Front Manage Bus, 2023, 4(1): 303-315
DOI: 10.25082/FMB.2023.01.005

RESEARCH ARTICLE

How does industrial agglomeration affect firm performance of Chinese high and new technology industry?

Qianfei Shu

College of Foreign Studies, Kansai Gaidai University, Osaka, Japan

Correspondence to: Qianfei Shu, College of Foreign Studies, Kansai Gaidai University, Osaka, Japan;
E-mail: sqianfei@kansaigaidai.ac.jp;

Received: February 20, 2023;
Accepted: May 1, 2023;
Published: May 5, 2023.

Citation: Shu Q. How does industrial agglomeration affect firm performance of Chinese high and new technology industry? *Front Manage Bus*, 2023, **4**(1): 303-315. https://doi.org/10.25082/FMB.2023.01.005

Abstract: Many researches have discussed the relationship between industrial agglomeration and firm performance. However, the relationship between policy-directed industrial agglomeration in the context of Chinese high and new technology (HNT) industry remains unclear. This study aims to investigate the correlation between industrial agglomeration and China's HNT firm performance by using the two-stage least squares (2SLS) and the system generalized methods of moments (GMM) approaches on account of the panel data of HNT industries in China during 2004-2015. The estimation results revealed that industrial agglomeration has a positive impact on HNT firm performance, including productivity and sales growth. To be specific, by taking advantage of agglomeration effect, foreign-owned firms have demonstrated excellent performance in both labor productivity and sales growth. In contrast, private-owned firms have not performed well in terms of productivity, but have shown sound performance in term of sales growth. Unfortunately, state-owned firms do not benefit from the industrial agglomeration. Moreover, large firms perform better in respect of labor productivity, while small firms experience higher sales growth.

Keywords: high and new technology industry, labor productivity, sales growth, China

1 Introduction

The study of industrial agglomeration has been the subject of debate among economists for more than one hundred years [1–6].

Marshall (1920) [5] first explained the reasons why firms spontaneously agglomerate in spatial concentrations from the perspective of external economies, which was confirmed by subsequent researchers [7–9]. The first reason is that industrial agglomeration leads to savings on transport expenses and the time spent commuting between suppliers and customers. This reason laid the foundation for the crucial hypothesis that was proposed in the later model of 'New Economic Geography' [4]. The second reason is that the concentration of firms generates economies of scale with a stronger labor force. The third reason centers on the easy flow of technology and ideas that result from geographic proximity. Krugman (1991b) [4] proposed that these three advantages of industrial location can be summarized using modern economic terms: backward and forward linkages, thick local labor market, and information spillover effect. There are many successful examples of industrial agglomeration worldwide: Silicon Valley in the U.S.; Carlton in Canada; Baden-Wurttemberg in German, *etc.* These forms of industrial agglomeration are characterized by a market orientation.

However, different from western developed countries, industrial agglomeration in China is directed by government policy, which is particularly noticeable in capital- and technology-intensive industries. Since China's economic reform and opening of borders in 1978, the Chinese government identified specific areas, termed Special Economic Zones (SEZs), and implemented a series of policies (*e.g.* attracting foreign direct investment (FDI), advanced technology, management and production systems), to stimulate regional economic development. In 1980, four SEZs were set up in Shenzhen, Zhuhai, Shantou, and Xiamen. The government encouraged the firms to target the international market and increase exports. The SEZs were first established in coastal regions (i.e., the Pearl River Delta and Yangtze River Delta regions). Over the 20 years that followed, SEZs were upgraded to define different types of zones with heterogeneous features throughout the country. Specifically, the following four types of SEZs were identified: High and New Technology Industrial Development Zone (HNTIDZ); Economic and Technology Development Zone (ETDZ); Export Processing Zone (EPZ); Free Trade Zone (FTZ). The establishment of these zones promoted Chinese economy in terms of GDP growth, total factor productivity (TFP), wage, employment, and foreign direct investment (FDI) [10–13].

An increasing number of firms entered into these zones over the course of the process of agglomeration development [14].

In essence, Chinese industrial agglomeration in the form of SEZs is distinct from market-oriented industrial agglomeration in western developed countries. Rather, it derives from the guidance of government policy, which motivates this current study: Does policy-directed industrial agglomeration, as the form of SEZs, affect firm performance? This study tries to investigate the effect of policy-directed industrial agglomeration on firm performance in China.

Furthermore, in this study, I pay attention to high and new technology (HNT, According to the definition of high and new technology industries provided by the Ministry of Science and Technology and the National Bureau of Statistics, the high and new technology industry comprises of six 'four-digit' industries i.e., the manufacturing of electronic chemicals (2665), manufacturing of medicines (2710–2770), manufacturing of medical equipment and measuring instruments (3681–3689, 4110–4119, 4121–4129, 4141, 4190), manufacturing of electronic and communication equipment (4011–4019, 4020, 4021, 4031–4039, 4051–4059, 4061, 4062, 4071, 4072, 4090), manufacturing of computer and office equipment(4041–4043, 4154, 4155), and the manufacturing of aircraft and spacecraft (3761–3769). In this study, 'HNT' is an abbreviation of 'high and new technology'.) industry, rather than all manufacturing industries. Over the last three decades, China has emerged as an important contributor in global manufacturing and exports. However, the competitive edge of low-cost labor that China enjoyed was disappearing because of advancements in manufacturing technology by Southeast Asian nations, such as Vietnam and Bangladesh, particularly after the 2008 financial crisis. Therefore, the upgrade of industrial structure from low-tech and medium-low-tech to high-tech industries has become increasingly crucial. The HNT industry is identified by intensive knowledge and technology [15], which can effectively mitigate risks in an unpredictable economic environment due to its high value-added products. In a result, HNT industry is widely recognized as a key driver of industrialization in transitional economies. The HNT industry in China is still in its infancy, beset by many difficulties such as financing constraints, talent shortage, imperfect innovation environment, *etc.* If SEZ, as a place-based policy by Chinese government, can promote the development of HNT firms, it may help China to move beyond the status of a "middle-income trap" in the future.

Figure 1 illustrates the conceptual diagram of this study. The remainder of this article is organized as follows. Section 2 analyzes the relationship between industrial agglomeration and firm performance, followed by a literature review on the effect of agglomeration on firm performance. Section 3 describes the data and explains the industrial agglomeration indicator used in this study. Section 4 presents the baseline specification and methodology, and Section 5 shows estimated results. Section 6 concludes and discusses the policy implications.

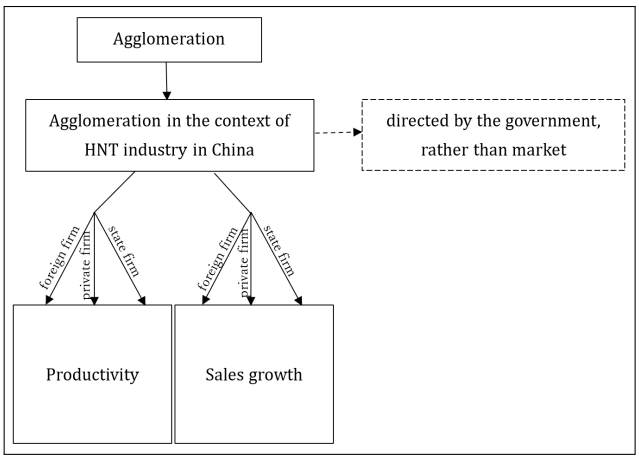

Figure 1 Conceptual diagram of the study

2 Related literatures: Industrial agglomeration and firm performance

I aim to explore the impact of industrial agglomeration on firm performance from the angle of institutional externality of agglomeration. As discussed before, theoretically, industrial agglomeration generates three positive externalities: dense local labor market; backward and forward linkages; information and knowledge spillover effect [4]. These positive externalities elicited by industrial agglomeration play a significant role in firm performance including productivity, profit, export and innovation activity.

Focusing on developing countries, numerous studies found that there exists a positive relationship between geographic agglomeration and firm performance. For example, using a firm-level panel dataset from 2000 to 2007, Hu et al. (2015) [16] examined the influence of industrial agglomeration on productivity growth in China by evaluating a comprehensive range of industries and extending the analysis to upstream industries. The study found that industrial agglomeration led to a 14% increase in productivity growth. They also found that private firms benefit the most from the effects of agglomeration. Due to the knowledge spillover that results from agglomeration, Ito et al. (2015) [17] suggested that the initial costs of exporting can be reduced, thus promoting Chinese firms' entry to export markets. Using Chinese firm-level data for the period 1998–2007, Zhang (2015) [18] found that agglomeration economies play a significant role in facilitating product innovation. The researches outlined above evaluated a large dataset of manufacturing firms in China and demonstrated that industrial agglomeration fosters a firm's performance.

In addition, some research investigated the contributions of SEZ policy in China. Alder et al. (2016) [19] used a panel dataset of 270 Chinese cities for the period 1988–2010 to investigate the influence of SEZs on a city's GDP growth. The study suggested that the establishment of state-level zones generates an increase of approximately 12% in GDP. Wang (2013) [11] argued that the place-based SEZ program achieves agglomeration economies and increases the total factor productivity (TFP) growth. Zheng et al. (2017) [20] found that spillover effects occur not only within SEZs but also in the surrounding districts. More recently, by using DID (Difference-in-Difference) approach, Tian and Xu (2022) [21] found that national high-tech zones promote local innovation and entrepreneurial activities.

This article is closely related to two studies by Lu et al. (2019) [14] and Wei et al. (2020) [22]. However, despite some similarities in the research subject on the effect of industrial agglomeration, this study is distinct from these two studies in several aspects, including research angle and object. While Lu et al. (2019) [14] focused on exploring the impact of place-based policy, SEZ, on productivity, this study aims to provide a more comprehensive and in-depth understanding of industrial agglomeration and its role in promoting productivity in the context of China's HNT industry, taking into account both policy-directed and market-oriented agglomeration effect. This study emphasizes that the agglomeration of China's HNT industry is a combination of policy guidance and market orientation, not just government intervention, which differs from the research focusing on SEZ policy as the object of study. Although SEZ policy is also a manifestation of agglomeration economies, its purpose is not to investigate the impact of agglomeration effect on productivity, but rather to stimulate local economy through specific policy measures. Therefore, I employ EG (Ellison and Glaeser) index to measure the degree of agglomeration, which can more specifically reflect the agglomeration situation of HNT industry, rather than just focusing on the government's policy guidance. Furthermore, while Wei et al. (2020) [22] explored the differential effects of agglomeration across regions and industries, this study examines the heterogeneous agglomeration effects of different ownership structures in the context of HNT industry, and analyzes the possible reasons for their differences. In China's HNT industry, firms with different ownership structures face different issues such as historical background, technological gaps, financing channels, and government subsidies, which may have an impact on their agglomeration effects. Therefore, it is necessary to consider the influence of these factors when analyzing agglomeration effects. The findings of this study may be useful in improving the implementation of policies. Taking into account all the aforementioned research gaps, this article contributes to previous studies by investigating the impact of industrial agglomeration in the field of HNT industry, which plays a pivotal role in stimulating economic development and technological advancement in China.

3 Data and measurement of industrial agglomeration

3.1 Date source

A firm-level dataset of Chinese manufacturing firms drawn from the National Bureau of Statistics of China was used, covering the period of 2004-2015. This database stores the basic information of all manufacturing firms with annual sales above 5 million RMB. (above 20 million RMB since 2011).

In this study, I focus on the high and new technology (HNT) industry. The Ministry of Science and Technology and the National Bureau of Statistics define the high and new technology industry to comprise six 4-digit industries: manufacturers of electronic chemicals (2665), manufacturers of medicines (2710-2770), manufacturers of medical equipment and measuring instruments (3681-3689, 4110-4119, 4121-4129, 4141, 4190), manufacturers of electronic and communication equipment (4011-4019, 4020, 4021, 4031-4039, 4051-4059, 4061, 4062, 4071, 4072, 4090), manufacturers of computer and office equipment (4041-4043, 4154, 4155), and

manufacturers of aircraft and spacecraft (3761-3769). Moreover, firms with less than three successive years of data are excluded since it is a common practice for system GMM estimation.

Initially, I obtain the unbalanced panel consisted of 47,176 firms with 235,413 firm-year observations. Table 1 summarizes the selected variables for the whole firm panel.

Table 1 Descriptive Statistics[1]

Variables	Mean	Std. Dev.	Obs. No.
Dependent Variables			
Labor productivity[2]	3.228	4.472	235,413
Sales growth[3]	0.132	0.813	235,413
Independent Variables			
Agglomeration Variable			
EG index[4]	0.048	0.012	6,084
Control Variables			
Firm age	8.326	11.224	235,413
Firm size[5]	11.137	1.762	235,413
Current assets/total assets	0.045	0.426	235,413
City R&D[6]	23.613	53.275	6,084
Foreign owned share[7]	0.362	2.145	235,413
Private owned share[8]	0.317	0.963	235,413

[1] Source: National Bureau of Statistics of China for the period 2004 to 2015.
[2] Labor productivity is calculated as the natural logarithm of value added/labor.
[3] Sales growth is measured by ($sales_t$-$sales_{t-1}$)/$sales_{t-1}$.
[4] The calculation of the EG index is based on the city level.
[5] Firm size is calculated as the natural logarithm of firm's employment.
[6] City R&D is calculated as the natural logarithm of city's R&D expenditure.
[7] Foreign owned share is the percentage ratio of total shares held by foreign, Hong Kong, Marco, and Taiwan investors.
[8] Private owned share is the percentage ratio of total shares held by individual investors.

3.2 Measurement of industrial agglomeration

How could industrial agglomeration be measured? As discussed before, HNT industrial agglomeration is directed by Chinese government as the form of special economic zones. Does the policy-directed industrial agglomeration achieve the substantial agglomeration effect? To explore this issue, I quantize the degree of industrial agglomeration by adopting "EG index" developed by Ellison and Glaeser (1997) [1]. The EG index, as the most standard and widely employed agglomeration index in previous studies [23–25], captures the degree of agglomeration within an industry and co-agglomeration across industries. The ratio of an industry's size within a certain region, the ratio of the aggregated size of manufacturing sectors within a certain region, and the market concentration of an industry are considered simultaneously in the EG index. Specifically, the EG index (r_j) is expressed as follows:

$$r_j \equiv \frac{G_j - \left(1 - \sum_c X_c^2\right) H_j}{\left(1 - \sum_c X_c^2\right)\left(1 - H_j\right)} \tag{1}$$

With the following formulas representing $G_j$and :H_j

$$G_j \equiv \sum_c \left(X_c - S_{jc}\right)^2 \tag{2}$$

$$H_j \equiv \sum_i Z_{ij}^2 \tag{3}$$

where j, c, and i represent industry, city, and firm, respectively. G_j expresses the spatial Gini coefficient, representing geographical concentration. The term X_c denotes the ratio of total employment within all HNT industries in city c. S_{jc} denotes the ratio of employment within the HNT industry of j in city c. The term H_j expresses the Herfindahl index of industry j, measuring industrial concentration. The term Z_{ij} denotes the ratio of firm i's sales in the HNT industry of j. In this study, EG index is calculated based on the city level.

In accordance with Ellison and Glaeser's (1997) [1] research, industries with $r_j > 0.05$, $0.02 \leq r_j \leq 0.05$, and an $r_j < 0.02$ are defined 'very concentrated', 'somewhat concentrated', and 'not very concentrated', respectively. Table 2 shows that the EG index experienced slow but consistent growth from 2008 to 2015, despite small fluctuations. Note that the term 'somewhat concentrated' can be applied to all HNT industries since 2008, except for the manufacture of medical equipment and communication equipment, which has been defined as 'very concentrated' since 2013. This result suggests that at some extent, the policy of establishing SEZs has contributed to HNT industrial agglomeration effect and remarkably increasing the level of industrial agglomeration of HNT firms.

Table 2 EG index based on the 4-digit HNT industries at city level for 2008-2015[1]

Industry	2008	2009	2010	2011	2012	2013	2014	2015
Manufacture of Electronic Chemicals	0.041	0.039	0.044	0.048	0.051	0.054	0.061	0.067
Manufacture of Medicines	0.045	0.048	0.056	0.061	0.064	0.066	0.062	0.069
Manufacture of Medical Equipment and Communication Equipment	0.026	0.024	0.028	0.033	0.035	0.038	0.043	0.042
Manufacture of Electronic Equipment and Communication Equipment	0.032	0.036	0.039	0.041	0.048	0.052	0.053	0.055
Manufacture of Computer and Office Equipment	0.039	0.043	0.046	0.053	0.058	0.062	0.061	0.064

Note: [1] According to China's administrative division, city level denotes 4 municipalities (Beijing, Tianjin, Shanghai and Chongqing) and 334 prefecture cities.

4 Research model

4.1 Firm performance model

To analyze the causality between industrial agglomeration and firm performance, the following empirical model is utilized:

$$\mathrm{Performance}_{\mathrm{ijct}} = \alpha_0 + \alpha_1 \mathrm{Agglomeration}_{\mathrm{jct}} + \alpha_2 \mathrm{X}_{\mathrm{ijct}} + \mu_{\mathrm{i}} + \mu_{\mathrm{j}} + \mu_{\mathrm{c}} + \mu_{\mathrm{t}} + \epsilon_{\mathrm{ijct}} \quad (4)$$

where i, j, c, and t indicate the firm, industry, city, and time, respectively. The dependent variable ($\mathrm{Performance}_{\mathrm{ijct}}$) denotes a firm's labor productivity and sales growth. Labor productivity is measured by the natural logarithm of value added/labor. I also use a firm's sales growth rate, measured by $(\mathrm{sales}_{\mathrm{t}} - \mathrm{sales}_{\mathrm{t-1}})/\mathrm{sales}_{\mathrm{t-1}}$, to represent growth performance.

$\mathrm{Agglomeration}_{\mathrm{jct}}$, as the main explanatory, is the proxy for the agglomeration level of the HNT industry. As aforementioned, the EG index is adopted to measure the agglomeration level. The acronym EG refers to the Ellison-Glaeser index of industrial agglomeration at the city level. If the firms located in areas with a higher level of agglomeration can achieve superior profit and growth performance, α_1 should be positive.

$\mathrm{X}_{\mathrm{ijct}}$ is a vector of control variables, including firm age, firm size, current assets, ownership share and a city's R&D expenditure. I use the natural logarithm of employment as a proxy for firm size, and firm age is measured as the difference between the year of establishment and the sample year. In previous studies, firm age and firm size have been discussed for their impact on firm performance [26–28]. Furthermore, current assets reflect internal working capital turnover of firms, which may affect a firms' performance [22]. This variable is normalized by the number of total assets. In addition, Hu et al. (2015) [16] found that the ownership plays an important role on firm performance. Thus, ownership share variables, foreign owned share and private owned share, are included in the regression. Foreign owned share is the percentage ratio of total shares held by foreign, Hong Kong, Marco, and Taiwan investors, while private owned share is the ratio of total shares held by individual investors. Finally, to further control for the possible influence of a city's R&D expenditure, this macro-level variable is also included, taking the logarithm type [23, 29, 30].

The disturbance term has four components: μ_i is the firm-specific fixed effect, and μ_j is the industry-specific effect by including HNT industry dummies. Representations of time and city-specific effect dummy variables are also included in the empirical model, denoted by μ_t and μ_c, respectively. ϵ_{ijct} is an idiosyncratic error term; α_1, α_2 are coefficients to be estimated.

4.2 Empirical study methodology

It is necessary to point out that agglomeration variable is likely to be endogenous due to reverse causality and self-selection problem. The phenomenon of industrial agglomeration might be a result rather than a reason of firm development. As discussed before, HNT industrial agglomeration is directed by Chinese government. Therefore, there exists a possibility that SEZ administration choose more productive firms to enter the zones so that it would be easier for them to create a "successful SEZ" in some sense [31]. Moreover, if the firms are certificated by local government to settle in the SEZs, they can enjoy many preferential policies such as tax deductions, discounted land-use fees and financial supports [11, 19, 20]. Thus, some firms may self-select to enter these SEZs for the purpose of utilizing these preferential policies.

To cope with the endogeneity concern, I employ the two-stage least squares (2SLS) estimation procedure with instrumental variables to identify the industrial agglomeration effects on firm performance. The choice of an exogenous instrument that is correlated with the agglomeration variable but does not have a direct impact on the firm performance variable is a crucial aspect in 2SLS estimation. Following Li and Lu (2009) [32], the historical population in China is adopted as the instrumental variable. To be specific, the historical population is measured by the natural logarithm of the population in each city in the year 1984 (The city-level population data is extracted from China City Statistical Yearbook. China City Statistical Yearbook was first published in the year of 1984, which report the population data in the year of 1983.

Unfortunately, there are many missing population data in the yearbook published in 1984. Thus, I employ the population data in the year of 1984, which was reported in the City Statistical Yearbook 1985.). The logic for adopting this instrument is based on the following argument: historical population is relevant to the degree of agglomeration because manufacturing firms tend to agglomerate in a city with a larger population due to its higher market demand [33–36] while historical population should not be directly correlated to firm performance. In other words, historical population should influence firm performance only through the way of industrial agglomeration.

Since the population in 1984 is time-invariant, I interact the population data with the year dummies to change the time-invariant instrument into a time-varying one [40]. The first stage of the panel instrumental variable regression is:

$$\text{Agglomeration}_{\text{jct}} = \beta_0 + \beta_1 \ln(\text{ population })_{\text{c},1984} \times \mu_{\text{t}} + \mu_{\text{t}} + \varepsilon_{\text{ijct}} \quad (5)$$

However, except for the endogeneity problem caused by industrial agglomeration variable, it is also possible that other independent variables exhibit endogeneity. Hence, the system generalized methods of moments (GMM) estimation designed by Arellano and Bond (1991) [37] and Blundell and Bond (1998) [38], is also employed to address the remaining endogeneity issue as robustness checks.

For the first-differenced equations in the system GMM, two or more period lagged endogenous variables are used as instrumental variables in (4), while firm age, ownership share, city's R&D expenditure and industry, city, year dummy variables are regarded as exogenous variables. One-period lagged dependent variables, $\text{Performance}_{\text{ijct}-1}$ ($\text{labor productivity}_{\text{ijct}-1}$ and $\text{sales growth}_{\text{ijct}-1}$) are included in the dynamic model.

For the system GMM, two tests are proposed to assess the validity of instrumental variables. The first, for confirming instrument exogeneity, is the Hansen test of overidentifying restrictions. The Sargan test is not adopted because it is not robust to heteroscedasticity. The second, for the serial correlation of error term (ϵ_{ijct}), is the autoregressive (AR) test. Following Arellano and Bond (1991) [37], first-order serial correlation of the error term is allowed in difference regression, while if there exists a second-order serial correlation for the error term, the null hypothesis of AR(2) test will be rejected.

5 Estimation results and discussion

5.1 Baseline results

Table 3 reports the 2SLS estimation results. The first stage of 2SLS estimation results are presented in Panel B of Table 3. The coefficients for all the instruments are positive and statistically significant, indicating that firms are more likely to agglomerate in the areas with even higher population densities. The result of the underidentification test implies that the agglomeration variable is endogenous indeed. Moreover, since the F-statistic in the first stage regression exceeds the Stock-Yogo critical values [39], It can conclude that our instrumental variables are strong.

Panel A and Panel C of Table 3 report the effect of industrial agglomeration on promoting HNT firm performance. The coefficients for the EG index are significantly and positively correlated with HNT firm productivity and sales grow after the industrial agglomeration variables are instrumented. This finding is consistent with many existing studies [16, 40–43]. The positive relationship between the two may be attributed to the externalities. As discussed, industrial agglomeration generates positive externalities, such as economies of scale, thick local labor market, as well as information and knowledge spillovers, thereby stimulating firm performance. Specifically, when there are many HNT firms located in the same area, they may be able to share infrastructure, transportation and other production resources, which can reduce transaction costs for individual firms and improve firm productivity. Second, a large pool of skilled labors and talented employees attracted by industrial clusters offer specialized knowledge and skills, thereby promoting the operational efficiency of the firms. Third, information and knowledge spillover effect helps the firms learn about new production techniques from neighboring firms, so that the performance of the firms located in the same area can be improved. This aspect is particularly important for HNT firm as it enable them to leverage the latest technological advances and accelerate innovation activities, which can achieve sustainable growth.

To check whether the exclusion restriction of the instruments is satisfied in this study, I undertake an informal test in Table 4. If the historical population affects firm performance only through the path of industrial agglomeration, then when both agglomeration and historical population variables are included in the estimation simultaneously, the historical population should not have any significant impact on performance variables. As presented in column 1 and

column 2 of Table 4, all the historical population variables no longer have statistically significant coefficients, confirming that our instrumental variables are exogenous.

Besides the 2SLS estimations, as a robustness check, I further conduct the two-step system GMM estimation to address the remaining potential endogeneity problem of the independent variables. The results are shown in column 2 and column 4 of Table 3. The Hansen test of overidentifying restrictions suggests that all the instruments used for the estimation are exogenous, and the results for AR(2) also cannot detect the serial correlation of ϵ_{ijct}. Thus, these results confirm the validity of the instruments used. Consistent with our previous findings, the industrial agglomeration variables remain significantly and positively associated with firm productivity and sales growth.

Regarding the influence of firm characteristics, the results suggest that younger HNT firms perform better in respect of both productivity and sales growth. Young firms typically have higher flexibility and innovation, which allows them to adapt more quickly to market demands and changes, adopting the latest technologies to enhance productivity and sales growth. Moreover, young firms tend to focus more on product research and development in the early stages, continuously improving the quality of their products, thereby establishing a certain band value and gaining a competitive advantage in the marketplace. In addition, larger scale firms are more likely to achieve greater productivity. This finding is consistent with Hu et al., (2015) [16]. Large firms usually own more resources and technological advantages, helping them better utilize economies of scales and division of labor to stimulate productivity and production efficiency.

Table 3 Agglomeration, labor productivity and sales growth: instrumental variable estimation results and two-step GMM results[1]

	Panel IV	Two-step system GMM	Panel IV	Two-step system GMM
	Panel A: Second stage Dep. Var. = Labor productivity	Dep. Var. = Labor productivity	Panel C: Second stage Dep. Var. = Sales growth	Dep. Var. = Sales growth
Column	1	2	3	4
Labor productivity$_{t-1}$		0.418*** (6.87)		
Sales growth$_{t-1}$				0.297*** (7.15)
Agglomeration (EG index)	0.069*** (3.16)	0.101** (2.14)	0.032*** (2.85)	0.079** (1.98)
Firm size[2]	0.157*** (2.94)	0.231** (2.23)	-0.092*** (-2.99)	-0.137** (-2.36)
Firm age	-0.001*** (-3.26)	-0.002*** (-3.46)	-0.019** (-2.43)	-0.008* (-1.94)
Current assets/total assets	0.228* (1.89)	0.181** (2.37)	0.092 (1.38)	0.236* (1.79)
Industry dummy	yes	yes	yes	Yes
City dummy	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes
Foreign owned share	0.064*** (2.59)	0.079** (2.28)	0.033** (1.99)	0.029* (1.83)
Private owned share	0.085 (1.42)	0.074* (1.92)	0.056** (2.23)	0.071*** (2.85)
City R&D	0.007 (0.89)	0.005* (1.69)	0.059 (1.43)	0.063 (0.86)
Constant	1.947 (0.75)	1.734* (1.71)	1.395 (0.74)	1.239 (1.46)
p-value of Hansen test		0.286		0.174
AR(2)		0.192		0.239
No. Obs	235,413	208,796	235,413	208,796
	Panel B: First stage Dep.var. =Agglomeration (EG index)			
Population1984×year 2004	0.285** (2.53)			
Population1984×year 2005	0.317*** (3.48)			
Population1984×year 2006	0.221*** (3.85)			
Population1984×year 2007	0.135** (2.39)			
Population1984×year 2008	0.276** (2.48)			
Population1984×year 2009	0.296*** (3.71)			
Population1984×year 2010	0.282*** (4.17)			
Population1984×year 2011	0.315** (2.26)			
Population1984×year 2012	0.326*** (2.91)			
Population1984×year 2013	0.261*** (2.87)			
Population1984×year 2014	0.294** (2.48)			
Population1984×year 2015	0.268*** (2.95)			
F-statistics	54.73			
Underidentification test p-value	0.0000			
Adj R-square	0.094			

[1] The table presents instrumental variable estimation results and Blundel and Bond's two-step system GMM results. The dependent variable is labor productivity ($\ln(\text{value added}/\text{labor})$) and sales growth ($\frac{\text{sales}_t - \text{sales}_{t-1}}{\text{sales}_{t-1}}$). z-statistics are reported in parentheses.

[2] Firm size is calculated as the natural logarithm of firm's employment.

* Significant at 10%. **Significant at 5%. ***Significant at 1%.

5.2 Agglomeration effects under different ownership structures

In China, local economic growth varies depending on the ownership structures. For example, state-owned firms, wholly or partially funded by the government, still dominate commanding heights sectors such as energy, railway, electronic communication, aerospace and satellite technology. These firms usually hold a considerable share in the market and receive preferential treatment from the government in respect of access to financing and other resources [40].

Table 4 Informal test for exogeneigy of the instrumental variables: OLS estimation results[1]

	Dep.var. = Labor productivity	Dep.var. = Sales growth
Column	1	2
Population1984×year 2004	0.187 (1.37)	0.094 (0.74)
Population1984×year 2005	0.173 (0.58)	0.089 (1.62)
Population1984×year 2006	0.098 (0.72)	0.092 (1.49)
Population1984×year 2007	0.169 (0.94)	0.097 (0.96)
Population1984×year 2008	0.164 (1.28)	0.083 (1.61)
Population1984×year 2009	0.171 (1.45)	0.076 (0.72)
Population1984×year 2010	0.189 (0.73)	0.095 (0.59)
Population1984×year 2011	0.183 (1.47)	0.081 (0.54)
Population1984×year 2012	0.191 (1.31)	0.079 (1.24)
Population1984×year 2013	0.189 (0.69)	0.083 (0.71)
Population1984×year 2014	0.185 (0.83)	0.086 (1.46)
Population1984×year 2015	0.194 (1.52)	0.092 (0.67)
Agglomeration (EG index)	0.078** (2.14)	0.025*** (2.62)
Firm size[2]	0.249*** (3.26)	-0.068* (-1.95)
Firm age	-0.008*** (-2.88)	-0.002*** (-3.24)
Current assets/total assets	1.218*** (4.37)	0.629* (1.83)
Industry dummy	yes	yes
City dummy	yes	yes
Year dummy	yes	yes
Foreign owned share	0.285*** (3.29)	0.147** (2.19)
Private owned share	0.174 (1.58)	0.062 (0.64)
City R&D	0.072	0.036
Constant	1.472 (0.72)	0.395 (1.29)
Adj R-square	0.241	0.178
No. Obs	235,413	235,413

[1] The table presents OLS estimation results. The dependent variable is labor productivity ($\ln(\text{value added}/\text{labor})$) and sales growth ($\frac{\text{sales}_t - \text{sales}_{t-1}}{\text{sales}_{t-1}}$). z-statistics are reported in parentheses.

[2] Firm size is calculated as the natural logarithm of firm's employment.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Recently, however, they have gradually lost their advantages due to inefficiency, bureaucracy and corruption [44]. On the other hand, private-owned firms do not receive as much support from the government as state-owned firms do. As a result, they have to be more efficient and innovative in order to survive and achieve sustainable growth in the marketplace.

Therefore, given the heterogeneous roles that ownership plays in the Chinese economy, in this section, I aim to shed light on the heterogeneity analysis based on different ownership structures by separating the firms into foreign, private, and state-owned.

The 2SLS estimation result are reported in columns 1-3 of Table 5 and 6, with column 1 for foreign-owned firms, column 2 for private-owned firms, and column 3 for state-owned firms. The first stage estimation results are presented in Panel B of Table 5. All the instruments are significantly and positively correlated with industrial agglomeration. Moreover, our estimation is not plagued by weak instrument problem, as evidenced by the F-statistic.

A striking observation is that only foreign-owned firms benefit from the agglomeration effect in promoting labor productivity. Agglomeration variable in column 1 of Table 5 has significantly positive coefficient, while the ones in column 2 and 3 are insignificant.

Why agglomeration effect fails to work for private and state-owned HNT firms? Xu (2011) [45] suggests that many of the concentration of private-owned firms in China today can be traced back to the township-village enterprises (TVEs) established in the early 1990s, and the majority of these firms are engaged in labor-intensive sectors, such as textile, footwear, cashmere, metal products, etc [23, 43, 46]. In these sectors, by breaking down the production process of a product into many small steps, private enterprises can easily join the industrial agglomeration because the entry barriers in terms of technology and capital are lowered [42, 47]. However, compared to labor-intensive sectors, it is much harder for private firms in the context of HNT industries to overcome the entry barrier of technical expertise and the need for substantial capital investment. In a result, private HNT firms have yet to form sizable agglomerations and have failed to capitalize on the productivity-enhancing effects of agglomeration. Furthermore, the lack of an impressive performance may prove to be a significant hindrance for private HNT firms seeking entry into government-managed SEZs [31]. Therefore, private HNT firms, particularly nascent ones, may not be able to benefit from agglomeration effects in respect of increasing productivity. Whereas for state-owned firms, they can achieve their development without relying on agglomeration effects because they have already received considerable support from the government.

Table 5 Agglomeration effects under different ownership structures (agglomeration and labor productivity): instrumental variable estimation results and two-step GMM results[1]

	Panel IV			Two-step system GMM		
	Panel A: Second stage Dep.var. = Sales growth			Dep. var. = Labor productivity		
	Foreign-owned firm	Private-owned firm	State-owned firm	Foreign-owned firm	Private-owned firm	State-owned firm
Column	1	2	3	4	5	6
Labor productivity$_{t-1}$				0.375*** (4.37)	0.259*** (3.21)	0.421*** (3.84)
Agglomeration (EG index)	0.076*** (3.71)	0.045 (1.08)	0.059 (1.54)	0.164*** (2.78)	0.112 (1.36)	0.082 (0.74)
Firm size[2]	0.132*** (2.87)	0.087** (2.17)	0.094*** (2.59)	0.226* (1.74)	0.119** (1.98)	0.143* (1.86)
Firm age	-0.002** (-2.45)	-0.006 (-0.93)	0.0009 (0.89)	-0.003*** (-3.25)	-0.001 (-1.34)	0.0008 (1.62)
Current assets/total assets	0.319* (1.78)	0.175** (2.36)	0.093 (1.54)	0.275** (2.33)	0.048 (1.28)	0.203* (1.93)
City R&D	0.018* (1.91)	0.003 (1.37)	0.026** (2.45)	0.009 (1.17)	0.017 (0.79)	0.009*** (2.86)
Industry dummy	yes	yes	yes	yes	yes	yes
City dummy	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes
Constant	1.374 (0.84)	0.857* (1.66)	0.749 (1.53)	0.661* (1.87)	0.373 (0.28)	0.289 (0.77)
p-value of Hansen test	0.214	0.189	0.272	0.163	0.194	0.329
AR(2)	0.375	0.537	0.421	0.269	0.469	0.582
No. Obs	130,414	70,925	34,074	117,380	63,834	30,660
	Panel B: First stage Dep.var. = Agglomeration (EG index)					
Population1984×year 2004	0.219** (2.54)	0.265*** (3.82)	0.188*** (3.57)			
Population1984×year 2005	0.312*** (4.16)	0.334*** (3.26)	0.298** (2.21)			
Population1984×year 2006	0.194*** (3.28)	0.279** (2.34)	0.242*** (4.72)			
Population1984×year 2007	0.185*** (4.64)	0.169** (2.42)	0.114*** (3.79)			
Population1984×year 2008	0.258** (1.98)	0.312*** (3.29)	0.248** (2.18)			
Population1984×year 2009	0.317*** (3.74)	0.293*** (3.69)	0.278** (2.39)			
Population1984×year 2010	0.249*** (3.17)	0.327*** (2.63)	0.216** (2.44)			
Population1984×year 2011	0.351*** (3.45)	0.281*** (2.67)	0.324*** (2.97)			
Population1984×year 2012	0.319** (2.38)	0.282** (2.35)	0.326*** (2.83)			
Population1984×year 2013	0.229** (2.57)	0.274*** (3.26)	0.262** (2.25)			
Population1984×year 2014	0.197*** (3.24)	0.236** (2.38)	0.259*** (2.96)			
Population1984×year 2015	0.218*** (2.64)	0.262** (2.28)	0.279** (2.17)			
F-statistics	27.84	32.93	25.48			
Underidentification test p-value	0.0000	0.0000	0.0000			
Adj R-square	0.087	0.076	0.081			

[1] The table presents instrumental variable estimation results and Blundel and Bond's two-step system GMM results. The dependent variable is labor productivity $(\ln(\text{value added}/\text{labor}))$. z-statistics are reported in parentheses.
[2] Firm size is calculated as the natural logarithm of firm's employment.
* Significant at 10%. **Significant at 5%. ***Significant at 1%.

Table 6 Agglomeration effects under different ownership structures (agglomeration and sales growth): instrumental variable estimation results and two-step GMM results[1]

	Panel IV[2]			Two-step system GMM		
	Panel A: Second stage Dep. var. = Sales growth			Dep. var. = Sales growth		
	Foreign-owned firm	Private-owned firm	State-owned firm	Foreign-owned firm	Private-owned firm	State-owned firm
Column	1	2	3	4	5	6
Sales growth$_{t-1}$				0.462*** (5.38)	0.349*** (5.61)	0.451*** (4.28)
Agglomeration (EG index)	0.037*** (3.51)	0.021** (2.53)	-0.016 (-1.18)	0.042* (1.83)	0.031** (2.35)	-0.013 (-0.94)
Firm size[3]	-0.085** (-2.45)	-0.054* (-1.75)	0.124 (0.78)	-0.063* (-1.68)	-0.078* (-1.82)	0.098* (1.94)
Firm age	-0.021*** (-2.87)	-0.015* (-1.86)	0.086* (1.91)	-0.035*** (-3.16)	-0.022** (-2.46)	0.073 (1.64)
Current assets/total assets	0.187* (1.89)	0.069 (0.53)	0.072** (2.27)	0.138 (0.86)	0.206 (1.24)	0.099* (1.78)
Industry dummy	yes	yes	yes	yes	yes	yes
City dummy	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes
City R&D	0.052 (0.93)	0.009 (1.45)	0.071* (1.73)	0.028** (2.52)	0.007* (1.77)	0.015 (0.54
Constant	1.48 (1.62)	0.97 (0.48)	1.37 (0.62)	1.53 (1.45)	1.84* (1.93)	0.92 (0.73)
p-value of Hansen test				0.289	0.379	0.361
AR(2)				0.659	0.584	0.517
No. Obs	130,414	70,925	34,074	117,380	63,834	30,660

[1] The table presents instrumental variable estimation results and Blundel and Bond's two-step system GMM results. The dependent variable is sales growth $(\frac{\text{sales}_t - \text{sales}_{t-1}}{\text{sales}_{t-1}})$ z-statistics are reported in parentheses.
[2] The first stage of instrumental variable estimation is omitted here as the results are the same as that of Table 5.
[3] Firm size is calculated as the natural logarithm of firm's employment. *Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Next, to re-run the regressions for sales growth separating firms by their type of ownership. The result is reported in Panel A of Table 6. A noticeable change was observed in the estimated coefficient of the agglomeration variable for private firms, with the coefficient becoming significant. This result implies that industrial agglomeration can help unlock the growth potential for private firms. Nevertheless, state-owned firms still cannot benefit from agglomeration effects to improve sales growth.

An informal test was conducted to check whether the instruments are entirely exogenous.

Table 7 Informal test for exogeneigy of the instrumental variables (Agglomeration effects under different ownership structures): OLS estimation results[1]

	Dep.var. = Labor productivity			Dep. var. = Sales growth		
	Foreign-owned firm	Private-owned firm	State-owned firm	Foreign-owned firm	Private-owned firm	State-owned firm
Column	1	2	3	4	5	6
Population1984×year 2004	0.293 (1.32)	0.187 (1.55)	0.254 (0.74)	0.174 (1.57)	0.214 (0.89)	0.275 (0.74)
Population1984×year 2005	0.238 (0.81)	0.174 (0.64)	0.169 (0.82)	0.264 (1.06)	0.314 (1.13)	0.236 (0.97)
Population1984×year 2006	0.250 (1.62)	0.228 (0.92)	0.156 (1.59)	0.173 (1.35)	0.169 (0.99)	0.204 (0.37)
Population1984×year 2007	0.183 (0.46)	0.148 (0.38)	0.215 (1.49)	0.206 (0.41)	0.182 (1.29)	0.169 (1.32)
Population1984×year 2008	0.228 (1.36)	0.315 (1.29)	0.263 (1.43)	0.189 (0.39)	0.203 (0.41)	0.241 (0.81)
Population1984×year 2009	0.171 (0.62)	0.194 (0.36)	0.159 (0.29)	0.218 (0.62)	0.204 (1.21)	0.132 (1.38)
Population1984×year 2010	0.239 (1.58)	0.302 (1.46)	0.273 (0.52)	0.181 (1.58)	0.196 (0.27)	0.218 (0.43)
Population1984×year 2011	0.149 (0.47)	0.231 (0.38)	0.195 (0.49)	0.182 (0.83)	0.210 (1.37)	0.253 (1.52)
Population1984×year 2012	0.171 (1.04)	0.197 (0.54)	0.205 (1.26)	0.235 (0.37)	0.167 (0.72)	0.179 (0.48)
Population1984×year 2013	0.231 (0.66)	0.285 (1.79)	0.249 (0.62)	0.304 (0.89)	0.274 (1.27)	0.184 (1.38)
Population1984×year 2014	0.159 (1.51)	0.185 (1.49)	0.148 (0.59)	0.159 (1.35)	0.173 (0.82)	0.162 (0.74)
Population1984×year 2015	0.248 (0.47)	0.215 (0.91)	0.193 (1.54)	0.189 (1.20)	0.231 (1.42)	0.218 (1.30)
Agglomeration (EG index)	0.019*** (3.73)	0.025 (1.62)	0.017 (1.47)	0.025*** (2.88)	0.041* (1.93)	0.073 (0.94)
Firm size[2]	0.125** (2.18)	0.214* (1.91)	0.195** (2.51)	-0.024** (-2.47)	-0.017** (-2.15)	0.072* (1.89)
Firm age	-0.0007*** (-2.93)	-0.001 (-1.25)	0.0009 (1.17)	-0.002** (-1.98)	-0.0008* (-1.74)	0.0006** (2.38)
Current assets/total assets	0.163** (2.45)	0.092*** (3.27)	0.131** (2.26)	0.102* (1.69)	0.114** (2.37)	0.143 (0.98)
Industry dummy	yes	yes	yes	yes	yes	yes
City dummy	yes	yes	yes	yes	yes	yes
Year dummy	yes	yes	yes	yes	yes	yes
City R&D	0.015	0.019	0.023	0.057	0.061	0.103
Constant	1.383 (0.85)	1.294 (0.53)	0.385 (1.53)	0.832 (0.67)	0.161 (1.37)	0.089 (0.47)
Adj R-square	0.116	0.088	0.092	0.132	0.128	0.106
No. Obs	130,414	70,925	34,074	130,414	70,925	34,074

[1] The table presents OLS estimation results. The dependent variable is labor productivity ($\ln(\text{value added}/\text{labor})$) and sales growth ($\frac{\text{sales}_t - \text{sales}_{t-1}}{\text{sales}_{t-1}}$). z-statistics are reported in parentheses.
[2] Firm size is calculated as the natural logarithm of firm's employment.
* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

The results in Table 7 show that all the instruments are exogenous. In addition, as shown in columns 4-6 of Table 5 and 6, the two-step system GMM estimation provides us a similar result, indicating that our previous findings about the agglomeration effects across ownership are robust.

6 Conclusion and future policy implication

Exploring the impact of policy-directed industrial agglomeration is important to assess the effectiveness of government policy to improve firm productivity and growth. Unlike previous studies that focused on a comprehensive range of industries, in this article, I examine the effect of industrial agglomeration in the context of HNT industry, which is regarded as a critical driving force for industrialization in transitional economies. Moreover, I investigate how the ownership structure of Chinese HNT firms affects their capacity to take advantage of agglomeration effect. Using the historical population as the instrumental variable, the 2SLS estimation results suggest that a higher level of industrial agglomeration stimulates both labor productivity and sales growth of HNT firms. However, the effect of industrial agglomeration varies across ownership. Only foreign-owned HNT firms benefit from the agglomeration effect to enhance productivity, while neither private nor state-owned firms benefit from it. However, both foreign and private-owned firms manage to leverage the agglomeration advantages in terms of sales growth.

The findings of this study also provide important insights for Chinese policymakers. First, both national and local governments should continue supporting the SEZ program to stimulate the agglomeration effect for the HNT industry. Specifically, when formulating SEZ programs, the government should pay more attention to private-owned firms and introduce more supportive policies, such as tax reductions, scientific and technological innovation subsidies, preferential land use and other financial assistance. The more firms that agglomerate within the SEZs, the greater they can enjoy the positive externalities generated by agglomeration to stimulate firm performance. Second, in order to further enhance the agglomeration effect, the government could promote the establishment of new types of SEZs with different functions and characteristics. For example, Yao and Whalley (2016) [48] pointed out that the China (Shanghai) Pilot Free Trade Zone (SPFTZ), set up in 2013, aims to relax investment restrictions and increase the openness of the financial system. The government relaxed market access and limits its administrative power, which emphasize the important role of market forces. The establishment of the SPFTZ is expected to help overcome trade barriers and support China's new strategy for opening up and reform. If this expectation is met, the set-up and expansions of SEZs accompanied by policy

change should be promoted nationwide.

References

[1] Ellison G and Glaeser EL. Geographic concentration in US manufacturing industries: A dartboard approach. Journal of Political Economy, 1997, **105**(5): 889-927. https://doi.org/10.1086/262098

[2] Fujita M. A monopolistic competition model of spatial agglomeration: Differentiated product approach. Regional Science and Urban Economics, 1988, **18**(1): 87-124. https://doi.org/10.1016/0166-0462(88)90007-5

[3] Krugman P. Geography and Trade. MIT Press, Cambridge, MA, 1991a.

[4] Krugman P. Increasing returns and economic geography. Journal of Political Economy, 1991b, **99**(3): 484-499. https://doi.org/10.1086/261763

[5] Marshall A. Principles of economics. London: Macmillan.

[6] Porter, E.M., 1998, Clusters and the new economics of competition, Harvard Business Review, 1920, **76**(6): 77-90.

[7] Combes PP and Duranton G. Labour pooling, labour poaching, and spatial clustering. Regional Science and Urban Economics, 2006, **36**(1): 1-28. https://doi.org/10.1016/j.regsciurbeco.2005.06.003

[8] Arzaghi M and Henderson V. Networking off Madison avenue. The Review of Economic Studies, 2008, **75**(4): 1011-1038. https://doi.org/10.1111/j.1467-937X.2008.00499.x

[9] Ellison G, Glaeser EL and Kerr WR. What causes industry agglomeration? Evidence from coagglomeration patterns. American Economic Review, 2010, **100**(3): 1195-1213. https://doi.org/10.1257/aer.100.3.1195

[10] Ma YF and Goo YJ. Technical Efficiency and Productivity Change in China's High-and New-Technology Industry Development Zones. Asian Business and Management, 2005, **4**(3): 331-355. https://doi.org/10.1057/palgrave.abm.9200135

[11] Wang J. The economic impact of special economic zones: Evidence from Chinese municipalities. Journal of development economics, 2013, **101**: 133-147. https://doi.org/10.1016/j.jdeveco.2012.10.009

[12] Wei SJ. The open door policy and China's rapid growth: evidence from city-level data. In: Ito, Takatoshi, Krueger, Anne O. (Eds.), Growth Theories in Light of the East Asian Experience. University of Chicago Press, Chicago, 1995.

[13] Zeng DZ. China's special economic zones and industrial clusters: the engines for growth. Journal of International Commerce, Economics and Policy, 2012, **3**(3): 1250016. https://doi.org/10.1142/S1793993312500160

[14] Lu Y, Wang J and Zhu L. Place-based policies, creation, and agglomeration economies: Evidence from China's economic zone program. American Economic Journal: Economic Policy, 2019, **11**(3): 325-60. https://doi.org/10.1257/pol.20160272

[15] Hong J, Feng B, Wu Y, *et al*. Do government grants promote innovation efficiency in China's high-tech industries? Technovation, 2016, **57**: 4-13. https://doi.org/10.1016/j.technovation.2016.06.001

[16] Hu C, Xu Z and Yashiro N. Agglomeration and productivity in China: Firm level evidence. China Economic Review, 2015, **33**: 50-66. https://doi.org/10.1016/j.chieco.2015.01.001

[17] Ito B, Xu Z and Yashiro N. Does agglomeration promote internationalization of Chinese Firms ? China Economic Review, 2015, **34**: 109-121. https://doi.org/10.1016/j.chieco.2015.03.009

[18] Zhang H. How does agglomeration promote the product innovation of Chinese firms? China Economic Review, 2015, **35**: 105-120. https://doi.org/10.1016/j.chieco.2015.06.003

[19] Alder S, Shao L and Zilibotti F. Economic reforms and industrial policy in a panel of Chinese cities. Journal of Economic Growth, 2016, **21**: 305-349. https://doi.org/10.1007/s10887-016-9131-x

[20] Zheng S, Sun W, Wu J, *et al*. The birth of edge cities in China: Measuring the effects of industrial parks policy. Journal of Urban Economics, 2017, **100**: 80-103. https://doi.org/10.1016/j.jue.2017.05.002

[21] Tian X and Xu J. Do place-based policies promote local innovation and entrepreneurship? Review of Finance, 2022, **26**(3): 595-635. https://doi.org/10.1093/rof/rfab029

[22] Wei W, Zhang WL, Wen J, *et al*. TFP growth in Chinese cities: The role of factor-intensity and industrial agglomeration. Economic Modelling, 2020, **91**: 534-549. https://doi.org/10.1016/j.econmod.2019.12.022

[23] Lin HL, Li HY and Yang CH. Agglomeration and productivity: Firm-level evidence from China's textile industry. China Economic Review, 2011, **22**(3): 313-329. https://doi.org/10.1016/j.chieco.2011.03.003

[24] Lu JY and Tao ZG. Trends and determinants of China's industrial agglomeration. Jouranl of Urban Economics, 2009, **65**(2): 167-180.
https://doi.org/10.1016/j.jue.2008.10.003

[25] Yang C, Lin H and Li H. Influences of production and R&D agglomeration on productivity: Evidence from Chinese electronics firms. China Economic Review, 2013, **27**: 162-178.
https://doi.org/10.1016/j.chieco.2013.09.005

[26] Biesebroeck JV. Firm size matters: Growth and productivity growth in African manufacturing. Economic Development and Cultural Change, 2005, **53**(3): 545-583.
https://doi.org/10.1086/426407

[27] Palangkaraya A, Stierwald A and Yong J. Is firm productivity related to size and age ? The case of large Australian firms. Journal of Industry, Competition and Trade, 2009, **9**(2): 167-195.
https://doi.org/10.1007/s10842-007-0028-4

[28] Rafiq S, Salim R and Smyth R. The moderating role of firm age in the relationship between R&D expenditure and financial performance: Evidence from Chinese and US mining firms. Economic Modelling, 2016, **56**: 122-132.
https://doi.org/10.1016/j.econmod.2016.04.003

[29] Mehran H. Executive compensation structure, ownership, and firm performance. Journal of Financial Economics, 1995, **38**: 163-184.
https://doi.org/10.1016/0304-405X(94)00809-F

[30] Helpman E, Melitz MJ and Yeaple SR. Export versus FDI with Heterogeneous Firm. American Economic Review, 2004, **94**(1): 300-316.
https://doi.org/10.1257/000282804322970814

[31] Li X, Wu X and Tan Y. Impact of special economic zones on firm performance. Research in International Business and Finance, 2021, **58**: 101463.
https://doi.org/10.1016/j.ribaf.2021.101463

[32] Li B and Lu Y. Geographic concentration and vertical disintegration: evidence from China. Journal of Urban Economics, 2009, **37**: 46-68.
https://doi.org/10.1016/j.jue.2009.01.001

[33] Davis DR and Weinstein DE. Market access, economic geography and comparative advantage: an empirical test. Journal of International Economics, 2003, **59**: 1-23.
https://doi.org/10.1016/S0022-1996(02)00088-0

[34] Hanson GH. Market potential, increasing returns and geographic concentration. Journal of International Economics, 2005, **67**: 1-25.
https://doi.org/10.1016/j.jinteco.2004.09.008

[35] Krugman P. Scale economies, product differentiation, and the pattern of trade. The American Economic Review, 1980, **70**: 950-959.
https://www.jstor.org/stable/1805774

[36] Li D, Lu Y and Wu M. Industrial agglomeration and firm size: Evidence from China. Regional Science and Urban Economics, 2012, **42**(1-2): 135-143.
https://doi.org/10.1016/j.regsciurbeco.2011.07.003

[37] Arellano M and Bond S. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equation. Review of Economic Studies, 1991, **58**(2): 277-298.
https://doi.org/10.2307/2297968

[38] Blundell R and Bond S. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics, 1998, **87**(1): 115-143.
https://doi.org/10.1016/S0304-4076(98)00009-8

[39] Stock JH and Yogo M. Testing for weak instruments in linear iv regression, in dwk andrews and jh stock, eds., identification and inference for econometric models: Essays in honor of thomas j. rothenberg. cambridge: Cambridge university press, 2005.

[40] Guo D, Jiang K, Xu C, *et al*. Clustering, growth and inequality in China. Journal of Economic Geography, 2020, **20**(5): 1207-1239.
https://doi.org/10.1093/jeg/lbz038

[41] Hashiguchi Y and Tanaka K. Agglomeration and firm-level productivity: A Bayesian spatial approach. Regional Science, 2015, **94**(s1): s95-s114.
https://doi.org/10.1111/pirs.12147

[42] Long C and Zhang X. Cluster-based industrialization in China: Financing and performance, Journal of International Economics, 2011, **84**(1): 112-123.
https://doi.org/10.1016/j.jinteco.2011.03.002

[43] Sonobe T and Otsuka K. Cluster-based industrial development: An East Asia model. New York: Palgrave MacMillan, 2006.

[44] Bai Y and Jia R. The oriental city: political hierarchy and regional development in China. Working Paper AD1000-2000, Chinese University of Hong Kong and UC-San Diego, 2018.

[45] Xu C. The fundamental institutions of China's reforms and development. Journal of Economic Literature, 2011, **49**(4): 1076-1151.
https://doi.org/10.1257/jel.49.4.1076

[46] Huang Z, Zhang X and Zhu Y. The role of clustering in rural industrialization: A case study of the footwear industry in Wenzhou. China Economic Review, 2008, **19**(3): 409-420.
https://doi.org/10.1016/j.chieco.2007.11.001

[47] Ruan J and Zhang X. Finance and cluster-based industrial development in China, Economic Development and Cultural Change, 2009, **58**(1): 143-164.
https://doi.org/10.1086/605208

[48] Yao D and Whalley J. The China (Shanghai) pilot free trade zone: Background, developments and preliminary assessment of initial impacts. The World Economy, 2016, **39**(1): 2-15.
https://doi.org/10.1111/twec.12364