

Abnormal Returns: Takeover Prediction Modelling - Shanghai Stock Exchange

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Abstract. Around the Merge and Acquisition (M&A) announcement date, the targets will experience dramatic increases in their share price. The movement of share prices brings investment opportunities. To successfully predict the future targets and make an investment strategy, investors can obtain the abnormal return from the increment of the share price. However, many articles of research show that even successfully predicted large numbers of targets, within the investment portfolio, are still unable to show the abnormal return. To make a successful investment strategy, researchers summarized the potential negative factors of the portfolios' return. For example, the investment timing, the distressed firms which share the common characteristics with predicted targets. This paper motivated by the potential improvement space for target portfolio's return, attempts to rationalise a successful investment portfolio. Through selecting the determinate characteristics of targets, building a prediction model, studying its abnormal return and analysing the influence of a distressed firm on the abnormal return, this paper determines that the targets can be distinguished from non-targets with the characteristics of inefficient management, misevaluation, high sales growth, low liquidity and larger free cash flow; consistent with determinant characters, the prediction model has a good predictability; however, good predictability could not produce the abnormal return; furthermore, even the empirical result shows that the target portfolio actually involves a certain percentage of the distressed firms which have significant differences from non-distressed firms, the portfolio can still not obtain abnormal return by screening the distressed firms using its characteristics.

Keywords: Merge and Acquisition (M&A), Prediction Model, Abnormal Returns.

1. Introduction

Companies can expand in two primary ways: internal growth, which requires longer-term development based on the company's own capabilities; and epitaxy growth, which involves rapid expansion through mergers and acquisitions. Given the global trend of economic integration, many firms employ acquisitions to swiftly achieve their goals, boost profits, and heighten competitiveness. Historical examples include multiple waves of M&As in the West since the 19th century, such as AOL Inc.'s acquisition of Time Warner in 2000.

China's acquisition activities began later, but have gained momentum with its economic development. China's acquisition history can be segmented into three phases:

1993-1996: Initial phase with limited acquisition activities, primarily to avoid delisting and safeguard shell companies.

1997-2004: Developmental phase marked by increased M&A activities, especially post-China's WTO entry in 2001. The government also introduced policies promoting genuine restructuring and protecting small investors.

Post-2005: A period of heightened M&A activities following the 2005 reform of non-tradable shares. The 2008 financial crisis further propelled Chinese companies to expand globally, leveraging RMB appreciation.

This paper tries to apply the ideas of Danbolt et al., who gained significant positive abnormal returns of around 0.9% per month [1], to Shanghai Stock Exchange A shares to identify whether this can offer an appropriate test as follows:

Hypothesis 1: Takeover investment strategy in the Chinese M&A market [2]. The relevant hypotheses that this research aims to targets can be distinguished from non-targets based on their characteristics [3-5];

Hypothesis 2: The M&A prediction model has predictive ability in the Chinese market;

Hypothesis 3: Abnormal returns can be obtained by using the takeover prediction model appropriately; and

Hypothesis 4: By adjusting potential non-targets, the abnormal returns of the predicted target portfolio can be improved.

This paper utilized the logit regression model, ANOVA, and Multicollinearity Testing to examine 6,942 M&A activities from 2000 to 2017. Some outcomes diverged from anticipated results. Key findings include: firstly, acquired companies in the Chinese market often exhibit low managerial efficiency, slow growth, and resource scarcity, suggesting that poor management can elevate the acquisition risk. Secondly, the likelihood of a publicly-traded company being acquired can be somewhat predicted using its financial data. Thirdly, similarities between target and distressed firms can lead to incorrect inclusion of non-target firms in predicted portfolios, contributing to unfavorable abnormal returns. Lastly, China's distinct stock market dynamics and a developing investment landscape prevent enhancing portfolio returns by adjusting variables in the prediction model.

The first section is an introduction, which mainly consists of the research background and significance, research questions, findings, and structural framework;

The second part is methodology, this section will study the hypothesis and model construction. Based on the viewpoints involved in creating the research hypotheses and pre-existing research conclusions, the variables needed and the samples required are selected and classified, and thus the model required to answer the research questions addressed by this dissertation is constructed;

The third section offers both empirical analysis and a robustness test. A single-factor analysis of variance and Logit regression model are used to analyse and study the financial characteristics of the target companies acquired in China in the focus period. Then, the relationship between company characteristics and acquisition probability is analysed using the least-squares method. Finally, the relationship between acquisition probability for a listed company and its abnormal returns due to an acquisition event is studied using event research and multiple regression analysis.

The paper then ultimately summarizes the research findings, analyses the limitations in the research process, and puts forward some feasible suggestions for future research directions; The final part offers the references and appendix.

2. Model Building

2.1. Methods for Proving Hypothesis 1

Hypothesis 1 is focus on identifying distinctive financial characteristics of M&A target companies in comparison to non-targets. Variables from previous studies are used to identify target company characteristics. One-way ANOVA is employed to discern if there are significant differences in these indicators between target and non-target companies. The results are shown in Table 2. Furthermore, Model Correlation Coefficient Test and VIF Test are used to determine the significance of target variables and check for collinearity problems, respectively

The predicting model for the takeover likelihood of a listed firm, based on its public information from a prior period, is given by:

$$P_{it} = \frac{1}{1 + e^{-Z_{it-1}}} \quad (1)$$

Where P is the takeover likelihood of a listed firm i. We can examine the takeover *it* likelihood of firm i in period (t) based on its public information in period (t-1), given as follows:

$$Z_{it-1} = \beta_0 + \beta_1 X_{1it-1} + \dots + \beta_K X_{Kit-1} + \varepsilon_{1it-1} \quad (2)$$

Table 1. Variable Table

Hypothesis	Variables	Calculation Formula
Inefficient Management	AER	$((1+AR1) \times (1+AR2) \times \dots \times (1+AR11) \times (1+AR12)) - 1$
	ROCE	EBIT/Total Capital
Misevaluation	Tobin's Q	(Market Value Equity + Book Value of Debt) / Book Value of Total Assets
Industry Disturbance	IDDummy	IDDummy=1 any firm in the same industry complete the merge prior to the bid in question; Otherwise, IDDummy=0
Growth Resource Mismatch	Sales Growth	$(Revenues - Revenues_{n-1}) / Revenues_{n-1}$
	Liquidity	Cash / Total Assets
	Leverage	Total Debt / Total Assets
	GRDummy	GRDummy=1 When high/low Sales Growth, low/high Liquidity and high/low Leverage; Otherwise, GRDummy=0
Firm Size	Size	$\ln(\text{Total Assets})$
Free Cash Flow	Free Cash Flow	$(\text{Operating Net Cash Flow} - \text{Capital Expenditure}) / \text{Total Assets}$
Real Property	Tangible Assets	Property Plant and Equipment / Total Assets
Firm Age	Age	Year - Base Year

Table 1. Variable Table

Hypothesis	Content	Variables	Coefficient	Predicted Signs
1(a)	AER	X_{1it-1}	β_1	-
	ROCE	X_{2it-1}	β_2	-
1(b)	Tobin's Q	X_{3it-1}	β_3	+
1(c)	IDDummy	X_{4it-1}	β_4	+
1(d)	SGrowth	X_{5it-1}	β_5	+/-
	LIQ	X_{6it-1}	β_6	+/-
	LEV	X_{7it-1}	β_7	+/-
	GRDUMMY	X_{8it-1}	β_8	+
1(e)	SIZE	X_{9it-1}	β_9	-
1(f)	AGE	X_{10it-1}	β_{10}	-
1(g)	FCF	X_{11it-1}	β_{11}	+
1(h)	TANG	X_{12it-1}	β_{12}	+

Note: The Tobin's Q is calculated according to Chung & Pruitt (1994) [6] whereby Tobin's Q = (Market Value Equity + book value of debt) / book value of total assets; Net Assets Per Share (NAPS) = Total Capital / NOSH, Market Value Equity = (Number of Non-tradable Shares × NAPS + Number of Tradable Shares × Closing Price of the Year); The sample uses all the companies which received the bid as targets. Unless otherwise stated the remainder are non-targets. A target which received the bid in the current year give the value one and zero otherwise; To eliminate the outliers in the sample, the variables AER, ROCE, Tobin's Q, sales growth, liquidity, leverage, free cash flow and tangible assets are minorized at the 1st and 99th percentiles. The remaining variables will not be adjusted.

2.2. Methods for Proving Hypothesis 2

For the purposes of assessing the reliability of the above prediction model, this paper will utilize an appropriate logit regression model. Results will display the relationship between a firm's characteristics and its takeover likelihood. The interpretation ability of the model will be expressed as R^2 . Figure 1 and Table 4 will be used to demonstrate that the model does have the predictive value. The main reason the predicting model cannot generate abnormal returns is the presence of distressed or bankrupt firms within the target portfolio [2]. This paper identifies *ST and delisted firms as proxies for distressed and bankrupt entities, respectively, and excludes them from the portfolio.

2.3. Methods for Proving Hypothesis 3

Table 6 illustrates the rate of return for the model. The return rate here is measured by Capital Assets Pricing Model (CAPM) and Fama-French Three Factor Model (FF3F) whilst the sample is divided into seven cases to analyse the return rate and make comparisons with the rate of return of the portfolio obtained by the model. The cases are as follows: (1) use of the prediction model to select top 20% of companies most vulnerable to takeover; (2) all the target companies; (3) (1) finally complete the M&A; (4) all non-target companies; (5) (a) there is no final completion of the merger; (b) 20% after takeover likelihood shooting; (6) the return of non-target portfolio, wherein the predicted non-target portfolio consists of the bottom 20% predicted target firms ranked according to how likely they are to be the subject of a takeover; (7) the firms in the (6) which have not been successfully merged or acquired.

2.4. Methods for Proving Hypothesis 4

Table 7 shows the difference between bankruptcy and non-bankruptcy in the sample. Figure 1 confirms that extraction of the target portfolio contains the error, and table 7 shows the significant difference in error on the three variables between the two. Combining the information from figure 1 and table 7, table 8 presents the logit regression results of the 8 portfolios' calculated rate of return based on size (measured by market capitalization), liquidity, and leverage. The aim is to determine if the model can improve the rate of return after all errors are eliminated. The following 8 models were used: (1) portfolio return after all bankruptcy is removed; (2) the top 20% (quintile 1) of market capitalization (Q1); (3) market capitalization rankings in Q1 and Q2; (4) and (5) leverage to retain 20% of the bottom (Q5) after the arrangement of leverage, and then forty percent of the bottom (Q4, Q5); (6) (7) ranking the firms of predicted portfolio by liquidity, the first 20 percent (Q1) and then the Q1 and Q2 will be retained in order of liquidity; (8) elimination of small size, small liquidity, and large leverage simultaneously to obtain the rate of return

3. Results Analysis

3.1. Empirical Analysis of Determination of Takeover Targets

3.1.1 Descriptive Statistics

Table 2 shows the results of the panel data set, presenting the differences between target and non-target accounting characteristics. The results reveal the significantly different characteristics between targets and non-targets and thereby confirm the interpretative capacity of the target company.

Table 2. Descriptive Statistics

	Full sample		Targets		Non-target		Difference P-value
	Mean	SD	Mean	SD	Mean	SD	
AER	0.025	0.354	0.011	0.364	0.028	0.352	(0.002)***
ROCE	0.1	0.209	0.096	0.196	0.101	0.212	(0.059)*
Tobin's Q	2.05	1.503	2.469	1.873	1.945	1.375	(0.000)***
IDDummy	0.965	0.184	1	0	0.957	0.204	(0.000)***
SGrowth	0.233	0.691	0.291	0.806	0.217	0.656	(0.000)***
LIQ	0.185	0.142	0.17	0.122	0.188	0.146	(0.000)***
LEV	0.471	0.281	0.462	0.278	0.474	0.282	(0.001)***
GRDUMMY	0.264	0.441	0.282	0.45	0.259	0.438	(0.000)***
SIZE	21.713	1.331	21.773	1.321	21.698	1.333	(0.000)***
FCF	-0.007	0.087	-0.006	0.083	-0.008	0.088	-0.224
TANG	0.248	0.178	0.222	0.164	0.255	0.181	(0.000)***
AGE	13.187	5.878	14.745	5.697	12.791	5.858	(0.000)***

Note: * ** and *** indicate significance at the 10% 5% and 1% levels, respectively.

H1(a): According to table 2, the mean value of targets' ROCE (0.096) and AER (0.011) are lower than that of non-targets' ROCE (0.101) and AER (0.028). This suggests inefficient management, consistent with the inefficiency hypothesis: poorly-performing firms are more likely to become targets. H1(b): The average value of targets, using Tobin's Q, is 2.469, which is higher than the mean value of non-targets' Tobin's Q at 1.945. This indicates that targets are likely to be misevaluated, consistent with the misevaluation hypothesis. H1(e): Contrary to expectations, the mean value of the size of target firms (21.773) is slightly higher than that of non-target firms (21.698), suggesting that target firms in this sample tend to be larger. H1(f): The mean firm age for target firms is 14.745 years, which is greater than for non-targeted firms at 12.791 years. This suggests that older firms are more likely to be targeted in this context. H1(g): Based on Table 2, the mean value of the free cash flow of target firms (-0.006) is greater than that of non-target firms (-0.008), aligning with previous research findings.

3.1.2 Model Correlation Coefficient Test and VIF Test

Before Logit regression, correlation coefficient was tested to eliminate the possibility of multicollinearity between variables. The test methods employed were the Person and VIF tests, and the results are shown in table 3. The data in table 3 reveals that the absolute values of all variable coefficients are less than 0.4 [7], and the value of Variance Inflation Factor of the model is less than 10 [8], indicating that there no collinearity problem exists

Table 3. Correlation Coefficient and VIF

	TARGET	AER	ROCE	TobinsQ	IDDummy	SGrowth	LIQ	LEV	GRDUMMY	SIZE	FCF	TANG	VIF
AER	-0.019***	1	0.121***	0.271***	-0.028***	0.118***	0.042***	-0.025***	-0.003	0.008	0.079***	-0.028***	1.14
ROCE	-0.010*		1	0.006	0.030***	-0.007	0.066***	0.036***	0.039***	-0.347***	0.099***	-0.034***	1.13
TobinsQ	0.140***			1	0.001	-0.011**	0.007	-0.047***	0.033***	0.109***	-0.005	-0.028***	1.35
IDDummy	0.093***				1	0.019**	0.011**	-0.363***	0.204***	0.047***	0.020***	0.056***	1.04
SGrowth	0.043***					1	0.019***	0.014***	0.062***	-0.156***	0.022***	-0.049***	1.05
LIQ	-0.051***						1	0.083***	-0.099***	0.118***	0.133***	0.088***	1.51
LEV	-0.017***							1	-0.041**	-0.033***	-0.096***	0.104***	1.21
GRDUMMY	0.020***								1	-0.033***	0.001	-0.096***	1.08
SIZE	0.022***									1	0.002	0.056***	1.36
FCF	0.007										1	-0.072***	1.09
TANG	-0.072***											1	1.18
AGE	0.134***												1.23
MEAN													1.2

Note: * ** and *** indicate significance at the 10% 5% and 1% levels, respectively.

3.2. Empirical Analysis of Predictability of Takeover Predicting Model

3.2.1 Logit Regression

For the prediction model, Logit regression was adopted in order to explore the financial characteristics of the target companies, that is, the probability that the target company possesses the particular financial characteristics is acquired is high. The regression results are shown in table 4.

Table 4. Determinants of Firm Takeover Likelihood

Variable	Coefficient	p-value
AER	-0.316***	(0.0000)
ROCE	-0.205**	(0.0350)
TobinsQ	0.170***	(0.0000)
IDDummy	16.666	(0.9760)
SGrowth	0.082***	(0.0050)
LIQ	-2.473***	(0.0000)
LEV	0.064	(0.5930)
GRDUMMY	0.097**	(0.0360)
SIZE	0.287***	(0.0000)
FCF	1.314***	(0.0000)
TANG	0.122	(0.5970)
AGE	0.088***	(0.0000)
_cons	-3.444***	(0.0000)
Observations	20,279	
R ²	0.0999	(0.0000)
LR Chi ²	1487.49 ***	(0.0000)

Note: * ** and *** indicate significance at the 10% 5% and 1% levels, respectively.

Based on the results the empirical Results of Hypothesis 1 is as follows

Table 5. Empirical Results of Hypothesis 1

Hypothesis	Content	Predicted Result	Empirical Result	Results
1 (a)	management performance & takeover likelihood	negative relation	negative relation	support
1 (b)	company value & takeover likelihood	positive relation	positive relation	support
1 (c)	industry disturbance	/	not significant	not support
1 (d)	growth-resource mismatch - sales growth	positive/negative relation	positive relation	support
	growth-resource mismatch - liquidity	negative/positive relation	negative relation	support
	growth-resource mismatch - leverage	positive/negative relation	not significant	/
1 (e)	firm size	negative relation	positive relation	not support
1 (f)	firm age	negative relation	positive relation	not support
1 (g)	Free Cash Flow	positive relation	positive relation	support
1 (h)	tangible assets	positive relation	not significant	/

3.2.2 Prediction Results of the Model for 2007-2016

Figure 1 is the predicting result for the selected target portfolios 2007-2016 based on data from previous years.

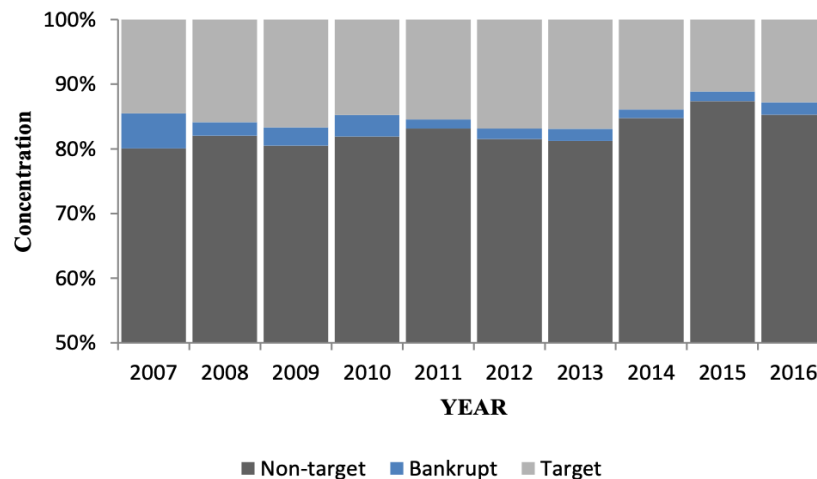


Figure 1. Proportion of Targets and Bankrupt Firms in Predicted Target Portfolios

As shown in Figure 1, the percentage of non-target firms in the target portfolio every year is approximately 80%-85%. By ranking the takeover likelihood of all the firms according to the predicting model, this paper has selected the most likely 20% of firms to experience merger or acquisition as the target portfolio. 879 targets out of a potential 3408 were correctly predicted by the model for the period 2007-2016, suggesting approximately an average of 14.92% for each year.

Table 6. Risk-adjusted Returns

	Target portfolio	All targets	Targets in target portfolio	All Non-targets	Non-targets in target portfolio	Predicted non-targets (last 20%)	Non-targets In Q1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CAPM alpha	0.007 (0.182)	0.004 (0.349)	0.007 (0.221)	0.007* (0.097)	0.007 (0.146)	-0.000 (0.890)	-0.001 (0.813)
FF3F alpha	-0.007*** (0.001)	-0.009*** (0.000)	-0.007*** (0.004)	-0.004*** (0.002)	-0.006*** (0.001)	-0.005*** (0.002)	-0.005*** (0.003)

The process of ranking the firms according to the probability of their being taken over is facilitated with the use of the prediction model, as revealed in Table 4. The alpha of the target portfolio is larger than the all target firms, thereby indicating that the prediction model both possess predictive capabilities and has the ability to assist investors.

The target firms in the target portfolio do not demonstrate a significantly higher abnormal return under CAMP, and it is even significantly lower under FF3F, in comparison to the all non-target firms. This may due to inherent inefficiencies within the Chinese financial market.

3.3. Empirical Analysis of Abnormal Return from Prediction Model

3.3.1 Bankrupt and Non-Bankrupt Descriptive Statistics Result in Size LIQ LEV

Table 7. Descriptive Statistics

Variable	Non-Bankrupt		Bankrupt		Difference (P-value)
	(Mean)	(SD)	(Mean)	(SD)	
LIQ	0.187	0.142	0.127	0.128	(0.000)***
LEV	0.458	0.248	0.774	0.627	(0.000)***
SIZE	21.738	1.311	21.124	1.625	(0.000)***

Note: * ** and *** indicate significance at the 10% 5% and 1% levels, respectively.

As can be seen from Table 7, compared with normal business enterprises, the bankrupt (delisted) enterprises have a smaller size, higher leverage and less liquidity.

As regards the information contained within Table 8, due to the similar characters shared by the distressed or bankrupt firms and target firms [1][9], the reason why there are no abnormal returns

generated from within the target portfolio can to some extent be explained. As shown in figure 1, the takeover

Predicting model may list a disproportionate number of distressed companies as potential targets. Distressed firms here strictly refer to those companies who are associated with *ST or have been delisted [10].

The securities market in China possesses several unique characteristics. Not least of these are the strict entry and exit procedures. There is also great heed paid to the potentially wide ranging and disruptive repercussions of any company's becoming officially bankrupt. Hence, once a listed company has fallen within the remit of ST regulations, it is granted a three-year period of grace during which it can reorganize and raise its standards of performance [10]. Hence the existence on the stock market of numerous quasi-bankrupt listed companies undergoing substantial reorganisation, none of whom are officially deemed to be bankrupt. In this paper, we define the businesses that are ultimately facing delisting as the adjustment items in the portfolio. In order to study the impact of these companies on the excess returns, this paper had tried to conclusively exclude these problematic companies from the target and calculate the excess returns of these portfolios.

3.3.2 Return on Strategies Based on Size LIQ LEV Screen

Table 8. Suggested Strategies and Risk-adjusted Returns to Portfolios of Predicted Targets

	Remove bankrupt firm (1)	1st 20% in Size ranking (2)	1st 20% & 2nd 20% in Size ranking (3)	5th 20% in LEV ranking (4)	4th 20% & 5th 20% in LEV ranking (5)	1st 20% in LIQ ranking (6)	1st 20% & 2nd 20% in LIQ ranking (7)	Strategies (3)(5)&(7) combined (8)
CAP M alpha	0.007 (0.193)	0.005 (0.200)	0.005 (0.315)	0.005 (0.279)	0.005 (0.329)	0.006 (0.204)	0.006 (0.218)	0.003 (0.499)
FF3F alpha	0.007*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)	-0.007*** (0.001)	-0.007*** (0.001)	-0.008*** (0.002)

*Note: * ** and *** indicate significance at the 10% 5% and 1% levels, respectively.*

Unlike conjecture, the portfolio's return did not improve significantly after removing what should have been an error in the model. As shown in Table 6 (model 1), after excluding the distressed companies the return of the target portfolio is the same as before. CAPM's adjusted portfolio return is 0.7 per cent per month, which is not considered to be significant. The monthly risk-adjusted return generated using the FF3F model and benchmark portfolio is also the same as the value when it has not been adjusted. Nevertheless, in order to verify the error terms in the model from various aspects, we still adjusted the model according to the characteristics of small size, high leverage and low liquidity.

After the size, liquidity and leverage screen, unsurprisingly, the return is not being improved, on the contrary, the returns were even lower than before. The possible reason for the excess negative influence of screening process is that the variables choose here may not the determinant characteristics of bankruptcy (or distressed). The meaning is, although the characters shown in the table 7 does indicated that the distressed firms is significantly different from non-bankruptcy firms as small size, high leverage and low liquidity. It does not mean that the firm with a relatively small size, high leverage and low liquidity is a distressed firm.

4. Conclusions

4.1. Research findings

Using the logit regression model, ANOVA and Multicollinearity Testing, this paper evaluated 6,942 M&A events during the period 2000-2017. Some of the findings were at variance to expected results.

The results of this paper are numerable and contextual where upon, it has initially targeted companies acquired in the Chinese market are characterized by low management efficiency, low growth rate and lack of resources. Which, indicates that the inefficient management of the company will increase the risk of the company being acquired. Secondly, the probability of a listed company being acquired can be predicted to a certain extent through public financial information. Thirdly, common characteristics shared by target firms and distressed firms increase the opportunity of getting non-target firms involved in the predicted target portfolio which is one of the reasons behind negative abnormal return. Finally, due to China's unique stock market mechanisms and the immature investment environment, it is not possible to improve the return rate of the portfolio through controlling the deductibles in the prediction model.

4.2. Research Limitation

Sample selection: this paper only excludes the financial industry from the sample. Were the overall sample to be divided according to industry, the performance of the takeover prediction model might be enhanced for sector-by-sector predictions well in excess of its capacity to generate generalised predictions. Consequently, the reliability of the relationship between takeover likelihood and firms' characteristics must be deduced.

China has a unique M&A environment, and changes in the M&A policies have influenced motivation levels for takeovers at different periods. This paper directly used all the developments and events during the years 2000-2017.

4.3. Recommendations

Forthcoming research should focus on separate analyses for different industries, since different M&A policies apply to different industries. One recommendation is to separate the normal stock, ST stock, and *ST stock. Furthermore, it would also be useful to consider work on the investment time[11] and the adjustment of screening variables based on the distress firm research of Geng, Bose, & Chen [10] to see if there are any improvements to the abnormal return on the predicting model as a result.

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