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Research Article

Knowledge Spillover and R&D in Manufacturing Enterprises

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Abstract: Based on the database of Chinese industrial industries, a model is constructed to empirically analyze the interaction between knowledge spillovers and R&D in manufacturing industries; the mean productivity values of county and city regions have a significant positive effect on firms' R&D, which gradually decreases; an interaction term between the number of neighboring firms and the average total factor productivity of industries in different regional scopes is added, and the greater the number of neighboring firms in the neighborhood, the greater the spillover effect on research and development. In order to increase the innovation input of companies, they need to be given the space to fully exchange ideas.

Keywords: Knowledge Spillover; Manufacturing Enterprise; Enterprise research and development

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1 Introduction

Enterprise R&D investment plays an important role in innovation and development. Government subsidies[1], financial environment[2] and market competition[3] have an important impact on enterprise R&D. The stability of the environment has an important impact on the R&D investment of enterprises, and changes in the external environment can make enterprises more willing to invest in R&D. Good external factors and advanced internal management factors play an important role in the improvement of enterprise R&D innovation. Intuitively, the transfer of knowledge environment between local enterprises will play a significant role in enterprise R&D innovation. Existing studies have found that enterprises can continuously transform the knowledge of partners into their own knowledge through learning and absorption, and realize the acquisition of knowledge, so that their enterprises can catch up with competitors to develop new products and put them into the market[4]. Knowledge input has an important impact on enterprise R&D and innovation. As the main body of innovation, the interaction process of resources emphasizes the exchange of knowledge. Koenig et al. (2010) pointed out that the knowledge and information between enterprises will be disseminated in a certain range of areas through informal or formal means, and enterprises obtain information in the communication and observation of surrounding enterprises[5]. Intuitively speaking, the closer the geographical distance, the easier the spread of information resources between companies, the more obvious the spillover effect on R&D and innovation, and the dissemination effect of knowledge and information resources will be weakened with the increase in geographical distance. Greenstone and Hornbeck (2010) found that the spillover effect of knowledge will attenuate as the spatial distance increases. Enterprises need to ensure that the distance between each other is in a space in order to enjoy the effect of knowledge spillover[6].

The essence of the process of enterprise innovation is the dynamic interaction process between knowledge and the innovation subject. On the one hand, the enterprise promotes innovation by absorbing external knowledge, and on the other hand, the enterprise will release relevant knowledge to the surrounding environment after innovation, which cyclically forms an innovation spiral style rise.

2 Research Design

2.1 Knowledge spillover mechanism and spatial distance attenuation

Defining different regional knowledge is the focus of this article, referring to Winston (2001) and Aw et al (2004) [7] [8]. First, regarding the level of enterprise knowledge, the total factor productivity is used as the standard to measure the level of knowledge of the enterprise. Identify three ranges of counties, cities, and provinces in the local county where the company is located, find the average value of the internal knowledge level represented by the total factor productivity of all neighboring companies in the three counties, and calculate the average value of the company's own knowledge. The information of total factor productivity is eliminated, and a regression equation is established:

$$R\&D_{it} = \beta_0 + \sum_{L=1}^{3} \beta^L TFP_{it}^L + \eta tfp_{it} + \lambda X_{it} + \varepsilon_{it} \quad (1)$$

If there is an expected spillover effect of local knowledge on R&D and the results are intuitive, β_1, β_2, and β_3 will also show a decreasing trend.

2.2 The adjustment of exchange opportunities to knowledge spillover

In reality, the spillover effect of knowledge in different regions may not only be related to the average value of the total factor productivity of neighboring firms, but also related to the number of firms in the neighboring range. The greater the possibility of information sharing, the better the effect of local knowledge spillover on enterprise R&D. The regression equation takes into account the number of neighboring enterprises in a local area. At the county, city, and provincial levels, this article focuses on the county level. The data is further analyzed to form the following equation:

$$\ln RD_{it} = \beta_0 + \beta_1 TFP_{it}^L + \delta TFP_{it}^L \times FN_{it} + \eta tfp_{it} + \lambda X_{it} + \varepsilon_{it} \quad (2)$$

FNit characterizes the number of neighboring companies faced by firm i in this local range at period t. When calculating this value, firm i is removed, and the interaction term between the number of firms in the local range and firm efficiency is added to the regression equation. By observing the value of δ the coefficient can be used to test the influence of the number of neighboring enterprises in a local area on enterprise R&D. The local spillover effect is affected by the number of neighboring enterprises in a local area. The more enterprises there are, the more exchanges and learning between enterprises will be. It is expected to capture δ Greater than zero.

3 Data, Variables and Empirical Results

3.1 Data Processing

This article uses data from the "Database of Chinese Industrial Enterprises" published and maintained by the National Bureau of Statistics. The sample data from 2005 to 2007 is retained due to data missing. Taking into account the impact of sample timeliness on the research conclusions, the 2009-2013 industrial enterprise data was further used, of which only 2010-2011 included R&D data as evidence of robustness. Misreporting and underreporting in the original data will affect the results of the empirical analysis. The samples are preprocessed according to the series of principles. After processing, a total of 697,829 samples were retained for 2005-2007 data, and a total of 57,642 samples were retained for 2010-2011.

3.2 Variables

The statistical indicators in the database used in this article include: enterprise R&D expenses, year-end balance of net fixed assets, original value of fixed assets, total wages, year of establishment, reporting year, total liabilities, total assets, export delivery value, employee training expenses. The area code of the company and the industry code of the company. Among them, the core indicator research and development of this article are described in two ways, one is 1 plus the total R&D investment of the enterprise, and then calculated by taking the logarithm, and the other is the measurement using 0-1 dummy variables, total liabilities and total assets Used to calculate the company's asset-liability ratio (LEC). Enterprise Total Factor Productivity (TFP) is to estimate TFP through the method of Olley and Pakes (1996) [9]. The other indicators in the data are the export dummy variables (EX), employee training dummy variables (TC), and the age of the company (AGE) used for the company.

3.3 Empirical Results

Table 1. Regression results

	lnRD:R&D intensive margin	RD:R&D extensive Margin	exchange opportunities
County-level (TFP^1_{it})	0.038***	0.002*	
	(5.51)	(1.86)	
City-level (TFP^2_{it})	0.022***	-0.002	
	(2.25)	(1.34)	
provincial -level (TFP^3_{it})	-0.255***	-0.068***	
	(-22.46)	(11,12)	
Total factor productivity (tfp)	0.144***	0.019***	
	(70.24)	(50.39)	
Neighbor efficiency (TFP_{it})			0.067***
			(6.94)
TFP_{it}*FNit			0.003***
			(7.13)

Note: t-values are in parentheses. *, **, and *** indicate significant at the significance levels of 10%, 5%, and 1%, respectively, and all control other variables and the effects of industry, region, and year

From the first column, it can be concluded that the spillover effect of the county and city level on R&D is very significant, reflecting that the spillover effect of local knowledge decreases with the expansion of the scope, but the spillover effect at the provincial level is shown to be negative. This can be explained to a certain extent that due to the long geographic distance between enterprise i and enterprise j at the upgrade level, the learning and communication mechanism between the two is relatively weak, so the positive results of the provincial-level knowledge spillover cannot be derived from the results of empirical regression effect. In general, the scope of neighbors has a positive spillover effect on R&D, but it will show a decreasing trend due to geographic distance. The results in the third column show that the number of neighboring companies in a local area can promote the R&D of the enterprise, and the number of neighboring enterprises is the path through which the enterprise's R&D gains knowledge spillover utility.

4 Conclusions

Based on the data from China's industrial enterprise database from 2005 to 2011, this paper identifies the average total factor productivity of neighboring enterprises facing enterprises at the county, city, and provincial levels, in order to characterize the knowledge spillovers faced by enterprises in different regions According to the results of empirical research: the average productivity of county and city regions has a significant positive impact on enterprise R&D, showing a trend of gradual decrease from near to far. For further research, the interaction term between the number of neighboring firms in a local area and the average total factor productivity of the firm is added. When controlling the average total factor productivity, the larger the number of neighboring firms in the neighboring range, the greater the spillover effect on R&D. The source of innovation drive is R&D investment. Increasing corporate innovation R&D investment is of great significance for realizing economic kinetic energy conversion. This article proposes suggestions from the perspective of mutual communication and learning knowledge spillovers between enterprises: To increase the innovation input of enterprises, it is necessary to give enterprises sufficient space for communication.

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