

Regional Distribution and Industry Evolution: Investigating the Geography of Guangdong Business Incubators

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Abstract

As the main body of regional innovation, technology business incubators play an important role in promoting regional economic development. Based on the analysis of the status quo of incubators, we take Guangdong Province incubator as an example, analyse the regional distribution characteristics and incubation differences of technology incubators from the perspectives of regional distribution and industrial distribution. Then analyze the differences between inter-area incubators from the perspectives of incubating ability, innovation ability and entrepreneurial ability. Finally, based on the industrial distribution of incubators, the relationship between incubator industrial distribution and regional economy is discussed in depth. The analysis shows that the incubators in the Pearl River Delta (PRD) region have become the mainstay of regional innovation and entrepreneurship, and the incubator industry has a high degree of matching with the regional industries to promote economic development.

Key words: Incubator; Regional distribution; Innovation ability; Industrial distribution

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INTRODUCTION

As a carrier to promote the transformation of technological achievements and foster high-tech enterprises and

entrepreneurs, technology business incubators have great significance to promote high-tech development and improve national and regional innovation systems. With the founding of Wuhan Donghu Entrepreneurship Center, the first incubator in China in 1987, incubators have gradually begun to take responsibility of making the secondary innovation of high-tech industry leading technology in our country. At present, the total number of incubators in the country has reached 2,530, and the incubating area has reached 86 million square meters, achieving the incubators full coverage of provinces. Compared with other provinces and cities, the incubator construction in Guangdong started earlier. With the strong support of national science and technology policies, the incubators in Guangdong Province have entered an accelerated period of development. However, regions have not benefited equally from the rapid expansion of business incubators during the past two decades, due to the policy support and economic conditions in different regions, Regional distribution and construction quality show a significant gap; Furthermore, the incubator industry plays an important role in promoting regional development and enhancing regional competitiveness, thus triggering the scholars to study the internal causes of regional disparities.

Technology business incubators play an increasing important in supporting startups (Mian, 1996), nurturing entrepreneurs (Aernoudt, 2004), and promoting the economic development (Markley & McNamara, 1995). Despite the growing concern about business incubators, a geographic perspective has been rare. The existing literature sheds little light on why business incubators appear in some regions but not others (Qian et al., 2010). Traditionally, regional differences in the formation of new firms are explained by population growth or migration, as well as the employment ratio of small firms (Reynolds et al. 1994). Entrepreneurial knowledge spillover theory suggests that knowledge is an important source of

entrepreneurial opportunities (Acs & Audretsch, 2009) and support human capital as another geographically restricted factors, may affect local entrepreneurial activity (Acs & Armington, 2006).

In the area of incubator geographical distribution, domestic scholars have focused more on incubator's regional innovation system, innovation performance, etc. Zhang (2010) explored the role of incubators in regional technological innovation and pointed out that incubators can accelerate technological innovation through four major roles: transit service platform and innovation support space, etc. Based on the externality theory, Zhu (2014) explored the impact of incubator urban externalities on efficiency and the impact on regional economic convergence and regional innovation convergence.

Therefore, due to the peculiarities of economic development in the PRD and other areas in Guangdong province, there are big differences in the construction of regional incubators. To some extent, there is a strong connection between regional economic development and incubator construction. Incubating ability, innovation capability and entrepreneurial capacity of regional incubators have affected the regional economic development. What are the current status of incubator construction in Guangdong Province? What causes the gap between the PRD and the other region of Guangdong? Does the construction of incubators drive the transformation of regional economy or provide strong support for the development of existing industries in the region? This article analyzes the development history and current situation of the incubator in Guangdong Province from the perspectives of regional development and industrial development, probes into the relationship between innovation incubator ability and industrial distribution and economic development in Guangdong Province.

1. INCUBATOR CLASSIFICATION AND DEVELOPMENT STATUS

1.1 Classification of Incubators

Among the foreign research literatures, scholars categorize incubators according to the investment background Smilor (1987) divides the incubators of private incubators, corporate incubators, community incubators and college incubators. According to Rosa Grimaldi and Alessandro Grandi (2005), incubators are divided into four types depending on the ownership of incubators. Elias G. Carayannis (2005) proposed five prototypes of incubators based on the research of Rosa Grimaldi and Alessandro Grandi: college incubators, business incubators, local incubators, intra-company incubators and virtual incubators. According to Becker and Gassman (2006), all incubators can be divided

into profit-making and non-profit based on the market orientation of investors.

In domestic studies, the classification differs greatly in terms of research questions. Qian (2000) believes that the types of enterprises under incubation can be divided into hybrid incubators, professional incubators and international incubators. In the scientific classification of business incubators, incubators can be divided into seven categories: modern integrated business incubators, professional, technical business incubators, etc. (Jing 2001).

In this paper, according to the criteria of dividing and analyzing the incubating targets we divide the incubators into two categories: comprehensive incubators and Professional incubators. Comprehensive incubator for all high-tech fields, using powerful network of intermediary services to accelerate the transformation of scientific and technological achievements to help enterprises rapid development, and they are committed to helping entrepreneurs solve the hatchery, share facilities, government connectivity, tax incentives and other basic problems, and they advocates intermediary service network for businesses such as venture capital and other important resources (Lin & Jiang, 2002), representative incubators are Zhongshan Torch Hi-Tech Venture Center, Guangzhou Hi-Tech Venture Service Center, etc.

Professional incubators only for a professional and technical areas of high-tech business incubator, providing shared technology platform, common professional technology and equipment and specialized incubation services, in a certain area of science and technology to concentrate its advantages of resources to incubators start-ups, which greatly improve the survival rate of enterprises, representative incubators are Guangdong Tuosi Software Science Park, Guangdong Guan Hao Life and Health Science Park.

1.2 Incubator Development Status

After more than 20 years of construction and development, incubators in Guangdong have made an important contribution to regional innovation and entrepreneurship, the development can be divided into the following three periods (Figure 1): First, the initial development period (1991-2000). In 1991, Guangzhou High-tech Venture Service Center, the first hi-tech business incubator in Guangdong Province, was established. During this period, incubators were slow development, mainly appeared in economically developed areas such as Guangzhou, Shenzhen and Zhongshan, providing relatively simple basic hatching conditions and incubation services. Second, the rapid growth period (2000-2010), in 2001 Guangzhou Torch Hi-Tech Venture Service Center was established, and actively promotes the incubator development. With the policy-driven and experience accumulated, incubators have been rapidly growing. By 2010, Guangdong Province has built 100 incubators, doubling the number of incubators and increasing the total area of incubators

nearly 11-fold. During this period, incubator construction gradually became mature; Third, the mature incubator (2011-now), incubators pay more attention to quality and service improvement. The incubator policies drive the incubator to a higher level such as diversified investment, professional service and flexible mechanism. By June 2016, the number of incubators reached 537 and the hatching area reached 18 million square meters. In recent 5 years, the growth rate of incubators has obviously accelerated. From 2011 to 2016, 437 incubators were added, accounting for 81.4% of the total, which is 5.37 times the total number of incubators from 1991 to 2010, showing a sharp increase in both the number and the area.

Among them, there are 367 comprehensive incubators (CI), and 170 professional incubators (PI). The development of early incubators is based on the comprehensive incubator, with the business needs and market development, professional incubators began to appear in large numbers (Figure 1). Incubators have entered a period of rapid growth since 2000, the growth rate of professional incubators has been steadily rising above comprehensive incubators. As a whole, Guangdong incubator is moving towards a period of professionalism, high quality and heavy service development, entering a mature period of “function improvement and service deepening”.

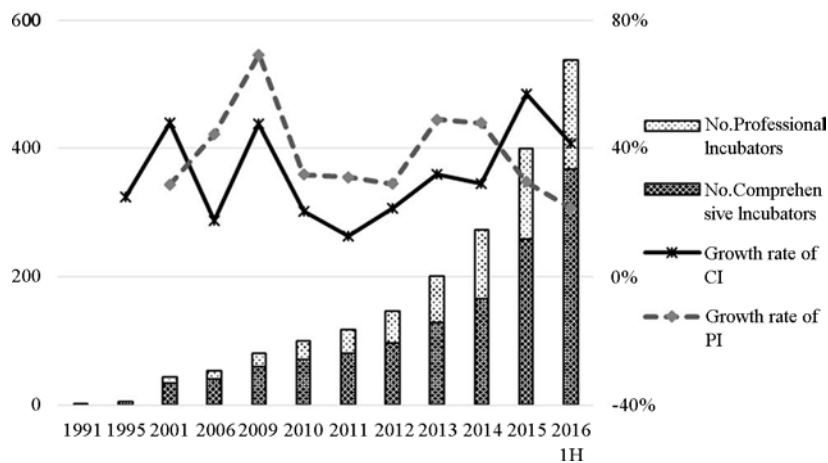


Figure 1
The Incubators Growth in Guangdong Province

2. REGIONAL DISTRIBUTION CHARACTERISTICS AND INCUBATION DIFFERENCES

In view of the unique advantages between technology innovation and production transformation, incubators have become socio-economic organizations that aim to promote and realize the industrialization of high-tech technologies and have made tremendous contributions in promoting regional economic development and promoting the optimization and adjustment of the industrial structure contribution. Technology incubators enable various innovative resources to interact with each other and optimize integration so as to promote the formation of an innovative mechanism of regional economy. It's an important carrier for spawning an innovation mechanism in the region. From an overall and investment perspective, we analyze regional distribution characteristics and incubator differences embodied in incubating ability, innovation ability and entrepreneurial ability, and strive to find out the problem of regional development imbalance.

2.1 Regional Distribution Characteristics

Relying on the regional data provided by the Science and Technology Department of Guangdong Province, the number of incubators is divided into 5 groups of 1-5, 6-10,

11-30, 31-40 and above 40 according to the data features. The ARCGIS 10.2 geographic information system is used to form an incubator geography (Figure 2). The size of the circle represents the number of incubators.

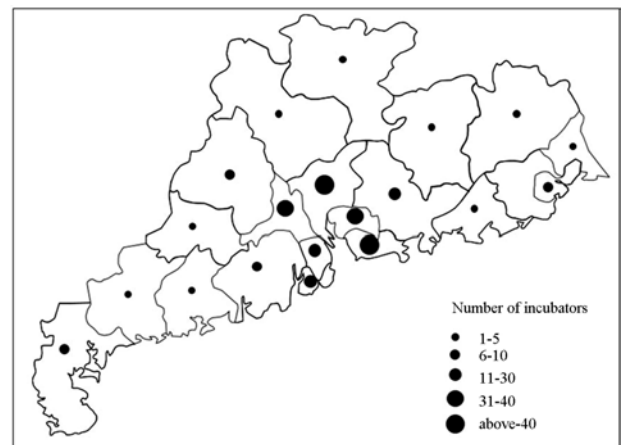


Figure 2
Regional Distribution of Incubators Across Guangdong

Source: Incubator information was collected by Guangdong Science and Technology Business Incubator Association.

As can be clearly seen from the figure, Guangdong has achieved full coverage of the incubators, but there are obvious gaps in the number of incubators in different

regions. Shenzhen, Guangzhou, Dongguan has become the main distribution, including more than 75% of incubators, relatively speaking, eastern Guangdong, western Guangdong and northern regions significantly lagged behind. Comparing the average ages of incubators, we found that the incubators are older where incubators number is relatively high, Shenzhen, Guangzhou reached more than seven years; While the average age in eastern and northwest Guangdong, Chaozhou and Zhanjiang in particular, the average age is less than 2 years, this further demonstrates the leading role of the Pearl River Delta incubator industry.

There is a big gap between PRD and the other district incubators, the regional development is extremely uneven (Table 1). 56 (96.6%) national incubators are located in the Pearl River Delta region, only 2 left in the other district. There is also uneven development inside PRD. The top three national incubators are Guangzhou (31%), Shenzhen (24.1%) and Dongguan (13.8%), and the top six incubators' average income is more than 100 million yuan, tenant firms more than 1,000, far exceeding the level of other regions. However, the three cities of Huizhou, Jiangmen and Zhaoqing lag far behind the rest of the Pearl River Delta Region.

Table 1
The Regional Distribution Index of the Incubator in Guangdong

Area	Number of incubators	National grade (%)	Tenant firms (thousands)	Incubating area (million sq.m)
PRD	490	56(96.6%)	24.351	17.35
Eastern area	25	1(1.7%)	0.741	0.32
Western area	15	0	0.439	0.19
Northern area	7	1(1.7%)	0.21	0.08
Total	537	58(100%)	25.747	17.93

2.2 Regional Incubation Differences

2.2.1 Regional Incubating Ability

With the constant development of science and technology innovation activities and the continuous expansion of high-tech industries, technology business incubators have played a huge role in incubating high-tech enterprises and transforming scientific and technological achievements. However, at the same time, such problems as the inefficiency of operation and deployment of incubators and the uneven development of regional science and technology incubators restrict the service functions of incubators (Huang, 2013). Therefore, some scholars have carried out some researches on the incubation efficiency and performance evaluation of incubators. For example,

KF Chan and Theresa Lau (2005) pointed out that service provision incubator must be adapted to the stage of development of enterprises, and thus proposed evaluation framework incubator containing 9 indicators, while Chinese scholars mostly studied on input-output theory, using data envelopment analysis to evaluate the overall efficiency of incubators. According to the experience scholars, we establish four indicators of incubating ability analysis: the average graduation rate of tenants (AGR), the average incubation time of graduating tenants (AGT), the number of high-quality staff in unit incubation area (NOS) and the number of tenant firms incubated in unit incubation area (NOF), thus to analyze the differences in incubation results between incubators in different regions.

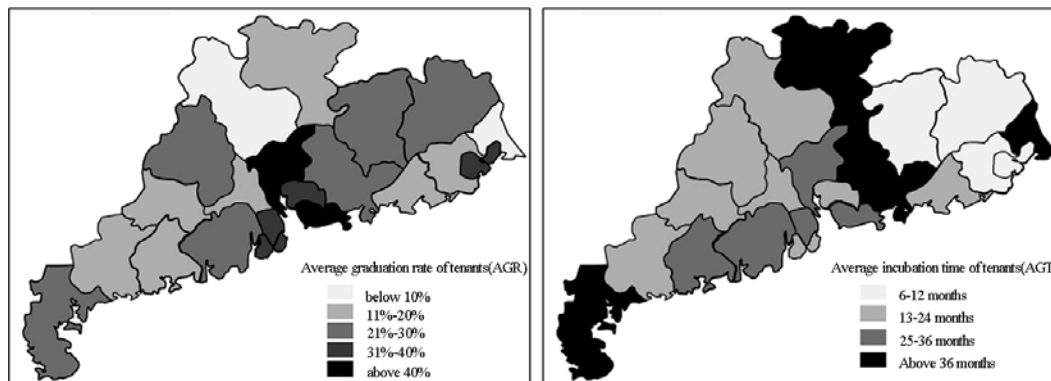


Figure 3
The Thermodynamic Chart of Regional Incubating Ability

The overall graduation rate of tenants is generally low (Figure 3), with an average graduation rate of 25%. Among the graduation rates of all regions, the graduation rates in most parts of the Pearl River Delta

are generally higher than those other areas, especially in Guangzhou and Shenzhen, reaching over 40%, Qingyuan, Chaozhou graduation rate is the lowest. The incubation time of graduating tenants is about 2 years, the overall

graduation rate is low because of the widespread existence of a phenomenon: the incubators didn't establish a sound standard of graduation, and they lack of a clear understanding of graduation. For tenants, the services and support they enjoy when choose to continue incubating is far outweighed from the benefits of graduation, so most enterprises do not choose to graduate without the

well-established graduation policy of incubators. For incubators, the experience and guidance that graduating tenants can provide to start-ups are considerable. Even though the Ministry of Science and Technology of the State Council stipulates that enterprises should not be incubated for more than three years, few incubators will implement this standard.

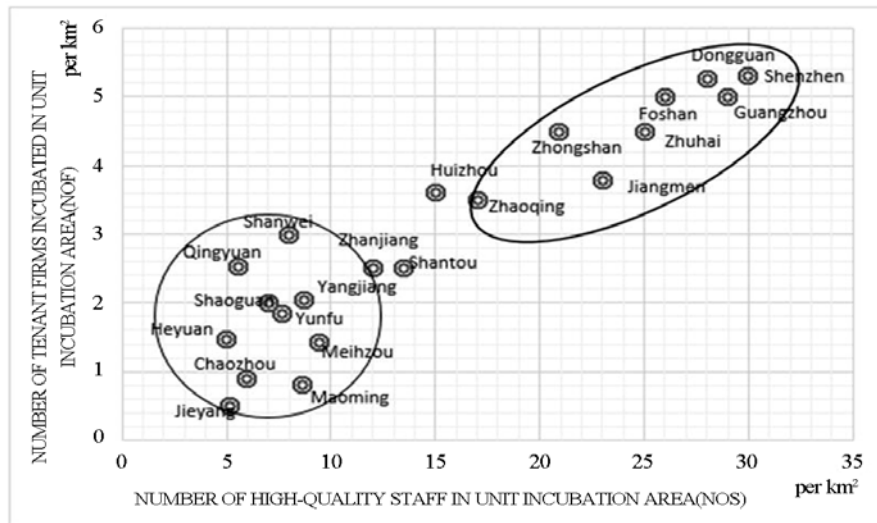


Figure 4
Distribution of Incubating Capacity (NOS, NOF) in Various Regions

The analysis showed that there was a tendency of concentration of incubating capacity in the Pearl River Delta Region and other regions, and there was a big gap in indicators between two Gathering circle. The management level and the utilization rate in the PRD are all higher than those in the other regions (Figure 4). The incubating area in developed areas host more enterprises, showing a tendency of “small area” incubating, and high incubating area utilization rate. The eastern, western, northern part of Guangdong give sufficient physical space to incubate enterprises, but the utilization of incubating area is lower. Combined with the geographical advantages of the region and the economic status quo, incubators in eastern, northwestern in Guangdong pay more attention to providing well-established infrastructure for incubating enterprises, especially physical space and hardware support such as basic properties. The PRD Region pays more attention to entrepreneurial mentors, high-quality management and other soft services, their perfect incubation services greatly increased the incubating capacity of their own incubators.

2.2.2 Regional Innovation Capacity

As the source of innovation, incubators have unparalleled advantages in promoting innovation and the commercialization of research findings. High-tech enterprises that hatched successfully from incubators all play an important role in local economic development.

The strength of technical innovation capability of incubators is an important measure of the technological innovation capability in different regions. It mainly shows that incubators activate and enhance the efficiency of regional independent innovation, promoting the continuous improvement of regional original innovation and system integration innovation. Since incubators have established 25 years, all the regional governments have invested a lot of money and resources in incubator construction. The innovative ability of incubators and their contribution to the development of regional economy are different in each area.

The number of incubator IPRs is highly concentrated and the regional development is uneven the number of IPRs totaled 18,883, of which 26,148 were in the PRD region, accounting for 97%. The level of R&D investment determines the number of intellectual property rights to a certain extent, the figure can be clearly seen in the incubation of enterprises with higher average R&D investment, the higher the number of IPRs. Analysis shows that Shenzhen, Dongguan, Guangzhou, Foshan are the most active areas in incubator innovation. Similarly, the transform rate of scientific research achievements in these areas is relatively high. The distribution of intellectual property and R&D investment rankings basically showed consistency, and we found some area which have less number of incubators but higher ability to innovate, such as Jieyang, Shanwei, and Meizhou.

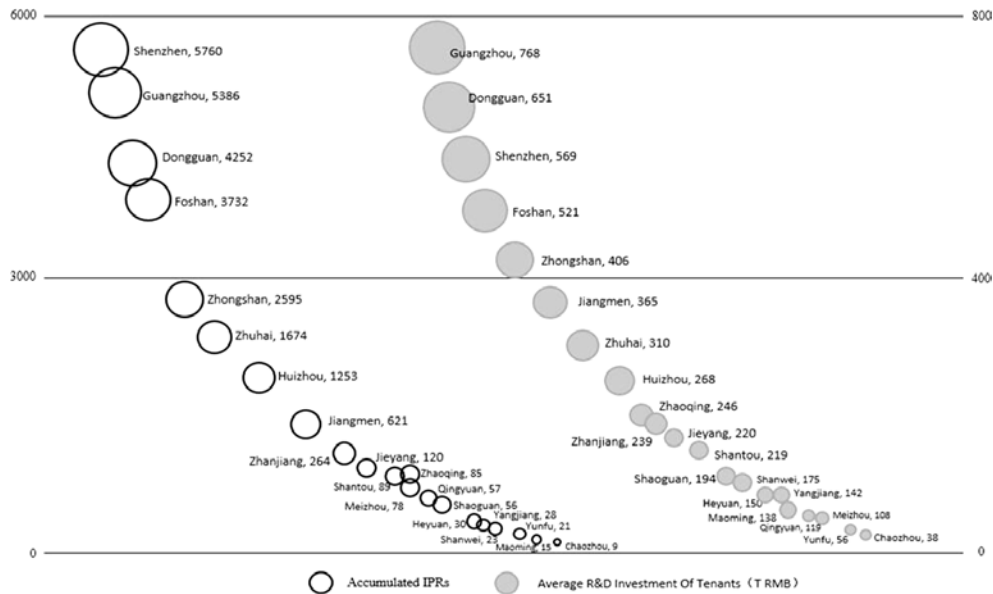


Figure 5
The Areal Distribution of IPRs and Average R&D Investment of Tenants

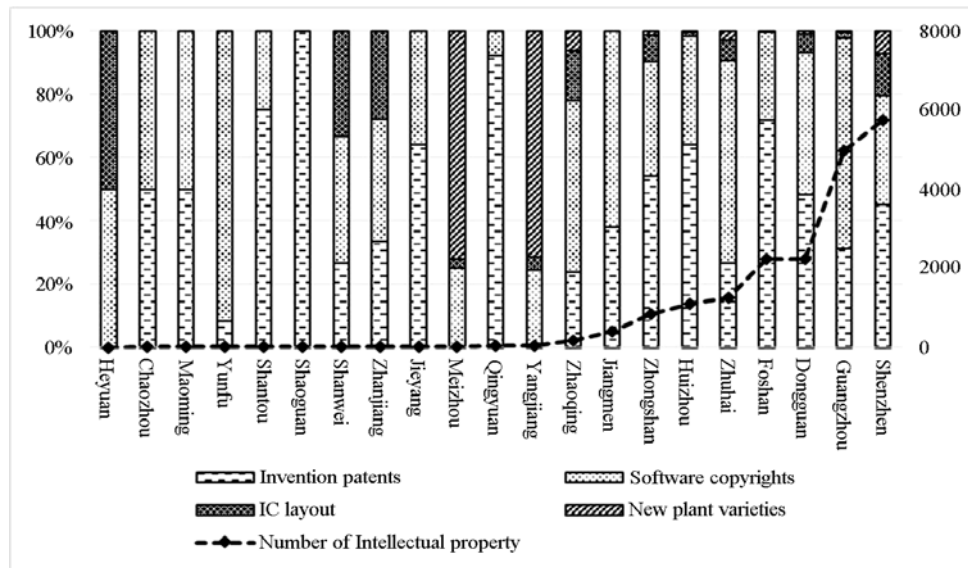


Figure 6
Comparison of Intellectual Property Types in Various Regions

Among the types of intellectual property identified by science and technology authorities, invention patents (41%) and software copyrights (44%) were the major types of intellectual property, with 8% of ic layout and 7% for new plant varieties (Figure 6). In general, industrial agglomeration and the close proximity of physical locations in the same industries facilitate the dissemination of knowledge, resulting in synergies and dynamic flow of knowledge, while the distribution of intellectual property types reflects the local industry specialization to some extent.

On the one hand, the regions focus on different industries lead to diversity in IPRs. In the more developed regions, the types of IPRs are more diversified. For example, the IPRs in Shenzhen, Guangzhou and other

PRD regions have formed a diversified and aggregated pattern. In contrast, backward regions are generally specialized in certain specialized industries such as electronic information, biomedicine and modern agriculture, such as 75% of new plant varieties in Meizhou and Yangjiang, 65% in software copyright of Yunfu, which is related to the construction of specialized industries in the region. It can be seen that the agglomeration of incubators in the PRD region shows a trend of diversification while the other area of Guangdong pay more attention to the industrial specialization.

2.2.3 Regional Entrepreneurial Ability

Incubators have become an important hematopoietic organ in regional economy and play an important role in fostering creative talents, and become the main force

in creating a new growth point of the regional economy (Yan, 2009). First, incubators can attract high-caliber talent to form a talent gathering spot. Second, high-tech and knowledge-intensive industries are capable of cultivating entrepreneurs and reserve jobs for regional development, become an important source of job growth and economic growth (Sable, 2006). At present, the number of people employed by enterprises in Guangdong Province for starting businesses has exceeded 390,000, while the number of employees driven by incubators has reached 200,000. Among them PRD region accounts for 97%. Incubator construction not only contribute to the growth rate of the local economy, but also promote the employment level to a large extent (Minguillo et al., 2015).

Incubation rates of new entrant rate show the opposite trend of regional distribution, higher in more backward

areas (Table 2). The average rate of incubation in eastern, western and northern areas is 29% higher than that in developed regions (PRD), which in part reflects the poor liquidity of tenants in the Pearl River Delta region, while the turnover rate of incubators in backward regions is even higher. The main reason is that incubators in eastern, northwestern regions have generally been established lately and are in high demand for incubation in early start-up stages and have a high rate of incubation failure. In contrast, in the PRD regions, incubators are well-established, enterprises have high viscosities and degrees of dependence on incubators. Tenants that moved into incubators in previous years were not able to leave quickly due to their stickiness and the incubators were already saturated at a steady period of time, resulting in lower flow rates.

Table 2
The Regional Entrepreneurial Ability Index of the Incubator in Gangdong

Area	New incubation rate (%)	Listed enterprises (accumulated number)	Listed enterprises (2016 1H)	Enterprises which operating income more than 50 million (2016 1H)
PRD	40%	652	96	257
Eastern area	63%	11	4	9
Western area	70%	6	3	5
Northern area	74%	3	2	4
Total	56.75%	672	105	275

As of June 2016, the accumulative graduate enterprises in the Guangdong have exceeded 6,000, and more than 4,000 high and new technology enterprises. Among them, more than 30% of the enterprises with the annual income of more than 10 million yuan, and the total revenue of the incubators exceeded 300 billion yuan. Technology business incubators have become an important carrier for our province to stabilize economic growth, enhance the vitality of economic development and enhance the capability of independent innovation. From a regional perspective, only the Pearl River Delta region has obvious advantages in entrepreneurial ability. In addition, incubators, as the cradle for nurturing high-tech enterprises, reflect the effect of incubation result and their impact on regional entrepreneurial ability to a certain extent, the listed enterprises in the PRD region and the number of high-income-earning enterprises are far beyond other regions, obviously become the main base for the growth of high-tech enterprises.

3. INDUSTRIAL DISTRIBUTION CHARACTERISTICS

Over the years, scholars have made in-depth discussions on the functional orientation of incubators and studied the function orientation of incubators through different theories such as environmentalism, organon and histography. According to Aernoudt (2004), the core social function of incubators is fostering regional

innovation capacity, while creating tax sources, nurturing entrepreneurs, providing employment opportunities are general social functions. Audretsch (1995) pointed out that incubators can be used as a booster for regional economic development by optimizing and integrating regional resources, fostering regional innovation themes, developing and nurturing related industries, promoting the upgrading of local industries and expanding tax sources.

In short, the establishment of incubator plays an important role in the development of industrial clusters, narrowing the regional disparities and promoting coordinated regional development. Professional incubators have become an important direction in the future. In order to further analyze the relationship and differences between regional incubator construction and economic development, the author explores the matching degree between regional industrial layout and planning, and analyse industrial distribution development time series, find the reasons for the regional differences caused by the incubator industrial distribution.

3.1 The Development of Industrial Distribution

At present, a total of 170 professional incubators have been established in Guangdong Province, and the diversification trend in the field of industrial distribution has taken shape. Combining with the “General Plan of Guangdong Province for the Construction of a Modern Industrial System”, this article classified the incubator industrial distribution into six industries: strategic emerging industry, modern service industry, advanced

manufacturing industry, traditional industries, modern agriculture and basic industry.

As shown in Figure 7, the incubator industrial distribution is mainly strategic emerging industries. During the sample period, 122 incubators for strategic emerging industries were allocated, accounting for 71%, followed by 25 modern service industries, accounting for 14%. In terms of time series, the number of incubators in the three main industries of strategic emerging industries,

modern service industries and advanced manufacturing industries all showed a continuous growth trend, with significant changes and enhancements after 2011, which is closely linked with the policies. The promulgation of a series of policies since 2008 has a significant stimulating and promoting effect on the construction of modern industrial system and professional incubator in Guangdong Province. The policy stimulating effect is obvious.

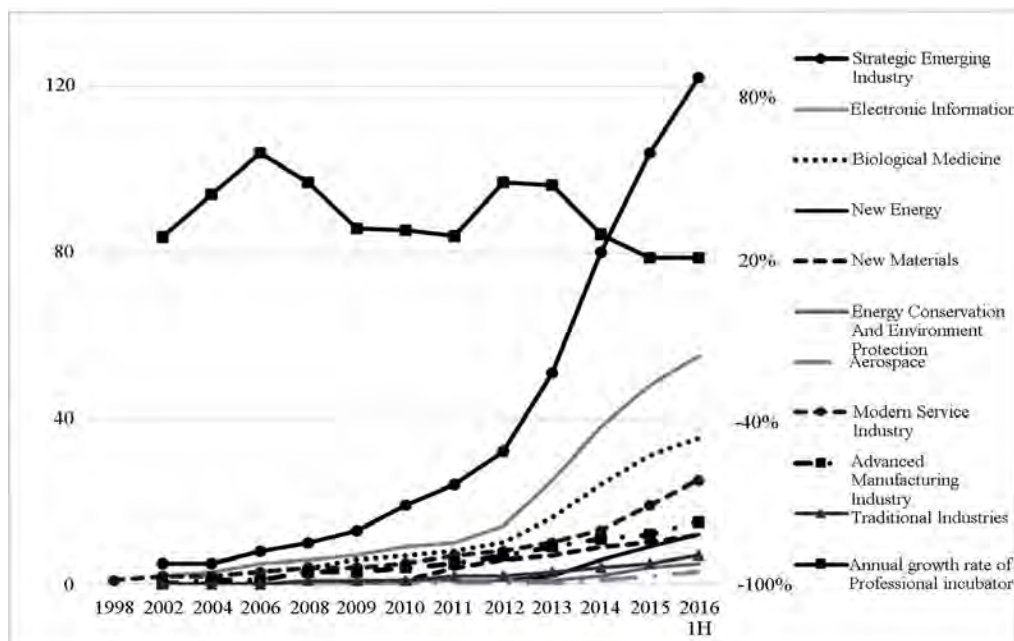


Figure 7 Time Series of Incubator Industry Distribution

3.2 Industrial Distribution and Synergistic Effect

The establishment of professional incubators has close ties with the development of industrial clusters in the region and the promotion of regional industrial restructuring and upgrading. In order to further investigate the matching between incubator industry construction and regional industry development, this paper analyzes incubator distribution industries in different regions in detail. The study found that strategic emerging industries are the main industries in the incubator layout in the Pearl River Delta. Compared with the incubator, a relatively small number of specialized incubators were established in the more backward areas in eastern and northwestern Guangdong. Most of the layout in the electronic information industry, a small amount of distribution in the modern service industry, advanced manufacturing and modern agriculture (Figure 8).

In line with the conclusion of the previous analysis of patent types, the incubator has a more specialized industrial layout in the backward areas of eastern and northwestern regions. For example, the software copyright and integrated circuit layout of Heyuan account for 89%

of the total, corresponding with the E-commerce business incubator. Further analysis found that 80% of incubators in the modern service industry are based on cultural and creative industries, such as Zhuhai Creative Park and Shunde Creative Industries Park. Among traditional industries, most are ceramic industry incubators, such as Foshan 1,506 Creative City and Foshan Dongxing Ceramics Technology Business Incubator, which show a high degree of consistency with the leading industries in Zhuhai and Foshan.

The more developed incubator areas, the more diversified the industries of incubators are. However, due to the differences in regional development planning and the advantages of regional industrial development, the focus of distribution industry is various in regions (Figure 9). The distribution of industries in the Pearl River Delta region is consistent with the overall layout of Guangdong Province. The leading industries in all regions are in line with the layout of their local industries. Comparative analysis, Guangzhou and Shenzhen have similar industrial structure, incubator layout of electronic information, bio-medicine and life health is corresponding with the current main body of the industry.

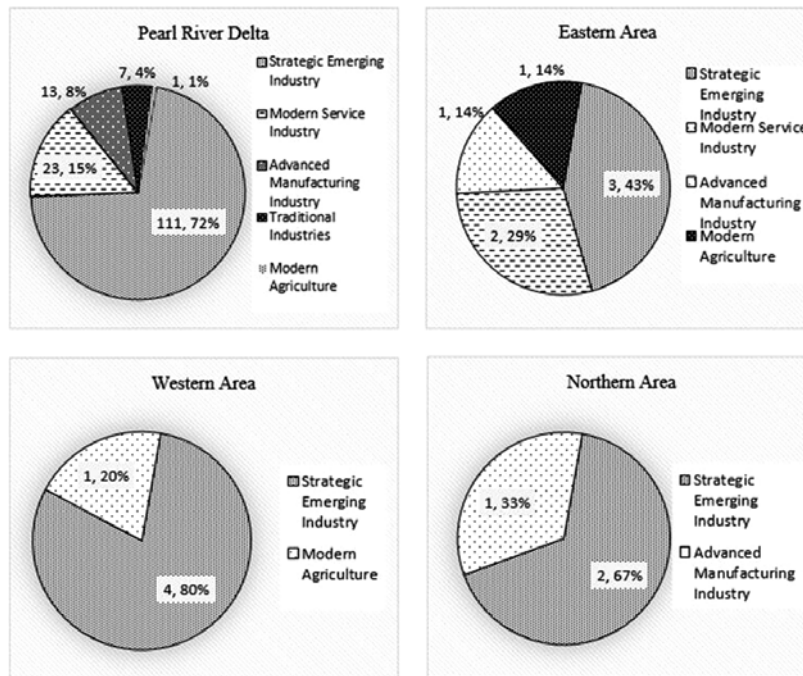


Figure 8
The Industry Distribution of Incubators in Guangdong Province

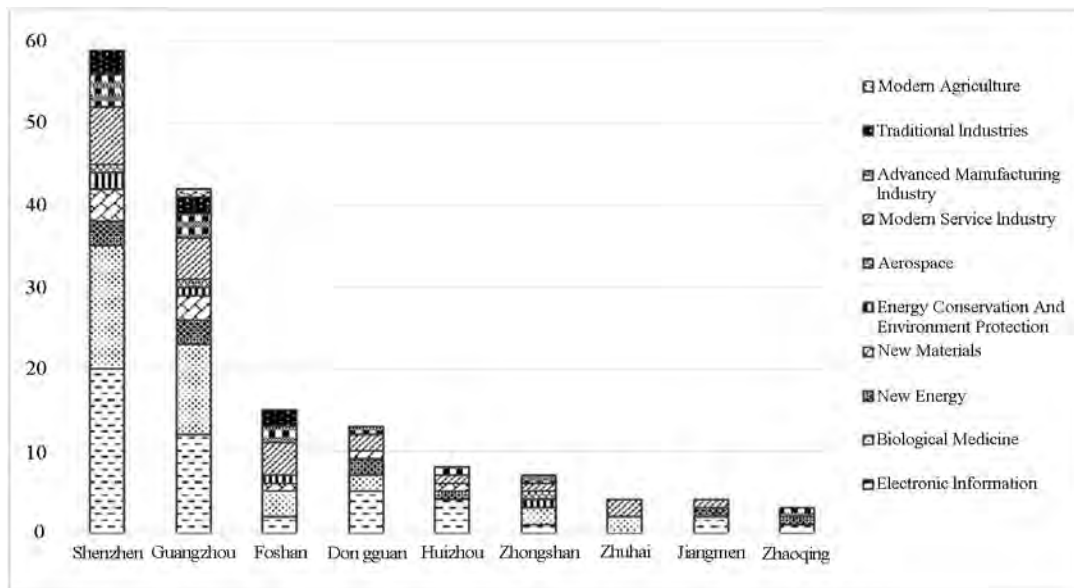


Figure 9
The Incubator Industry Distribution in the Pearl River Delta

Incubator is the source of spillover of regional science and technology industry. Incubator industry distribution and regional specialized division of labor promote the formation of industrial clusters, contributing to the synergic effect of regional resource cooperation and petition cooperation within the industry. Due to the close proximity and frequent economic connections, industrial clusters can promote knowledge transfer and spillover between enterprises, which are the unique advantage of professional incubators. The synergistic effect of competitive coordination and collaboration promoted by industrial clusters enhances

the quality of resources. With the competitive mechanism and learning effect of enterprise clusters, the sustained innovation of enterprises has led to the continuous improvement of the quality of resources in the region and the continuous growth of professional incubators.

CONCLUSION AND DISCUSSION

Incubator construction not only affects the ability of incubating, innovation and entrepreneurship in the region, but also affects the local industrial layout and economic

development. In contrast, the local economic development has affected the level of incubator construction, and they are mutually beneficial. In terms of regional distribution, the number and quality of incubators in the Pearl River Delta region have been significantly advanced. Their ability of innovation and entrepreneurship is obviously superior to that of eastern, and north-western areas and become the bridgehead for cultivating high-tech enterprises. This is closely linked to the developed economy and entrepreneurial needs of the PRD. Due to the differences in economic and policy conditions, the incubators in different regions have different focuses on services, the backward regions pay more attention to hardware support while the developed regions pay more attention to the promotion of soft services.

In the industrial distribution, the strategic emerging industries, modern service industries and advanced manufacturing industries are the three main industries of the incubator layout. The government's policies have obvious incentive effects. It is found that the construction of the incubator in the PRD provides strong support for the development of the existing industries in the region, while the construction of specialized incubators in the eastern, and north-western part of Guangdong supports the transformation and upgrading of the industries.

Therefore, paying attention to the incubator's regional and industrial layout is of great significance. In particular, the demand for innovation and entrepreneurship in both the country and the province nowadays is continuously strengthened. On the one hand, the developed economy has promoted the construction of incubators and the improvement of service quality. On the other hand, relying on the development of local industries, incubators play an important role in promoting regional economy and industrial restructuring and upgrading. Under the current policy and economic situation, incubator construction also plays an important role in promoting the coordinated development of the region and narrowing the gap in regional development.

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