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Smart City and Enterprise Innovation: An Empirical Study based on Regulatory Effect Model

Zhi Zhang

Fuzhou University of International Studies and Trade, Fuzhou, Fujian, China

*zhangzhi588@163.com

Abstract

In the context of smart city construction, 1655 observation data of A-share listed companies in Shanghai and Shenzhen Stock Exchange from 2014 to 2017 are applied to build a smart city regulation effect model. On the premise of controlling relevant variables, an empirical study is conducted on the impact of enterprise R & D expenditure, smart city category and their interaction on the innovation achievements of listed companies,The empirical results show that: ① there is a significant positive correlation between enterprise R & D expenditure and enterprise innovation achievements, that is, the more R & D investment, the more innovation achievements.② Smart city plays a positive role in regulating the relationship between enterprise R & D expenditure and enterprise innovation achievements, that is, smart city can promote the transformation of R & D expenditure into more innovation achievements.

Keywords

Smart city, Enterprise innovation, Innovative achievements.

1. Introduction

As early as 2016, China defined the direction of developing new smart cities.From informatization to intelligence and then to intelligence, it is the only way to build a smart city with broad prospects.During the "14th five year plan" period, China will accelerate the construction of a digital society, promote the construction of new smart cities by classification, integrate Internet of things sensing facilities and communication systems into the unified planning and construction of public infrastructure, and promote the application and intelligent transformation of Internet of things such as municipal utilities and buildings.As the core of innovation activities, smart city construction will bring the flow of innovation elements, so as to promote the innovation ability of enterprises.

2. Research Hypothesis

According to the innovation system theory, as one of the units of innovation activities, enterprises will be affected by the external innovation environment, including the activities of government institutions, financial system, education system and other auxiliary institutions.Over the past decade, China has accelerated the construction of a new smart city. The construction of a new smart city involves all aspects of the urban system, and has gradually improved and constructed various subsystems in the innovation system.To a certain extent, it provides favorable conditions for enterprises to carry out innovation activities, including smart infrastructure construction, smart government, smart transportation and so on.Based on the above analysis, hypothesis 1 is proposed.

H1: smart city construction plays a regulatory role in the relationship between R & D investment and innovation achievements of listed companies.

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3. Research Design

3.1. Samples and Data Sources

A-share listed companies in Shanghai Stock Exchange and Shenzhen Stock Exchange from 2014 to 2017 were selected as research samples, and screened according to the following methods: ① companies listed less than one year in the observation time were excluded.② Companies marked with ST, st * and other special treatment shall be eliminated.③ Eliminate the missing observation objects of key variables.A total of 1655 observation points were obtained.In order to control the influence of extreme values on regression results, continuous variables were winsorized according to the standard of 1%.The data source of the main variables in the study is Ruisi database, and stata12 software is used for descriptive statistical analysis and regression analysis.

3.2. Variable Definition

3.2.1. Explained Variable

The explanatory variable is the annual number of patents applied by the company, including invention patents, utility model patents and appearance patents.That is, the annual number of patents applied for is used to measure the company's innovation achievements.

3.2.2. Explanatory Variables

The explanatory variables are R & D expenditure, smart city category and their interaction.The R & D expenditure is the annual R & D expenditure of the listed company;The smart city variable is grouped according to the smart city score published by the Chinese Academy of Social Sciences and Guomai group every year. The value of the variable in the top 20 smart cities in the year is 1, otherwise it is 0.

3.2.3. Control Variables

Based on the research of Chinese scholars, the control variables are set as: free cash flow (cash, free cash flow per share) and company size (lnsize, natural logarithm of total assets).See Table 1 for variable settings and definitions.

Table 1. variable name and definition

Variable type	Variable name	Variable symbol	Variable description
Explained variable	Annual number of patents applied	Patents	Including invention patent, utility model patent and appearance patent
Explanatory variable	Enterprise R & D expenditure	Rdspend	Annual R & D expenditure of the enterprise
	Smart city category	Smartcity	Take 1 as the top 20 smart cities in the year, otherwise it is 0.
	Interaction between enterprise R & D expenditure and smart city category	Rdspend×Smartcity	Enterprise R & D expenditure multiplied by smart city city category.
control variable	cash flow	Cash	Free cash flow per share
	company size	Lnsize	Natural logarithm of total assets
	particular year	Year	Year dummy variable
	industry	Indu	Industry dummy variable

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3.3. Empirical Model

This paper constructs the model with the number of patents applied by enterprises in the year as the explanatory variable.CV in the model represents the control variable, and the meanings of other variables are shown in Table 1.

$$Patents = \beta_0 + \beta_1 Rdspend_{it} + \beta_2 Smartcity_t + \beta_3 Rdspend_{it} \times Smartcity_t + \sum_j \beta_j CV_{it} + \varepsilon_{it}$$

The above model uses unbalanced panel data for regression analysis, applies patent data and relevant financial data of enterprises from 2014 to 2017, as well as the construction of smart city in the place of enterprise registration, and obtains relevant regression results.

4. Empirical Results and Analysis

From the first three coefficients of the model estimation results, namely, the coefficients of enterprise R & D expenditure, smart city category and their interactive items, the enterprise R & D expenditure coefficient and interactive item coefficient are significantly positive, indicating that enterprise R & D expenditure has a great impact on enterprise patent application, and smart city has a positive regulatory effect on this impact,That is, in the smart city environment, it is conducive to the innovation activities of enterprises and can effectively improve the innovation achievements of enterprises.

Table 2. regression results

Variable	Patents
Rdspend	0.0201*** (0.000)
Smartcity	0.2353 (0.473)
Rdspend×Smartcity	0.0424** (0.0018)
Cash	0.00271*** (0.000)
Lnsize	9.644*** (0.000)
_cons	-0.696*** (0.000)
Indu	Yes
Year	Yes
N	1655

p-values in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

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5. Conclusion

This study collected 1655 observation points in the A-share market of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2014 to 2017, based on whether the construction of smart city has a regulatory effect on Enterprise R & D expenditure and innovation achievements.The results show that: ① smart city has a regulatory effect on Enterprise R & D and innovation achievements.② Smart city construction can transform R & D expenditure into more achievements of enterprise innovation activities.In view of this, it is suggested that major cities speed up the construction of smart cities to provide a good environment for enterprise innovation.At the same time, enterprises should seize the opportunity of smart city construction, have the courage to carry out innovative activities, increase investment in R & D expenditure and strengthen enterprise competitiveness.

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