

2014

# BioTechnology

*An Indian Journal*

FULL PAPER

BTAIJ, 10(18), 2014 [10485-10490]

## Comparative study on DEA-based mergers & acquisition trading efficiency of Chinese listed company

Shu-Rong Yan

College of medicine and health, Lishui University, Lishuizhejiang, 323000 (CHINA)

E-mail : tmw168@126.com

### ABSTRACT

Chinese M&A market is just unfolding, and its efficiency evaluation is very important. This paper carries out the innovation in research methods, first to distinguish between M&A transaction efficiency and integration efficiency, and improve DEA model to study the transaction efficiency. It finds: Since 2006, with the M&A marketability gradually the company's M&A can enhance company's value, but there are differences between purchase company and goal company, among Horizontal, vertical and mixed M&A; The strategic M&A performance is better than that of property peeling and asset replacement; The M&A efficiency of corporate-control shareholders is better than that of state-owned and Circulation-stock control Companies.

### KEYWORDS

M&A; Trading efficiency; DEA; Principal component ;China.



## INTRODUCTION

Merger and acquisition ("M&A" for short) is the mostly important resource reconfiguration means; the M&A efficiency level has the direct bearing on the resource configuration function exertion and the sustainable development of Chinese capital markets; therefore the study on the M&A efficiency of is always the one of the hot topics in the theoretical cycle and the academic circle. Whichever it is in China<sup>[1]</sup> or in foreign countries<sup>[2]</sup>, plenty of references have focused on the special study on the M&A efficiency and they have almost judged the M&A level from two aspects; firstly it is the one if the normal or excessive yield rate is obtained through the M&A transaction; the research methods corresponding to such aspect is the accounting research method, namely the accounting research method is used to study the long-term improvement level of the corporate financial performance. However since the research methods adopted by different scholars are different, the samples to be selected are different and the analysis angles to be used are different, there is no a conforming conclusion for the study result of the M&A efficiency till now; so the M&A efficiency is still waiting for a further and deeper study. In this paper, the author distinguishes firstly the M&A trading efficiency and the integration efficiency, adopts the DEA model<sup>[3]</sup> to study the M&A trading efficiency; therefore it is creative to some extent.

## METHODS

### Sample selection

In order to study the long-term performance change, the typical M&A events happened from year 2006 to year 2010 in Shanghai and Shenzhen Securities Exchange and the corporate financial data of sample companies from year 2004 to year 2012 were selected; the nonconforming samples were removed in accordance with the given rules; the data came from the CSMAR database.

### Financial index selection

The paper investigated the corporate performance by total 15 indexes from 4 categories, namely corporate profitability, cooperate operating capacity, and cooperate growth capacity and corporate debt-paying ability. Among which, the corporate profitability index includes the earnings per share (V1), the net assets income (V2), the net assets profit ratio (V3), the return on assets (V4) and the profit ratio of the main business (V5); the corporate operating capacity index includes the net assets turnover rate (V6), the total assets turnover rate (V7) and the turnover rate of the working assets (V8); the corporate debt-paying ability index includes the liquidity ratio (V9), the quick ratio (V10) and the asset-liability ratio (V11); the development capacity index includes the growth rate of the main business on year-on-year basis (V12), the growth ratio of the income from main operations on year-on-year basis (V13), the growth ratio of net profit on year-on-year basis (V14) and the total asset growth rate (V15). 15 new indexes can be obtained by subtracting the mean level of the respective industry during the corresponding period from V1, V2, ... V15, namely NV1, NV2, ... NV15 so as to relieve the impacts of the industrial economic prosperity. Letting AV1, AV2, ..., AV15 represent the mean level of V1, V2, ..., V15 of respective industry to which the company belongs in different years, so:  $NV1 = V1 - AV1, NV2 = V2 - AV2, \dots, NV15 = V15 - AV15$

### DEA model design

In this paper, the author adopted the modified DEA (data envelopment analysis) model and the principal component synthesis score model to make the empirical analysis.

The DEA method focuses on projecting the DMU onto the leading-edge surface by maintaining the input or output of the decision-making unit unchanged and by using the mathematical programming, and then evaluating their relative efficiency by comparing the degree the decision-making unit deviates from the leading-edge surface.

The corporate M&A evaluation model is detailed as follows: letting  $X_j$  and  $Y_j$  be respectively the input and output vector of the  $j$ th DMU, so  $X_j = (X_{1j}, X_{2j}, \dots, X_{mj})$  and  $Y_j = (Y_{1j}, Y_{2j}, \dots, Y_{nj})$ ; regarding the yearly financial data of every listed company as the decision-making unit (DMU), so its performance can be obtained from the input vector, output vector and experience production possibility set (PE) of the unit via comparison. In this paper, the author used the research methods adopted by Charnes et. al. (1992) and Copper et. al. (2001) to further improve the models of Xindan Li et. al. (2003) and Ehsan Feroz (2002), overcome the previous research defects, and then construct two models to calculate the yearly stability index  $\Theta^*$  of corporate merger and acquisition to obtain the comparatively assured performance index value of every DMU; which was used to judge the effectiveness (ineffectivity) degree size of the company in the year.

## EMPIRICAL ANALYSIS RESULTS

### Construction of principal components synthesis score model

Establish the principal component analysis model, and then made the principal component analysis according to the 3-period, 2-period and 1-period before merger and acquisition happens, year in which merger and acquisition happens, 1-period, 2-period and 3-period after merger and acquisition happens through SPSS14.0; finally the author, according to the characteristic value and the contribution rate of every principal component and by adopting the accumulative contribution rate of  $\alpha = 0.95197$ , the first 5 principal components were obtained to replace the previous 15 financial ratios; the 5 principal components include 95.197% of the previous index information. Meanwhile 7 synthesis score functions were obtained:

2-period before M&A:  $F_{i-2}=0.48159Y_{i1}+0.30147Y_{i2}+0.18572Y_{i3}+0.29014Y_{i4}+0.06595Y_{i5}$   
 1-period before M&A:  $F_{i-1}=0.36173Y_{i1}+0.10298Y_{i2}+0.47923Y_{i3}+0.10825Y_{i4}+0.37962Y_{i5}$   
 Period when M&A happens:  $F_{i0}=0.6027Y_{i1}+0.5129Y_{i2}+0.1725Y_{i3}+0.2150Y_{i4}+0.1024Y_{i5}$   
 1-period after M&A:  $F_{i1}=0.52018Y_{i1}+0.30827Y_{i2}+0.15249Y_{i3}+0.20318Y_{i4}+0.23691Y_{i5}$   
 2-period after M&A:  $F_{i2}=0.21475Y_{i1}+0.41529Y_{i2}+0.50276Y_{i3}+0.10237Y_{i4}+0.35124Y_{i5}$   
 3-period after M&A:  $F_{i3}=0.18927Y_{i1}+0.26597Y_{i2}+0.30125Y_{i3}+0.56238Y_{i4}+0.43627Y_{i5}$

afterwards, use the 7 functions to calculate the performance score of every sample company in the corresponding year before and after merger and acquisition.

**Analysis on the empirical study results**

**Integrated inspection of general acquisition samples**

Calculate the synthesis score of every sample company during the corresponding period before and after merger and acquisition in accordance with the above 7 synthesis score functions, and then sum up the synthesis score function of every period and calculate the mean value; which was used to stand for the merger and acquisition performance of every period; finally the difference transformation was made for the synthesis score of the corresponding year before and after merger and acquisition so as to obtain the result of the change in merger and acquisition performance of general samples during the investigation period; the inspection results are shown by TABLE 1 as follows.

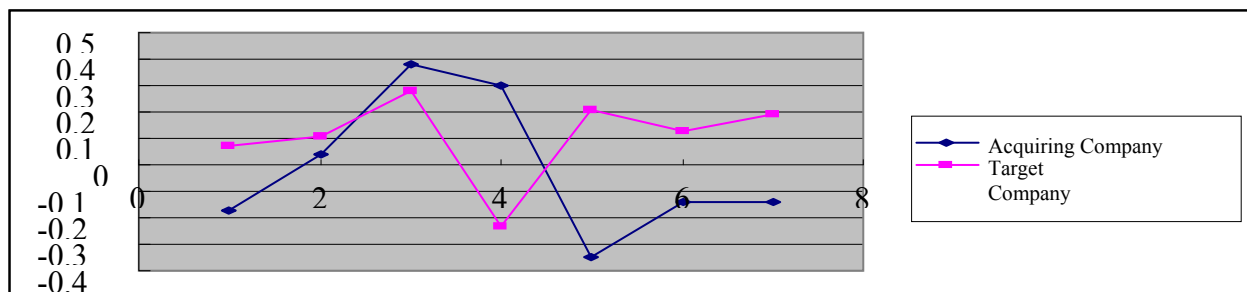
**TABLE 1 : Results of mean value and ratio inspection of all samples**

Difference value F	$F^2-F^3$	$F^1-F^2$	$F^0-F^1$	$F^1-F^0$	$F^2-F^1$	$F^2-F^1$	$F^3-F^2$	$F^3-F^1$
Mean value*	-0.013 (-0.027)	-0.025 (1.562) <sup>a</sup>	-0.023 (1.796) <sup>b</sup>	0.396 (2.598) <sup>c</sup>	0.253 (1.614) <sup>a</sup>	0.307 (1.824) <sup>b</sup>	0.126 (1.309) <sup>a</sup>	0.367 (2.452) <sup>c</sup>
Positive value ratio**	0.582 (-0.813)	0.479 (1.394) <sup>a</sup>	0.412 (1.875) <sup>b</sup>	0.674 (2.853) <sup>c</sup>	0.581 (1.869) <sup>b</sup>	0.601 (1.372) <sup>a</sup>	0.405 (1.913) <sup>b</sup>	0.527 (2.381) <sup>c</sup>
Sample n	643	643	643	643	643	643	519	519

**Note:**  $F^{-3}, F^{-2}, F^{-1}, F^0, F^1, F^2, F^3$  is respectively the M&A synthesis score each year. ; the number in the brackets in the row \*,\*\* is the test value t and the test value z; Where a, b and c shows the two-sided test is obvious at the level of 10%, 5% and 1%.

From the TABLE 1 above, it can be seen the performance of the merger and acquisition sample tends to decline before the merger and acquisition happens, such result coincides with most of previous researches. Starting from the year in which the acquires and acquisition happens, the mean value of  $F1-F0, F2-F1, F3-F2$  and  $F3-F-1$  is 0.396, 0.253, 0.126 and 0.367 respectively; which shows the merger and acquisition performance ascends generally; however it is obvious that the performance in the 1st year after the merger and acquisition happens increases maximally, and then slows down in the 2nd and 3rd year; where the significance level reduces too; which means the efficiency of the Chinese listed company improves for a short time (but not continues) after the merger and acquisition happens; where the general reaction is the resource configuration efficiency of the merger and acquisition market improves

The company happening merger and acquisition can be divided into two categories<sup>[4]</sup>, one is the acquiring company, the other one is the target company. The acquiring company is to acquire initiatives and the target company is the acquisition object, so the motivation or the result of the two types of merger and acquisition should be different from each other. the change of M&A performance of acquiring company and the target company can be known. As for the results, please see Figure 1 and 2 as follows.



**Figure 1 : Comparison on average value of M&A performance of acquiring company and target company**

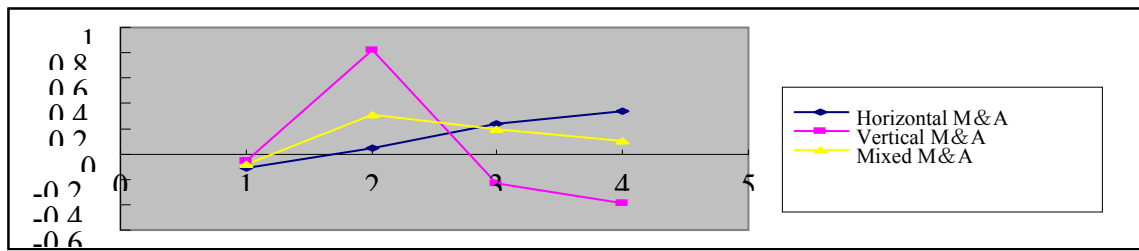


Figure 2 : Analysis on performance of different ways of M&A (horizontal, vertical and composite)

From Figure 1 above, it can be seen that the mean performance of the acquiring company before merger and acquisition goes up continuously, but the performance in the year in which the merger and acquisition happens goes down slightly, and the performance in the 1st year after the merger and acquisition happens declines hugely; such situation turns better from the 2nd year after the merger and acquisition happens; however the performance is still negative; as for the target company, the corporate average performance before the merger and acquisition happens increases slowly and is more than zero, but the average performance in the year in which the merger and acquisition happens gets deterioration, declines hugely, or even become negative (-0.23); the performance in the 1st year after the merger and acquisition happens rises again hugely and is more than zero, and the performance in the 2nd year after the merger and acquisition happens falls declines slightly, and then rises again thereafter and the merger and acquisition efficiency is improved; which shows there is difference in the merger and acquisition performance of the target company and the acquiring company due to the different motivations and purposes.

**Analysis on merger and acquisition performance of different ways of merger and acquisition**

Separate 230 horizontal M&A samples, 170 vertical M&A samples and 243 composite samples from the total samples; use the principal component model set previously to calculate the synthesis score respectively, and calculate the correlation test between the three kinds of ways of merger and acquisition and the M&A performance’s synthesis score; as for the results, please see TABLE 2, 3 and 4 as follows.

TABLE 2 : Correlation test for different ways of mergers and acquisition and M&A performance synthesis score

M&A Way	Test value	T-1	T	T+1	T+2	T+3
Horizontal M&A	Pearson Correlation	0.139758124	-0.235184376	-0.394783521	0.341298357	0.435762182
	Sig. (2-tailed)	0.314759421	0.031476905*	0.046587296*	0.012753904**	0.010853276**
Vertical M&A	Pearson Correlation	0.257349568	0.126580296	-0.035067835	-0.343627735	-0.452164382
	Sig. (2-tailed)	0.825739654	0.312964351	0.063247963*	0.031746382*	0.014259102**
Mixed M&A	Pearson Correlation	-	0.203762435	0.468725769	-0.073251806	-0.082937615
	Sig. (2-tailed)		0.563829734	0.602783586	0.025736478*	0.014657802**

Note: \*,\*\*,\*\*\* shows the one that is apparent at the level of 10%, 5% and 1%

From the Figure 2 above, it can be seen the horizontal merger and acquisition performance is not apparent in the year in which the merger and acquisition happens and in the first year after the mergers and acquisition happens; the horizontal M&A performance’s synthesis score in the year (T) in which the merger and acquisition happens and in the first year (T+1) after the merger and acquisition happens is negatively correlative to the performance synthesis score, and is apparent at the level of 10%. However from the T+2 periods, the Figure 2 shows the rising tendency of the performance; however in the third year after the merger and acquisition happens, the horizontal M&A performance is better than that of the composite merger and acquisition. From the perspective of the correlation coefficient, the correlation coefficient of the T+3 period is apparently positive; which means the long and medium-term performance of the horizontal M&A is apparent and the scale economy is achieved to some extent.

As for the vertical merger and acquisition, the Figure 2 shows the performance in the year in which the merger and acquisition happens and in the first year after the merger and acquisition happens is not apparent, especially the performance in the second year after the merger and acquisition happens tends to decline rapidly. From the perspective of the correlation coefficient shown by TABLE 2, the performance in T+1, T+2 and T+3 after the merger and acquisition happens is of apparently negative correlation on the level of 15%, 10% and 5%; which means the blind vertical merger and acquisition

between upstream and downstream enterprises in China does not bring any interests (such as the one to save the transaction expenses), does not cause to realize the synergistic effect, and does not promote company value and performance.

As for the mixed merger and acquisition, the Figure 2 shows the performance in the year in which the merger and acquisition happens and in the first year after the merger and acquisition happens goes up, and then declines year after year. The correlation coefficient in TABLE 2 proves further that the performance in the 2nd (T+2) and the 3rd (T+3) year is apparently negative (when the correlation coefficient is respectively on the level of 5% and 1%). As for the composite mergers and acquisition, its short-term performance is improved to some extent, but its long and medium-term performance is not improved substantially. The possible reasons is the one that some underperformance listed companies make the composite merger and acquisition for the purpose of improving financial indexes; but such merger and acquisition is only the statement-oriented regrouping, but not the strategic merger and acquisition or the value-oriented merger and acquisition; meanwhile, many listed companies adopting the composite merger and acquisition in China, although some short-term M&A interests are obtained, but since they do not master the “exclusive industrial management ability” and the “exclusive corporate non-management human capital” of the target companies of the non-related industries, it is very difficult to integrate the target enterprises fundamentally; moreover the merger and acquisition weakens the main business; therefore the M&A performance in a long time is inevitable to decline.

### Analysis on merger and acquisition performance of different types of mergers and acquisitions<sup>[5]</sup>

For the different types of mergers and acquisitions, there are hugely differences in the principal entity of merger and acquisition, merger and acquisition motivation and merger and acquisition process; therefore there is the difference in the merger and acquisition performance too.

Select every year before and after corporate merger and acquisition as the decision-making unit (DMU), and the establish the DEA model; where the output indexes are: main business income (y1), total profit amount (y2); the input indexes are: main business cost + tax and extra charges of main business (X1), general expenses (X2), total assets (X3). Among which, the general expenses include selling expenses, overhead expenses, financial expenses, exchange loss and buying expense. Take a single listed company as the research object, use the 7 observation years before and after the vertical merger and acquisition as the DMU, and then establish the DEA-oriented corporate performance evaluation model; finally calculate the corporate M&A performance stability index  $\Theta^*$ , including the yearly performance  $\Theta^*$  value and the yearly average value before and after mergers and acquisition; calculate the total average performance value of all M&A samples and all separation samples, and compare and analyze the difference in the M&A efficiency. As for the results, please see TABLE 3 as follows.

**TABLE 3 : Comparison on average performance before and after merger and acquisition**

Type of merger and acquisition	Sample number	r%	Q1*	Q2*	Difference	Value P
External mergers and acquisition (for expansion)	172	70%	0.0625	0.1359	0.0734	0.003***
Change in stock rights (equity transfers)	265	56%	0.0417	0.0936	0.0519	0.027**
Asset stripping or stock right offering	157	46%	0.0683	0.0615	-0.0068	0.935
Assets swap	49	49%	0.0527	0.0539	0.0012	0.574
All samples	643	56.7%	0.0536	0.0945	0.0409	0.026**

From the results shown by TABLE 3 and in the four groups of samples, it can be seen the percentage of the company in which the performance is improved is different; the company having the strategic merger and acquisition performance accounts for the maximum percentage, which is respectively 70% and 56%; however the company in which the performance improves after the merge and acquisition happens through the asset swap and the asset stripping accounts for a percentage less than 50%. Upon the double analysis on the average performance inspection results, it is found the performance of the external merger and acquisition (expansion-oriented merger and acquisition) is apparently higher than the performance before the merger and acquisition happens, which ranks only second to that of the expansion-oriented merger and acquisition; but there is no obvious difference in the average value of the performance before and after the asset stripping and asset swap happens. Therefore it can be known most of mergers and acquisitions through asset stripping and asset swap are made for the purpose of improving corporate financial conditions in a short time, and most mergers and acquisitions happen at the end of a year; such mergers and acquisitions can not improve the corporate performance substantially, which means the strategy-oriented merger and acquisition can improve the corporate performance.

### Analysis on M&A performance of listed company of different equity structures

All samples are divided into three groups by equity structure, namely the group with the maximum corporate share percentage, the group with the maximum state-owned share percentage, and the group with the maximum A shares tradable shares percentage. Upon the DEA model established previously, the results are shown by TABLE 4 as follows.

**TABLE 4 : Average performance of different equity structure groups before and after merger and acquisition happens**

Equity structure	Sample number	r%	Q1*	Q2*	Difference	Value P
Maximum percentage of corporate shares	270	69.5%	0.0471	0.0925	0.0454	0.005***
Maximum percentage of state-owned shares	148	54.3%	0.0625	0.0893	0.0268	0.314
Maximum percentage of A shares tradable shares	225	51.8%	0.0498	0.0716	0.0218	0.807
Total samples	643	56.7%	0.0536	0.0945	0.0409	0.026**

**Note: \*,\*\*,\*\*\* shows the performance at the level of 0.1, 0.05 and 0.01 is apparent;**

From the TABLE 4 above, it can be known that the sample group with the maximum percentage of corporate shares has a performance higher than that of the sample group with the maximum percentage of state-owned shares and the tradable shares, and the average value of the performance is apparent on the level of 0.01; however the difference in the average value of the performance of the state-owned share group and the tradable share group before and after the merger and acquisition happens is not apparent; the value P of the wilcoxon inspection is huge, but not apparent; which proves that equity structure dominated by the state-owned property right is lack of good incentive compatibility mechanism, and there is no way to bring better M&A benefits to enterprise.

### CONCLUSIONS

In this paper, the author adopts the DEA model and the principal component analysis method to make a multilevel study on the M&A trading efficiency of the Chinese listed company. Upon the empirical analysis, it is found the corporate merger and acquisition, since the merger and acquisition has realized its marketization in 2006, can improve the corporate value; however there is the difference in the performance of the acquiring company and the target company before and after the merger and acquisition happens; the different ways of merger and acquisition, such as the horizontal merger and acquisition, vertical merger and acquisition, and composite merger and acquisition, have different impacts on the merger and acquisition performance; the strategy-oriented merger and acquisition performance is better than the statement-oriented merger and acquisition, such as the asset stripping and asset swap; the merger and acquisition efficiency of the company controlled by institutional shareholders is higher than that of the company controlled by state-owned share shareholders and by tradable share shareholders.

### ACKNOWLEDGMENTS

This research was supported by Foundation item of the national social science fund (13CGL030) ; Public welfare item of Science and Technology Bureau of LiShui (2013JYZB12); the key disciplines item of Regional Economics of Zhejiang Province.

### REFERENCES

- [1] Bai Yunxia, Wu Lian Sheng; The transfer of control right, the change of ultimate controlling shareholder and the performance of the company. *financial research*, **6**, 130-143 (2008).
- [2] C.EBai, J.Y.Lu, Z.G.Tao; Property Rights Protection and Access to Bank Loans: Evidence From Private Enterprise in China.*Economics of Transition*, **14**, 611-628 (2006).
- [3] Tian Manwen; Comparative study on M & A Efficiency of different economic regions and industry.*finance and economics science*, **9**, 73-81 (2009).
- [4] Li Zhe, Hejia; The listing model,M & A type and performance of state-owned listing Corporation.*the world economy*, **9**, 64-73 (2007).
- [5] Li Zengquan, Yu Qian, Wang Xiaokun; Empty, support and mergers and acquisitions.*economic research*, **1**, 95-104 (2005).