Modeling and analysis of entrepreneurs' behavior patterns under M&A

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Abstract. For enterprise mergers and acquisitions impact on entrepreneurs' behavior patterns, in this paper, by establishing the model of transparent analysis of entrepreneur's behavior pattern, combined with the observation visualization of data, by introducing the concept of mergers and acquisitions, dynamic research points out for more than one time above the entrepreneur behavior patterns, so as to make the information as much as possible close to the reality, and analysis provides quantitative reference for the entrepreneur behavior patterns.. On this basis, this paper draw lessons from Arkadiyv. Sakhaetov and Timothy B.folta (2014), and other scholars research model, entrepreneurial behavior change (mainly for the innovation behavior) brought from mergers and acquisitions, established the mathematical model, analyzed the resources and the conflict of two kinds of variables influence on it, and the relationship between each variable has been carried on the theoretical deduction, to some extent the analysis confirms the rationality of the enterprise merger.

1. Introduction
Entrepreneurs are senior managerial talents who are responsible for the effective organization and management of land, capital, labor and other factors of production, and are full of risk taking and innovative spirit. They are the people in enterprises who can make enterprises operate legally and have social responsibility for continuous development. With the development of society and the reform of economic system, entrepreneurs must follow the modern way of thinking to establish their own mode of behavior. In other relevant literature, for example, Zheng Jiang in 2000 in addition to the public economy, a large number of active non-public enterprises, such as private enterprises, individual industrial and commercial households, foreign-invested enterprises, etc., emerged. According to the statistics of the State Administration for Industry and Commerce, since 1990, the average annual growth rate of the number of enterprises in China has been 10.86%, among which the average annual growth rate of public enterprises has been 6.93%, that of foreign-invested enterprises 37.48%, that of private enterprises 38.53%, and that of individual industrial and commercial households 11.53%[1].In 2004, Wang Dong fang of Huazhong University of Science and Technology found that from 1985 to 2003, the growth rate of China's telecom enterprises exceeded the GDP growth rate for 18 consecutive years, and even exceeded more than 40 percentage points at the fastest time. From 1989 to 1999, the income and investment of China's telecommunications enterprises increased by 3 times, with an annual growth rate of 43%, 4 times the average growth rate of GDP in the same period [2].In 2018, Zhou Yang min and Zhao YA li clarified the definition of institutional entrepreneur in academic circles, analyzed the characteristics of institutional entrepreneur in institutional economics school and...
organizational neo-institutionalism school, and explained the behavior pattern of institutional entrepreneur from two aspects of institutional change and institutional innovation [3]. In 2020, Liu Ning hui Tang Xiao le according to the classification of the sample statistics, found that mergers and acquisitions are mainly concentrated in six industries, in turn, is the electronic products industry (34.4%), computer equipment (31.3%), aerospace manufacturing (15.6%), chemical products industry (10.9%), software (4.7%) and instruments manufacturing (3.1%) [4]. Domestic M&A continued to grow at an annual rate of 70 per cent between 1998 and 2002. In 2002, the value of china-wide M&A deals involved was more than $30 billion, accounting for about 20 per cent of the value of published similar deals in Asia excluding Japan [5]. According to statistics, 11,174 mergers and acquisitions took place in China in 2018, with a total value of 2,486.3 billion yuan, 2.55 times that of 2010 [6].

However, the modeling and analysis of the entrepreneur behavior patterns are not in mergers and acquisitions mode were analyzed, and the consideration to the environmental factors is not complete, the entrepreneur's behavior patterns are not specific to the point of analysis, this paper will be based on the behavior of the merger and acquisition the environment for entrepreneurs to try modeling, the resources of the environment and conflict for entrepreneurs to make innovation behavior to establish a mathematical model, and carries on the further analysis.

2. Algorithm and principle

Mergers and Acquisitions (M&A) is a general term of Mergers and Acquisitions. The essence of M&A can be summarized as the act of one company acquiring control over another in accordance with the definitions in The Company Law of China (revised 2014) and the Securities Law of China (revised 2014). In other words, the act of merger and acquisition between enterprises is the act that enterprise legal persons acquire the property rights of other legal persons in a certain economic way on the basis of equality, voluntariness, equivalence and compensation. It is also a main form of capital operation and management of enterprises.

The analysis of entrepreneurial behavior patterns in the context of enterprise mergers and acquisitions can be shown in the following structure.

![Figure 1. Analysis of entrepreneurial behavior patterns under corporate Mergers and Acquisitions.](image-url)
The specific division can be seen in the following figure.

![Diagram showing functional connection, influence factor, norms and constraints, and various influence factors like physical factors, emotional factors, personality factors, mentality factors, natural environmental factors, and social environmental factors.]

**Figure 2.** Specific analysis of entrepreneurial behavior patterns.

This article focuses on the entrepreneur in mergers and acquisitions in the behavior model under the conditions of the main point of Technology Innovation behavior modeling, for enterprise merger and acquisition of resources, according to the hypothesis function mainly through synergies, reference Arkadiyv. Sakhaetov and Timothy B. folta (2014), and other scholars research model, resource for enterprise Technology Innovation brought by the (Technology Innovation) increment is:

\[
I_A^* = E_A^* S_A^* S_T^* \alpha_{AT}(s)^* \beta_T(u)
\]  

(1)

\(E_A\) degree of resources for enterprise mergers and acquisitions, \(S_A\) and the \(S_T\) (Source), respectively, for the enterprise mergers and acquisitions party itself and merger and acquisition of party get technical resources from the target (not only refers to the patent technology, but also the scientific research team, scientific research equipment and other resources) stock, the theoretical value are greater than zero, therefore, \(E_A^* S_T\) represents the merger and acquisition, the resource integration of the implementation of the target behavior. \(\alpha_{AT}\) is the synergetic effect factor caused by the resource integration between the acquire A and the target T. \(\beta_T(u)\) analyzes the influence of the autonomy of the target party on the R&D efficiency of the target party. According to the hypothesis, the autonomy of the target party affects the efficiency of technological innovation.

As for the conflicts under merger and acquisition, according to the hypothesis, the impact of technological innovation on entrepreneurial behavior pattern is mainly explained from the perspective of cost. Mergers and acquisitions will break the original social embedding path of entrepreneurs and inevitably lead to conflicts. According to Hambrick, Cannella (1993), Libation et al. (2001), Zhong Fangfang, Chen Fei QIONG et al. (2015) and other scholars' research models, employee conflict and culture conflict are positively correlated with friction costs, that is, the greater the difference between employees and culture, the higher the corresponding friction costs will be. Therefore, based on the analysis of friction cost by Zhong Fangfang, Chen Fei and other scholars (2015), this paper sets the cost of enterprise merger and acquisition as:

\[
A = f(I, c)/2* E_A^* S_T^2
\]  

(2)

Among them, \(E_A\) still represents the degree of resources of the acquirer, and \(S_T\) still represents the stock of technical resources obtained by the acquirer from the target. Here, \(f(I, c)\) is mainly introduced to analyze the effect of Labor conflict and Culture conflict on friction cost.
3. Experimental design

The greater the difference between employees and cultures of both parties, the higher the friction cost and the increasing marginal cost will be. Meanwhile, the higher the degree of integration implemented by the merger party to the target party, the higher the friction cost will be and the increasing marginal cost will be.

According to the analysis, the entrepreneurial innovation effect after enterprise merger and acquisition theoretically reduces the technological innovation increment by the cost, namely:

\[ I = I^* - A \]  \hspace{1cm} (3)

According to formula (1), (2) and (3):

\[ I = E_A * S_A * S_T * \alpha_A(s) * \beta_T(u) - f(l, c) / 2 * E_A * S_T^2 \]  \hspace{1cm} (4)

For the convenience of analysis, let \( I \) be integrated with \( c \) variables, and \( f = f(l, c) \) is set. Therefore, the model can be reduced to:

\[ I = E_A * S_A * S_T * \alpha_A(s) * \beta_T(u) - f / 2 * E_A * S_T^2 \]  \hspace{1cm} (5)

According to the analysis of the actual situation, entrepreneurs will face two situations under enterprise merger and acquisition: one is that the benefits of synergies exceed the friction costs, and the successful enterprise merger and acquisition can realize the improvement of entrepreneurs' innovation behavior mode; The other is that the synergetic benefit is lower than the friction cost, so the merger is obviously a failure.

This paper first looks for the top ten entrepreneurs in China whose influence is due to M&A, as shown in Table 1:

| Rank | Figure            | News media influence | Influence of we media | Composite scores |
|------|-------------------|----------------------|-----------------------|-----------------|
| 1    | Jack ma           | 10.00                | 9.74                  | 9.87            |
| 2    | Ma Huateng        | 6.99                 | 8.52                  | 7.76            |
| 3    | Li Yanhong        | 6.53                 | 8.27                  | 7.40            |
| 4    | Wang Sanshous     | 6.87                 | 7.77                  | 7.32            |
| 5    | Liu Qiangdong     | 5.19                 | 7.84                  | 7.01            |
| 6    | Che Pinjue        | 5.31                 | 6.70                  | 6.00            |
| 7    | Cheng Wei         | 5.78                 | 6.19                  | 5.98            |
| 8    | Zhou Hongwei      | 5.70                 | 5.92                  | 5.81            |
| 9    | Lei Jun           | 5.45                 | 6.07                  | 5.76            |
| 10   | Ren Zhengfei      | 5.16                 | 5.86                  | 5.51            |

Since M&A can determine both the degree of integration and the autonomy of the target party, we obtain the first partial derivative of the degree of integration \( E_A \) and the autonomy \( u \) of the target party on the basis of equation (5) above, and obtain the following two conditions:

\[ \frac{\partial I}{\partial E_A} = S_A * S_T * \alpha_A(s) * \beta_T(u) - f(l, c) / 2 * E_A * S_T^2 \]  \hspace{1cm} (6)

\[ \frac{\partial I}{\partial u} = E_A * S_A * S_T * \alpha_A(s) * \frac{\partial \beta_T(u)}{\partial u} = 0 \]  \hspace{1cm} (7)

Equation (6) is simplified:

\[ E_A * \alpha_A(s) * \beta_T(u) * S_A / f * S_T \]  \hspace{1cm} (8)

In Equation (7), since the degree of resources, the technical resources stock of the acquire and the target, and the synergetic effect factor of both parties are not 0(if 0, the merger will be meaningless and not in line with reality), it can be obtained that:

\[ \frac{\partial \beta_T(u)}{\partial u} = 0 \]  \hspace{1cm} (9)
For the convenience of analysis, combined with the characteristics of $T(u)$ which is more in line with the quadratic function, we concretized the model and made it

$$\frac{\partial \beta T(u)}{\partial u} = 2k_1u + k_2 \quad (k \text{ is a constant}),$$

so equation (9) can be written as:

$$u = \frac{-k_2}{2k_1}$$

(10)

For further analysis, first, for Equation (8), the first partial derivative of $E_A$ with respect to $f$ can be obtained as follows:

$$\frac{\partial E_A}{\partial f} = \alpha_{AT}(s) \beta T(u) \frac{S_A / S_T}{f^2}$$

(11)

Then, for equation (8), the first partial derivative of $E_A$ with respect to $s$ can be obtained as follows:

$$\frac{\partial E_A}{\partial s} = \alpha_{AT}(s) \beta T(u) / f$$

(12)

4. Results and discussion

In the above equation (11), if $\beta T(u)$ and $S_A / S_T$ are not considered to be 0 (that is, the autonomy of the target party is 0 or the technical resource stock of enterprise merger is 0, which is almost impossible in reality), $\beta T(u)$ and $S_A / S_T$ are always positive, and $\alpha_{AT}(s)$ is greater than 0. Therefore, $\frac{\partial E_A}{\partial f} < 0$.

Therefore, we can conclude that entrepreneurs should choose a lower degree of integration when it is difficult to integrate M&A conflicts; Similarly, when the difficulty of conflict integration is smaller, entrepreneurs should choose a higher degree of integration. According to Equation (12), when the merger and acquisition and integration of enterprises are small, entrepreneurs should improve the degree of integration, so that the increment of entrepreneurs' behavior mode of technological innovation will be large. The reverse should also be true.

From the above experimental analysis, it can be concluded that entrepreneurs should choose a lower degree of integration when it is difficult to integrate M&A conflicts. Similarly, when the difficulty of conflict integration is smaller, entrepreneurs should choose a higher degree of integration. When merger and integration is small, entrepreneurs should improve the degree of integration, so that entrepreneurs' behavior pattern of technological innovation will increase greatly. The reverse should also be true. Meanwhile, the amount of enterprise M&A from 2006 to 2016 is collected, as shown in Figure 3 and Figure 4 below.

**Figure 3.** Amount and number of M&A transactions.
Meanwhile, the confidence index of entrepreneurs from 2010 to 2013 is collected, as shown in Figure 5 below.

By the above results, the current entrepreneurial behavior patterns have not yet in a merger and acquisition environment keep rising trend, the entrepreneurs' confidence is also have a downward trend, which is harmful to the enterprise, this paper also by looking up the trend in recent years, the number of private enterprises, this article has failed to give the chart data such as displayed in a specific change), found in mergers and acquisitions under the entrepreneur's behavior mode, Chinese private enterprises especially small and medium-sized private enterprises of the average survival
period was only three years, can achieve more than five years is very low, the proportion of more than 10 years is rare. So, combining the experimental analysis, in the face of mergers and acquisitions, combined with the above-mentioned, M&A transaction amount and the amount is not in the rising trend, and even in slow decline year by year, and that entrepreneurs confidence index is in a downward trend year by year, but look through entrepreneur's popularity and its relevant entrepreneurs can produce bigger impact also benefit from the environment of the enterprise merger and acquisition, so M&A impact on entrepreneur is a two-way, the key lies in the different situation of entrepreneurs, the specific method in the process of entrepreneurs to adopt innovation behavior model, entrepreneurs should also improve the target party autonomy, Thus, the enthusiasm of employees can be brought into play, which is conducive to the improvement of the enterprise's life cycle.

5. Conclusions
Through the previous research, we have carried out theoretical analysis, mathematical derivation and empirical test on the behavior pattern of enterprises around merger and acquisition. Here, this paper will combine with the practice of enterprise mergers and acquisitions entrepreneurs to do a summary. With the influence of mergers and acquisitions, entrepreneurial behavior, behavior pattern is also developing rapidly, entrepreneurs in order to surpass each other, has adopted the new behavior patterns, especially in the way of innovation, thanks to the influence of the merger and acquisition, when entrepreneurs take different ways to deal with, this kind of entrepreneur behavior patterns, can maximize its technological innovation behavior patterns. This article through to mergers and acquisitions under the entrepreneur behavior model for mathematical modeling, and obtained the above experiments under different conditions of two kinds of conclusion, also collected from 2006 to 2016 years of corporate mergers and acquisitions trend chart and from 2010 to 2013 entrepreneurs confidence index trend diagram, awareness of some entrepreneurs are not able to very good use mergers and acquisitions to improve themselves, their behavior patterns still need through the concrete analysis of this paper argues that the choice of entrepreneurial behavior patterns should control, to carry on the whole process of mergers and acquisitions to enterprise merger conduction path to maintain a state of omniscience. Only in this way can entrepreneurs have higher competitiveness in the competition among most enterprises.

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