Research on Risk Effect of Scientific and Technological Achievements Transformation and Interests Mechanism

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Abstract. Risk characteristics of scientific and technological achievements transformation is analyzed in this paper. Objective existence of the effect of risk mechanisms is also studied. The balance model of risk effect and binding effect is temptation to build. It establishes the mathematical model of the partnership income allocation mechanism effectively based on "investment, risk sharing, revenue sharing" principle and multi-function differential principles. It also gives the scientific calculation method of “β” which can make the ratio of profits allocation considering the investment and of partners.

1. Introduction
As we known, scientific and technological achievements are creativity achievements. It is a valuable asset of mankind and the necessary resources to promote the development of economics, technology and society. Scientific and technological achievements transformation are defined as activities of follow-up experiments, development, deployment, diffusion up to the formation of new products, new processes, new materials, development of new industries. Science and technology achievements are the whole process of knowledge goods to material goods which can sold in the markets. In other words, it is technological and economic behavior. However, there are 10 thousand items of scientific and technological achievements every year in China. At last the formation of productive forces is only about 5%. Contribution rate of science and technology to the economy is far less than the western developed countries. Technology resource is very serious waste. There is a problem worthy of attention that how to effectively transform scientific and technological achievements and reduce risks and transaction costs of conversion in the process of transformation of scientific and technological achievements. It is necessary to analyze the risks and benefits mechanisms of transformation of scientific and technological achievements scientifically. Technology transformation risk is mainly reflected the volatility and uncertainty of the input and output.

Different scholars have different interpretation of the risk meaning. For example Mowbray (1995) thinks that risk uncertainty. Williams (1985) thinks risk in the future is the results of the changes in a given condition. Rosenbloom (1972) describes that risk is defined as the uncertainty of loss and opportunity of Events or events of limited With the probability description. Liu (2009) discusses it faces technical risk, financial risk, marketing risk, the risk of team leadership, financial risk, institutional risk, policy and legal risks in the process of high-tech industry in China through the implementation of the transformation of scientific and technological achievements. He constructs a mathematical model to measure the size of risk and provides many measures to avoid risk of Transformation of scientific and technological achievements. These measures should be the development of risk investment, strengthening of self-construction of high-tech enterprises, full play to the role of government functions. In summary transformation risk of scientific and technological
achievements is uncertainty of risk results which the necessary conditions is the corresponding risk factors of achievements transformation and the sufficient conditions is the corresponding risk events of achievements transformation.

2. Risk effect analysis of scientific and technological achievements transformation

2.1. Risk characteristics of scientific and technological achievements transformation
As we all know, any investment has risk. The risk characteristics of scientific and technological achievements transformation is different from ordinary investment risk and has its inherent specificity. These characteristics are: risk appears high probability, risk the uncertainties, the risk appears regularly, the risk is controllable, the risks and benefits of the dialectical unity.

2.2. Mechanism and model of risk effect
Risk effect is the effect which produced by risk characteristics of the event itself and the internal mechanisms. It is an important condition to make the right decisions for understanding this effect. Risk effects in addition to the risk of investment projects and their status directly related to the objective risk, but also to the attitude of investors is closely linked to the risk.

2.2.1. The temptation to effect risk. Risk of uncertainty, control, regulation, in particular the dialectical unity of risks and benefits can bring the temptation to many decision-makers. Great risks often associated with high profit potential. It is hard to imagine there will be decision-makers are willing to accept the risk of net loss if there is no temptation of the potential benefits. The risk of interest to investors is an external stimulus germination to a certain motive. Then investors make a choice and lead to investment behavior. Of course, interest is a potential risk of interest. It is a possible interest or a future interest. It is not a certainty interest. It can really get to know these benefits only after the outcome of risk. This seems to see the enormous benefits but is not available, any person has different levels of temptation.

Risk degree is determined mainly by the following temptation factors: the potential benefits size of venture capital project of technology transformation \( y_1 \); the probability size By the potential benefits into real profit of venture capital project of technology transformation \( y_2 \); the length of payback period of venture capital project of technology transformation \( y_3 \); the degree of difficulty and size of risk of venture capital project of technology transformation is found and identified \( y_4 \); size of the cost and difficulty of risk transfer and control of venture capital project of technology transformation \( y_5 \).

These several factors are closely related to the specific risks of venture capital project of technology transformation. Degree of risk the temptation to effect size \( X \) is the complex function of the number of factors and don’t simply depend on traditional factors of risk interest because different projects of venture capital project of technology transformation are different risk profiles and the different size of risks. Temptation factor will be different because of different risk. It can be expressed as follows:

\[
X = f(x_1, x_2, x_3, x_4, x_5)
\]

The strength of these pull factors and different combinations of the extent determines the nature and size of the lure of risk degree. That is:

\[
Max(X) = f(max x_1, max x_2, min x_3, min x_4, min x_5)
\]

\[
Min(X) = f(min x_1, min x_2, max x_3, max x_4, max x_5)
\]

Risk degree of the temptation will not only affect people on the risks of selection and selection of motives of strength, but also have social effects. For example, the transformation of a technology, its market development of products, market risk if the lure of this degree, the market will attract many competitors. The market will attract many competitors if the lure of this market risk degree. In general, the risk temptation is much greater, the degree of risk selection competition and business competition is more intense, otherwise gently.
2.2.2. Risk constraint effect. People will make some selections to resist or avoid losses and taken to avoid conduct when people are subject to risks of possible loss of investment projects or dangerous signal of stimulation. In general, the deterrence, suppression and hindering the binding effect of risk factors are risk constraint effect. Risk constraint factors are constituted generally not a single as to the risk of temptation to effect. It is multiple, multi-level, and have collective, and systemic features. These factors and risk of their own investment risk inherent are close ties. They may come from outside the subject, that the external constraints, such as for project managers, natural disasters, international political and economic situation, changes in domestic economic policies, the degree of increased market competition, etc. While others may come from the main house, that the internal constraints, such as mismanagement, poor decisions, mood swings and other workers. These several factors are closely related to the specific risks of venture capital project of technology transformation. Degree of risk the constraint to effect size ($Y$) is the complex function of the number of factors and don’t simply depend on traditional factors of risk interest because different projects of venture capital project of technology transformation are different risk profiles and the different size of risks. Constraint factor will be different because of different risk. It can be expressed as follows:

$$Y = g(y_1, y_2, y_3, y_4, y_5)$$

(4)

The strength of these pull factors and different combinations of the extent determines the nature and size of the lure of risk degree. That is:

$$\text{Max}(Y) = g(\text{max } y_1, \text{max } y_2, \text{max } y_3, \text{max } y_4, \text{max } y_5)$$

(5)

$$\text{Min}(Y) = g(\text{min } y_1, \text{min } y_2, \text{min } y_3, \text{min } y_4, \text{min } y_5)$$

(6)

Correct understanding of the risk constraint effect, investors can avoid the risk of investment in science and technology achievements into management decision-making activities blindness. Investors must fully consider the risk of possible losses and negative results when they develop strategies, plans, objectives and activities. Investors can not be just a moment of subjective desire and passion to take risks and act recklessly, but should size up the situation and capabilities, and attention to scientific and practical decision-making. On the other hand, it stressed that the binding effect of the risk should not have fear of risk, the risk of loss can only see one side. If investors focus only on the negative effects of the risk of passive avoidance, and thus lose some of the opportunities and benefits.

2.2.3. Balance model of risk effect. The above analysis that the risk of transforming scientific and technological achievements, on the one hand, has enticing effect which can drive venture capitalists to obtain the potential risks of interest and do some kind of investment choices; on the other hand, has constrain effect which can have the inhibition of a deterrent effect to the investors choices and behavior. These two effects exist and place together. Technology Transformation for each risk event necessarily conflict with each other on the existence of such effects, offsetting the effect. The result is between the two effects will appear in a crossover point, the risk of temptation to equal effect and binding effect, known as the risk effect of balance. This balance is the risk of temptation to effect transformation of scientific and technological achievements and constraints result of the interaction effect. Therefore, the risk effect of technological achievements into equilibrium position for different decision makers is not the same because the same technological achievements into different risk events for the temptation of policy makers and binding effect of different effects. The process of formation of equilibrium, in essence, two kinds of people on the effects of temptation and restraint to recognize, compare, evaluate the process. That is process of an idea, thought processes, determine process and selection process. In this process, in which people combine their own experience, the risk in keeping with technological achievements into the objectivity of the risk and benefits for the loss of a "dynamic equilibrium". It is shown as figure 1:
3. Mathematical analysis of interest mechanism of technology transformation

The interest mechanism of technology transformation prominently reflects in the interest relations between the supply system and the main system of scientific and technological achievements. It is mainly economic interests and intellectual property. In the conversion process, the main reason of conflict of interest are: one is the pricing of outcome and property rights; second, the technology and capital inputs and the vested property rights of the secondary development of scientific and technological achievements; third, the distribution of benefits of the industrialization and commercialization of scientific and technological achievements. In order to protect the effective transformation of scientific and technological achievements, which there is a problem worthy of attention: the industrialization of scientific and technological achievements, the distribution of benefits after the issue of commercialization.

Technology transformation is high-risk and high profitability. The investment return and risk are inseparable for each partner. The key issues the cooperation partners can achieve a reasonable investment income/risk allocation/sharing determines the success or failure of cooperation in the process of technology transformation to some extend. How to build and design an effective distribution mechanism and investment, profit/risk ratio for the determination of the actual operation of the process are partners in a problem must be addressed among them.

The mathematical model of an effective distribution mechanism for partners is established in the paper based on "investment, risk sharing, revenue sharing" principle and multi-function differential principles. The risk and investment of partners are considered comprehensively.

3.1. The proportion of income distribution to determine the mathematical model

Assuming there are \( n \) partners in the process of technology transformation. \( V_i, \beta_i, I_i, R_i \) is income, income distribution ratio, investment and risk factor of \( i \) partner. The proportion of income distribution of \( i \) partner is the function itself \( \beta_i(R_i, I_i) \) based on "investment, risk sharing, revenue sharing" principle and the irreversibility of investment and opportunity costs. In addition, in determining the distribution of income ratio "\( \beta \)”, the following questions must be consider:

1. “Win-Win principle”: The main purpose of cooperation and the common objective of partners are some kind of economic interests and the interests in the market in the process of technology transformation. Therefore, the determination of the proportion of income distribution should ensure participation of all scientific and technological achievements transformation cooperation caught "profitable". It is possible to form such a partnership relation of cooperation-trust.

2. “the incentive mechanism which can promote equitable distribution among partners”: How much revenue should be different because of the different work the partner is responsible for and different investment. So partners can be more enthusiasm for work and investment. In addition, the dynamic revenue distribution mechanism, not only to ensure that partners “profitable”, and should also ensure that partners can “more work”. Of course there's “Work”means the risks and the investment incurred of partners.

3.2. Distribution ratio of cooperation benefits-scientific method of “\( \beta \)”

The There were \( n \) partners who participate in a scientific and technological achievements transformation, The final benefit is \( V \), so benefits of cooperation partner \( i \) is:
\[ V_i = \frac{I_i R_i}{\sum_{i=1}^{n} I_i R_i}, \quad i = 1, 2, \ldots, n \]  

(7)

\( R_i \) is risk coefficient, \( R_i \in (0,1) \), that is evaluation of risk partner \( i \) bears (technical risk \( R_T \), market risk \( R_M \), cooperation conflict risk \( R_C \)), \( I_j \) is investments (start-up capital, labor costs and financing costs).

### 3.3. Risk coefficient determination of cooperation partner

For example, risk coefficient determination of technology, similar to the availability of other risk factors. It is the key of establish a scientific, reasonable and feasible risk assessment system to evaluate the risk of technology transformation. The following evaluation index system will be established based on the design principle: "systematic, scientific, operational, forward-looking".

![Fig 2. Risk assessment system](image)

It can determine the risk weight of each evaluation index by analytical hierarchy process (AHP) based on risk assessment system of figure 2. The key to determine the risk weight of each index key is to accurately determine the specific risks at all levels from top to bottom relative importance of indicators of the degree by AHP. It is the risk weight of each evaluation by relevant expert’s judge, scoring, structure comparison matrix according to the level of the single matrix measurement and consistency test sequencing.

### 3.4. Examples

Calculation steps of the proportion of income distribution is following according to the above model: The first, determining the technical risk coefficient every partner faces \( R_{IT}, i = 1, 2, \ldots, 5 \). Technical risk coefficient \( R_{IT} \) of partner \( i \) is got firstly, The fuzzy relation matrix judged by a panel of experts is following:

\[
R = \begin{bmatrix}
0.4 & 0.2 & 0.2 & 0.1 & 0.1 \\
0 & 0 & 0.2 & 0.3 & 0.5 \\
0.1 & 0.2 & 0.5 & 0.2 & 0 \\
0.6 & 0.3 & 0.1 & 0 & 0
\end{bmatrix}
\]

(8)

Similarly the availability of the remaining technical risk partners are:

\[ R_{2T} = 0.3741, R_{3T} = 0.2278, R_{4T} = 0.0795, R_{5T} = 0.1058 \]

(9)
Similarly the market risk coefficient is $R_M = 0.3021$. The cooperation risk coefficient is $R_C = 0.1957$. The total risk coefficient of every partner is $R_i, i = 1,2,\ldots,5$ from formula 6 (1).

$$R_1 = 0.6503, \; R_2 = 0.6487, \; R_3 = 0.5665, \; R_4 = 0.4833, \; R_5 = 0.4981$$ (10)

If the partners of the investment are: $I_1 = 2700$ ten thousands Yuan, $I_2 = 3500$ ten thousands Yuan, $I_3 = 2400$ ten thousands Yuan, $I_4 = 2050$ ten thousands Yuan, $I_5 = 1700$ ten thousands Yuan,

$$\beta_i = \frac{I_i R_i}{\sum_{i=1}^{n} I_i R_i}, \; i = 1,2,\ldots,5$$

(11)

Income distribution rate of all partners are:

$$\beta_1 = 0.2431, \; \beta_2 = 0.3143, \; \beta_3 = 0.1882, \; \beta_4 = 0.1372, \; \beta_5 = 0.1172$$ (12)

4. Conclusion

Profits distribution mechanism which is justice is key factor of success or failure to coordinate in the process of technology transformation. This paper proposes the mathematical model of an effective distribution mechanism for partners is established in the paper based on "investment, risk sharing, revenue sharing" principle and multi-function differential principles. The risk and investment of partners are considered comprehensively. It provides a “$\beta$”scientific method of the proportion of income distribution based on the use of Analytic Hierarchy Process (AHP) and fuzzy comprehensive evaluation method.

It has the following innovations conclusion: it is proportional that partners receive the benefits and bear the risks or invest. This helps to improve the enthusiasm of partner. Thus it better reflects the principle of "investment, risk sharing, revenue sharing" between partnership.

References

[1] Zhang Qin. An Economic Analysis of Transformation Difficulty of Science and Technology Achievement. The Journal of Fuzhou University (Philosophy and Social Sciences), 2005, (3):36-39.

[2] Wan Wentao, Huang Yunqin. Agility Problem Study of Scientific and Technological Achievements of College. Industrial Technology & Economy, 2007, (5):64-67.

[3] Chen Youxing. A Discussion of Enterprise Management Change in the Process of Revolution. Information Technology, 2006, (2):27-28.

[4] Xu Hui, Cau Guohua, Ding Muhua. Risk Identification and Quantitative Measurement of Technology Transformation. Industrial Technology & Economy, 2005, (2):82-84.

[5] Xie Shengqiang. Risk Effect Study on Venture Investment Project of High Technology. Scientific Management Research, 2003, (3):109-117.

[6] Xie Jicheng, Liu Chengping. Fuzzy Mathematics and Its Applications. Huazhong University of Science University Press, Wuhan, 2006.

[7] Williams C A, Heins R M. Risk Management and Insurance. New york:mmcGrawHill, 1985.

[8] Rosenbloom J S. A case study in Risk Management. Prentice Hall, 1972.

[9] Liu Tie. Risk and Avoidance of High Technology Industry in China. Academic Communication, 2009, (11):90-95.