Influence on R & D project of Chinese IT corporations by talent introduction -a real option model

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ABSTRACT

The IT Corporations' Market environment in China is different from other countries. The roles of Chinese IT Corporations in technology are followers, and most of their products are imitated from the leader corporations. However, the key factor of R&D project in a corporation is human resource. So, the purpose of this paper is analyzing the relationship between of cost and benefit of corporation's R&D project by real option and econometrics. A modified real option model is used and is counted by specific numbers. The result shows that ratio of cost and benefit of R&D project is the key factor of making decision of talent introduction and the degree of making decision of talent introduction it can affect, it also proves that the existence the relationship of cost and benefit of R&D project. In other words, this result explains the reason of the liquidity of technical personnel and intense rate of skilled employees robbing between corporations. Moreover, this result can offer advice and development direction for Chinese IT Corporations.

Key words: Chinese IT Corporations; R&D; talent introduction; real option; strategy
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INTORDUCTION

Research and Development(R&D) is become more and more important in enhancing corporations' competitiveness. In the R&D project, the key factor is human resource, and companies usually recruit technical personnel for improving their products or service. Mayers[1] points out that the traditional methods for project evaluation are nor useful now, first of all, the methods don't consider the impact of decision making by sunk cost; secondly, discount rate of the methods are considered invariant; thirdly, the methods can't reflect the value of decision making by managers. However, the theory of real option has conquered these problems, so the real option is a popular way to evaluate R&D project in nowadays.

Real option theory is used for decision making of R&D project since it has been proposed. Lots of researchers have worked on it. Huisman、Pawlina&Kort[2,3] had put forward that asymmetric model depended on the asymmetric initial investment cost, they got three equilibriums: preemptive equilibrium, sequential equilibrium and simultaneous investment equilibrium by described the degree of initial investment cost in two companies with parameter k, and they also analysis the existence condition of the three equilibriums. In China, there are lots of scholars as well. AnYinghui& Zhang wei[4] had described the game options theory's development in full-scale. Wu Jianzu[5] had studied game options of asymmetric firms' R&D investment problems and indicated that the optimal timing of firms' R&D investment depended on the prediction of other firms' investment risk, the more risk they had, the earlier they invested. Yu dongping&Qiuwanhua[6] had studied new production strategic investment decisions with game options and impacting on firms value and investment time by benefit-cost and market uncertainty.

According to this, we know that the hypothesis of former research is a standard market environment. But in China,

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the market environment of IT firms is different from others. They are followers, and their products are imitated from the leader corporations. However, they lost the advantages of being leaders of market, they have another advantages of low cost of imitation. The key factor of R&D is human resource in IT industry[7]. Mostly, Chinese IT corporations employ the skilled technical personnel from other lead companies with higher salary to improve their own ability of R&D or reduce the time of R&D. The purpose of this paper is to find out a real options model of investment decision making and standard of decision making by analyzing the process of decision making of recruiting technical personnel in Chinese IT corporations with real options theory[8].

REAL OPTIONS MODEL

As well know, R&D project is considered a real option, a BS model[9] is used in this study.
Hypothesis The market is free competition and information symmetric. The value of Chinese corporations' R&D project will be changed once the corporations employ skilled technical personnel from other companies[10]. The changed value seemed as Pt'.

For ordinary R&D project, the BS model is:

$$P_t = P_0\phi[\frac{\ln\left(\frac{P_0}{C} + (rf + \frac{\sigma^2}{2}T)\right)}{\sigma\sqrt{T}}] - Ce^{-rf(T)}\phi[\frac{\ln\left(\frac{P_0}{C} + (rf - \frac{\sigma^2}{2}T)\right)}{\sigma\sqrt{T}}] \quad (1)$$

P_0 is original price, C is executive price, T is the research time of R&D project, r is risk-free rate, σ is volatility rate.

In IT industry, the R&D projects could be seemed as European options which are fitted for BS model, the main executive price is the salary of employees because the main resource of IT corporation is the human resource compared with hardware resource. So the C could be seemed C*T, C in here is the salary of employees.

Now, x is considered the cost of new technical personnel which is recruited from other companies. Once the new employee is employed, the value of IT R&D project is changed. To IT R&D project, the time of R&D will be changed because of recruitment[8]. So, the T could be seemed as T-t. And the model could be changed into:

$$P_t = P_0\phi[\frac{\ln\left(\frac{P_0}{(C+x)(T-t)} + (rf + \frac{\sigma^2}{2}(T-t))\right)}{\sigma\sqrt{(T-t)}}] - (C+x)(T-t)e^{-rf(T-t)}\phi[\frac{\ln\left(\frac{P_0}{(C+x)(T-t)} + (rf - \frac{\sigma^2}{2}(T-t))\right)}{\sigma\sqrt{(T-t)}}] \quad (2)$$

NUMERICAL CALCULATION

Now, we assume a series of value of numbers for identifying the relationship of benefit-cost and testing this model. P_0=100, C=10, T=10, r=5%, σ=20%. When manager doesn't decide to recruit skilled technical personnel x is 0, t is 0. So putting them into the improved model as (2), the original price is P_t=45.192974.

When the managers decide to recruit skilled technical personnel, the cost will increase into C+x, x is the new members' salary. x' range is [1,30], once recruiting new members the time of R&D will change, the variable is t which range is [0,10]. In this paper, $\triangle x = x_t - x_t - 1 = 1$, $\triangle t = t_t - t_t - 1$.

After calculation with STATE which is statistical software, we can get the outcomes of impaction of the two variables on IT R&D projects[9]. Because the manager will make the decision of recruiting new members when the benefit is more than cost and the number of date is huge, we list the numbers of x, P_t' and t which are around original Pt which is original project's value, as table 1.

From this table, we can find that t get longer with x getting higher compared with the former t, and x in P_t, so, we set x as horizontal coordinate, t as longitudinal coordinate, as figure 1. $\triangle t$ getting smaller and smaller with the x changing in equal interval. It indicates that with increasing the equal interval cost, the benefit of company is getting lower.

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Table 1 Impaction on Pt by $\triangle x$ and $\triangle t$

| x	t	$\triangle t$	$P_t^{'}$	x	t	$\triangle t$	$P_t^{'}$
1	2.1	2.1	45.29	16	7.65	0.1	45.87
2	3.25	1.15	45.29	17	7.75	0.1	45.88
3	4.1	0.85	45.37	18	7.85	0.1	46.08
4	4.75	0.65	45.20	19	7.9	0.05	45.32
5	5.25	0.5	45.20	20	8	0.1	45.82
6	5.7	0.45	45.58	21	8.05	0.05	45.28
7	6	0.3	45.26	22	8.15	0.1	46.11
8	6.3	0.3	45.41	23	8.2	0.05	45.80
9	6.55	0.25	45.47	24	8.25	0.05	45.56
10	6.75	0.2	45.37	25	8.3	0.05	45.42
11	6.95	0.2	45.46	26	8.35	0.05	45.36
12	7.1	0.15	45.22	27	8.4	0.05	45.40
13	7.25	0.15	45.22	28	8.45	0.05	45.54
14	7.4	0.15	45.50	29	8.5	0.05	45.76
15	7.55	0.15	46.03	30	8.55	0.05	46.09
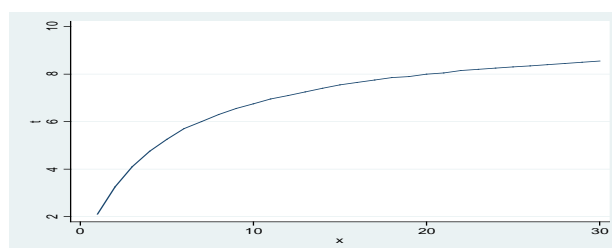
Fig. 1 relationship of x and t

According to above analysis, the best decision is not getting x higher and higher which means recruiting more and more technical personnel because of $\triangle t$ is becoming smaller. The decision making must depend on the condition of different firms. When the capital is enough manager can recruit the new members as much as the cost makes $\triangle t=0$, and in this time benefit is largest, otherwise, manager must make decision when the ratio of benefit and cost is reasonable.

RELATIONSHIP BETWEEN COST AND BENEFIT
According to the date analysis, it shows the relationship of value Pt', cost x and time t, as table 2. It shows the relationship of x and y, y and t, y and Pt' are negative correlation, the relationship of cost x and time t is positive correlation.

Table 2 Correlation of C T-t and P

	x	t	$P_t^{'}$	y
x	1			
t	0.8941	1		
$P_t^{'}$	0.4889	0.4892	1	
y	-0.8563	-0.996	-0.5057	1

The date t must be checked by unit root test before being used for econometrics analysis, as table 3. It shows that t value of t is -3.399109 which is smaller than the value in significant level of 1%, 5% and 10%. This means the null hypothesis is rejected which has a unit root test. Generally speaking, date of t is stable which can be used for econometrics analysis.

Table 3 the unit root test of t

unit root test of t		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.99109	0.021
Test critical values:	1% level	-4.32398	
	5% level	-3.58062	
	10% level	-3.22533	

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Table 4 regression analysis of t and x

Source	SS	df	MS	Number of obs	30
				F(2, 27)	316.57
Model	76.487	2	38.243	Prob> F	0
Residual	3.262	27	.12080	R-squared	0.96
				Adj R-squared	0.96
Total	79.748	29	2.74995	Root MSE	0.348
t	Coef.	Std. Err.	t	P>t	95%Conf. Interval
x	0.4704	.0303067	15.52	0	0.409	0.532
x1	-0.010	.0009486	-10.27	0	-0.012	-0.008
_cons	2.758	.2038073	13.53	0	2.340	3.176

Regression analysis of t and x as table 4, the model is $t=0.4704x-0.010x2+2.758+\varepsilon$, ε is white noise disturbance term. In table 4, the absolute value of t and F is much higher, value of P is 0, R2 is 0.96. The result of table 4 shows us that the model we design is well fitted. From this model, the relationship of t and x is nonlinear and second countdown is less than zero which means it has maximum value. So, it is the max benefit when $\triangle t=0$. It proves the chapter 2s result because the cost x is related to the number of recruiting new members and decreasing research time t is related to benefit of project.

In other words, t is the time a project must reduce to when a manager decide to pay x to recruit technical personnel compared with former project's value. According to the raising of x, $\triangle t$ is decreasing. It can be seemed as marginal benefit with recruiting technical personnel. So, manager can afford more members when the $\triangle t$ is 0 which is a standard for recruiting members.

The time of R&D project will be changed when manager recruits technical personnel. From this paper a standard time is be calculated. The decision of whether recruiting technical personnel or not is sure when actual time is higher than the standard time, otherwise, the decision is negative. When they are the same as each other, manager can make his choice depend on his company's business conditions. He can make this decision for enterprise strategic plan or give it up for saving money. On the other side, it can be seemed the excepted returns which is standard of decision making from the model when recruiting members.

CONCLUSION

The IT Corporations' Market environment in Chinese is different from other countries. The role of Chinese IT Corporations in technology is follower, and most of their products are imitated from the leader corporations. However, the key of R&D project in a corporation is human resource. So, in the study, a modified model is proposed. The hypothesis of this study is closed to reality. It has very important sense. By numerical analyzing, the result shows that ratio of cost and benefit of R&D project is the key factor of making decision of talent introduction and the degree of making decision of talent introduction it can affect, it also proves that the existence the relationship of cost and benefit of R&D project. It also shows three choices when a manager of Chinese IT firm decides to recruit a skilled technical personnel. In other words, this result explains the reason of the liquidity of talents and intense rate of talents robbing between corporations. Moreover, this result can offer advice and development direction for Chinese IT Corporations.

There are lots of other problems in recruiting skilled members, such as asymmetric information which means the technical personnel can self-packing. In this condition the manager can mislead to get the wrong valuation of talent introduction which can make big loss of firm. In the case of that, game theory is a very good way to resolve this problem. The next step is analyzing this problem with combination of game theory and real option.

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