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The Impact of Innovation Investment and Technology Trade on the Innovation Ability in the High-tech Industry Cluste

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Abstract: Innovation is the key for high-tech industries improving their competitive ability and promote the development of other industry and innovation investment and technology trade are the most important factors that affect the innovation ability, the high-tech industrial cluster will be the inevitable product when the industry develop to a certain stage, the concentration degree of high-tech industry in an area reflect the development of the industry, so it is one of the factors that we can't ignore when analysis the industry innovation ability, but the impact of these factors can't achieved success overnight, we should consider the lagging effect. Therefore this study Use the panel data of China's 30 provinces (not including Tibet) in 1997-2009 years to analyze the impact of high-tech industry innovation investment and technology trade situation to innovation ability based on the industry cluster.

Key words: Innovation investment, technology trading, industrial clusters, lag

INTRODUCTION

As a high technology, high innovation, high yield,The High technology industry is a emerging industry and innovation is the soul of improving the industry's own competitiveness and play its role to other industry and promote the development of national economy. In 1981 the Organization for Economic Cooperation and Development (OECD) pointed out that technology innovation includes new products and new technology and the original product and the significant changes in technology. If the innovation was implemented on the market, or applied innovation in the production process, then the "innovation" was implemented.

For the influence factors of innovation capability in high-tech industrial, scholars has carried on the theoretical and empirical analysis in different angles, most of their study concluded that innovation investment was the most important influence factor, the fund of scientific and technical that invested by government, enterprise scale, industrial structure and technology transfer is also one of the most important factors.

In the empirical analysis of Zhu (2011), concluded that the investment of innovation resources (mainly for the R and D funds and R and D personnel input) has significant effects on innovation performance (Zhu, 2011). In the studies of Eaton and Kortum (1996) mentioned technology advance can be divided into the self-reliance innovation, technology transfer, imitation and absorb to the outside world in the Follower countries which the latter has played an increasingly important role in the technological progress (Coe *et al*., 1997; Eaton and Kortum, 1996; Keller, 2002). The research about the impact of introduction, digestion and absorption on the innovation ability in high technology industry, is not much, Feng *et al.* (2011), using the stochastic frontier analysis method, researched that the impact of technology purchased in domestic and introduced from foreign and other forms of external technology sources on the innovation performance of high-tech industry in China (Feng *et al.*, 2011). Liu (2008) dialectically analyzes the "two-sided" impact of the introduction of international advanced technology on the development of high technology industries in China (Liu, 2008).

Wei (2010) proposed a modular organization, could promote international industrial competitiveness and create new growth for the industry space (Wei, 2010). As the rapid development of high technology industry in the region, industry cluster has been an inevitable product. The industrial agglomeration degree reflects the progress of the industry in the area and is one of the most important influence factors of industrial innovation. In the areas that industry cluster has been relatively mature,

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improving the regional innovation ability of high technology industry is crucial to enhance the comprehensive competitiveness of the industry and promote regional economic development. This article is based on the high technology industry panel data on 30 provincial-level administrative regions in China (except Tibet),and studies the industrial innovation and technical trading's impact on the innovation ability.

Transactions in technology market affect innovation capacity needs to be a certain amount of time, most of scholars agree that the research and development of lag for two years, so this article innovation investment and technology trade impact on the ability to innovate and considering the lag effect two years.

CONSTRUCTION, VARIABLES AND DATA SOURCES OF A MODEL

When this article carries on the analysis using panel data, at the same time, considering the time and space effect, Transactions in technology market affect innovation capacity needs to be a certain amount of time, most of scholars agree that the research and development of lag for two years, so this article innovation investment and technology trade impact on the ability to innovate and considering the lag effect two years. According to majority of studies, the lag period of influence of the research and development was two years (Gujarati and Porter, 1992). So in this study, the time lag effect about the impact of various factors on new products output, is set to no more than two years and in order to analysis hysteresis effect of 13 variables to the explained variable, design the following panel econometric model:

Base Period:

$$Y_{it}=aX_{1it}+bX_{2it}+cX_{3it}+dX_{4it}+eX_{5it}+fX_{6it}+gX_{7it}+hX_{8it}+iX_{9it}+jX_{10it}+kX_{11it}+lX_{12itt}$$

One-period Lagged Variable:

$$Y_{it}=a'X_{1it}+b'X_{2it}+c'X_{3it}+d'X_{4it}+e'X_{5it}+f'X_{6it-1}+g'X_{7it-1}+h'X_{8it-1}+i'X_{9it-1}+j'X_{10it-1}+k'X_{11it-1}+l'X_{12it-1}+m'X_{13it-1}+e'X_{it}$$

Two-period Lagged Variable:

$$Y_{it}=a''X_{1it}+b''X_{2it}+c''X_{3it}+d''X_{4it}+e''X_{5it}+f''X_{6it-2}+g''X_{7it-2}+h''X_{8it-2}+i''X_{9it-2}+j''X_{10it-2}+k''X_{11it-2}+l''X_{12it-2}+m''X_{13it-2}+e''X_{it}$$

Optimalmodel:

$$Y_{it}=a'''X_{1it}+b'''X_{2it}+c'''X_{3it}+d'''X_{4it}+e'''X_{5it}+f'''X_{6it-e}+g'''X_{7it-e}+h'''X_{8it-e}+i'''X_{9it-e}+j'''X_{10it-e}+k'''X_{11it-e}+l'''X_{12it-e}+m'''X_{13it-e}+e'''X_{it}$$

"Base Period" means using variables of the Base Period for regression analysis; represent the explanatory variables that one/two period lagged are used for regression analysis. Then use the explanatory variable of the biggest impact as the explanatory variables in the optimal model of regression analysis and control variables remain the same.

In the above model, the subscript i = 1, 2,…,30, on behalf of the ith section observation unit; t= 1 represent Base Period, t-1,t-2,t-e respectively represent one/two/e period Lag; α is the intercept term;Epsilon is random disturbance, on behalf of the influence of other variable that without considered; The description of the meaning of X and Y are shown in Table 1.

In this study, all data comes from related yearbooks which according to the relative statistic data of the high technology industry comes from the High technology industry in China statistical yearbook from 2002 to 2010

Table 1: Relevant variables and symbols

	Classification	Name	symbol (unit)
explainedvariables	iunovation ability	New products output	Y(10,000 yuan)
controlvariables	extemal environment	educational expenditure	X_1(10,000 yuan)
		marketization index	X_2
	Industrial cluster degree	concentration ratio of fixed assets	X_3
		corporate focus	X_4
		locationquotient of employee	X_5
explanatory variable	iunovation investment	internal spending of R&D funds	X_6(10,000 yuan)
		Budget of the new products	X_7(10,000 yuan)
		R&D personnel FTE	X_8(person–years)
	transactionintechnology	Trading of technology market	X_9
		technology import funds	X_{10}(10,000 yuan)
		technical digestionfunds	X_{11}(10,000 yuan)
		technical innovationfunds	X_{12}(10,000 yuan)
		Purchase funds in the domestic technology	X_{13}(10,000 yuan)

Concentration of fixed assets = fixed assets of regional high-tech industry at the end of the year/fixed assets of national high-tech industry at the end of the year, Enterprise concentration = regional high-tech industry companies' quantity/national high-tech industry companies' quantity, Workers' location quotient value = (No. of employees of each regional high technology industries/No. of employees of all regional high technology industries)/(employment No. of the national high technology industry/the national employment for all industry)

and transportation mileage, residents' consumption level, education spending comes from China statistical yearbook from 1998 to 2010.

EMPIRICAL ANALYSIS

Empirical research on the panel data model, usually selected three kinds of forms, hybrid estimation model, fixed effect model and the random effects model, to study. Hausman test first, if the check values significantly, we will choose the fixed effect model. Instead using the random effects model. When we choose the former, a constrained F value can make a further decision, if significant; we chose to use a fixed effects model, otherwise for the hybrid model (Zhang and Chen, 2009). Because there are too many test results, the results of the maximum likelihood ratio test is, in this study, the model does not apply to hybrid estimation model, Hausman test results of the lag issue of model should be suitable for random effects model, the others, fixed effects model should be adopted, Due to there is suitable for the random effects and fixed effect model, this article first analyzed fixed effect and the random effects model of every stage, the results are as follows.

Random effects analysis results show, the basic coefficient of X6, X10, one-period Lagged coefficient of X8, X9, X10, X11 and Two-period Lagged coefficient of X7, X13 are the largest and as well as the lag issue, in X8, X12; Lag phase two of X13 not through significance test, the rest are all through the significance test. In addition to one-period lagged X8, X12 and Two-period lagged X13 failed the test of significance and the rest are all through the significance test.

Fixed effect analysis results show that the base coefficient of X6, X10, X12, one-period Lagged coefficient of X9, X11 and Two-period Lagged coefficient of X7, X8, X13 are the largest and all through the test of significance, but the base Period of X12 and Two-period Lagged X8, X13 all not through the test of significance .

Analysis results of both fixed and random effects are basically identical, each stage variable that the coefficient was maximum and all through significance test are same, So this article treat the explanatory variables with biggest coefficient as explanatory variables and control variables and explanatory variables unchanged for analysis, then carries on the maximum likelihood ratio test and the Hausman test results.

Table 2: Preliminary results of random effects regression

	Base period		One-period lagged		Two-period lagged variable	
Explanatory variable	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
C	-1283959	0.0009	-1506099	0.0008	-2120221	0.0002
X_1	-0.391945	0.0002	-0.259501	0.02	-0.269989	0.0396
X_2	362502.9	0	352672	0.0002	490018.6	0
X_3	7197416	0.0925	8529624	0.0514	21027456	0
X_4	-10790451	0.0177	-7801233	0.1696	-4046142	0.5673
X_5	170316.7	0.0794	292852.7	0.01	116583.3	0.3959
X_6	10.58228	0	8.69464	0.0001	10.51378	0.0001
X_7	4.323168	0.003	7.395157	0	9.926213	0
X_8	-73.04956	0.0028	-54.06131	0.0521	-67.71118	0.0593
X_9	0.690537	0	0.861317	0	0.750129	0
X_{10}	7.31354	0.0001	3.74049	0.0456	-2.828684	0.2043
X_{11}	21.85022	0.0024	34.18736	0	11.05666	0.1768
X_{12}	3.021569	0.1227	0.700236	0.7439	-5.232476	0.0689
X_{13}	24.18251	0.2312	1.764194	0.9389	28.4737	0.3028

Table 3: Preliminary results of fixed effects regression

	Base period		One-period lagged		Two-period lagged variable	
Explanatory variable	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
C	-432789.4	0.5906	-1470385	0.0856	-1701544	0.1035
X_1	-0.213518	0.1128	-0.130987	0.3359	-0.030049	0.8524
X_2	138854.3	0.235	212991.6	0.0837	195835.4	0.2124
X_3	7685980	0.1321	9752580	0.0483	21480270	0.0001
X_4	2741041	0.8525	12114521	0.4479	46313805	0.0118
X_5	-208739.8	0.2929	49070.77	0.8273	-737374.7	0.0025
X_6	11.96273	0	8.716283	0.0005	8.131948	0.0056
X_7	1.87053	0.2737	6.085092	0.0011	8.282041	0.0002
X_8	-45.42412	0.1004	-33.29387	0.2907	-3.471918	0.9338
X_9	0.818294	0	1.018037	0	0.842162	0
X_{10}	5.543407	0.0051	2.772211	0.1696	-6.270056	0.01
X_{11}	23.38661	0.0016	30.74567	0.0002	11.01527	0.1817
X_{12}	3.938725	0.0948	0.631394	0.7966	-4.338935	0.1729
X_{13}	10.76155	0.6164	-5.65976	0.814	18.39982	0.5192

Table 4: Maximum likelihood ratio test

Effects test	Statistics	Degree of freedom	Probability
Cross-section F	2.992 925	-25.182	0
Cross-section Chi-square	76.108 183	25	0

Table 5: Hausman test

Test summary	Statistics	Degree of freedom	Probability
Cross-section random	29.850 824	13	0.0049

Table 6: Optimal fixed effects model

Explanatory variable	Coefficient	Probability
C	-991 980	0.313 4
X_1	-0.097 574	0.520 2
X_2	93 602.58	0.506 1
X_3	6 026 463	0.277 3
X_4	13 293 180	0.441 8
X_5	53 631.3	0.824 4
X_6	7.438 396	0
$X_{7(-2)}$	7.586 946	0.000 1
$X_{8(-2)}$	-61.710 57	0.124 6
$X_{9(-1)}$	1.101 264	0
X_{10}	4.249 133	0.046 8
$X_{11(-1)}$	32.169 06	0.000 1
X_{12}	3.089 719	0.259 4
$X_{13(-2)}$	21.478 93	0.401 5
R^2 0.958 8F statistics 109.2		
adjusted R2 0.950 02probability of the F statistics 0		
DW statistics 2.054 943		

From the test results we can see that all associated probability is 0 which rejected the null hypothesis. So we should set up a fixed effects model rather than a mixed effects model. From Table 5, the associated probability of the Hausman test is 0.0049, so the Hausman test results rejected the null hypothesis, namely random effects model can't be set up. So the above four panel data models should set up a fixed effects model.

Table 6 shows that R2 is 0.958 8, the adjusted R2 is 0.950 02 and value the D-W is 2.054 943 and probability is 0, that the goodness of fit of the regression model is better which shows the goodness of fit of the regression model is better.

CONCLUSION

We know from the regression results, if R and D expenses within budget and technology transfer funds increase 1 unit, the Base Period new products' output will respectively increase 7.438 396 and 4.249 133 units. If trading of technology market and technology digestion correspondingly increase by one unit, one-period lagged new products output will increase 1.101 264 and 32.169 6 units. If the budget of new products increase one unit, two-period lagged new products output will rise to 7.586 946 units.

Regression results show that the most significant positive impact factors of surplus product output in the high technology industry, are the ultimate issue of technological assimilation founds. Next influence from big to small in turn is the Two-period lagged budget of the different products, technology import funds and internal spending of R and D funds for basic Period. One-period lagged trading of technology market.

Technical digestion funds is the one of the most significant positive impact factors of new product output of high technology industry, Conclusion is different from most previous literature that R and D input is the major influence factor, This may be due to the amount of previous quantitative literature about technology digestion is less, But also because the amount of research based on the viewpoint of regional industry cluster is less. Most of the article do not consider the degree of industrial concentration in a region and separately based on the country or an area for research, therefore, the research on impact of industrial cluster degree on innovation ability is correspondingly less. In this study, we treat the degree of industry cluster as a control variable and finally, the size of coefficient is not much economic significance, but it can be seen that the degree of industrial clusters and new product output is positively correlated.

POLICY RECOMMENDATIONS

According to the analysis of various influencing factors of high-tech industry innovation capability, this study puts forward the following suggestions.

The first suggestion is that we should use and distribute the investment funds reasonably. The empirical results show that the most significant positive factors of new product output is lag in technology digestion for years, but the new product investment are more better for lag two years, Although the effect of the R and D internal expenditure of technology introduction and funding for new product output are significantly, we can not only see the short interest, the reasonable allocation of expenditures have an important role in improving the competitiveness of high-tech industries.

Another suggestion is that we should pay attention to the role of high-tech talent. In high technology industries, there are many practitioners, but the real high-tech talent is not much and the R and D staff's professional quality is not high and innovation ability is not strong, so the number of R and D increases instead of decrease in the number of new product output. In order to develop the high technology industry, we should focus on the introduction of talents and improve the enthusiasm and the professional quality of the existing scientific and technological research.

The latest suggestion is that we must actively technology market; accelerate the transformation of scientific research. Technology market is the link of the combination of science and technology and economy of a country and region, technology innovation and management innovation platform. It's an important channel to achieve the local high technology industrialization through achieving regional technology market. Only if we actively technology market, we can accelerate the development and introduction of systematic research and improve the rate of scientific and technological achievements, so consequently promote the rapid development of high-tech industries and increase its role in promoting the development of national economy.

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