University Innovation Input, Industry-university Cooperation and the Innovation Output of Large and Medium-sized Industrial Enterprises

—Based on the Empirical Research of Thirteen Provinces and Cities in China

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Abstract University innovation input and industry-university cooperation can affect the innovation output of enterprises to some extent, but the existing research has seldom put the two factors into the same framework. Based on the economic statistics of thirteen provinces and cities in China from 2001 to 2010, this paper studied the impacts of university innovation input and industry-university cooperation on the innovation output of large and medium-sized industrial enterprises. The empirical results show that university innovation input and industry-university cooperation can positively affect the patent output of enterprises, and industry-university cooperation can improve the marginal contribution of enterprises' innovation capital input to the patent output. While the results of regions classified by innovation capacity show that university innovation input can promote the two kinds of innovation output of enterprises in the region with the first level innovative capacity. The industry-university cooperation, as the independent and adjustable variable respectively, can also improve the two kinds of innovation output remarkably in the region with the first level innovative capacity. While in the region with the second level innovative capacity, the positive effects are mainly embodied on the patent output.

Keywords University Innovation Input, Industry-university Cooperation, Large and Medium-sized Industrial Enterprises, Innovation Output

the enterprises are greatly innovative is the core for them to acquire technical advantages and thus to be competitive in the market. Generally speaking, there are two methods for enterprises to realize the improvement of innovation capacity: the first is to depend on their own R&D input and R&D performance to boost innovative output; the second is to make use of the spillover effect of external innovation activities to strengthen their own innovation capacity. As to spillover effect of external innovation activities, corporations again can rely on two ways: for one, local enterprises could absorb spillover of foreign-funded companies via channels like imitation, personnel turnover and competition; for the other, they might allocate innovation resources through R&D cooperating with other innovation agencies.

Accompanying the changes in economic conditions in China, the transformation of economic development and upgrade of industrial structure has been put on agenda. For the time being, the total industrial output value has accounted for forty percent of the total GDP value in China, while the output value of large and medium-sized industrial enterprises enjoys a relatively high share in the total industrial output value, thus their transformation and upgrade plays a key role in realizing the improvement of domestic economy. In recent years, except for the increase in R&D investment, external innovation activities available to large and medium-sized enterprises have been also experiencing changes. Affected by factors like the attenuation of the demographic dividend and the increase in the prices of raw materials, the inflow momentum of foreign direct investment (FDI) and its spillover effects have been declining. Meanwhile, thanks to the better educational level and manpower resources, the R&D capacities of organizations like universities and scientific research and development institutions have been improved. To some extent, institutional arrangements like

1. Introduction

In the age of knowledge-based economy, the exclusive possession of advanced technologies has been regarded as the key for enterprise to gain interest, and whether or not

university-industry cooperation could better facilitate enterprises' innovative development. Consequently, it is both practical and legitimate to carry out a research on the effects of university innovative input and university-industry cooperation on enterprises' innovation output. This paper employs a panel data of thirteen provinces and cities in China from 2001 to 2010 to investigate the effects listed above and hopefully to advance suggestions and ideas to promote innovation output of large and medium-sized industrial enterprises.

2. Literature Review

Scholars, home and abroad, have conducted deep and detailed studies on the possible impacts of university innovation activities on industrial enterprises, which includes two aspects: one is focused on the spillover effects of university innovation input on enterprises' innovation output capacity; the other is centered on the cooperative relationship between university and industry, through which industrial enterprises could directly use universities' R&D capacity and improve their innovative performance.

With respect to the spillover effect of university innovation activities on regional or enterprises' innovation output, foreign scholars have been engaged in this area earlier. For example, Audresch and Feldman [1] and Ansenlin et al. [2] carried out the empirical studies on the links between university R&D input and regional innovation or regional economic growth with the employment of knowledge production function, discovering that university R&D activities could strengthen both of them. Woodward et al. [3] found out that university R&D funding could significantly affect domestic enterprises' choices of location, but the marginal increase in university R&D expenditure exerted limited influences on the emergence of new high-tech corporations. Audretsch et al. [4] utilized data from high-tech listed enterprises to conduct an empirical research and noted that university innovation activities could positively influence enterprise innovation activities, but might squeeze out enterprises' own creative efforts. Domestically, it has been still the highlight of academic studies, for instance, Wang Liping [5] through the study of the scope and extent of university R&D spillover, discovered that universities can positively affect high-tech industries and high-tech innovation in adjacent regions with characters of spatial dependence. Zhao Wenhong and LiuLilan [6] pointed out that university R&D could play a role in encouraging the establishment of high-tech enterprises and thus indirectly promote regional employment and economic growth. Liao Shumei [7] arrived at the conclusion that universities' R&D activities had imposed significant geographical spillover effect on enterprises' patent and new product output according to her research on the relation between university R&D activities and enterprise innovation. Her studies also suggested that universities' R&D activities could also positively stimulate enterprises' new product output in China's east and middle

regions. Lu Fangyuan and Zhao Yinghu [8] took the six provinces in central China as the subject and discovered that R&D investment in universities mainly come from government, but it was inadequate and focused on different R&D activities, showing a low expenditure in basic research and insufficient attention to original innovation.

Industry-university cooperation has been proven to be important for the improvement of enterprise innovation capacity. Hagedoorn and Duysters [9] believed that among the departments characterized by widespread knowledge and fast technological development, it was almost impossible for any single company to acquire all the conditions necessary to be technologically competitive, thus working with other agencies like universities or colleges was vital for corporation's development. The current literature has normally integrated industry-university cooperation into regional innovation systems and conducted meticulous studies on the obstacles and performance in the process, evolutionary trend and so on. For example, Veugelers and Cassiman [10] analyzed the specific characters conducive to cooperation between universities and industries by using community innovation survey data of Belgium and confirmed that cooperating with each other could be complementary to the shortcomings of one another. Dongjing et al. [11] started from the conflicts of intellectual property rights in the process of university-industry cooperation, and found that the flexibility of the agencies, the communication, and the completeness of the contract, the length of the cooperation, the relevant experience, and the intermediary agents had significant effect on reducing the relevant conflicts. Wu Yuming [12] and Chen Ao et al. [13] both believed that the strength of university-industry cooperation played an important role in promoting regional innovation output, with the difference that the former positive effect was reflected on the patent output, the latter being shown on the new product output. Xiao Dingding et al. [14] using the data of industry-university collaboration with MOE&MOST in Guangdong province, proved that the need of SMEs participating in University-Industry cooperation was much stronger, but the effect was less satisfactory compared with large enterprises, and the export orientation had insignificant promotion for cooperative enterprises to absorb foreign technology spillover. LiShichao [15] suggested that the relational embeddedness of university-industry collaboration indirectly influenced the innovation performance of firms through two major mechanism of firms' external knowledge acquisition (the explicit knowledge transfer and the joint problem solving arrangement). Liu Jiansheng [16] based his assumption on symbiosis theory and analyzed four major forms of industry-university cooperation, namely the point symbiotic, symbiotic intermittent, continuous symbiosis, and symbiotic integration, thus showing that the mechanism of industry-university cooperation evolved from simplicity to complexity.

In conclusion, from the perspectives of university innovation input and industry-university cooperation

respectively, scholars and researchers have analyzed the possible effects of university innovation activities on enterprise innovation capacity, and most of them approved that the two factors had positive spillover effects. However, both of them have been seldom put in the same study framework. University innovation activities not only include universities' own innovative input, but many other forms of links with enterprises, which may exert possible influences on enterprise innovation capacity. Meanwhile, in the process of cooperation, the efficiency of enterprises' R&D could be improved, which may also lead to the change in its marginal contribution to innovation output. Consequently, it is quite necessary to continue relevant studies based on the aforementioned points.

This paper plans to establish a panel data model to investigate the effects of the two factors, namely university innovation input and industry-university cooperation, and medium-sized industrial enterprises in thirteen provinces and municipalities in China, and then puts forward targeted proposals and suggestions based on the former results. The steps are as follows: firstly, choose preferable indicators to represent the two factors and establish the panel model; secondly, discuss the directions and value of the coefficients resulted from regression; finally, raise relevant suggestions based on the results above.

3. Indicator Selection and Data Sources

3.1. Dependent Variable

For the comprehensive measurement of innovation output of enterprises and regarding the limitations of indicator selections and data availability, this paper uses two kinds of indicators: one of them is patent output, and the other is represented by new product value. As for patents, it has been applied to an increasing number of innovative products in that the protective mechanism of patents has been better improved in China. And patent application tends to be free from the impact of institutional and human factors. However, the use of the number of patent as a measure of innovative activity has been criticized in the existing literature. This is due to the fact that patents are not final outcome of innovative activity and different patents may stand for different development intensity and different market value. Thus, patents could not be used as an objective and comprehensive measurement for innovative activity [17]. Hence, this paper adopts another indicator, new product value, to show the ultimate value form of innovation for the compensation of patent's deficiencies. The new product value employed by this paper is from large and medium-sized industrial enterprises within the sample areas, and has been deflated by PPI with 2001 as its base period.

3.2. Independent Variable

For the research of the influences of university

innovation input and industry-university cooperation on the innovation output of enterprises, this paper sets up the following three indicators.

3.2.1. Indicator of Innovative Input of Industrial Enterprises

New Economic Growth Theory has proven that innovation growth relies on the input of innovation resources, including innovators and innovation capital. As for the measurement of innovators, this paper uses the number of science and technological personnel in large and medium-sized enterprises. Since innovation capital bears accumulative effect, which means not only it can affect the output in the current period, but impact the innovation ability in the future, this paper adopts stock indicator estimated through the method of perpetual inventory referring to Bai[18], which formula is as follows:

$$K_{i,t} = K_{i,t-1} * (1 - \delta) + E_{it} \quad (1)$$

$K_{i,t}$ and $K_{i,t-1}$ respectively represent different region's capital stock in period t and $t-1$. δ represents depreciation rate which is 15% in this paper. E_{it} , deriving from nominal spending deflated by price index, is the actual internal spending of funds for science and technological activities. And the formula for price index is as follows:

$$\begin{aligned} \text{price index} &= 0.55 \times \text{consumer price index} + \\ &+ 0.45 \times \text{fixed asset price} \end{aligned} \quad (2)$$

This paper used 2001 as its base period for deflation. In the model of perpetual inventory, the formula for initial capital stock is as follows:

$$K_{i0} = E_{i0} / (g + \delta) \quad (3)$$

K_{i0} is the initial capital stock, E_{i0} is the initial internal spending of funding for science and technological activities, and g is the growth rate of the actual internal spending of funds for science and technological activities.

3.2.2. Indicator of University Innovation Activities

Enterprises' own innovation efforts are not their only innovation source. Through collaboration with organizations like universities and R&D institutions, enterprises could retain extra support from their innovation activities which could improve enterprise innovation capacity. This paper thus establishes two indicators, namely university innovation input and industry-university cooperation, to measure the effect of university innovation activities on enterprise innovation capacity.

As for the indicator of university innovation input, we use the data of science and technological personnel in universities. Regarding the indicator of industry-university cooperation, for the ambiguity of the cooperation's concept and the inadequacy of available data, it is difficult to ascertain a precise indicator. Thus, this paper adopts intermediary one as an alternative which could represent their financial relations during the cooperative process[19]. The formula is as follows:

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$$= \frac{\text{Enterprise - Subsidized Funding for Universities' Science and Technological Activities}}{\text{Total Funding for Universities' Science and Technological Activities}} \quad (4)$$

3.2.3. Indicator of Enterprises' Scale

In the existing literature regarding innovation, an enterprise's scale has been normally used as a control variable for the study of enterprises' innovation output. Thus, this paper employs the average quantity of employment in large and medium-sized industrial enterprises to investigate its effect on enterprises' innovation output.

3.3. Data Sources

Because of the disparities in economic development and location advantage, there are differences in innovation input of universities, innovation activities of enterprises and innovation output among provinces and municipalities in China. To accurately investigate their relations, this paper adopts K-means cluster analysis through Euclidean distance based on the total number of the new product value, patent application, invention patent application accumulated within sample period from large and medium-sized enterprises in places and areas in China (Tibet excluded). This paper further divides the 30 areas into three groups which are areas with A level innovation capacity, B level innovation capacity and C level innovation capacity, the result is as follows:

Table 1. Classification of areas with different innovative levels

Category	Areas
A level innovation areas	Shanghai, Jiangsu, Zhejiang, Shandong, Guangdong
B level innovation areas	Beijing, Tianjin, Liaoning, Jilin, Fujian, Hubei, Chongqing, Sichuan
C level innovation areas	Hebei, Shanxi, Nei Monggol, Heilongjiang, Anhui, Jiangxi, Guangxi, Hainan, Guizhou, Yunnan, Shanxi, Gansu, Qinghai, Ningxia, Xinjiang

Within the sample areas selected, this paper removes c level innovation areas. In the end, there are 13 provinces and municipalities: Beijing, Tianjin, Liaoning, Jilin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Hubei, Guangdong, Chongqing, and Sichuan. The period span of independent variables is 2001~2008. The period of new product value is one year lagged ranging from 2002 to 2009, and the period of patent output is two years lagged spanning from 2003 to 2010. The overall data comes from the following sources: 1) China Statistical Yearbook on Science and Technology from 2002 to 2011; 2) China Statistical Yearbook from 2002 to 2011; 3) the yearbooks from the listed 13 provinces and municipalities.

As to the unit of measure, the capital input was booked by RMB and accurate to bits, patents output booked by

number and accurate to bits and new product output booked by RMB and accurate to bits.

4. Model Building

Enterprise innovation output comes from not only their own innovative efforts, but also impacted by innovation activities of other organizations conducting R&D, such as spillover of university innovation and industry-university cooperation. To incorporate these factors, this paper establishes the following model to represent the relationship between the innovation output and its influencing factors:

$$IP = f(L, K, KF, Z) \quad (5)$$

IP is enterprise innovation output, represented by patent and new product output; L and K indicate respectively S&T personnel and funding; KF (key factors), the highlight of this paper, consist of university S&T personnel (UL), university S&T funding (UK), and the strength of link between universities and enterprises ($LINK$). What's more, this paper also set cross term by multiplying the $LINK$ and UK to testify the adjusting role of innovation input; Z represents other possible factors which may affect innovation activities, and in this paper, enterprise scale is chosen to show so. Considering that there is time lag between dependent variables and independent ones, this model can be expanded into the following form by employing Cobb-Douglas production function.

$$NPV_{i,t+1} = C + \alpha_1 FL_{it} + \alpha_2 FC_{it} + \alpha_3 KF_{it} + \alpha_4 EM_{it} + u_{it} \quad (6)$$

$$PAT_{i,t+2} = C + \beta_1 FL_{it} + \beta_2 FC_{it} + \beta_3 KF_{it} + \beta_4 EM_{it} + u_{it} \quad (7)$$

$NPV_{i,t+1}$ is the new product value of large and medium-sized enterprises from sample areas in period $t+1$, and $PAT_{i,t+2}$ is the corresponding patent output. FL_{it} and FC_{it} respectively represent enterprise S&T personnel and funding. KF_{it} consists of university S&T personnel (UL_{it}), university S&T capital (UC_{it}), the strength of industry-university cooperation ($LINK_{it}$), and the cross term ($LINK_{it} \times FC_{it}$); EM_{it} represents the average quantities of employment in large and medium-sized enterprises. C is intercept term and u_{it} is the error term.

The further study of the relations between variables shows that there is a high relativity between FL_{it} and FC_{it} , UL_{it}

and UC_{it} . To avoid the appearance of multicollinearity during regression, FL_{it} and UL_{it} are removed from model(6) and model(7). Meanwhile, to reduce heteroscedasticity resulting from different variable units, this paper logs on variables by putting L before each variable processed except for $LINK_{it}$. Consequently, this model can be further simplified as follows:

$$LNPNV_{i,t+1} = C + \alpha_1 LFC_{it} + \alpha_2 KF_{it} + \alpha_3 LEM_{it} + u_{it} \quad (8)$$

$$LPAT_{i,t+2} = C + \beta_1 LFC_{it} + \beta_2 KF_{it} + \beta_3 LEM_{it} + u_{it} \quad (9)$$

As listed above, KF_{it} includes LUC_{it} , $LINK_{it}$ and $LINK_{it} \times LFC_{it}$.

5. Empirical Research

This paper chooses 13 provinces and municipalities as sample areas with an 8 year period as its research span to study the effects of innovation input of universities and cooperation between universities and industries on the

innovation output of large and medium-sized industrial enterprises. The results of regression developed by eviews 6.0 are as follows:

5.1. University Innovation Activities and Innovation Output of Enterprises in the Overall Area

As is shown in the table 2, the column (1), (2) and (3) are the regression results aimed at patent output, while the column (4), (5) and (6) are the results regarding new product output. To put this in perspective, in column(1), the elasticity coefficient of university innovation input(UC_{it}) to patent output is 0.465, significant at 1% level; while the coefficient of UC_{it} to new product value is insignificant. The results discussed above combined show that the effect of university innovation input on enterprises' innovation output is mainly reflected on patent, instead of new product. This is because those universities pay more attention to the basic research field of new knowledge and new invention, rather than the realization of market value of new knowledge and technology which results in the promotion of enterprises' patent output, other than the other way around.

Table 2. The regression results of effects of university innovation activities on enterprises' innovation output in the whole area

Variable	Patent				New Product		
	(1)	(2)	(3)		(4)	(5)	(6)
C	-5.256***	-7.445***	-6.904***		1.632	1.509	1.541
	-1.577	-1.680	-1.642		-1.513	-1.580	-1.538
FC_{it}	0.690***	1.096***	1.052***		0.838***	0.950***	0.945***
	-0.114	-0.055	-0.054		-0.099	-0.051	-0.050
EM_{it}	-0.426*	-0.196	-0.180		0.063	0.098	0.102
	-0.222	-0.222	-0.223		-0.207	-0.202	-0.203
UC_{it}	0.465***				0.142		
	-0.127				0.108		
$LINK_{it}$		1.670***				0.191	
		-0.537				0.495	
$LINK_{it} \times FC_{it}$			0.121***				0.016
			-0.040				0.036
Adj. R ²	0.805	0.799	0.797		0.778	0.773	0.773
H-Value	4.352	3.178	3.207		2.960	6.164	6.071
Utility Model	RE	RE	RE		RE	RE	RE

Note: *, **and ***indicate t statistics is significant respectively at levels of 10%, 5% and 1%. FE and RE represent fixed effect model and random effect model. H value is Hausman Test value, and if it is statistically significant, null hypothesis will be rejected and fixed effect model will be accepted.

Table 3. The regression results of effects of university innovation activities on enterprise innovation output in different areas

Variable	A Level Innovation Areas						B Level Innovation Areas					
	Patent			New Product			Patent			New Product		
	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
UC_{it}	0.297***			0.151*			0.431			0.084		
	-0.003			-0.08			-0.29			-0.445		
$LINK_{it}$		1.088** -0.489			0.666* -0.391			1.642** -0.773			0.143 -0.874	
$LINK_{it} \times FC_{it}$			0.076** -0.036			0.05* -0.029			0.121** -0.058			0.013 -0.065
Adj.R ²	0.96	0.955	0.954	0.96	0.959	0.96	0.708	0.718	0.717	0.75	0.749	0.75
H-Value	1.312	1.775	1.737	7.826	21.726	21.494	5.218	3.791	3.799	6.56	7.43	7.64
Utility Model	RE	RE	RE	FE	FE	FE	RE	RE	RE	FE	FE	FE

Note: with table 2, and this table shows coefficients beforeucit, linkit, linkit*FCIT and rules out the ones before C, FCit and EMit..

Indicated by the column (2), the regression coefficient of the strength of cooperation ($Link_{it}$) to patent output is 1.67, significant at 1% level. In the column (3), the coefficient before the cross term is 0.121, significant at 1% level. However, in the column(5) and (6), $Link_{it}$, both as the single and regulated variable, fails to pass the significance test, showing no evident role in the promotion of new product output in industrial enterprises. This outcome shares some similarity of the characteristics of university innovation input, whose main role is reflected on the promotion of patent output, instead of new product in the large and medium-sized industrial enterprises. An important reason behind the phenomena is the lack of deep cooperation between universities and enterprises. It seems that this link could stimulate positively the basic research development like the patent output, but when it comes to the applied research and experiment regarding new product output, its function is relatively limited. For one thing, it is because the different innovative intention of enterprises and universities, the former being more concerned about putting new inventions and technologies into practical use to achieve financial returns and enlarge its market profit; for another, the mechanism guiding the process of this cooperation is beyond completion, they haven't realized full cooperation in the field of basic research, applied research and experimental development.

In addition, enterprises' innovation input shows a strong effect on the output both of new product and patent and both of their elastic coefficients are significant at 1% level, indicating it is a rather important source of their innovation output. Table 2 also shows that the scale of these industrial enterprises is not closely related to the improvement of innovation output in this model.

5.2. University Innovation Activities and Innovation Output of Enterprises in Different Areas

In accordance with the disparity of innovation capacity of large and medium-sized industrial enterprises in different provinces and municipalities, this paper classifies the

chosen 13 areas into two groups, which are areas with A level innovation capacity and areas with B level innovation capacity. As is shown in table 3, in A level areas, university innovation input significantly affects enterprises' patent and new product output, with coefficients respectively being 0.297 and 0.151, While in B level areas, the result is on the opposite, indicating that the spillover effect of university innovation activities could only be positive on the enterprises in A level areas. This is because these industrial enterprises mainly spread across Yangtze River Delta or Pearl River Delta where there are solid economic base allowing for better infrastructure, more beneficial innovative policies and other favorable factors related to the comprehensive innovation environment. And these elements are quiet crucial to a enterprise's R&D and absorptive capacity.

Another fact displayed by table 3 is that, in A level areas, $Link_{it}$ both as single and regulated variable, markedly elevates the production of patent and new product. In B level areas, $Link_{it}$ could positively affect patent output with coefficient being 1.642, significant at 5% level. As regulated variable, $Link_{it}$ also elevates the marginal contribution of innovation capital to patent output and the coefficient is 0.121, significant at 5% level. However, $Link_{it}$ shows no positive effect on new product output. Compared with B level areas, the competition is fiercer in the areas with better innovation capacity and a better innovation capacity would allow enterprises a competitive edge in the market. Thus, enterprises in this area have been forced to search for deep cooperation with universities in the field of basic research, applied research and experimental development, which in turn strengthens the link between universities and enterprises.

6. Conclusions and Suggestions

Based on the data collected from large and medium-sized industrial enterprises in 13 provinces and municipalities in China from 2001-2011, this paper does research on the effects of university innovation input and

industry-university cooperation on the innovation output of large and medium-sized industrial enterprises by establishing panel data model and conducting regression analysis. The main conclusions are as follows:

- (1) There exists a difference of the promotion exerted by university innovation input of the two kind of innovation output of large and medium-sized enterprises. In the whole sample area, university innovation input significantly improves enterprises' patent output rather than new product output because of their different innovation orientation. The regression results of the classified areas based on their innovation capacity show that university innovation input evidently elevates the production of patent and new product of large and medium-sized enterprises in A level areas, while in B level areas, it is a different story which could be attributed to the different comprehensive innovation environment.
- (2) In the whole sample area, the strength of cooperation between universities and enterprises can positively affect enterprises' patent output, and as regulated variable, it also boosts the marginal contribution of innovation capital to patent output. While, neither as the single nor regulated variable, it shows no significance to new product output. Based on the results of classified areas, the strength of cooperation plays a positive role in stimulating the two innovation output and as regulated variable, it also strengthens innovation capital's marginal contribution to the two output in areas with A level innovation; but in B level areas, it only affects the patent output. This is mainly because universities pay more attention to studies in basic areas, while enterprises attach more emphases to the application of new knowledge and technologies. Besides that, compared with B level areas, universities and enterprises enjoy more sufficient cooperation and complete cooperative mechanism in areas with A level innovation capacity.
- (3) Enterprises' own innovation input is still the important source of its innovation output. Based on the regression results, enterprises' innovation input significantly improves the production of patent and new product of large and medium-sized industrial enterprises within 13 provinces and municipalities. However, in this model, enterprise scale imposes no important influences on innovation output.

Based on the conclusions listed above, this paper advances suggestions as follows:

Firstly, strengthen governmental support for enterprises' R&D. While enhancing their independent innovation capacity, improve enterprises' ability of assimilation of external knowledge. For one thing, enterprises should take full advantage of research organizations' human resources like universities and R&D institutions to help boost their own manpower's comprehensive R&D capacity; for another, government should build relative infrastructure in favor of

enterprises' technological inventions to expand channels of technological spillover. At the same, cooperation between universities and enterprises in different regions should also be encouraged especially when enterprises are in B level innovation regions.

Secondly, deepen cooperative levels between universities and enterprises for the full cooperation of them two in the fields of basic research, applied research and experimental development. Initially, tendering system for industry-university cooperation should be carried out to lower the cost of innovation input of enterprises and universities which could encourage their cooperation during the process of patent R&D and the new product invention; and then, efforts should be made for the guidance of the innovative orientation of universities in knowledge invention, diversion and application to minimize their difference and tighten their links during cooperation; finally, emphasize the cultivation of a comprehensive innovation system which is aimed at market demand, and take universities and other innovative organizations as the important supplement to enterprises' innovation source of innovation capacity.

Thirdly, complete the equity transaction system for intellectual property right and innovation outcomes for the guidance of benign competition among enterprises in different regions. Through establishing regional environment with appropriate competition, it could encourage friendly competition and cooperation between different innovation organizations for the attainment of more innovation resources. Meanwhile, it is necessary to make clear equity transactions system, and ascertain the distribution of the ultimate ownership of innovation outcomes between universities and enterprises. Also, innovation organizations like universities and enterprises should raise their legal awareness to protect their innovative product. Thus, the dispute during the cooperation could be minimized by elevated executive strength and efficiency of laws and regulations.

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