improve the robustness of the estimation results, we exclude the firms in the city which has no SEZ. The results are reported in line (5) of Table 5. (2) Firms with larger scales may be more efficient because of their economies of scale. Using the work of Arimoto et al. (2014) as reference, we eliminate the firms above the 75th pencentile in number of employees. The results are reported in line (6). (3) The average age of the firms in the SEZs is 5.70 years, whereas that of firms in NSEZs is 6.53 years[8]. Compared with new firms, the older ones are more likely to have higher productivity because of their mature technology and abundant capital. The average productivity of firms aged above the median is 3.95, whereas that of firms aged below the median is 3.81. This finding may underestimate the efficiency improvement caused by the agglomeration effect of the SEZs. Therefore, we exclude the firms aged above the 75th pencentile, and the results are reported in line (7). The results in line (5)–(7) are still robust.

Third, we change the way of identifying the firms in the SEZs. In the baseline regression, all firms located in the county with an SEZ are identified as SEZ firms, thereby overestimating the sample size of the SEZs. Thus, we use the other methods to identify the SEZ firms. (1) Referring to the field identification method of Xiang and Lu (2015), as well as Wang and Zhang (2016), if the name or address of a firm includes "Economic and Technological Development Zones," "Industrial Development Zones," "High-Tech Industrial Development Zones," "Industrial Park," "Export Processing Zones," or "Bonded Zones," then the field is considered to be an SEZ firm. (2) Some SEZs have their own regionalism codes, which identify the firms with the same codes as the SEZ firms. (3) In accordance with the range dimension of national-level SEZs, the codes of township streets contained in each SEZ are identified. Moreover, the firms corresponding to these township streets are identified as the SEZ firms. The three methods are used to identify the SEZ firm merger as an SEZ sample. The estimated results, as shown in line (8)[9], are robust.

**Table 5**
Source identification of productivity advantages in the SEZs: Robustness tests

| | | | *A* | *D* | *S* | $R^2$ | Observations |
|---|---|---|---|---|---|---|---|
| Different estimation methods of firm productivity | （1） | OLS by all firms | 0.262***<br>(0.006) | 0.968***<br>(0.001) | -0.001***<br>(0.0001) | 0.988 | 1,450,498 |
| | （2） | OLS by industry | 0.189***<br>(0.006) | 0.975***<br>(0.001) | -0.0002**<br>(0.0001) | 0.980 | 1,451,454 |
| | （3） | OLS using the main business revenue | 0.174***<br>(0.007) | 0.977***<br>(0.001) | -0.001***<br>(0.0002) | 0.954 | 1,450,498 |
| | （4） | Per capita revenue | 0.312***<br>(0.041) | 0.967***<br>(0.006) | -0.003<br>(0.002) | 0.983 | 1,451,899 |
| Different sample size | （5） | Eliminating cities without SEZs | 0.164***<br>(0.006) | 0.976***<br>(0.001) | -0.001***<br>(0.0002) | 0.942 | 1,438,775 |

[8] The calculation method of firm age refers to the work of Dong and Yuan (2014). For the statistical year minus the start-up year, for example, the age of the enterprise that started in March 2004 is 2008-2004 + (12-3)/12 = 4.75 years old.

[9] Compared with the baseline identification method, although these three identification methods improve the identification accuracy of a single firm, a large sample size overall deviation greatly reduces the number of firms in the SEZs.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | （6） | Eliminating large scale firms | 0.172***<br>(0.008) | 0.976***<br>(0.002) | -0.001***<br>(0.0003) | 0.910 | 1,102,126 |
| | （7） | Eliminating old firms | 0.192***<br>(0.006) | 0.971***<br>(0.001) | -0.002***<br>(0.0002) | 0.932 | 1,093,811 |
| Different identification methods of the SEZ firms | （8） | | 0.235***<br>(0.010) | 1.065***<br>(0.002) | -0.006***<br>(0.0004) | 0.976 | 1,451,451 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Different from manufacturing industries, producer service industries cover a wide range of industries and business disparities. They also have a strong industry heterogeneity. Thus, we estimate the results of the sub-industry, as shown in Table 6. Except the R&D and other technology services, the estimated value of agglomeration effect *A* of the other nine industries is considerably positive. Thus, in general, the SEZs attract a large number of firms to move in, and the resulting agglomeration effect has an important role in promoting productivity. The R&D industry is a high-tech and knowledge-intensive industry, which is not sensitive to the preferential policies and location of the SEZs. Among the 10 industries, only 3 have positive estimates of *S*, namely, financial services, productive leasing services, and wholesale economic agency services. However, these estimates are small and insignificant. Thus, the left truncation of the productivity distribution of producer service industries between the SEZs and NSEZs has a minimal difference and even shows a higher proportion of inefficient firms.

**Table 6**
Source identification of productivity advantages in the SEZs: Industry heterogeneity

| Estimation method of TFP | TFP estimated by province and industry | | | | TFP estimated by industry | | | | Observations |
|---|---|---|---|---|---|---|---|---|---|
| | *A* | *D* | *S* | $R^2$ | *A* | *D* | *S* | $R^2$ | |
| R & D and other technical services | -0.006<br>(0.024) | 1.033***<br>(0.007) | -0.002***<br>(0.001) | 0.950 | 0.039*<br>(0.021) | 1.036***<br>(0.006) | -0.001<br>(0.0004) | 0.980 | 108,716 |
| Freight transportation, storage and postal express service | 1.056***<br>(0.031) | 0.782***<br>(0.007) | -0.034***<br>(0.004) | 0.895 | 0.674***<br>(0.021) | 0.829***<br>(0.005) | -0.008***<br>(0.001) | 0.927 | 10,279 |
| Information service | 0.[illegible]56***<br>(0.02[illegible]) | 1.004***<br>(0.007) | -0.013***<br>(0.002) | 0.952 | 0.156***<br>(0.020) | 1.035***<br>(0.007) | -0.009***<br>(0.001) | 0.957 | 12,135 |
| Financial service | 0.665***<br>(0.131) | 0.921***<br>(0.033) | 0.004<br>(0.008) | 0.950 | 0.582***<br>(0.083) | 0.930***<br>(0.023) | 0.006<br>(0.004) | 0.928 | 21,561 |
| Energy saving and environmental protection services | 0.351***<br>(0.065) | 1.015***<br>(0.013) | -0.006*<br>(0.003) | 0.986 | 0.217***<br>(0.048) | 1.051***<br>(0.011) | 0.001<br>(0.001) | 0.997 | 26,374 |
| Productive Leasing Service | 0.121***<br>(0.040) | 1.001***<br>(0.012) | 0.001<br>(0.002) | 0.917 | 0.170***<br>(0.044) | 0.979***<br>(0.015) | -0.0003<br>(0.002) | 0.959 | 13,968 |
| Business services | 0.230***<br>(0.019) | 0.965***<br>(0.005) | -0.001<br>(0.001) | 0.967 | 0.235***<br>(0.015) | 0.966***<br>(0.004) | 0.0004<br>(0.0003) | 0.977 | 201,676 |
| Human resource management and training services | 0.257***<br>(0.040) | 0.979***<br>(0.011) | -0.005**<br>(0.002) | 0.944 | 0.242***<br>(0.039) | 0.973***<br>(0.011) | -0.004**<br>(0.002) | 0.967 | 27,885 |
| Wholesale agency services | 0.137***<br>(0.013) | 0.990***<br>(0.002) | 0.0001<br>(0.0002) | 0.838 | 0.271***<br>(0.010) | 0.967***<br>(0.002) | 0.001***<br>(0.0002) | 0.981 | 665,323 |
| Trade and economic agency services | 0.109***<br>(0.020) | 1.004***<br>(0.004) | -0.003***<br>(0.001) | 0.945 | 0.170***<br>(0.020) | 1.000***<br>(0.005) | -0.001***<br>(0.0003) | 0.989 | 161,826 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

# 5. Mechanism of agglomeration and selection effects

Through the non-parametric estimation method, we conclude that the productivity advantages of producer service industries in the SEZs come from the agglomeration effect. The selection effect inhibits the productivity improvement of producer service industries in the SEZs. For the producer service industries, manufacturing firms are their demanders. The scale of manufacturing determines the market potential of producer service firms. Therefore, the agglomeration effect of producer services in the SEZs theoretically depends on the scale of local manufacturing industries and the intensity of industrial linkage. The selection effect of producer services in the SEZs is reflected as follows: the existence of policy rent in the SEZs reduces the entry costs of firms, thereby establishing inefficient firms. Thus, new firms have a low level of productivity, thereby inhibiting the improvement of producer services productivity in the SEZs.

## 5.1 Agglomeration effect

This part discusses the impact of agglomeration effect on the productivity of producer services from three perspectives: local market size, agglomeration externalities and firm heterogeneity.

### 5.1.1 Perspective of local market size

NEG theory shows that the increase of market potential brought by the market access produces the agglomeration effect and promotes the productivity of firms. Manufacturing firms are the most important service object of producer service industries. From the perspective of local market size, this study explores the mechanism of the agglomeration effect of the SEZs on the productivity of producer service industries. The establishment of the SEZs enlarges the scale of manufacturing industries, thereby promoting the productivity of producer service industries.

Firstly, we examine the impact of the establishment of the SEZs on the scale of manufacturing industries.We measure the scale of the local manufacturing industries by using the logarithm of the total output value of a district or county (*lnsiav*) and control other variables, such as manufacturing average wage (*lncwage_m*), revenue proportion of state-owned firms (*stapec_m*), revenue proportion of foreign firms (*forepec_m*), average tax rate (*taxrate_m*), and city level (*lev1*, *lev2*). To overcome the endogeneity,we use the fitting variable constructed above as an IV of the dummy variable of whether a district or county has SEZs. We estimate the model using 2SLS method. The results are reported in Table 7. The impact of the establishment of the SEZs on the scale of manufacturing industries is considerably positive.



**Table 7**
Impact of the establishment of the SEZs on the scale of manufacturing industries

| | (1) | (2) |
|---|---|---|
| *The 1st stage* | *zone* | *zone* |
| *fitz* | 0.915*** | 0.921*** |
| | (0.000) | (0.000) |
| *observation* | 2,723 | 2,723 |
| *F statistics* | 545.15 | 541.39 |
| | [0.000] | [0.000] |
| The 2nd stage | *lnsiav* | *lnsiav* |
| *zone* | 8.260*** | 8.202*** |
| | (0.361) | (0.359) |
| *lncwage_m* | -0.957*** | -1.008*** |
| | (0.221) | (0.223) |
| *stapec_m* | 0.0729 | 0.0999 |

| | | |
|---|---|---|
| | (0.323) | (0.321) |
| *forepec_m* | -2.083** | -2.053** |
| | (0.968) | (0.966) |
| *taxrate_m* | -7.452* | -6.958 |
| | (4.286) | (4.263) |
| *lev1* | | -0.191 |
| | | (0.388) |
| *lev2* | | 0.498** |
| | | (0.213) |
| *Constant* | 14.410*** | 14.520*** |
| | (0.585) | (0.587) |
| *Underidentification test (LM statistics)* | 455.050 | 452.710 |
| *p-value* | [0.000] | [0.000] |
| *Weak identification test (F statistics)* | 545.150 | 451.390 |
| *10% critical value* | 16.380 | 16.380 |
| *observations* | 2,723 | 2,723 |
| $R^2$ | 0.944 | 0.945 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Second, we examine the impact of manufacturing scale on the productivity of producer service industries. To overcome endogeneity, we use the manufacturing scale of 2007 as an IV[10], which is highly related to the variable of manufacturing scale and independent to the TFP of producer services. The estimated results also show that the IV *L.lnsiav* has passed under identification and weak identification tests. We control other variables and estimate them using the 2SLS method. The regression results are presented in Table 8. The regression coefficients of each model are considerably positive and robust. The scale of manufacturing industries significantly improves the average productivity of producer service industries.

**Table 8**
Impact of scale of manufacturing industries on average productivity of producer service industries

| | (1) | (2) |
|---|---|---|
| The 1st stage | *lnsiav* | *lnsiav* |
| *L.lnsiav* | 14.823*** | 14.799*** |
| | (0.000) | (0.000) |
| *observations* | 2,744 | 2,744 |
| *F statistics* | 210000 | 210000 |
| | [0.000] | [0.000] |
| The 2nd stage | *ctfp0* | *ctfp0* |
| *lnsiav* | 0.154*** | 0.147*** |
| | (0.0107) | (0.0108) |
| *lncwage* | 0.416*** | 0.385*** |
| | (0.0532) | (0.0541) |
| *stapec* | -0.555*** | -0.545*** |
| | (0.086) | (0.086) |
| *forepec* | -1.413*** | -1.421*** |
| | (0.256) | (0.258) |
| *taxrate* | -17.39*** | -17.18*** |
| | (1.166) | (1.164) |
| *lev1* | | -0.00603 |
| | | (0.102) |
| *lev2* | | 0.255*** |
| | | (0.0584) |
| *Constant* | 2.227*** | 2.376*** |
| | (0.187) | (0.192) |
| *Underidentification test (LM statistics)* | 2709.240 | 2708.800 |
| *p-value* | [0.000] | [0.000] |

[10] Data are from the "*Annual Surveys of Industrial Firms of China (2007)*".

| | | |
|---|---|---|
| *Weak identification test (F stattistics)* | 210000 | 210000 |
| *10% critical value* | 16.380 | 16.380 |
| *observations* | 2,744 | 2,744 |
| $R^2$ | 0.967 | 0.967 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Furthermore, the local market effect also depends on the intensity of industrial linkage between producer service industries and the planned dominant manufacturing industries of the SEZs. When the local government establishes the SEZs, it promotes manufacturing as the main industry for investments and supports development on the basis of the local industrial foundation and the industry's growth prospects. If the producer service firms located in the SEZs have a strong industrial correlation with the leading manufacturing industry planned for the SEZs, then a stronger externality occurs, and the productivity advantages from the agglomeration effect become more obvious. Thus, we can infer that the intensity of industrial linkage between producer service industries and the planned leading manufacturing industries must be a key factor that influences the degree of agglomeration effect, and the producer service firms in the SEZs with stronger industrial linkage benefit more from the agglomeration effect.

To test this hypothesis, we calculate the linkage index between the planned leading industries and productive service industries of the SEZs. For the producer service industry $d$ in county $i$, the industrial linkage index between industry $d$ and the planned leading manufacturing industries of the SEZs in the county that $d$ belongs to is as follows:

$$SM_{id} = \sum_{u=1}^{n} s_{iu} a_{ud} \tag{20}$$

where the subscript $d$ and $u$ represents a productive service industry and a planned leading manufacturing industry, respectively; and $n$ is the number of planned leading manufacturing industries of SEZs in a district or county. $S_{iu}$ is the revenue of the planned dominant manufacturing sector $u$ accounted for the share of all planned dominant manufacturing sectors in county $i$, and $a_{ud}$ represents the intermediate input coefficient between the producer service sector $d$ and the manufacturing sector $u$.[11]

Using the mean of industrial linkage index, we divide the sample of firms in the SEZs into two groups, namely high-related firms and low-related firms, and compare them with the samples from the NSEZs firms to estimate. The results are reported in Table 9. Under the two calculation methods of firm productivity, the agglomeration effect parameter $A$ of the high-related sample is estimated to be larger, which means that the agglomeration effect can bring more obvious productivity advantages to firms in the SEZs with high industrial linkage index.

Therefore, in general, the agglomeration effect is the source of productivity advantages of producer service industries in the SEZs. Further study on the mechanism of agglomeration effect also shows that the SEZs promote the productivity of producer service industries by expanding their main market size, and the agglomeration effect of the SEZs is positively affected by the correlation between producer service firms and the planning leading manufacturing industries of the SEZs.

[11] As producer service industries are mainly suppliers of manufacturing industries, we use the direct input coefficient of producer service sector $d$ to manufacturing sector $u$ to measure the industrial linkage index between them, and calculate it according to the "*Input–Output Table of China (2007)*".

**Table 9**
Sources of productivity advantage of producer services in the SEZs with different industrial relevance degrees

| | | A | D | S | R2 | observations |
|---|---|---|---|---|---|---|
| Calculate industry share based on total revenue | high-related firms in SEZs and firms in NSEZs | 0.902*** | 0.945*** | -0.007*** | 0.985 | 1,000,511 |
| | | (0.011) | (0.002) | (0.001) | | |
| | low-related firms in SEZs and firms in NSEZs | 0.096*** | 0.775*** | -0.015*** | 0.991 | 839,481 |
| | | (0.010) | (0.002) | (0.001) | | |
| Calculate industry share according to main business revenue | high-related firms in SEZs and firms in NSEZs | 0.901*** | 0.945*** | -0.007*** | 0.985 | 1,000,580 |
| | | (0.013) | (0.003) | (0.001) | | |
| | low-related firms in SEZs and firms in NSEZs | 0.076*** | 0.781*** | -0.014*** | 0.990 | 839,411 |
| | | (0.009) | (0.002) | (0.001) | | |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

5.1.2 Perspective of agglomeration externality

We also verify whether Marshallian externalities from the agglomeration of a single industry or Jacobs' externalities from the agglomeration of different industries can promote the productivity of producer services well. Industrial specialization and diversification indexes are frequently used in empirical literature to measure Marshallian and Jacobs' externalities (Glaeser et al., 1992; Henderson et al., 1995; Feldman and Audretsch, 1999). Following the method of Duranton and Puga (2001), we calculate absolute specialization and diversification indexes to represent Marshallian and Jacobs' externalities, respectively, and define $S_{ci}$ as the employment share of producer service industry *i* in district *c*. Then, the absolute specialization is $zi_c = \max_i(s_{ci})$, and the absolute diversification index is calculated by the reciprocal of Herchmann–Herfindahl Index (*HHI*), that is, the reciprocal of the sum of the squares of the employment share of all sectors expressed as $di_c = 1/\sum_{i=1}^{n} s_{ci}^2$.

Table 10 summarizes the estimated results of the impact of the SEZs on the externalities index of producer services. The results of the two methods are similar. The dummy (*zone*) negatively affects the specialization index (*zi*) and positively affects the diversification index (*di*), thus indicating that the existence of the SEZs is conducive to the diversification development of producer services.This finding is confirmed by the following conclusions of Xi et al. (2015): When the demand scale is small or the demand is simple, the producer service industry is suitable for specialized development. By improving the level of manufacturing development, the scale and category of demand for an intermediate input of producer service in manufacturing transformation and upgrading are expanded, and the producer service industry is suitable for selecting a diversified development mode. The development level of the manufacturing industry in the SEZs is frequently high, and a diversified allocation of producer services is required to support the manufacturing industry.

**Table 10**
Impact of the SEZs on the externalities

| | (1) | (2) |
|---|---|---|
| The 1st stage | *zone* | *zone* |
| *fitz* | 0.921*** | 0.921*** |
| | (0.000) | (0.000) |

| | | |
|---|---|---|
| *observations* | 2,723 | 2,723 |
| *F statistics* | 541.390 | 541.390 |
| | [0.000] | [0.000] |
| The 2nd stage | *zi* | *di* |
| *zone* | -5.808*** | 0.446*** |
| | (1.375) | (0.129) |
| *Constant* | 4.726** | 3.399*** |
| | (2.247) | (0.211) |
| *Underidentification test (LM statistics)* | 452.710 | 452.710 |
| *p-value* | [0.000] | [0.000] |
| *Weak identification test (F statistics)* | 541.390 | 541.390 |
| *10% critical value* | 16.380 | 16.380 |
| *observations* | 2,723 | 2,723 |
| $R^2$ | 0.166 | 0.795 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

The results of estimating the impact of the specialization and diversification indexes of producer services on productivity are presented in Table 11.Here, we also use manufacturing total output (*L.lnsiav*) as an IV, as the manufacturing scale have a negative and positive impact to the specialization index and diversification index of producer services (Xi et al ,2015). The results suggest that the impact of the specialization index (*zi*) on the productivity of producer services is negative, whereas the impact from the diversification index (*di*) is positive. The SEZs promote the overall increase in the productivity of producer services through agglomeration effect, but the paths of the different types of agglomeration effect vary. The diversified development modes of various producer service industries in the SEZs have a strong agglomeration effect through Jacobs' externalities, which can promote the productivity of producer services in the SEZs.

**Table 11**
Impact of the externality on the productivity of producer services

| | (1) | (2) |
|---|---|---|
| The 1st stage | *zi* | *di* |
| *L.lnsiav* | -0.218*** | 1.137*** |
| | (0.000) | (0.000) |
| *observations* | 2,744 | 2,744 |
| *F statistics* | 68.110 | 82.600 |
| | [0.000] | [0.000] |
| The 2nd stage | *ctfp0* | *ctfp0* |
| *zi* | -10.01*** | |
| | (1.604) | |
| *di* | | 1.914*** |
| | | (0.286) |
| *Constant* | 12.450*** | 1.728*** |
| | (1.399) | (0.454) |
| *Underidentification test (LM statistics)* | 66.651 | 80.418 |
| *p-value* | [0.000] | [0.000] |
| *Weak identification test (F statistics)* | 68.111 | 82.604 |
| *10% critical value* | 16.380 | 16.380 |
| *observations* | 2,744 | 2,744 |
| $R^2$ | 0.845 | 0.866 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

### 5.1.3 Firm heterogeneity of agglomeration effect

The empirical results show that inefficient firms can derive high returns from the agglomeration effect. To verify this finding, we divide the sample into high-efficiency sample and low-efficiency sample in accordance with the median productivity of the producer services. Then, we use a manufacturing scale that represents the market size of producer services to regress the productivity of producer services in districts and counties. The results are reported in Table 12. The results show that the elasticity values of manufacturing size (*lnsiv*) to the productivities of high- and low-efficiency samples are 0.026 and 0.099, respectively, thus indicating that, in the same manufacturing scale market, inefficient firms are assumed to gain more producitvity improvement than efficient firms ,which corresponds to the abovementioned conclusion of D < 1.

**Table 12**
Impact of manufacturing scale on different productivity districts and counties

| | (1)<br>High TFP Samples | (2)<br>Low TFP Samples |
|---|---|---|
| The 1st stage | *lnsiav* | *lnsiav* |
| *L.lnsiav* | 15.540*** | 14.200*** |
| | (0.000) | (0.000) |
| *observations* | 1,395 | 1,349 |
| *F statistics* | 140000 | 110000 |
| | [0.000] | [0.000] |
| The 2nd stage | *ctfp0* | *ctfp0* |
| *lnsiav* | 0.026* | 0.099*** |
| | (0.013) | (0.009) |
| *Constant* | 5.155*** | 3.220*** |
| | (0.238) | (0.155) |
| *Underidentification test (LM statistics)* | 1381.430 | 1333.320 |
| *p-value* | [0.000] | [0.000] |
| *Weak identification test (F statistics)* | 140000 | 110000 |
| *10% critical value* | 16.380 | 16.380 |
| *observations* | 1,395 | 1,349 |
| $R^2$ | 0.983 | 0.984 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Similarly, we examine the impact of Marshallian and Jacobs' externalities on samples with different productivity levels[12], and the results are presented in Table 13. The results show that the decline of the specialization index and the rise of the diversification index improve the productivity of producer service firms. Moreover, the coefficient of diversification index to counties with higher TFP and lower TFP is 0.026 and 1.022, respectively.The improvement of inefficiency samples is superior, thereby further verifying the characteristics of D<1 in the distribution of firm productivity.

**Table 13**
Impact of externality on the productivity of producer services with different productivity level

| | (1)<br>High TFP<br>Samples | (2)<br>Low TFP<br>Samples | (3)<br>High TFP<br>Samples | (4)<br>Low TFP<br>Samples |
|---|---|---|---|---|
| | *zi* | *zi* | *di* | *di* |
| The 1st stage | | | | |
| *L.lnsiav* | -0.346*** | -0.236*** | 1.529*** | 1.374*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| *observations* | 1,395 | 1,349 | 1,395 | 1,349 |
| *F statistics* | 80.61 | 44.69 | 76.92 | 61.40 |
| | [0.000] | [0.000] | [0.000] | [0.000] |
| The 2nd stage | ctfp0 | ctfp0 | ctfp0 | ctfp0 |

[12] Limited by the length of the article, only the estimated results of the specialization index *zi* and the diversification index *di* calculated using employment share are reported here.

| | | | | |
|---|---|---|---|---|
| *zi* | -1.152* | -5.943*** | | |
| | (0.647) | (1.017) | | |
| *di* | | | 0.260* | 1.022*** |
| | | | (0.146) | (0.157) |
| *Constant* | 6.581*** | 9.137*** | 5.298*** | 2.972*** |
| | (0.668) | (0.857) | (0.218) | (0.294) |
| *Underidentification test (LM statistics)* | 76.618 | 43.502 | 73.295 | 59.063 |
| *p-value* | [0.000] | [0.000] | [0.000] | [0.000] |
| *Weak identification test (F statistics)* | 80.606 | 44.685 | 76.915 | 61.401 |
| *10% critical value* | 16.380 | 16.380 | 16.380 | 16.380 |
| *observations* | 1,395 | 1,349 | 1,395 | 1,349 |
| $R^2$ | 0.980 | 0.941 | 0.980 | 0.952 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

## 5.2. Selection effect: A perspective of "policy rent"

The non-parametric estimates show that *S* representing the selection effect is negative, that is, the proportion of inefficient firms in the SEZs is slightly higher than that in the NSEZs. Two internal mechanisms may lead to this result. One is that under the preferential policies of low tax rate and high subsidy in the SEZs, the inefficient firms in the SEZs may survive more sustainably than those outside and cannot not be eliminated easily. The other is that the preferential policies of the SEZs can lower the threshold for the creation of new firms and enable the establishment of inefficient firms that would otherwise be difficult to establish outside the SEZs. A greater number of inefficient firms exist among the new firms, thus improving the proportion of inefficient firms in the SEZs. Limited by the cross-section data of the SNEC, we face difficulty in investigating the sustainability of firms, but we can empirically explore the second mechanism.

Firstly, we examine the impact of the SEZs on the average tax rates. The regression equation can be set as follows:

$$taxrate_i = \beta_0 + \beta_1 zone_i + \beta_X X + \varepsilon_i \quad (21)$$

where $taxrate_i$ is the average tax rate of county *i*, and $zone_i$ is the dummy variable representing whether the county *i* has any SEZs. The control variables include the average wage of producer service industries of a district or county (*lncwage*), proportion of the revenue of the *SOE*s to the revenue of all firms (*stapec*), proportion of the revenue of foreign-funded enterprises to the revenue of all firms (*forepec*), and city level (*lev1*, *lev2*). The results in Table 14 show that the establishment of the SEZs has a significant negative impact on the average tax rate of a district or county. The 2SLS regression coefficients imply that overall, the establishment of the SEZs bring the average tax rate of producer service firms down by 1.2%.

**Table 14**
Impact of the establishment of the SEZs on the average tax rate of producer services

| | (1) | (2) |
|---|---|---|
| The 1st stage | *zone* | *zone* |
| *fitz* | 0.909*** | 0.916*** |
| | (0.000) | (0.000) |
| observations | 2,723 | 2,723 |
| F-statistics | 549.85 | 545.42 |
| | [0.000] | [0.000] |
| The 2nd stage | *taxrate* | *taxrate* |
| *zone* | -0.012*** | -0.012*** |
| | (0.002) | (0.002) |
| *lncwage* | 0.003*** | 0.004*** |

| | | |
|---|---|---|
| | (0.001) | (0.001) |
| *stapec* | -0.005*** | -0.005*** |
| | (0.002) | (0.002) |
| *forepec* | -0.016*** | -0.015*** |
| | (0.005) | (0.005) |
| *lev1* | | -0.003* |
| | | (0.002) |
| *lev2* | | -0.003*** |
| | | (0.001) |
| *Constant* | 0.017*** | 0.015*** |
| | (0.003) | (0.003) |
| *Underidentification test (LM statistics)* | 458.170 | 455.380 |
| *p-value* | [0.000] | [0.000] |
| *Weak identification test (F statistics)* | 549.85 | 545.42 |
| *10% critical value* | 16.380 | 16.380 |
| observations | 2,723 | 2,723 |
| $R^2$ | 0.559 | 0.567 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Furthermore, we examine the impact of tax rates on the number of new firms. We identify the productive services established in 2008 (the year of the Second Economic Census) as new firms, and divide them into two groups according to the median of TFP. The number of efficient and inefficient new firms in each county are the dependent variables. Then, we use the average tax rate to regress the number of efficient and inefficient firms. At the same time, other explanatory variables affecting the location choice of firms are controlled. To minimize the endogeneity, all explanatory variables are calculated using the data of firms established before 2008.

The dependent variables are non-negative integers and have ordering significance, and the samples are over-dispersed. Thus, we construct the following negative binomial regression econometric model:

$$finumh_i = exp(\beta_{0hi} + \beta_{1hi} taxrate_i + \beta_{2hi} X_i) + \varepsilon_{hi} \quad (22)$$

$$finuml_i = exp(\beta_{0li} + \beta_{1li} taxrate_i + \beta_{2li} X_i) + \varepsilon_{li} \quad (23)$$

We estimate the impact of tax rates and other variables on the number of efficient new enterprises (*finumh*) and the number of inefficient new enterprises (*finuml*) in a district or county, and then calculate the average marginal effects of all explanatory variables, which are reported in Table 15. We can observe that the average tax rate has a significantly negative impact on the number of inefficient and efficient new firms, and according to the values of the average marginal effects, the impact of tax rate on the number of inefficient new firms is much greater than its impact on the number of efficient new firms. The average marginal effect of the tax rate on the number of efficient new firms and the number of inefficient new firms is –112 and –365.9, respectively (as shown in columns (3) and (4)), which means that one percentage point reduction of the tax rate leads to the creation of 1.12 efficient producer service firms and 3.66 inefficient producer service firms, indicating that the low tax rates are more likely to induce the creation of inefficient new firms.

**Table 15**
Impact of tax rate on the number of new firms with heterogeneous productivity

| Dependent variable | (1)<br>*finumh* | (2)<br>*finuml* | (3)<br>*finumh* | (4)<br>*finuml* |
|---|---|---|---|---|
| *taxrate* | -195.000*** | -420.000*** | -112.000*** | -365.900*** |
| | (42.240) | (41.450) | (42.300) | (40.520) |
| *lnsiav* | 10.070*** | 6.965*** | 10.170*** | 6.818*** |

| | | | | |
|---|---|---|---|---|
| | (0.600) | (0.501) | (0.606) | (0.488) |
| *lncwage* | 48.990*** | 30.460*** | 39.060*** | 17.420*** |
| | (2.861) | (2.120) | (2.563) | (1.870) |
| *stapec* | -28.340*** | -7.007** | -27.550*** | -3.183 |
| | (3.565) | (3.069) | (3.518) | (2.958) |
| *forepec* | 8.976 | 77.780*** | 0.239 | 67.480*** |
| | (10.070) | (13.270) | (9.586) | (11.870) |
| *zone* | 2.213 | 2.177* | 5.504*** | 4.865*** |
| | (1.387) | (1.311) | (1.422) | (1.314) |
| *lev1* | - | - | 26.790*** | 37.390*** |
| | | | (3.634) | (3.919) |
| *lev2* | - | - | 28.470*** | 32.280*** |
| | | | (2.416) | (2.542) |
| *confidence interval of α* | [1.063,1.191] | [1.157,1.289] | [0.951,1.069] | [0.987,1.104] |
| *observations* | 2,614 | 2,614 | 2,614 | 2,614 |
| *Pseudo* $R^2$ | 0.105 | 0.088 | 0.118 | 0.108 |

Notes: standard errors in parentheses, and P-value of the corresponding tests in square brackets. * denotes p<0.10, ** denotes p<0.05, *** denotes p<0.01.

Therefore, in general, the "policy rent" brought by the establishment of the SEZs reduces the tax rate of producer service industries, and the lower tax rate lowers the threshold of entry of the SEZs, which are more attractive to the inefficient new firms. This result verifies the negative influence of selection effect on the productivity of producer service industries.

## 6. Conclusion

With producer services gradually replacing the manufacturing industry as the main driving force of economic growth, the effect of producer services on the development of SEZs is bound to deepen. The research on the efficiency of producer services in SEZs is conducive to guiding the optimization and adjustment of SEZ policies. Based on the data of more than 1.46 million producer service firms in the SNEC, this study estimates the existence and sources of productivity advantages of producer services in the SEZ by means of instrumental variable method and unconditional distribution characteristic-parameter correspondence method under the framework of the NNEG theory. From the perspective of the association between producer service and manufacturing industry and heterogeneous firm location, this study verifies the mechanism of the agglomeration and selection effects of SEZs.

The main findings and conclusions are as follows. First, different from the current research focusing on exploring the productivity advantages of the manufacturing industry in China's SEZs, this study verifies the productivity advantages of producer services in SEZs, which is conducive to a comprehensive evaluation of the economic performance of SEZs, and enriches the understanding of the place-based policies. Overall, the establishment of SEZs has effectively promoted the efficiency improvement of the producer services. In the process of industrial restructuring and upgrading, the government should adhere to the agglomeration development model and guide producer services to gather in SEZs.

Second, the agglomeration effect is the source of the efficiency advantage of producer services in SEZs, and its strength is positively related to the size of the local manufacturing industry. When the correlation between producer services and the planned dominant manufacturing industry is high, the agglomeration effect is stronger. When formulating the development plan of producer services in SEZs, local governments should thoroughly consider the development basis of the manufacturing industry in the development zones and their surrounding areas, prioritize the development of producer services that are closely related to the local planning-led manufacturing industry, and end the blind pursuit of high-tech services, so that the producer services can be integrated with the manufacturing industry and the efficiency of SEZs can be promoted.

Third, the development zone is an industrial agglomeration formed by the government-led attraction of firms through a series of preferential policies or subsidies. These preferential policies reduce the entry threshold, and then attract a higher proportion of inefficient firms to settle under the effect of the selection effect, thereby inhibiting the improvement of the efficiency of producer services. The existence of agglomeration effect enables SEZs to attract firms' automatic inflow through spontaneous market forces without policy stimulation. Therefore, the government should abandon the blind implementation of policies and instead allow the laws of the market to play their role in allocating resources. By selecting appropriate preferential policies, the government can form a "joint force" with the natural endowment and industrial base of SEZs to promote the efficiency of producer services.

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Highlights

- Guided by a "new" new economic geography model, we prove the productivity advantages of producer service industry in the special economic zones (SEZs).
- Agglomeration effect is the source of the productivity advantages of producer services in the SEZs. A high industrial relevancy between the producer services and the leading manufacturing industry in the SEZs results in a strong agglomeration effect.
- The preferential policy in the SEZs reduces the entry barrier for firms and attracts a high proportion of inefficient firms entering with the selection effect. This result has a negative impact on promoting the productivity of producer services.