Effect of Special Economic Zones on Innovation : Evidence from Chinese High and New Technology Firms in the Pearl River Delta

関西外国語大学 研究論集 第118号（2023年 9 月）
Journal of Inquiry and Research, No.118（September 2023）

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Abstract

Fruitful studies have discussed the relationship between Special Economic Zone (SEZ) and firm performance. However, the relationship between SEZ and firm innovation performance in the context of the Chinese high and new technology (HNT) industry remains unclear. The instrumental variable estimation is used in this study to explore the effect of SEZs on the innovation performance of the Chinese HNT industry. I find that SEZs have a positive impact on HNT firm innovation output, and such impact varies across ownership structures. To be specific, foreign owned firms located in the SEZs exhibit superior innovation output. However, private and state-owned firms do not benefit from the policy of SEZs.

Keywords: Special Economic Zone, China, Innovation, High and new technology industry

1 Introduction

The high and new technology (HNT) industry is characterized as a knowledge-based, research and development (R&D)-oriented, and large-scale industrial collaborations (Hong et al., 2016). As an important innovation-driven strategy, the development of HNT industry has played a critical role in promoting upgrades of industrial structure and national technological competitiveness in China (Cao et al., 2020; Wan et al., 2021). The Chinese government has implemented a series of public policies to support the development and innovation activities of HNT firms, including subsidiary programs, tax remission, discounted land-use fees, and intellectual property protection (Bronzini and Iachini, 2014; Chen et al., 2008). On the other hand, the HNT industry in China is still in its infancy, beset by many difficulties such as a lack of well-developed financial system, high-end talent, advanced technology, and a perfect market environment. Nevertheless, despite facing numerous obstacles and challenges, Chinese HNT firms have demonstrated tremendous potential over the past thirteen years.

As shown in Table 1, from 2008 to 2020, the growth rate of the number of HNT firms, profit, the output value of new products and the patent applications is 55.7%, 354.8%, 426.6% and 778.9%[1] respectively. How were Chinese HNT firms able to overcome various difficulties to achieve such remarkable growth? This study attempts to expound this puzzle from the perspective of "Special Economic Zone" (SEZ). Clarifying this problem and understanding the development process of Chinese HNT firms is of significant importance in achieving sustainable economic growth in China.

The SEZ program, as a representative place-based public policy directed by Chinese government, plays an important role in promoting the development of HNT industry in China (Hong et al., 2016; Wright et al., 2008; Yang et al., 2009). Since China's economic reform and opening of borders in 1978, the Chinese government has designated SEZ as testing laboratories that aim to attract foreign investment and new technology and promote exports to test the effectiveness of market-oriented economic reform. In 1980, SEZs were set up in Shenzhen, Zhuhai, Shantou, and Xiamen. These four SEZs enjoy a location advantage because they are situated in the Pearl River Delta region (adjacent to Hong Kong and Macao) and the Min Delta region (adjacent to Taiwan). Hong Kong, Macao, and Taiwan provided capital, logistics, advanced technology and management skills, and access to international markets. From 1980 to 1984, the GDP of the four SEZs grew on average 28%[2] per year, more than twice the national rate. As the initial success in the Pearl River Delta region was proved, the State Council set up additional different types of zones with heterogeneous features throughout the country over the four years that followed. Specifically, the following four types of zones were identified: High and New Technology Industrial Development Zone (HNTIDZ); Economic and Technology Development Zone (ETDZ); Export Processing Zone (EPZ); Free Trade Zone (FTZ). As of 2021, there were 552 national-level zones, 1991 provincial-level zones, and 2543[3] zones in total. Fruitful research has found that these SEZs contributed to the Chinese economy through GDP growth, total factor productivity (TFP), employment, wage, and foreign direct investment (FDI) (Alder et al., 2016; Lu et al., 2019; Ma and Goo, 2005; Wang, 2013). While studies about SEZ programs have proliferated along with the programs themselves, these studies, however, ignore the impact of SEZs on firm innovation performance. Moreover, few studies have offered insight into the context of HNT industry, which is the important driver for China's economic resurgence (Wan et al., 2021). With the objective to fill this gap, in this study, I analyze the effect of SEZs on HNT firm innovation performance.

In addition, I chose the Pearl River Delta as the study area because the development of HNT industry in this region exhibits a significant advantage over the national level, particularly in terms of innovation capability. Table 1 shows that the output value of new products and patent applications in the Pearl River Delta region account for 34% and 38% of the national total in 2020, while its land area fills only 0.6% of the country. Many of China's well-known HNT industry clusters have also emerged in the Pearl River Delta region in the past decades. For example, Shenzhen is hailed as China's Silicon Valley and is home to a large number of HNT firms such as Huawei Technology, Zhongxing Telecommunication, and Tencent, with a high level of international recognition and influence in the global HNT industry (Zeng, 2012). Furthermore, as aforementioned, the Pearl River Delta is the earliest region in China to carry out market-oriented reform and opening-up. The Pearl River Delta has unique geographic advantages, as it is adjacent to Hong Kong and Macau while being far away from Beijing, the administrative center of China. This allows it to leverage capital, logistics, advanced management skills, and access to international markets and technology provided by Hong Kong and Macau, while also avoiding political interference (Yeung et al., 2009). As a result, the Pearl River Delta has achieved a high degree of marketization despite its origin in government policy guidance. If the SEZ in the Pearl River Delta contributes to firm activities, then this style of industrial agglomeration, which combines policy direction and market orientation, could serve as a valuable reference for other developing countries.

The remainder of this article is organized as follows. Section 2 analyzes the relationship between SEZ and innovation, followed by a literature review on the impact of the establishment of SEZs. Section 3 presents the baseline specification and methodology. Section 4 describes the data, and Section 5 shows the estimated results. The conclusion is presented in Section 6.

Table 1 Comparison of the number of HNT firms, profit, the output value of new products, and patent applications in the Pearl River Delta and China in 2008 and 2020[1]

		2008	2020	Growth rate from 2008 to 2020
Number of HNT firms (unit)	Pearl River Delta	5,649	10,670	88.9%
	Nation	25,817	40,194	55.7%
Profit (100 million yuan)	Pearl River Delta	538	3,001	457.5%
	Nation	2,725	12,394	354.8%
Output value of new products (100 million yuan)	Pearl River Delta	3,201	23,358	629.7%
	Nation	13,018	68,549	426.6%
Patent applications (piece)	Pearl River Delta	21,185	131,935	522.8%
	Nation	39,656	348,522	778.9%

[1] Data source: China Statistic Yearbook on High Technology Industry, 2009-2021. The data published in the yearbook are all from the previous year.

2 Related literature

SEZ is a form of "industrial agglomeration" guided by Chinese government's policy, which differs from the one formed by market-oriented forces in Western developed countries. In the past few decades, the economic phenomenon of the unique agglomeration of manufacturing firms has been of particular interest to many researchers, generating a series of correlation studies, such as the well-known 'New Economic Geography' by Krugman (1991, 1998). Following this, Porter (1998) defined industrial agglomeration as the geographical clustering of interconnected companies and institutions in a specific business field. Other scholars have also developed similar definitions. For example, Schmitz and Nadvi (1999) defined agglomeration as a sectoral and spatial concentration of firms. Mytelka and Farinelli (2000) classified the agglomeration of firms as spontaneous or constructed. Many examples of industrial agglomeration in Western developed countries are characterized by market orientation, thus indicating spontaneous agglomeration. For example, Silicon Valley in the U.S.; Carlton in Canada; Baden-Wurttemberg in German, etc. However, as discussed above, many cases of industrial agglomeration in China are defined by policy direction from the outset, which is particularly evident with capital- and technology-intensive industries. This form of industrial agglomeration is named "Special Economic Zone", reflecting constructed agglomeration. In both cases, industrial agglomeration may generate positive externalities (Devereux et al., 2007; Glaeser et al., 1992; Li et al., 2021). Krugman (1991) summarized these

positive externalities as the modern economic terms i.e., backward and forward linkages, thick local labor market, and the information and knowledge spillover effect.

How does a SEZ affect firm innovation performance? I attempt to describe this problem from the perspective of the institutional externality of agglomeration. First, backward and forward linkages denote the relationships between firms in the same or related industries. HNT firms tend to rely on complex supply chains and close relationships with suppliers and customers. In the SEZs, HNT firms can benefit from access to a wider range of suppliers and customers, which helps to reduce costs and improve efficiency (Dai and Liu, 2009). This enables HNT firms to invest more resources into R&D, thus leading to superior innovation performance. Second, a thick local labor market refers to the concentration of skilled workers in a specific region. In comparison with other industries, the HNT industry is more likely to require specialized skills and knowledge. SEZs can attract a large number of highly skilled workers, thereby improving the quality of R&D and fostering innovation activities. Third, the spillover effect of information and knowledge is also a critical determinant for the development of the HNT industry that strongly depends on the latest technological advancements and best practices (Zheng et al., 2017). SEZs serve as an ideal platform for firms to tap into a vast pool of information and knowledge, including new technologies, cutting-edge practices, and advanced research outcomes. Consequently, SEZs not only help reduce the knowledge gap but also boost innovation.

Intensive studies have evaluated China's SEZ program. Existing literature on SEZs focuses on the SEZs' effects on regional economic growth, labor productivity, foreign direct investment (FDI), employment and wage. For example, using city-level data, Wang (2013) found that the establishment of SEZ promotes the local economy by attracting foreign capital, achieving agglomeration economies, and increasing local workers' wages. Alder et al. (2016) suggested that the establishment of national-level SEZs generates an increase of approximately 12% in the GDP of cities across China. Zheng et al. (2017) argued that SEZs generate spillover effect both within SEZs and the surrounding areas. More recently, Lu et al. (2019) showed the SEZ program has a positive impact on capital investment, output, productivity and firm employment.

Promoting the regional economy and increasing firms' TFP, employment, and export are considered to be important factors necessary to enhance China's competitiveness. Nevertheless, it remains unclear whether the establishment of SEZ leads to better innovation performance of firms with targeted areas, especially in the context of HNT industry. Using

firm-level panel data for HNT firms, this paper aims to fill this gap in the literature by exploring the impact of SEZ on firm innovation.

3 Empirical model

3.1 Innovation model

To investigate the causality between SEZs and firm innovation performance, the following empirical model is employed:

$$Innovation_{it} = \alpha_0 + \alpha_1 SEZ_{it} + \alpha_2 X_{it} + \mu_j + \mu_c + \mu_t + \varepsilon_{it} \quad (1)$$

where i, j, c, and t indicate the firm, industry, city, and time, respectively. I use "output value of new products" ($Innovation_{it}$) to capture firm innovation performance, measured by the ratio of output value of new products to total industrial output value. This variable has been widely employed in studies (Hall et al., 2010; Kuchiki and Tsuji, 2009; Zhang, 2015). Although TFP is also one of the measurements of innovation, in addition to technological innovation, many other elements such as institutional environment, market openness, organizational efficiency, and resource allocation may exert influence on TFP as well. Thus, TFP may not be the most accurate indicator for measuring firm innovation performance. Furthermore, many studies utilized patent statistics to quantify innovation performance (Hall and Jaffe, 2018; Tian and Xu, 2022). However, patent statistics cannot be considered as a direct indicator of innovation activities because not all innovations have been applied for patent (Griliches, 1998).

SEZ_{it} is a binary variable that equals 1 if firm i is located in a national-level or provincial-level SEZ[4] in year t, and 0 otherwise. Following Li et al. (2021), I use the firm address to distinguish the firm location status. If the address includes "jingjiqu", "yuanqu", "gaoxinqu", "kaifaqu", "kejiyuan", "huojuyuan", "gongyeyuan", "gongyequ", "chanyeyuan", "chanyequ", "chuangyeyuan", "baoshuiqu", "chukoujiagongqu" (Howell, 2019), the firm is defined as being located in the SEZs and otherwise not. It is expected that firms located in SEZs would perform better in innovation. X_{it} is a vector of control variables and indicates firm characteristics that could affect a firm's innovation output. As a proxy for firm size, the natural logarithm of employment is used, while firm age is measured as the difference between the year of establishment and the sample year. I also include average wage and

city-level R&D expenditure in the HNT industry as proxies for human capital and government support for corporate innovation, respectively, which are considered important factors for innovation performance. The natural logarithm is taken for both variables in the regression (Tian and Xu, 2022; Zhang, 2015).

The disturbance term has three components: μ_j is the industry-specific effect that is controlled for by including HNT industry dummies. Representations of time and city-specific effect dummy variables are also added in the estimation, denoted by μ_t and μ_c, respectively. ε_{it} is an idiosyncratic error term, α_1, α_2 are coefficients to be estimated.

3.2 Estimation methodology

It is worthwhile to note that SEZ variable is likely to be endogenous due to reverse causality and self-selection issue. Firms with sound innovation capabilities are likely to enter these zones (Baldwin and Okubo, 2006; Melitz and Ottaviano, 2008). Moreover, there are some firms located in the SEZs that may have self-selected to enter these zones for the sake of enjoying preferential policies such as tax reduction and export and import tariff exemption. To address the endogeneity issue and pinpoint the causality between the SEZ variable and innovation, I use the instrumental-variable (IV) estimation strategy.

A key issue in instrumental variable estimation is the choice of an exogenous instrument that is correlated with the SEZ variable but does not affect the firm innovation variable directly. Here, I employ the "administrative affiliation" (*Affiliation*) of a firm as the instrument, which reflects the degree of connection between firms and the government. As aforementioned, all the SEZ programs are directed by the Chinese government. Thus, firms with higher levels of administrative affiliation are more likely to secure the application permits to enter the SEZs. Meanwhile, the affiliation variable is unlikely to directly affect firm innovation performance. To be specific, I classify the administrative affiliation[5] into four groups in descending order: group(1): central and provincial level (10,20); group(2): city and county level (40,50); group(3): town and village level (60,61,62,63,70,71,72); group(4): no affiliation (90). The affiliation variable denotes ordinal variable, which takes the value of 4,3,2,1 when the firms' affiliation belongs to group (1),(2),(3),(4), respectively. The affiliation variable can be expected to be positively correlated with the SEZ variable. We also assume here that it affects firm innovation performance only through its impact on SEZ variable.

4 Data and overview

The data used in this study are drawn from the National Bureau of Statistics of China for the period 1998-2009. This database includes basic information and financial statements pertaining to all manufacturing firms with annual sales in excess of 5 million RMB. The data were first cleaned using the following procedures.

According to the definition of the high and new technology industry, as provided by the Ministry of Science and Technology and the National Bureau of Statistics, the high and new technology industry encompasses 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). For the present study, the first five industries were selected as there are very few aircraft and spacecraft firms located in the Pearl River Delta Region. Firms from these industries were selected from cities within the region, namely, Guangzhou, Shenzhen, Foshan, Dongguan, Zhongshan, Zhuhai, Jiangmen, Zhaoqing, and Huizhou city.

Moreover, due to the lack of data on the output value of new product in 2004, I used the average value of this variable in 2003 and 2005 as an estimate by interpolation.

Thus, 5,250 firms with 20,860 firm-year observations comprised the unbalanced panel. The descriptive statistics for whole firms are reported in Table 2. The mean value of SEZ variable is 0.327, indicating that over 30% of firm-year observations are firms located in the SEZs. Table 3 provides comparisons between the firms located in SEZs and the ones outside the SEZs for the variables of interest: Innovation, Firm size, Firm age, Ln(average wage) and Ln(R&D expenditure). As expected, firms located in the SEZs have better innovation performance compared with firms that are outside the SEZs. Furthermore, firms located in the SEZs are younger than those outside the SEZs.

Table 2 Descriptive Statistics[1]

Variables	Mean	Std.Dev.	Obs. No.
Dependent Variables			
Innovation[2]	0.020	0.119	20,860
Independent Variables			
SEZ[3]	0.327	0.442	20,860
Firm size	4.962	1.142	20,860
Firm age	7.175	10.247	20,860
Ln(average wage)	7.568	1.317	20,860
Ln(R&D expenditure)	17.136	51.275	108

[1] Source: National Bureau of Statistics of China for the period 1998 to 2009.
[2] Innovation is measured as output value of new product/total industrial output value.
[3] SEZ takes a value of one if the firm is located in a national-level or provincial-level SEZ.

Table 3 Comparisons between firms in and outside the SEZs

	in the SEZs		outside the SEZs		
Variables	Mean	Std. Dev.	Mean	Std. Dev	t value for the gap
Innovation[1]	0.027	0.142	0.017	0.109	20.036
Firm size	5.286	1.163	5.147	1.152	36.501
Firm age	23.997	27.872	24.730	29.149	-7.755
Ln(average wage)	8.282	1.453	7.999	1.441	51.503

[1] Innovation is measured as output value of new product/total industrial output value.

5 Regression results

5.1 Benchmark result

Table 4 reports the panel instrumental variable estimation results. The first stage estimation result is reported in column 1 of Table 4. The instrument is positively and statistically significantly associated with the SEZ variable, suggesting that firms with higher levels of affiliation are more likely to enter the SEZs than firms affiliated with lower levels or

without affiliation. Moreover, the Hausman test is adopted to test the endogenous issue. The result rejects the exogeneity assumption, which indicates that the SEZ variable is endogenous indeed. The F-statistic in the first stage regression is significantly above the Stock-Yogo critical values (Stock and Yogo, 2005), implying that the estimates do not suffer from a weak instrument problem.

Column 2 of Table 4 reports the role of SEZ in stimulating HNT firms' innovation capacity. The coefficient estimates on SEZs are positive and significant at the 1% level, indicating that compared with the firms outside SEZs, the ones located within SEZs exhibit better innovation performance. This may be attributed to several factors. One of the most prominent factors is the technology spillover effect, which is facilitated by the relatively closed geographical area within the SEZs. This environment offers firms more opportunities to interact and exchange knowledge with other firms and research institutions. Consequently, technology and knowledge are transferred and shared among different firms, ultimately enhancing overall innovation capabilities (Aghion and Jaravel, 2015). Notable, this effect is particularly significant in HNT industry, where the benefits of knowledge and technology sharing are more pronounced. In addition, Howell (2016) pointed out that low access to finance leads to lower innovative success. The firms located in SEZs are more likely to enjoy financing support from the government, which alleviates the financing constraints of firms when engaging in innovation activities, thus improving innovation performance. Moreover, the development of SEZs attracts a pool of high-quality, high-skilled personnel, leading to a talent agglomeration effect that further bolsters the innovation capabilities of firms located within SEZs.

Next, I employ an informal test to check whether the instrumental variable is entirely exogenous. If the instrumental variable, *Affiliation*, influences firm innovation performance only through the channel of SEZ, then it should not have any significant influence on innovation performance when including both SEZ and affiliation in the regression simultaneously. Column 3 of Table 4 shows that the coefficient of *Affiliation* became insignificant, implying that the exclusion restriction is satisfied here.

Table 4 IV estimation on SEZ and firm innovation[1]

	Dep.var.= Output value of new product/total industrial output value		
	First stage estimation	Second stage estimation	Informal test for exogeneity of the IV
Column	(1)	(2)	(3)
Affiliation	0.009***(4.68)		0.012(1.18)
SEZ		0.431***(4.39)	0.149***(10.90)
Firm size	0.019***(5.11)	0.071*(1.74)	0.107**(2.55)
Firm age	-0.0001***(-5.63)	0.002***(4.51)	.0001*(1.85)
Ln(average wage)	0.033***(10.57)	0.462***(4.71)	0.206***(3.46)
Ln(R&D expenditure)	0.089***(3.09)	0.053**(2.14)	0.023*(1.66)
Industry dummy	yes	yes	yes
City dummy	yes	yes	yes
Year dummy	yes	yes	yes
Constant	0.171***(4.33)		2.341***(2.82)
F-statistics	19.530		
Hausman test	0.0279		
Adj R-square	0.094		0.103
No. Obs	20,860	20,860	20,860

[1] The table presents instrumental variable estimation results. The dependent variable is output value of new product/total industrial output value. t-statistics are reported in parentheses.
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

5.2 Heterogeneous effects of SEZ on firm innovation across ownership

In this section, I try to shed some light on the diverse influences of SEZ across firms of different ownership. I would like to separate the firms into foreign, private, and state-owned.

The panel instrumental variable estimation results are presented in columns 4-6 of Table 5, with column 4 for foreign-owned firms, column 5 for private-owned firms, and column 6 for state-owned firms. Columns 1-3 report the first-stage estimation results. All the instruments have significantly positive coefficients and the F-statistic shows our instrumental variable is

strong.

A notable finding is that the positive impact of SEZ on firm innovation performance is limited to foreign-owned firms. Why does the SEZ not benefit private and state-owned firms? Private firms located in SEZs, while benefiting from improved environmental and policy conditions, still face serval challenges. Firstly, most of the private-owned HNT firms in the Pearl River Delta region are start-up businesses. The founders of these private firms are usually people with certain industry background or technical experience. However, they lack sufficient entrepreneurial experience and innovation awareness (Luo and Tung, 2007). The primary goal of these firms is profitability and survival, rather than long-term innovative development. Therefore, in order to better meet market demand, they tend to focus more on improving productivity, which leads to poor innovation performance. Secondly, due to limited start-up capital for many nascent private firms, there is relatively less investment in R&D, resulting in insufficient technological accumulation. In this situation, private firms may lack technological advantages, which further constrains their innovation capability. Whereas for state-owned firms located in the SEZs, although the government provides corresponding policy support, their systems and mechanisms make it difficult to effectively promote innovation activities. State firms are more likely to be subject to the complexity of internal management and government regulation, which may impede the progress of innovation projects (Liu and Buck, 2007). Furthermore, state firms may lack the pressure of market competition that drives innovation activities since they enjoy monopolistic positions or possess significant market power. In addition, the complex stakeholder structure of state firms, including government, employees and shareholders, may cause the decision-making process regarding innovation to be slow and cumbersome, and may lead to a lower tolerance for innovation risk.

The informal test in Table 6 shows the instrumental variable used is exogenous.

Table 5 Heterogeneous effects of SEZ on firm innovation across ownership[1]

	Dep.var.= Output value of new product/total industrial output value					
	First stage estimation			Second stage estimation		
	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)
Affiliation	0.053*** (8.61)	0.003*** (8.89)	0.128*** (9.68)			
SEZ				0.965*** (3.60)	0.925 (0.81)	0.838 (1.54)
Firm size	0.006*** (5.10)	0.013*** (8.74)	0.005* (1.82)	0.104* (1.87)	0.027*** (8.16)	0.222*** (5.73)
Firm age	-0.0005 (-1.58)	0.0003 (0.81)	-0.0004*** (-5.70)	-0.001* (-1.75)	0.001 (0.16)	0.001** (2.23)
Ln(average wage)	0.053** (2.31)	0.041*** (3.27)	0.049** (2.29)	0.274*** (3.15)	0.316*** (2.89)	0.332* (1.68)
Ln(R&D expenditure)	0.021** (1.98)	0.029* (1.77)	0.189** (2.18)	0.024** (2.23)	0.046* (1.92)	0.041** (2.43)
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	0.254*** (4.83)	0.171*** (5.41)	0.282*** (4.83)	2.626*** (3.97)	4.401* (1.90)	1.823*** (5.08)
F-statistics	37.521	15.444	25.701			
Hausman test	0.0154	0.0371	0.0263			
Adj R-square	0.102	0.085	0.091			
No. Obs	10,290	9,567	1,003			

[1] The table presents instrumental variable estimation results. The dependent variable is output value of new product/total industrial output value. t-statistics are reported in parentheses.
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

Table 6 Informal test for exogeneity of the instrumental variable[1]

	Dep.var.= Output value of new product/total industrial output value		
	Foreign-owned firm	Private-owned firm	State-owned firm
Column	(1)	(2)	(3)
Affiliation	0.006(0.39)	0.029(1.32)	0.015(0.45)
SEZ	0.193***(9.26)	0.140***(6.23)	0.184***(4.64)
Firm size	0.083***(11.10)	0.135***(4.75)	0.192***(6.51)
Firm age	-0.0001(-1.56)	0.0001*(1.68)	-0.00006*(-1.89)
Ln(average wage)	0.142**(2.32)	0.113*(1.89)	0.105(1.43)
Ln(R&D expenditure)	0.015**(2.46)	0.073***(2.87)	0.048***(3.58)
Industry dummy	yes	yes	yes
City dummy	yes	yes	yes
Year dummy	yes	yes	yes
Constant	2.417***(5.72)	2.514***(3.83)	1.800**(2.52)
Adj R-square	0.118	0.097	0.106
No. Obs	10,290	9,567	1,003

[1] The table presents OLS estimation results. The dependent variable is output value of new product/total industrial output value. t-statistics are reported in parentheses.
*Significant at 10%. **Significant at 5%. ***Significant at 1%.

6 Conclusion

The development of high and new technology (HNT) industry in China is characterized by policy-directed industrial agglomeration which takes the form of "Special Economic Zone" (SEZ) established by the Chinese government in 1980. Using firm-level data from 1998 to 2015 for HNT firms in the Pearl River Delta (i.e., incorporating the cities of Guangzhou, Shenzhen, Foshan, Dongguan, Zhongshan, Zhuhai, Jiangmen, Zhaoqing, and Huizhou), this study investigates the impact of SEZ on firm innovation performance. Moreover, this study also examines how the ownership structure affects firms' capacity to leverage the advantages of SEZs. Employing the administrative affiliation of the firm as the instrumental variable, the

2SLS estimation results indicate that SEZs are viewed as an effective means for driving innovation performance of HNT firms. However, the findings demonstrate that not all types of firms are equally able to benefit from the SEZs, rather, it varies depending on the ownership. Only foreign-owned firms located in the SEZs exhibit superior performance in innovation, whereas private and state-owned firms fail to excel in this area.

Future research can improve by empirically analyzing the mechanisms through which SEZs promote firm innovation performance in depth. For example, SEZ may affect firm innovation output through alleviating firms' financial constraints. Firms located in SEZs would have access to more financing, including bank loan, trade credit, and government subside, which enable HNT firms to invest more in R&D and generate better innovation performance. SEZ may also attract a large pool of talent, therefore improving innovation capabilities.

Notes

[1] Data source: China Statistic Yearbook on High Technology Industry, 2009-2021.

[2] Data source: China Association of Development Zone (CADZ).

[3] Data source: China Association of Development Zone (CADZ).

[4] The national-level SEZs are authorized by China's central government, while the provincial-level SEZs are certificated by local government.

[5] According to "Code for subordination of organization in China (two-digit)", firms are divided into 12 categories of administrative affiliations: Central Committee of the Communist Party of China(10); Province, Municipality and Autonomous Region(20); City(40); County(50); Subdistrict, Town and Township(60,61,62,63); Residents and Villagers committee(70,71,72); Other(90). "Other" denotes the firm does not have any administrative affiliation.

This article is an expansion and revision of a portion of Chapter 4 of my doctoral dissertation (Kyoto University, 2019).

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