Journal of Korea Trade Vol. 24, No. 6, October 2020, 37-60
https://doi.org/10.35611/jkt.2020.24.6.37
ISSN 1229-828X

Innovation Space Driving Business Growth of Semiconductor Enterprises: A Case Study of South Korean Samsung's Investment in China*

JKT 24(6)

Received 12 March 2020
Revised 20 May 2020
Accepted 8 September 2020

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Abstract

Purpose – The purpose of this study is to investigate the direct and indirect impact of innovation space factors on the growth of semiconductor enterprises.

Design/methodology – This empirical study uses the financial statements of 83 semiconductor listed companies in 23 provinces from 2004 to 2019 approved by CSRC (2019). A stepwise regression and backward regression are employed in order to examine the role of innovation space to expand technology investment in promoting business growth and uses South Korean Samsung's investment in China as a test case.

Findings – Results indicate that innovation space, technology input, geographical area, owner's background, operating years and financing liabilities all contribute to a boost in business growth. Factors such as carbon emission, financial liberalization, government efficiency, technology input, and financing liabilities further influence management growth. Innovation space follows a nonlinear pattern, and this plays a positive role in magnifying the influence of technology on management growth. Additionally, operations of the state-owned companies and expansionary financing enterprises are influenced by the external economy. Regarding the spatial distribution, the Samsung investment in 24 companies in China shows that Samsung focuses on the acquisition of scarce resources for semiconductor production as a component of its investment and innovation strategy.

Originality/value – Even though prior research has considered the concepts studied here, this study contributes to empirically evaluate the direct impact of innovation space on business growth, and the indirect impact of innovation space on business growth through technology investment. This study includes an in-depth discussion of the practical effects that innovation space has on China's economy, using a case of South Korean Samsung's investment in China as a test the empirical findings.

Keywords: Business Growth, Innovation Space, Semiconductor Industry, Samsung's Investment, Technology Investment
JEL Classifications: C12, F18, O30

1. Introduction

Innovation space is a form of material space which promotes the knowledge economy; this spatial concept is larger than industrial agglomeration space. The knowledge economy has

* This work was supported by Shanghai Municipal Education Commission "Research on Intellectual Property Public Domain Issues under the Strategy of Innovation-Driven Development" (2019-01-07-00-07-E00077) the China Science and Technology Association (Project: NO.19WURD006).
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become an important factor in improving the competitiveness among countries, regions, and cities. Science, technology, and innovation capability aim to attract enterprises' investment and promote regional economic growth (Bercovitz and Feldman, 2007). Innovation space includes the urban belt space innovative cities and innovative units. Moreover, innovation space comprises the following: a group of manufacturing enterprises engaged in the production and supply of innovative products, educational and research institutions, and governments. Educational institutions aim to train innovative talents; research institutions are further engaged in the dissemination of innovative knowledge and technology. Government agencies and commercial intermediaries support innovation activities through finance, policies, and regulations.

In practice, the impact of innovation space on business growth plays an important role which may be that of a "promoter" and/or a "blocker". Additionally, strengthening industrial agglomeration, increasing knowledge spillover effect, and geographical distribution of patents can significantly promote the sales of local enterprises (Luan Chun-Juan, Wang Xu-Kun and Lin Ze-Yuan, 2008).

China's innovation space can enhance the competitiveness between Chinese enterprises and foreign enterprises, improve the human cost of enterprises, and intensify the impact of foreign enterprises on local enterprises. In 2018, China formulated several policies to promote scientific and technology innovation. With a series of enacted laws and regulations to promote innovation, it is clear that innovation space could play a pivotal role in promoting business growth in China.

Globally most economists agree that innovation space can influence business growth, but, in China, consensus has not yet been reached. Two main arguments have been postulated: the first measures the distribution of innovation density in Chinese cities by using Newton's gravity model. This demonstrates a significant positive spatial correlation between geographical characteristics and innovation input and output (Li Jing, Tan Qing-Mei and Bai Jun-Hong, 2010). Chen Yu and Xie Fu-Ji (2017) argued that the Pearl River Delta, the Yangtze River Delta, and the Bohai Rim have enjoyed significant increases in innovation in the last few years; whereas, the Shenzhen, Suzhou and Tianjin cities play an obvious role in the growth rate. In terms of input and output efficiency, Niu Xin and Chen Xiang-Dong (2013) adopted low input and high efficiency for Tianjin, high input and high efficiency for Beijing, high input and low efficiency for Shanghai, Jiangsu, Shandong and Guangdong, and low input and low efficiency for Shaanxi.

The second argument is based on China's provincial panel data from the macro-regional environment, which includes property rights protection, tax preference, capital loans, university R&D, talent acquisition and the industrial chain. This data is used to analyze the impact of innovation space on business growth. Bai Jun-Hong, Jiang Ke-Shen and Li Jing (2009) postulate that the government is the first external agent of technological innovation, and the scientific and technological talents are the main drivers of innovation strategy. Xie Zuo-Miao and Peng Juan-Juan (2006) and Wang Wen-Ting and Kan Li-Rong (2020) believe that the proportion of foreign direct investment (FDI) in a region provides a pivotal role in promoting technology investment. On the other hand, Chen Yu, Li Xiao-Ping and Bai Peng (2007) and Xie Jia-Zhi, Liu Si-Ya and Li Hou-Jian (2014) believe that the scale of urban credit has a significant positive effect on the R&D investment.

However, macro data fails to identify the parameters of innovation space that influence specific industries. The innovation space factors affecting business growth are not yet identified in China's semiconductor industry. As a corollary, the current Chinese literature focusing on the heterogeneity of the business growth model mostly uses sample estimation and threshold regression. In this approach, the apriorism subjectivity and deviation of sample selections are unavoidable.

We therefore pose the following questions: Can innovation space improve the operational growth of the semiconductor industry? From an innovation space perspective, what are the factors that affect the heterogeneity of the semiconductor industry? What is the significance of Samsung's spatial distribution investment in China's semiconductor industry? This study uses a "data-driven" method to investigate the role of innovation space to expand technology investment in promoting business growth. Using the financial statements of listed companies in 2004-2019 approved by CSRC (2019), we carry out a direct comparison of relevant variables of innovation space factors. Under the endogeneity control, we use stepwise regression to determine the main effect model. Using the main effect variables, we develop a multivariate quadratic model and backward regression to eliminate non-significant variables. We also investigated the interaction effect and non-linear trend between the independent variable and the dependent variable. To test the findings, we pick South Korean Samsung Electronics Co., Ltd (Samsung)'s investment in China as a test case.

The rest of the paper is structured as follows: Section 2 provides the literature review. In Section 3, we develop the hypothesis and provide data collection and methods. Section 4, we carry out the empirical research based on the financial statement data of China's listed companies in 2004-2019, and the basic results are tested with alternative variables. In Section 5, we analyze the investment space strategy of Samsung Electronics in China as a test case. In Section 6, we summarize the paper and offer policy recommendations.

2. Literature Review

Innovation space is an important growth pole for regional and national development. From a global perspective, innovation space of different scales is booming. High-end innovation produces high-level innovation results and improves the innovation competitiveness in cities. However, in China, it believed that "crowding-out effect" was found in the current innovation space (Yu Yong-Ze and Liu Da-Yong, 2013). The repeated city construction, waste of resources, and political influence on enterprises have significant negative effects on business growth (Bai Yi-Xin, Liu Xing and An Ling, 2008). Two different consensuses in academic circles are positive innovation space in promoting economic growth and its consistent impact.

In the first argument, we must consider whether China's urban innovation space offers "positive externality" roles, consistent with promoting business growth, or whether the innovation space lacks information communication and sharing, resource scarcity conflict, market competitions, human cost increase and imparts other negative effects. The Chinese city's economic growth reflects the enterprise's technology investment behavior. In practice, urban managers should moderately influence the government to guide their innovation and R&D. They should also identify the government as the external driver of technological innovation, using the scientific and technological talents as the urban innovation strategy (Xie Wei-Min, Tang Qing-Quan and Lu Shan-Shan, 2009). The market mechanism should provide the spatial spillover innovation effect, help to break the regional monopoly, and enhance the production capacity, learning and research. This also strengthens the communication between cities and avoids "negative externalities". Regarding innovation investment, managers should use the best input and output according to the innovation stage. From the enterprise development perspective, technology investment has a significant impact on the sales volume in the early stage of internationalization. In the later stage, the influence of the enterprise-scale economy on business performance will increase (Chen Heng and Chen Wei, 2006). Growth is recorded in enterprises when management, technological innovation, and transformation technology are put in place. Moreover, executive incentives, the relationship between executive and innovation efficiency, should be adjusted appropriately. Executive equity incentives have a significant role in promoting technology investment based on an inverted U-shaped relationship (Xu Ning, 2013). However, Bai Jun-Hong and Jiang Fu-Xin (2015) argue that avoiding the excessive politicization of enterprises is essential.

The second argument is whether the innovation space of China's semiconductor industry is consistent with foreign experience, or whether there is marked heterogeneity in the innovation space of China's semiconductor industry. Many studies use empirical research to understand the role of technology inputs on business growth and the role of government technology in enterprise technology. FDI promotes the innovation of local enterprises in the short term; however, the impact of technology on the local enterprises is insignificant (Zhang Qian-Xiao and Feng Gen-Fu, 2008). From the classification of geographical location, Tianjin, and Shaanxi in China have low input efficiency; whereas, Beijing, Shanghai, Jiangsu, Shandong, and Guangdong have high input efficiency. This argument cannot reasonably explain the investment behavior of Samsung chips in Xi'an, which is the capital of Shaanxi Province and maintains a local semiconductor industry worth approximately 8 billion US dollars annually. In 2018, Samsung invested 181.5 billion Yuan (approximately 25.53 billion US dollars) in semiconductor projects in Xi'an. Within the Samsung investment space in China, the government introduced policies that supported Samsung's investment to increase the number of research institutions in colleges and universities. Samsung investment also serves as the "external substitution" for Japan's semiconductor core materials in response to trade disputes between South Korea and Japan.

Xi'an city is rich in production of polyimides, photoresistors, and high-purity hydrogen fluoride. It has great advantages as a material supplier. However, the host country lacks scarce resources for multinational corporations (Xi Guo-Ming and Ge Shun-Qi, 2000). Sun Zao and Song Wei (2012) believed that the technology investment intensity in state-owned listed companies is significantly lower than that of privately listed companies. Moreover, political policies related to enterprises tend to reduce innovation efficiency. Particularly, technical efficiency, raw materials, and political connection of China's semiconductor industry determine the impact of innovation space on business growth. Table 1 summarizes previous studies that focus on the innovation space in China.

In the first argument, a relationship between innovation space and business growth is related to the "positive-negative" relationship. The "homogeneous-heterogeneous" relationship is remarked in the second argument. By establishing multiple high-order regression models, this study investigates an "optimal-nonoptimal" relationship as well as the optimal economic point of enterprises with different eigenvalues. Due to page limitations, this article does not discuss relevant literature on control variables.

Previous studies have verified the relationship between innovation space, technology investment, and business growth based on the heterogeneity of regions, industries, and scales. However, the following gaps are observed in the existing studies: First, lack of data to compare the innovation space group and non-innovation space group. Previous studies used a GDP indicator or urban line data but failed to classify or code the comprehensive coefficient of innovation space. Second, many studies target specific industries, specific scales, and individual projects. With bias in sample selection, it is difficult to observe the innovation space from different perspectives. Moreover, the lack of evaluation of the intermediary variables and control scalars reveals that innovation space and business growth have an intermediary role.

Table 1. Summary of Previous Studies on Innovation Space in China

Author	Research Topics	Data Sources	Research Conclusion
(1) Impact of Innovation Space on Business Growth			
Fang Yuan-Ping and Xie Man (2012)	Provincial Innovation	Panel data of 31 provinces in China	A negative correlation of patent level for every 10000 college students
Wang Wen-Ting and Kan Li-Rong (2020)	Strategic Emerging Industries	2013-2017 China high-tech zone data	Strategic emerging industries and high-tech zone variables are correlated.
Lu Yan-Qin and Zhao Bin (2020)	Foreign Investment	Provincial panel data 2000-2017	FDI and regional innovation play a positive role in promoting urban economic development.
(2) Classification of Technology Input Based on Innovation Space Factors			
Gu Yuan-Yuan and Shen Kun-Rong (2012)	Government Behavior	China inter-provincial panel data	Full competition of officials has a positive effect on enterprises technology investment
Shen Kun-Rong and Sun Wen-Jie (2009)	Market Competition	Data of large and medium-sized industrial enterprises and foreign-funded enterprises in China from 1998 to 2004	In the short term, foreign capital has obvious negative effects on China enterprises, which narrows the gap in the long term
(3) Classification of the Intermediary Role of Expanding Technological Input and Business Growth Based on the Innovation Space			
Li Mei (2010)	Human Capital Accumulation	China's FDI data 1985-2008	Lack of capital accumulation and R&D personnel harms the technology absorption capacity.
Cheng Zhong-Hua and Liu Jun (2015)	Urban Space	Industrial data of 285 cities above prefecture level in China from 2005 to 2007	Diversification and intra industry competition promote manufacturing innovation.
(4) Classification of Operating Performance According to Other Factors			
Xu Feng (2010)	Innovative Methods	Case study of Samsung China R & D center	The success of innovation such as Six Sigma and TRIZ within Samsung's enterprise can improve the innovation ability.
Chen Yu and Xie Fu-Ji (2017)	Innovation Center City	Data of 25 cities in the Yangtze River Delta	Innovation presents the phenomenon of space locking, and innovation is concentrated in Shanghai and Hangzhou.

Previous studies borrow the concepts of "capital structure" and "financing scale"; however, some hidden intermediary factors are ignored such as the characteristics of enterprise owners, regional enterprises, and the enterprise debt ratio. To control the missing variables, this study adds control variables, such as the owner's gender, educational background, engineering background, the level of corporate debt, nature of technology ownership, business operating years, and geographical areas. However, previous studies pay more attention to the linear relationship of variables. They neglect that innovation space factors and control variables have a multi-dimensional effect on business growth. This shows that the relationship is nonlinear.

3. Research Hypotheses, Data, and Methods

3.1. Research Hypotheses

A systematic model is developed, taking semiconductor business growth as a research object, innovation space as the independent variable, technology investment as the intermediary variable, and the characteristics of owners and enterprises as control variables.

Innovation space, called the spatial distribution of technological innovation, is a cluster innovation network of funds, talents, patent technology, suppliers, and technology service companies within a certain space area. Cassiman and Veugelers (2006) note that the knowledge spillover effect on innovation space helps enterprises to access market information and reduce transaction costs. By forming a spatial regional brand, organizations can obtain positive external benefits. Finally, many investors believe that enterprises with innovation space are more likely to obtain bank loans and venture capital than those without innovation space. Thus, market competition and technology investment can strengthen the social reputation and help enterprises to expand access to key resources.

Gao Yu et al. (2017) believe that innovation space affects both the semiconductor IDM market and other markets such as FABLESS and FOUNDRY. Focusing on funding factors, Adler and Kwon Seok-Woo (2002) identifies a spatial difference between capital gathering and regional economic growth—when semiconductor listed companies move to the innovation space. The cost advantage of obtaining capital gathering is more obvious. The diversity and convenience of financing are achieved formally or informally (Di Zhou and Mao Xiang-Huang, 2019). The accumulation of talents and patent property rights has a positive effect on the mutual promotion of industrial structure upgrades (Yin Xiu-Fang, 2019). Moreover, universities, technical service enterprises, and suppliers promote regional economic development (Wu Jie, 2011). Semiconductor market opportunities often promote R&D to develop new products. Moreover, the innovation space, superior talents, and university resources can promote business growth (Fang, Palmatier and Evans, 2008). Using Marshall's research on the relationship between industrial space agglomeration and macro-economics, Carlsson (2006) discussed the innovation space extensively to provide enterprises with "international vision" and "innovative thinking". Innovation space significantly affects how companies respond to market competitions, promote economic growth, increase labor productivity, and reduce transportation costs and transaction costs. Innovation space continues to migrate along with the industrial transfer (Niosi and Bellon, 1994).

Economies of scale, economies of scope, spillover effects, bank loans, and venture capital are the factors that facilitate the growth of Chinese semiconductor listed companies. Typically, innovation space enhances the economies of scale. For example, the expansion of an internal scale offers benefits to an enterprise. Moreover, external economies of scale facilitate markets of raw materials and products, which help to achieve spatial competitive advantage and the growth of the supply chain. Additionally, the economic effect of innovation space is generated as an output of industrial agglomeration. Enterprises depend on each other based on the implementation of the division of labor. This reduces the average cost and increases competition and cooperation, thereby improving the enterprise's operating profits.

These facilitate the growth of semiconductor listed companies. This leads to Hypothesis 1.

H1: Innovation space has a positive effect in promoting the growth of semiconductor enterprises.

Technology investment is a technique enterprise use to achieve competitive market advantage. It reflects the importance enterprises attach to technological innovation, and it is an indicator that affects sustainable business growth. Different factors such as the owner's gender, education level, engineering background, and the ownership of technology are motivators for technological investment. For example, public shareholders and government R&D subsidies improve production efficiency and sustainable business growth (Jerome, 2001). Specifically, positive government policies on R&D and tax benefits influence technological investment and innovation space. Technology input theory emphasizes a restriction of market pressure on enterprises' behavior. Rover (1956) noted that enterprises must comply with market rules and regulations, neglecting an initiative to increase technological input. For innovation space to be effective in driving business growth, enterprises must invest in advanced technology, expand business strategy, and increase R&D expenditure. These initiatives will have a positive impact on a global value chain.

Reppas and Christopoulos (2005) pointed out that technology investment can accelerate technology, reduce the waste of resources, and improve production efficiency in the manufacturing industry. In response to market competition, Porter's environmental hypothesis shows that enterprises in innovation space will adopt technology input that meets the government's expectation to market. The impact of innovation space on investment is reflected in the way business owners pay attention to the export and the strategy of semiconductor technology, rather than achieving low cost (He Jian, 2005). If enterprises actively respond to environmental regulations and market competition, they will derive opportunities from technology investment, obtain subsidies, tax reliefs, land, and other key resources, helping them to achieve competitive advantages. While expenditure on R&D increases the operating cost, it helps enterprises to reduce production costs, improve production efficiency, break down technical barriers, and obtain the best quality per unit cost. Fang, Palmatier and Evans (2008) use empirical studies to demonstrate that innovation space promotes greater technology investment in technology-intensive industries than the non-technology intensive industry.

H2: The positive effect of innovation space on technology investment

Innovation space has a positive impact on technology investment and business growth. Typically, enterprises with innovation space can define the direction of investment, the intensity of investment, and the acquisition of financing through technology investment. With innovation space, enterprises will achieve benefits that include administrative approval, land acquisition, loan guarantee, and policy preference (Güner, Malmendier and Tate, 2008). Moreover, the distribution of information and resources is different between enterprises with innovation space and enterprises without innovation space. Rejean, et al. (2002) proved that Chinese semiconductor listed companies with innovation space rely on their social networks to expand information channels and enhance decision-making. This showed that enterprises with innovation space faced lower investment uncertainty and enjoyed shorter investment cycles. Besides which, innovation space offers unique advantages related to access to key resources. Before implementing technology investment, the listed companies use innovation space to determine the impact of the net inflow. Implementing technology investment is ultimately reflected in the enterprises' products, revealing that innovation space offers market opportunities and easy access to human resources.

H3: Innovation space expands positive technology investment and business growth.

3.2. Data and Research Methods

We collect 2004-2019 data from the financial statements of 83 semiconductor listed companies located in 23 provinces of CSRC (2019). To avoid data selectivity bias, we select the data set that consists of innovation space factors information, demographic characteristics of business owners, and other attributes of enterprises. This enhances data credibility and helps to explore the listed companies from different perspectives.

A defined innovation space is different between China and other countries. At present, three representatives of innovation space are the EU Innovation Scoreboard proposed by the European Commission, the National Innovation Capability Index proposed by Porter and Stern, and the Global Innovation Index. Using 5 first-level indicators and 53 second-level indicators, evaluation of China's innovation space represents the regional innovation capability evaluation proposed by the Chinese Academy of Sciences. In this paper, the indicators of innovation space include education and scientific research as well as the annual high school graduation rate. The urbanization index is an increase in the number of urban residents compared to the previous month. The carbon emission index is the annual carbon emission per capita. The tax policy index is the annual comprehensive tax burden rate, divided by the national fiscal budget revenue and the annual GDP output. The financial marketization index is the ratio of annual credit scale to the annual GDP output value. The major factors envisioned to attract economic migration to the city are government efficiency, the number of days to start an enterprise, and the human settlement environment.

By the end of the third quarter of 2019, the net income and owner's equity of the innovation space group were 23.109 billion Yuan and 2.719 billion Yuan, respectively, higher than that of the non-innovation space group. This reflects that the innovation space has increased the technology, R&D, and the operations of Chinese semiconductor enterprises. Some differences are noted in the operation growth of innovation space. However, the results do not prove that innovation space influences business growth. For enterprises with technology investment, does innovation space influence technology investment and promote business growth? To solve endogeneity, stepwise regression and backward regression are used to establish the optimal model of investigation. Table 2 shows the definitions of related variables.

To improve data accuracy, the sample data are processed as follows: First, we reduce the difference between variables, logarithm for the dependent variable of owner's equity, and operating income, as shown in equation (1):

$$y^{*} = Ln(y) \tag{1}$$

Moreover, the independent variable, intermediate variable, and control variable. The variable interaction and the value of variables are encoded, refer to equation (2):

$$\mu_i = \frac{T-\bar{x}}{s} \tag{2}$$

Table 3 provides the descriptive statistics of relevant variables; the peak value of variable data is greater than 0, indicating that the overall data distribution is steep compared with the normal distribution. The skewness of variable data is 0.445-1.770, showing z little deviation between the data distribution and the normal distribution.

Table 2. Definitions of Variable Indicators

	Variable	Symbols	Definition
Dependent Variable	Owner's Equity	Equi	Owner's equity at the end of the accounting period
	Business Income	Inco	Amount of operating income at the end of the accounting period
	Education	Educ	High school graduation rate
	Urbanization	Urba	The annual urban population growth rate
Independent Variable	Carbon Emission	Carb	Annual per capita carbon emissions tons
	Tax Policy	Tax	The ratio of annual urban fiscal income to GDP
	Financial Marketization	Finamark	The ratio of annual urban credit scale to GDP
	Government Efficiency	Goveeffi	Days needed to start a business
	Living Environment	Liveenvi	The net amounts of urban migrants
	Innovation Space or Not	Innospac	(x1-x7) the composite coefficient is 0lower than the sample mean (- 0.081), others are 1.
Intermediary Variable	Technology Input	Techinpu	Amount invested in technology R&D at the end of the accounting period
	Owner's Gender	Gend	Gender of executive director at the beginning of the accounting period, 0 for female and 1 for male
	Education Background of the Enterprise Owner	Educback	The educational level of the executive director at the beginning of the accounting period: 1 for below University, 0 for University, 1 for above university
	Engineering Background	Engiback	Whether it is an engineering major or engineer title, not 0, but 1
Control Variable	Geographical Area	Geog	The city of the enterprise is - 1 in the western region, 0 in the central region, and 1 in the eastern region
	Form of Owner	Formowne	The non-state-owned capital holding of the enterprise is 0, and the state-owned capital holding is 1
	Years of Operation	Yearoper	Number of years of establishment
	Financing Liabilities	Liab	Amount of financing liabilities at the end of the accounting period

Table 3. Descriptive Statistics of Variables

Variable	Obs	Mean	Median	Std.dev.	Kurt	Skew	Mini	Maxi
Equi	937	11.455	11.530	1.132	0.113	-0.403	7.157	14.433
Inco	937	11.445	11.446	1.169	-0.077	0.116	7.962	14.821
Educ	937	92.827	96	21.4411	1.2912	-0.4452	29	153
Urba	937	1.2480	0.95	1.4510	2.5198	1.0915	-2.2	8.1
Carb	937	7.4026	6.545	4.9407	6.2443	1.7704	0.31	35.92
Tax	937	17.15	17	6.1163	-0.091	-0.014	0.1	33.4
Finamark	937	96.008	80.75	56.1551	0.0556	0.8108	10	271.7
Goveeffi	937	19.306	18.5	17.688	2.9447	1.6933	2	60
Liveenvi	937	216.76	69.5	396.06	9.4360	2.0013	-263	1335
Innospac	937	0.267	1	0.443	-0.899	1.049	0	1
Techinpu	937	15480	8863	21344.08	29.978	4.422	382	259590
Gend	937	0.980	1	0.137	47.333	-7.016	0	1
Educback	937	0.402	1	0.708	-0.683	-0.755	-1	1
Engiback	937	0.565	1	0.495	-1.933	-0.265	0	1
Geog	937	0.863	1	0.431	10.032	-3.272	-1	1
Formowne	937	0.29	0	0.454	-1.145	0.925	0	1
Yearoper	937	16.16	15	7.977	6.414	1.744	1	61
Liab	937	130284	50620	254734	34.020	5.127	1206	2377000

To overcome endogenous problems, stepwise regression and backward regression are used to build the optimal fitting model: For endogeneity, the explanatory variable and the interpreted variable are the causal problems. We are concerned about whether business growth can promote innovation space. Western studies believe that the innovation space can increase attraction to cities and improve the cities' economic growth and innovation competitiveness. The influx of foreign-funded enterprises will reduce the business growth of local enterprises in the short term. However, using the knowledge spillover effect, local enterprises can narrow the gap between innovation ability and foreign-funded enterprises to promote their growth in the long run. Chinese studies demonstrate the positive role of innovation space, which includes the improvement of technical efficiency, improvement of capital structure, and the diversification of geographical trade. These facilitate the business environment and business growth. Regardless of the mechanism of innovation space, the logical argument of Chinese and Western theories on this issue is as follows: innovation space investment facilitates business growth; thus, no endogenous problem is detected.

For the second endogeneity, there is a choice of whether to omit variables. Enterprises have a certain selection mechanism in deciding whether these variables affect both innovation space and business growth. However, the variables of representation are difficult to count. The enterprises in innovation space are regarded as the treatment group, rather than using the enterprises in innovation space as the control group. To evaluate whether innovation space can promote business growth, a direct approach is to compare the difference between the operating income and the ending balance of the owner's equity of the treatment group and the control group. This helps to detect if the operating income of the innovation space group is higher than that of the non-innovation space group. For rational enterprises, we choose an innovation space environment to explain a rise in the innovation corridor and innovation cities.

This study uses a counterfactual framework (Rubin, 1974) to show whether enterprise (i) is in innovation space with virtual variable $D_i = \{0, 1\}$, where (1) represents innovation space, and (0) represents non-innovation space; (D_i) is the processing variable, reflecting whether the enterprise (i) is processed. The business income and innovation space are (Y_i) and (D_i), respectively. Besides, we observe the value of technology investment of enterprises, recorded as (X_i) and known as the covariate. In this way, the population can be represented by (Y_0, Y_1, D, x). Whether the enterprise (i) is in the innovation space environment depends on the observable characteristics of the owner's population, the debt ratio of the enterprise, and the form of ownership (Z). The specific steps of the model are deconstructed as follows:

The first step is to build a model of explanatory variables:

$$Y_i=x_i\beta+\gamma D_i+u_i \tag{3}$$

To analyze the impact of innovation space and technology investment on business growth, this paper focuses on two aspects: business income and owner's equity. After substituting the variables, the regression model is as follows:

$$\text{In(income)}=\beta_0+\gamma Is+\beta_i X_i+u \tag{4}$$

$$\text{In(Owner's equity)}=\beta_0+\gamma Is+\beta_i X_i+u \tag{5}$$

We use are natural logarithm for variables business income and owner's equity: (Is) is the two values virtual variable of innovation space; (X) is the control variable, and (u) is the random error. If $\gamma > 0$, there is positive innovation space effect; otherwise, if $\gamma < 0$, there is negative innovation space effect.

In the second step, the Probit model is used to build the processing equation:

$$D^*=\alpha+\delta Z+\varepsilon \tag{6}$$

If $D^* > 0$, then (Is) = 1, if $D^* < 0$, then (Is) = 0

$$\text{Prob}(Is=1|Z)=\varphi(\delta Z)$$

$$\text{Prob}(Is=0|Z)=1-\varphi(\delta Z)$$

Equation (6) is used to analyze whether the potential selection variables will affect the innovation space mechanism. After substituting the variables set, the selection equation is as follows:

$$D^*=\alpha+\delta_1 Z_1+\delta_2 Z_2+\varepsilon \tag{7}$$

In this Equation (7), (Z) is the latent variable; the intervention effect model assumes that the two random error terms (u) and (ε) are subject to the binary normal distribution and that VAR (u) = σ^2, VAR (ε) = 1, Cov (u, ε) = $\rho\,\sigma^2$; (ρ) is the correlation coefficient of the two random error terms (u) and (ε). Here, we must test the likelihood of the original hypothesis to indicate that the two random variables (u) and (ε) do not have the same parameters: the regression equation and the selection equation are independent of each other, and OLS regression is appropriate.

The stepwise regression is used to develop the optimal model. The main effect model in Table (2) was analyzed using stepwise regression and to identify the most important variables. Table 7 shows the specific definition of the innovation space category variable. Based on the principle of a frugal model, the unitary model is used as the basic regression equation; the formula is shown in equations (8) and (9):

$$Ln(y) = E(y) + \varepsilon \tag{8}$$

$$E(y) = \beta_0 + \beta_1 x_1 \tag{9}$$

Table 4 summarizes the stepwise regression, T value, and corresponding p-value of each step. The model (1) adds the virtual variable of innovation space. Moreover, the correlation coefficient is positive and significant, showing that innovation space has a positive role in promoting business growth. Second, the model (2) adds the technical input index; the correlation coefficient is positive, showing that it is significant, and the adjusted R^2 coefficient increases. Third, the model (3) shows that the owner's gender, educational background, and engineering background have no significant effect. However, the geographical region of the enterprise has a positive and significant effect on its growth coefficient. The decision coefficient increased after adjustment. In the models (4), (5) and (6), the owner form, operation period, and financing liability index are included. The display coefficient is positive, both are significant. The T value and the adjusted R^2 are improved.

The stepwise regression is recommended in the final model. This includes innovation space, technology investment, geographical region, owner background, operation period, and financing liabilities. The basic regression equation is as follows:

$$E(y) = \beta_0 + \beta_1 Innospac + \beta_2 Techinpu + \beta_3 Geog + \beta_4 Formowne + \beta_5 Yearoper + \beta_6 Liab \tag{10}$$

However, equation (10) ignores the interaction and higher-order terms of potential variables. In the variable selection, we use backward regression for the dependent variable. We eliminate the insignificant variables in the second-order model owing to the limited space; this paper does not report the specific backward regression. The equation (11) gives the following output:

$$E(y) = \beta_0 + \beta_1 Innospac + \beta_2 Techinpu + \beta_3 innospac * Techinpu + \beta_4 Techinpu^2 + \beta_5 Geog + \beta_6 Formowne + \beta_7 innospac * Techinpu * Formowne + \beta_8 Yearoper + \beta_9 innospac * Techinpu * Yearoper + \beta_{10} Liab + \beta_{11} \text{innospac} * \text{Techinpu} * \text{Liab} + \beta_{12} Liab^2 \tag{11}$$

The final model includes innovation space, technology investment, innovation space, geographical region, owner background, operation period, financing liability, and financing the second term of liabilities. The Pearson correlation coefficient was tested in each variable in the regression equation (11). The results show that the correlation coefficient of the main variables is 0.3 or less, proving no obvious multicollinearity problem between the variables and regression analysis. Table 5 shows the results.

Table 4. Stepwise Regression Modeling for Business Growth

Stepwise	(1)	(2)	(3)	(4)	(5)	(6)
Constant	11.102	10.902	11.089	11.363	10.849	10.879
Innospac	1.315	0.834	0.841	0.832	0.649	0.624
T value	18.371 ***	11.285 ***	11.425 ***	11.276 ***	9.008 ***	8.533 ***
Techinpu		0.455	0.447	0.439	0.381	0.338
T value		13.858 ***	13.696 ***	13.344 ***	12.025 ***	8.523 ***
Geog			0.213	0.188	0.280	0.293
T value			3.201 ***	2.748 ***	4.281 ***	4.454 ***
Formowne				0.106	0.166	0.149
T value				1.603 *	2.626 ***	2.326 **
Yearoper					0.038	0.038
T value					10.372 ***	10.243 ***
Liab						0.072
T value						1.822 *
Standard error	0.970	0.884	0.880	0.879	0.833	0.832
R^2	26.52	39.05	39.71	39.88	46.10	46.30
Adjusted R^2	26.44	38.92	39.52	39.62	45.82	45.95
F value	337.49 ***	299.25 ***	204.89 ***	154.57 ***	159.31 ***	133.64 ***
Obs	937	937	937	937	937	937

Note: *p<0.1, **p<0.05, ***p<0.001.
Data source: CSRC (2019).

Table 5. Pearson Correlation Coefficient

	Innospac	Techinpu	Geog	Formowne	Yearoper	Liab
Innospac	1					
Techinpu	0.46	1				
Geog	0.00 *	-0.05 *	1			
Formowne	0.16 *	0.20 *	-0.23 *	1		
Yearoper	0.33	0.28 *	0.13 *	-0.03 *	1	
Liab	0.36	0.30 *	0.02 *	0.23 *	0.27 *	1

Note: the coefficient below 0.3 is a low correlation, expressed by *.

4. Empirical Test

In this empirical research, we examine the impact of innovation space factors on business growth (hypothesis 1). We also empirically measure the impact and significance of each factor. Moreover, we investigate the impact of innovation space factors on the growth of technology investment (hypothesis 2). We distinguish the virtual variables of innovation space, test the effect of innovation space, and technology investment on business growth. Moreover, we test whether hypothesis 3 is supported. Finally, operating income is used as an alternative variable of the owner's equity. Regression analysis and F value are used to test the robustness of the impact of innovation space and technology investment on business growth.

4.1. Innovation Space Factor and Business Growth

Indicators of innovative spatial factors are education and scientific research, urbanization, carbon emissions, tax policies, financial marketization, government efficiency, and human settlements. Using stepwise regression to verify the main effect model, the relationship between carbon emission curve and tax policy is not significant. The regression equation between innovation space factor and business growth is as follows:

$$E(y) = \beta_0 + \beta_1 Educ + \beta_2 Urba + \beta_3 Finamark + \beta_4 Goveeffi + \beta_5 Liveenvi \quad (12)$$

By using the quadratic formula of multiple variables, the optimal model results are given in equation (13) after removing the insignificant variables:

$$E(y_1) = 5.065 + 0.016Educ + 0.1Urba - 0.060Carb + 0.002Carb^2 + 0.011Finamark - 0.000023Finamark^2 - 0.025Goveeffi + 0.000067Goveeffi^2 + 0.0001Liveenvi \quad (13)$$

From the regression results in Table 6, the primary indicator, the education level has increased the owner's equity by 1.61%. The growth rate of urbanization promotes 10.51% of owners' equity, reduces carbon emissions, and promotes 6.18% of financial marketization. It reduces the number of business days and increases the owner's equity by 2.46%. The relationship between the above independent variables and business growth is linear.

Table 6. Regression Results of Innovation Space Factor of Owner's Equity

Dependent Variable		*Ln*(*Equi*) (13)			
		B-Coefficient	Standard Error	T-value	P-value
Independent Variable	Educ	0.016	0.002	5.571	0.000 ***
	Urba	0.100	0.040	2.495	0.013 ***
	Carb	-0.060	0.004	-4.997	0.000 ***
	Carb2	0.002	0.000	5.226	0.000 ***
	Finamark	0.011	0.003	3.860	0.000 ***
	Finamark2	-0.000023	0.000	-1.950	0.052 *
	Goveeffi	-0.025	0.005	-4.819	0.000 ***
	Goveeffi2	0.000067	0.000	3.648	0.000 ***
	Liveenvi	0.0001	0.000	1.313	0.190
Intercept		5.065 (7.773***)			
Correlation Coefficient		90.60			
R^2		82.09			
Adjusted R^2		81.05			
Number of samples		202			
F value		79.176 (0.000***)			

Note: **p*<0.1, ***p*<0.05, ****p*<0.001.
Source: CSRC (2019).

The trend is not linear in the second project. Although this reduces carbon emissions and promotes business growth, we determine a positive U-shaped structure with the notch upward, the curvature is 0.002; the tangent point is 9.187. Financial marketization and business growth are inverted U-shaped structures with a concave downward curvature of -

0.000023. The cut-off point is 122.47%. The curve relationship between the number of days to start a business and the business growth is a positive U-shaped structure with a curvature of 0.000067 and a cut-off point of 19.31 days. This shows that the lower the carbon emission is better. When the carbon emission is lower than the concave point, the business growth and carbon emission will decrease. When the financial marketization is not active, the better. The point cut shows that when the scale of credit exceeds 122.47%, the business operation is significantly reduced. Regarding government efficiency and administrative efficiency, administrative costs are curvilinear. The cut-off point shows that the optimal external economy exists when the number of business days is 19.31.

4.2. Innovation Space, Technology Investment, and Business Growth

Innovation space, the criterion of the virtual variable is whether the comprehensive coefficient of x1-x7 factors is greater than -0.081 of the sample mean. If it is greater or equal to 1, this is in innovation space. If it is lower, it is not an innovation space. In the main effect model of stepwise regression, the impact of tax policy is not significant; so, the classification index is deleted. A comprehensive coefficient = education and scientific research coefficient + urbanization coefficient - carbon emission coefficient + financial market coefficient - government efficiency coefficient + residential environment coefficient ($\mu_i \geq -0.081$), judged as innovation space. Refer to Table 7 for details:

Table 7. Comprehensive Coefficient of Innovation Space Discrimination

Factor	Mean	Std.dev.	Formula	Mean	Std.dev.	Coefficient	Comprehensive
Educ	92.827	21.4411		0.147	1	1/6	0.024
Urba	1.2480	1.4510		-0.205	1	1/6	-0.034
Carb	7.4026	4.9407		-0.173	1	1/6	-0.028
Tax	96.008	56.1551	$\mu_i = \frac{T-\bar{x}}{s}$	-0.271	1	1/6	-0.045
Finamark	19.306	17.688		-0.045	1	1/6	-0.007
Goveeffi	216.76	396.06		-0.371	1	1/6	-0.061
Mean Value of the Comprehensive Coefficient							-0.081

Technology input and control variables constitute a part of the main effect model. Intermediary variables are examined through an interaction between innovation space and technology input. Stepwise regression was used to verify the main effect of the model. Besides, the gender, educational background, and engineering background of the business owner have no significant effect on business growth. By using the quadratic formula for multiple variables, the optimal model results are provided in equation (14) after removing the insignificant variables:

$$\begin{gathered} E(Equi) = 10.822 + 1.012Innospac + 1.729Techinpu + 0.551Innospac * Techinpu \\ -0.902Techinpu^2 + 0.242Geog + 0.143Formowne + 0.279Innospac * Techinpu \\ * formowne + 0.032Yearoper + 0.380Innospac * Techinpu * Yearoper \\ +0.188Liab + 0.548Innospac * Techinpu * Liab - 0.363Liab^2 \end{gathered} \tag{14}$$

From the basic regression results in Table 8, the interaction coefficient between innovation space and technology investment is significant; whereas, the coefficient of the second term of technology investment is negative, indicating that the relationship between technology investment and business growth correlates with an inverted U-shaped structure. The curvature is -0.902. The notch is downward, and the tangent point is 3.1725. The data of technical input is substituted with the formula (2). The calculated cut-off point is 831.93 million Yuan.

Table 8. Regression Results of Innovation Space Technology Investment Business Growth

Dependent Variable		$Ln(Equi)$ (14)			
		B-Coefficient	Standard Error	T-value	P-value
Independent Variable	Innospac	1.012	0.090	11.175	0.000 ***
	Techinpu	1.729	0.096	17.965	0.000 ***
	Innospac*Techinpu	0.551	0.135	4.076	0.000 ***
	Techinpu2	-0.902	0.062	-14.417	0.000 ***
	Geog	0.242	0.057	4.246	0.000 ***
	Formowne	0.143	0.061	2.343	0.019 **
	Innospac*Techinpu *Formowne	0.279	0.040	6.978	0.000 ***
	Yearoper	0.032	0.003	9.327	0.000 ***
	Innospac*Techinpu *Yearowne	0.380	0.090	4.197	0.000 ***
	Liab	0.188	0.078	2.406	0.016 **
	Innospac*Techinpu *Liab	0.548	0.107	5.089	0.000 ***
	Liab2	-0.363	0.095	-3.809	0.000 ***
Intercept		10.822 (135.55***)			
Correlation Coefficient		77.97			
R^2		60.80			
Adjusted R^2		60.29			
Number of samples		937			
F value		119.46 (0.000***)			

Note: **p*<0.1, ***p*<0.05, ****p*<0.001.
Source: CSRC (2019).

In the eastern region, state-owned holding, operating years, and financing liabilities promote the growth of owners' equity. Innovation space - technology investment - owner form, innovation space - technology investment - operating life, and innovation space - technology investment - financing debt has a positive effect. Moreover, we record an inverted U-shaped curve relationship between financing liabilities and owner's equity growth, with a curvature of -0.363. In a concave downward, the code value of the cut-off point is 5.188. In equation (2), the financing cut-off point is approximately 14.518 billion Yuan. The innovation space coefficient is significant, indicating that the innovation space can promote business growth. This supports Hypothesis 1. The regression equation of innovation space and technology investment is $Ln(Techinpu) = -0.284 + 1.060 * Innospac$. T=16.274, F=264.873, adjusted R2=0.4698. This significantly supports Hypothesis 2. The coefficients of innovation space, that of technology input owner is 0.279; technology input operation life is 0.380, and that of technology input financing debt is 0.548. This shows that the innovation space of technology investment has an impact on business growth.

4.3. Robustness of Test

Based on the backward regression and regression model in equation (10), the optimal model of the independent variable and business income is established. The equation is as follows:

$$E(Inco) = 11.530 + 0.5836Innospac + 0.3318Techinpu + 0.1173Geog \\ +0.2034Formowne - 0.015Techinpu * Formowne + 0.212Innospac \\ * Techinpu * Formowne \quad (15)$$

Table 9 shows the regression results. Innovation space, technology investment, geographical region, state-owned holding background, and innovation space technology investment owner form promote the growth of business income.

Table 9. Regression Results of Operation Income

Dependent Variable		$Ln(Inco)$ (15)			
		B-Coefficient	Standard Error	T-value	P-value
Independent Variable	Innospac	0.5836	0.0901	6.4721	0.000 ***
	Techinpu	0.3318	0.1335	2.4847	0.013 ***
	Geog	0.1173	0.0487	2.4076	0.016 **
	Formowne	0.2034	0.0861	2.3609	0.018 **
	Techinpu*Formowne	-0.0150	0.0057	-2.6235	0.008 ***
	Innospac*Techinpu *Formowne	0.2120	0.1076	1.9694	0.049 **
Intercept		11.530 (222.865***)			
R^2		63.00			
Adjusted R^2		56.95			
Number of samples		937			
F value		104.216			

Note: *$p<0.1$, **$p<0.05$, ***$p<0.001$.
Source: CSRC (2019).

In the scatter diagram of variable residuals, the results E (ε) = 0. No obvious trend is found in the residuals of each variable, showing that the model is not incorrectly assumed. Forecast ($\hat{y}$) residual map of the model assumes that the error variance is constant. The residual histogram generated by the normal distribution assumes that normal error is reasonable. From the residual diagram in time sequence, the positive residual value is significantly higher than that of a negative number, and the fitting degree of the multiple regression model is F = 104.216. The adjustment R^2=0.5695. Therefore, the assumption of independent error is reasonable. In conclusion, OLS regression is appropriate.

5. Space Strategy of Samsung Investment in China

Presently, South Korea is the third-largest semiconductor industry transfer, having overtaken Japan. In 2018, sales of global semiconductors reached US $437.3 billion. Samsung, SK Hynix, and MEGULAR in the United States accounted for 95% of the global DRAM market share. Samsung alone accounts for 43.9% of the global market.

The semiconductor industry invests in the ecological industrial chain to accumulate profits. It is also a national industry for South Korea that exploits both strategic and market opportunities. In the spatial shifts of the semiconductor industry, the industry and universities collaborate to promote the transfer of a range of semiconductor technologies from Boston to Silicon Valley. With this collaboration, the governments, industry, and academic institutions realized market opportunities for the transfer of semiconductors in Japan. Samsung is promoting the "future of semiconductor component development project" with the University. For example, the company signed a "cooperation agreement with six universities in South Korea to carry out on human resource training to develop semiconductor materials, components, and equipment technology". The focus of this cooperation is to strengthen the industrial support for enterprises, upstream the industrial chain, and provide SW-SOG solutions to achieve market competitive advantage for system semiconductors.

In 2019, South Korea's semiconductor exports accounted for approximately 20% of the total exports. The semiconductor industry is one of South Korea's largest sectors, and it provides supports for other weak industries. The most recent trade friction between South Korea and Japan started on June 28, 2019. Japan announced that it would remove South Korea from its trade "white list" and impose "embargo" on South Korean export to Japan. Japan restricted the importation of polyimines, photoresistors, and high purity hydrogen fluoride for semiconductor production. However, trade and investment between South Korea semiconductor and China may help to mitigate the impact of this trade friction. Since Samsung has entered China 27 years ago, the company has followed the Chinese government industrial guidance. Samsung has adjusted its industrial layout to adapt to the rapid development and change in the international market. Based on the Samsung news report of 2018, Samsung's industrial layout in China has been transformed into a high-end manufacturing industry in line with Chinese government guidance. Over the past six years, the company has continued to invest in high-end industries in China, with investments valued more than 20 billion US dollars higher than the industrial adjustment.

In the future, Samsung will continue to invest in high-end industries in China. As the largest consumer of semiconductor DRAM products, China imported DRAM products valued more than 13 billion US dollars in 2016. China is gradually developing semiconductor innovation space, and the Yangtze River Delta region, Shanghai, and Suzhou have formed the most complete and concentrated industrial chain in China's semiconductor industry. The Bohai Rim region, Beijing, and Tianjin are the core of the industrial region. The Pearl River Delta region and Shenzhen also form the industrial cluster. At present, Samsung invested 181.5 billion Yuan in the Xi'an market, filling the gap in the industrial chain of Northwest China.

From the perspective of innovation space factors, Samsung investment in Xi'an project in South Korea is characterized by the following features: in June 2014, China successively issued the national integrated circuit industry development promotion program, GUANZHONG-TIANSHUI Economic Zone Development Plan. Several state council policies facilitate software development and the integrated circuit industry. State preferential policies on software and the integrated circuit industry have increased through Shaanxi Provincial People's government Laws and regulations. The government also formulated the 12th Five Year Plan for the development of the software industry, integrated circuit industry, and Xi'an integrated circuit industry.

To provide a good environment for the continued development of the semiconductor industry, the Xi'an government subsidizes 30% of Samsung's investment, constructs factories for Samsung, provides free land, and provides basic amenities such as water, electricity, transportation, and greening. Besides these factors, the government levies 15% corporate income tax on the Samsung project after 10 tax exemptions and 10 half-tax reductions.

Regarding R&D and innovation, Xi'an has 672 scientific research institutions, 130 national key laboratories, and 731 universities. The level of training of personnel offers an absolute advantage for the city as its strength of scientific research ranks third in China. Xi'an is located at the center of China, connecting the East, the West, and the north. The geographical trade position is unique. Moreover, Xi'an has obvious advantages in human resources (Qian Xiao-Ye, Chi Wei and Li Bo, 2010). According to the national income data of China Statistics Bureau in 2018, the annual average salary of Xi'an in 2018 was 50,436 Yuan, while that of Suzhou in the Yangtze River Delta is 94,124 Yuan, Tianjin in the Bohai economic zone was 70,452 Yuan, and that of Shenzhen in the Pearl River Delta was 111,708 Yuan. Moreover, Xi'an is rich in production of polyimides, photoresistors, and high-purity hydrogen fluoride. The resources provided good "substitution" for South Korea during recent South Korea-Japan trade friction. Dover is China's largest supplier of high-purity hydrogen fluoride; it is also the world's largest semiconductor silicon chip producer. LONGJI Co. Ltd. and 15 other large semiconductor raw material suppliers offer huge advantages to China.

To avoid the endogeneity of explanatory variables and interpreted variables, this paper lists the establishment dates of raw material suppliers, compared with the establishment date of Samsung (Xi'an). No problem is found in the cause and effect inversion. Table 10 compares the data.

Table 10. Main Variables and Statistical Description of Samsung's Investment Space in China

Variable Name	First-tier and Second-tier Cities	Non-First tier and Second-tier Cities	Variable Name	First-tier and Second-tier Cities	Non-First tier and Second-tier Cities
Raw Material Supplier	214	20	Distribution of Investment Enterprises in China	22	2
GDP Output Value (trillion)	39.84	2.05	Population (100 million)	2.89	0.23
Number of Colleges and Universities	731	9	Insured Number (10000)	5.20	0.83
Law Firm	11108	201	Credit Scale (trillion)	92.8	3.42
Owner's Equity (100 million yuan)	669.86	49.76			

To grasp the impact of South Korean Samsung's investment innovation space in China, we carry out empirical research to investigate the impact of various factors of innovation space on business growth**.** We selected a total of 24 enterprises, which Samsung in China has investment interest as of February 2020. We develop the regression model using the following variables: number of raw material suppliers, urban GDP, urban population, number of colleges and universities, number of social security participants, legal rights on properties, financial marketization, urban line level, and legal protection of property rights - urban line-level interaction, as shown in equation (16):

$$E(Equi) = -100.917 + 15.40Raw + 0.230Urba + 4.527Educ + 0.016Goveeffi + 16.072Finamark + 63.308Cityline \quad (16)$$

Table 11 shows the regression results. The regression coefficients are significant for raw material suppliers, the number of the urban population, colleges and universities, social insurance participants, financial marketization, and urban line-level division. Besides, innovation space factors, the factors of raw material suppliers, social security, and the first and second-tier cities have a positive relationship with business growth. This evidences the reasons for Samsung's continuing investment in the Xi'an semiconductor project.

Table 11. OLS Regression Test

Variable	Owner's Equity (16)		
Raw	12.60	11.979	15.400
	(0.007) ***	(0.009) ***	(0.003) ***
GDP	-81.98	-69.287	-62.855
	(-0.150)	(-0.161)	(-0.069)
Urba	0.011	0.114	0.230
	(0.882)	(0.359)	(0.100) *
Educ	2.068	3.076	4.527
	(0.069) *	(0.031) **	(0.009) ***
Goveeffi	0.014	0.014	0.016
	(0.157)	(0.172)	(0.100) *
Lega	0.032	0.011	0.103
	(0.559)	(0.837)	(0.141)
Finamark	10.622	7.728	16.072
	(0.100) *	(0.067) *	(0.046) **
Cityline		63.570	63.308
		(0.077) *	(0.067) *
Interaction			0.0678
			(0.117)
Intercept	-103.68	-105.193	-100.917
	(-0.173)	(-0.879)	(-0.356)
Sample size	24	24	24
Adjusted R^2	0.466	0.522	0.601

Note: *p<0.1, **p<0.05, ***p<0.001.
Source: CSRC (2019).

6. Discussion

This paper examines the role of innovation space to expand technology investment in promoting business growth. We use the financial statements of 83 semiconductor listed companies in 23 provinces from 2004 to 2019 approved by CSRC (2019). In particular, we establish a model of innovation space to promote the growth of the Chinese semiconductor enterprises using stepwise regression and backward regression. It measures the degree and trend of each factor of innovation space, technology input, and variables affecting the business growth. In this section, we first discuss the theoretical and practical implications of our findings. We conclude with an acknowledgement of the limitations of this study and offer suggestions for future research.

6.1. Theoretical Implications

Globalization, the knowledge economy, and innovation have become important factors in improving the competitiveness among countries, regions, and cities. Science, technology, and innovation capability aim to attract enterprises' investment and promote regional economic growth (Bercovitz and Feldman, 2007). Moreover, the approach to human capital, finance, and the legal environment have become an important strategic choice of enterprises (Gu Yuan-Yuan and Shen Kun-Rong, 2012). China's innovation space can enhance the cometitiveness between Chinese enterprises and foreign enterprises, improve the human cost of enterprises, and intensify the impact of foreign enterprises on local enterprises. China's provincial panel data from the macro-regional environment, which includes property rights protection, tax preference, capital loans, university R&D, talent acquisition, and the industrial chain are used to analyze the impact of innovation space on business growth.

However, previous studies, some hidden intermediary factors are ignored such as the characteristics of enterprise owners, regional enterprises, and the enterprise debt ratio. They neglect that innovation space factors and control variables have a multi-dimensional effect on business growth. In addition, they pay more attention to the linear relationship of variables. Thus this research makes three important theoretical contributions.

First, this study adds control variables, such as the owner's gender, educational backround, engineering background, the level of corporate debt, nature of technology ownership, business years, and geographical areas.

Second, we investigated the interaction effect and non-linear trend between the indeendent variable and the dependent variable. In the analysis, the relationship is linear between independent variables, intermediary variables, and control variables on business growth. However, the trend relationship of some indicators is non-linear. Carbon emission and government efficiency have a positive U-shaped relationship with business growth, with cut-off points of 9.187 tons/person and 19.13 days. The effects of Green Economy and the government's efforts to promote business growth are not linear. The relationship between financial marketization, technology investment, financing liabilities, and business growth is an inverted U-shaped trend. It is estimated that the growth of China's semiconductor industry is 122.47%. The debt level of billion Yuan has reached the optimal economy. For enterprises, we can use the regression model to calculate the optimal economic point of the enterprise.

Third, among the factors hypothesized to enhance innovation space, education and scientific research, urbanization, carbon emission, financial marketization, and government efficiency significantly promoted the business growth of semiconductor enterprises. However, the impact of tax policy and human settlements on the dependent variables is not significant. It is generally agreed that a reduction of the tax burden can improve profits and promote the business growth of enterprises. However, this paper demonstrates that tax policy is not related to business growth. Previous research mostly shows that the value-added tax rate or urban tax rate directly ignores the tax burden of some cities in China. By controlling the tax deduction and increasing tax collection and management, the tax administration offset the effect of a decrease in the value-added tax rate. It is reasonable to divide the urban fiscal income by the GDP percentage. When human settlements and urban population growth rate index is adopted, a large deviation is noted between China's statistical caliber and the actual situation. The urban mobility of the non-urban population is not included in the urban employment rate, resulting in the deviation of the empirical results.

The spatial distribution of South Korean Samsung in China and the analysis of Xi'an investment projects shows that the innovative spatial growth effects of first-tier and second-tier cities are better than those of non-first tier and second-tier cities. In the first and second-tier cities, we analyze the impact of various innovative space factors on business growth. Moreover, the number of raw material suppliers and social security factors have a positive impact on business growth. However, the protection of property rights measured by the number of law firms has no significant impact on business growth. China has strict approval procedures for the establishment of law firms with no positive correlation with the degree of urban development. However, the scale of law firms in first-tier and second-tier cities is larger than that of non-first tier and second-tier cities.

6.2. Practical Implications

In addition to providing theoretical implications, this study sheds light on policy sug-estions.

Innovation space may cause temporary income reduction in China. However, in the long term, the spillover effect of knowledge can improve economic growth and welfare. The innovation space can promote the operating income and owner's equity of semiconductor listed companies. Innovation space plays a greater role in promoting business growth of the state-owned holding enterprises, debt expansion, and enterprises with more than average operating years. The state should play a leading role in technology investment and relaxing financial market financing constraints.

It is recommended to promote investment in technological innovation in China's semi-onductor industry and improve investment to promote business growth. The results show that technology investment can promote business growth. China's semiconductor market has a large capacity. Thus, it is urgent to increase the input of technological innovation to increase the value-added per unit and promote the business growth of semiconductor enterprises. However, there is an inverted U-shaped structure in the relationship between technology investment and business growth. Enterprises must calculate the optimal investment benefit by combining the eigenvalues.

The Chinese government and the semiconductor industry association should strengthen the innovation connection with scientific research institutions and draw lessons from the production, research, and learning of Samsung in South Korea. To create the material space, we should facilitate policy for institutional space and economic growth. The integrated circuit industry education, innovation platform, and semiconductor R&D innovation fund can solve the problem of talent acquisition in the semiconductor industry. The R&D and human settlements indicators are positively related to business growth.

This study establishes a model of innovation space to promote the growth of semionductor enterprises. It measures the degree and trend of each factor of innovation space, technology input, and variables affecting the business growth.

However, some limitations are noted in the research. New variables can be introduced to explore the relationship between the characteristics of business owners, legal protection of property, and other indicators that affect business growth. The professional experience of business owners, political relevance, availability and capability of lawyers, and court property cases can expand the analysis of business growth. Further research could expand this inquiry into these contexts. Addition of variables related to these characteristics would benefit a future revision of this model.

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