

Internal Factors Associated with Business Failures of Public Companies in China —From a Financial Analytical Perspective

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Abstract

This paper is intended to identify the internal factors, especially financial measures that may be associated with the business failures of public companies in China. We use the occurrence of special treatment as a proxy for business failures, because bankruptcy usually doesn't follow business failures and is not an applicable measure of business failure in China. First, we identified 26 potential financial measures that we believe are associated with business failures. Then, we selected 16 of them that are potentially correlated with the occurrence of business failures. After a factor analysis, the group of financial factors was further downsized to six. They are profitability, liquidity condition, operation efficiency, expense structure, growth condition and profit structure. In the logistic regression, only the factors of profitability, liquidity, growth and profit structure are significantly associated with the likelihood of operation failure for public companies. Based on the four factors, we construct a prediction model for business failures. The overall accuracy of the model is over 80%.

1 . Introduction

Over the past twenty years, China has achieved great success in its economic development. Its annual GDP growth has been maintained at least ten percent since 2000 on average. In 2006, China ranked number one worldwide in attracting oversea investment and in holding foreign currency reserves. However, such huge achievement did not parallel the performance of its securities markets; The Shanghai and Shenzhen Stock Exchanges. A-shares plunged over 40 percent during 2001-2005. After a meteoric peak in 2007, with the Composite Index of Shanghai as high as 6,124 points on Oct. 16 of that year, the market quickly collapsed in 2008 due to an unprecedented financial crisis. At the same time, business failures, such as declining performance, degrading management quality, lack of a solid inherent foundation to support the growth of firm value, and the general lack of confidence in the market by the investors, have continued to plague the public companies in China. Therefore, what factors contribute to business failure in China and how to identify the potentially failing companies have become relevant issues for investors and stakeholders.

Little research was done in this area before 1999 owing to the short history of Chinese securities markets. But in recent years, as more and more failures in listed companies continue to emerge, concerns about the management quality of listed companies in China have soared. Most of the current literature is mainly focused on the introduction of foreign research results. There are a few empirical studies that intend to provide prediction model of business failures in Chinese capital market, such as Chen (1999), Wu and Lu (2001) and Zhang (2000). However, most of such studies focus on the manufacturing industry rather than the entire market, which constrains the generalizability of the prediction models. Further, even though their prediction models are based on financial measures, cash flow measures are deemed as unimportant factors in the models.

Most importantly, all the samples are from before 2000. Since then, China has implemented new delisting policies and new financial accounting standards. For example, before 2002, the effective corporate income tax rate was only 15% for listed companies and 33% for private companies in China. Beginning in 2002, listed companies have been treated equally as private companies and are subject to the corporate income tax rate of 25%. Ceteris paribus, a higher income tax rate may drive an otherwise profitable company to losses. Therefore, an applicability of prior prediction models is limited. With these factors in mind, whether it is plausible to identify any internal factors that can be used in predicting business failures in Chinese capital market is an interesting topic. The focus of this paper is to identify financial measures which connect closely to the failures of listed companies in China and provide a model to predict business failures based on the financial indicators.

The remainder of the paper is organized as follows. Section II discusses the factors associated with business failures for Chinese listed companies. Section III discusses the potential financial measures in this study. Section IV describes samples and data. Results are presented in section V, and concluding remarks are in the final section.

ii. Business Failure for Chinese Listed Companies

In prior literature such as Altman (1968, 1977, 1983 and 1995), Deakin (1972), Ohlson (1980), Zmijewski (1984), Ward & Foster (1997), business failures are usually measured by bankruptcy. However, such a measure is not applicable in the capital market of China. In order to signal the listed companies with serious management problems and warn investors about the related risks, securities exchanges in China place such companies into a different section in the listing, such as ST companies, * ST companies and delisted companies¹. Most of the listed companies which are subject to serious liquidity or insolvency risks in China, by possessing the "shell resources", are able to defer and avoid bankruptcy for years. Even if a listed company is de facto bankrupt, it will very likely avoid being delisted through mergers and acquisitions, debt-equity swap, asset restructuring, asset replacement and other methods.

Moreover, many local governments often try to help the ST companies, for the sake of local interests or reputation, through financial subsidies, tax relief and other administrative measures. All of these factors will make those ST companies unlikely to enter into bankruptcy proceedings. This is why although the provisions of bankruptcy do exist in China's Bankruptcy Law, bankruptcy procedures have never been successfully implemented in the last two decades in this part of the world. Therefore, in lieu of a typical measure of business failure--bankruptcy, we need to rely on other measures of business failures of public companies in China in our study. In this paper, business failure of Chinese listed companies is assumed (1) once a listed company has been assigned to the section of special treatment, or (2) if a listed ST company is subject to special transfer, delisting warnings, termination or bankruptcy. In China, business failures are likely to be associated with some internal factors and other unique factors. The internal factors include: (1) lack of core competitiveness, (2) inadequacy of corporate governance and poor decision making, (3) aggressive diversifications, and (4) problems in capital structure and cash flows.

Lack of core competitiveness

Core competitiveness is the key to sustainable growth for public companies. Unfortunately, the deficiency of core competitiveness has been pervasive among Chinese public firms, owing to a lack of either core technology or core products. There are five major factors that may have contributed to this situation: (1) the success of many companies is out of non-replicable and incidental factors, rather than through mastering key technologies, methods and systems, accomplished through a series of strategic planning, operational decisions, market predictions, research and development, production processes, human resource management and customer service; (2) most companies, without a prominent goal before hand, drastically diversify and expand the operation, which may have a negative impact on the core competitiveness; (3) most of the restructuring and reorganization transactions are initiated for cosmetic purposes rather than to strengthen core competitiveness²; (4) weak R&D cannot support the upgrade in product structure and technology per the market's demand³; (5) there is volatility in earnings, due to the extraordinary items, which include related-party transactions nonmonetary exchange, accounting changes and governmental subsidies. Related-party transactions and nonmonetary exchanges are two major items.

All the above factors are widely believed to be related to the problems emerging from the transition to market economy from planned economy in China in the past decades, and because of the lack of an existing system, industry, financial market, organizational capital and human capital to help incubate core competitiveness.

¹ On April 22, 1998, both stock exchanges in China began to apply specialized treatment to the listed companies in abnormal financial and other conditions (usually when a listed company has net loss for two consecutive years). The stock exchanges prefix ST, the initials of special treatment, to the names of such stocks in the listing. An ST company, if continuing to lose in the third year, is at the risk of being delisted. In order to warn investors, an asterisk with ST ("*ST") is to be prefixed to the name of such stock.

² Li et al. (2001), in their case study of refinancing and regulation of public companies, pointed out there are at least three forms of ineffective restructuring: (1) Acquisition of bankrupt or near-to-bankrupt businesses; (2) Cancelling the liabilities of controlling shareholders by acquiring their assets; and (3) Acquisition of assets at year end to boost consolidated net income.

³ According to Wu (2004), in 1999, the R&D expenditures amounted to 67.89 billion RMB across China, which was only 0.83% of GDP of the year. Among those, only 33.67 billion was spent by businesses. In 2007, the R&D expenditures amounted to 153.96 billion RMB across China, which was only 1.13% of GDP of the year. Among those, 92.54 billion was spent by businesses.

Inadequacy of corporate governance and poor decision making

Effective corporate governance is supposed to ensure the effectiveness of operations through delegation and balancing of power thus preventing agency issues. The corporate governance in Chinese public companies is far from perfect. The most serious issue is that the controlling interest is highly clustered within the hands of a few shareholders. Small shareholders are not able to protect themselves from the agency issues in such an ownership structure. The over-clustering of the ownership may lead to the imbalance of corporate governance, myopic behaviors by companies, and related-party transactions; all of which can contribute to unwise decisions.

Aggressive diversifications

Diversification is a way of reducing risks in operations. However, aimless expansion and diversification, without adequate understanding of new businesses in new industries and new regional markets, is often associated with failures. The statistical analysis of diversification processes by M.E. Porter (1987), an expert of strategic management from Harvard Business School, shows that diversification through mergers and acquisitions is subject to highest failure rate. Aggressive diversifications may dwarf the main operations of the company. Main operations involve daily and recurring activities to fulfill operational target, and are deemed key to the sustainability and development of a company. The continuous shrinkage of main operations may ultimately lead to huge loss of earning, which usually signals the start of a series of business crises. Without strong main operations, businesses lack core earnings power.

In recently years, due to the worsening of the economy and the irrational investments, many public companies are transitioning to diversification in hope of optimizing resource allocation, diversifying risks and benefiting from tax savings. However, increasing agency costs may offset the benefits brought about by diversification. A diversified business is prone to have a relative complicated management structure and information asymmetry, which may contribute to difficult and inefficient management. With the easy access of capital in the stock market, firms are less likely to scrutinize the investment projects. Therefore, misuse of diversification may dampen the appropriate allocation of resources and lead to more risky operations.

Problems in capital structure and cash flows

The stability of financial position and financial risks of a company are related to its capital structure. A highly leveraged company has a high risk of insolvency. The public firms with high risks of business failure in China have an unusually high leverage ratio. Table 1 presents the leverage ratios for a sample of ST firms, a sample of regular firms and the entire population of public firms in year 2005. As we can see from the table, ST companies are highly leveraged than regular companies. In the group of ST companies, debt-to-asset ratio and long-term-debt-to-asset ratio are higher than those of the regular companies. Some ST firms have long term debt higher than total assets, meaning the shareholders' equity is negative. Theoretically, they are bankrupt.

Table 1. Capital Structure (ST firms vs. Regular firms) in 2005

<i>ST firms</i> (n=67)	Mean	Min	Max	St. dev
Debt-to-asset ratio	100.83%	2.47%	289.36%	58.76
Long-term Debt-to-asset ratio	164.68%	-111.7%	78.87%	10.11
<i>Regular firms</i> (n=67)				
Debt-to-asset ratio	44.36%	10.93%	94.30%	19.15
Long-term Debt-to-asset ratio	31.43%	0	559.32%	81.74
<i>All public firms</i> (n=1381)				
Debt-to-asset ratio	43.14%	0.90%	98.88%	17.69
Long-term Debt-to-asset ratio	23.18%	-70.98%	7887%	21.37

The deficiency of cash flows, especially the deficiency of cash flows from operating activities, is the most important and direct cause of business failure. When debts become due, a business lack of cash is subject to the risk of bankruptcy or being taken over. Weak management of cash flows is associated with overstocking of inventory, slow collection of accounting receivables, sluggish payment of debts, and other going-concern issues, which may drag a company into more serious crises. Sometimes, even a temporary problem in financial position, coupled with the external impact from the operating environment, may bring an entire company to its knees. Besides the above general internal factors of business failures, there are some unique factors associated with business failure in China.

In the public market of China, an ever worsening problem is the misappropriation of company's funds by large shareholders. Such behaviors impaired the normal ongoing business of their companies and turned many firms into empty shells. They embezzled the financial resources of the companies through frequent related-party transactions and guarantees.

Related-party transactions and misappropriations by large shareholders

Related-party transactions by listed companies refer to those transactions or arrangements of resources or obligations between listed holding companies or their subsidiary companies and related-parties. This is a very serious problem in China. For example, based on the information in the annual reports of 2005 collected by Shenzhen and Shanghai Exchanges, there were 773 listed firms involved in related-party transactions. In total, 1,123 related-party transactions that amounted to 109 billion RMB were disclosed by the listed firms during the year. Without an effective regulatory system, a business might become more risky, or in a worse scenario, might have to endure financial distress or even bankruptcy as a result because the terms in those related party transactions usually do not reflect the economic realities of otherwise arm's length transactions.

A typical case of misappropriations by large shareholders can be reflected in a large amount of other receivables, especially other receivables that are past due for a long time, or without due dates. For example, 2.58 billion RMB of other receivables in the financial report by Qinqi Corp in 2001 was due from its parent company. In 2004, the problem of misappropriation by large shareholders existed in 297 listed firms, accounting for 20.3% of the population of listed firms in China. The amount of misappropriated funds was as high as 8.57 billion RMB. Table 2 presents the listed ST or *ST companies between 1998 and 2005 with the amount of other receivables higher than 0.5 billion RMB. The amount is from the year prior to when the listed firms received special treatment.

Table 2. Other receivables (more than 0.5 billion RMB) of ST and *ST companies between 1998-2005

Stock code	Stock ticker	ST since	Amount of Other Receivables (in 10 thousand RMB)
600698	ST Qingqi	2002	146,195
000588	PT Kingman	1999	116,787
000921	Kelon	2002	109,255
600053	ST JXpaper	2003	97,964
000535	*ST KMK	2001	96,059
600187	*ST Blackdragon	2005	95,812
600876	Luoyang Glass	2004	81,860
000832	*ST Longdi	2004	79,941
000156	*ST Genuine	2005	78,794
000522	Baiyunshan A	1999	72,436
000561	*ST CLG	2003	68,926
600870	Xiamen Elecronic	2002	67,651
000529	*ST Meiya	2003	65,740
000030	ST Sunrise A	1998	64,792
000631	*ST Lanbao	2005	60,886
600181	*ST Unida	2005	60,754
600159	GST NCLJ	2003	56,971
000571	Sundiro A	2002	52,484
000766	*ST TH Golden Hors	2004	51,150
000017	*ST CHN Bicycle	1999	50,857
000533	Macro	2002	50,205

Guarantee

At present, the issues in guarantees by listed companies in China are: (1) too many companies are involved with large guarantees; (2) the ratio of amount guaranteed to net asset is too high; (3) noncompliance with guarantee policies. A widely known case is Kingman, one of the first delisted public companies in China. Its parent company, Kingman Group, misappropriated 995 million RMB of the public company, which had already been burdened by providing a guarantee of 270 million RMB to another subsidiary of the group. After 2000, the problem of inter-guarantee and guarantee circle among listed companies became even worse.

The complicated inter-guarantee relationships result in chains of contingency liabilities. If the chain breaks at some point, the domino effect usually leads to a series of bankruptcies. For example, the guarantee circle of 1.14 billion RMB between Huguang Business (000863.SZ), Juyou Net (000693.SZ), Neptunus Bioengineering (000078.SZ), CHN Kejian (000035.SZ) and their interest controllers started to wiggle and broke in March 2005.

iii. Financial Measures Associated With Business Failures

From the above discussion of the factors associated with business failures in public companies in China, we identified six groups of financial measures which can be constructed from public financial reports. The cause and pathway which leads to business failure of listed companies may vary. However, no matter what contributes to the failure, abnormalities in financial measures can be detected.

Liquidity

Many listed companies in China are financed by borrowing to cope with the shortage of capital due to ineffective operations. When the rate of return on capital is lower than the rate of interest of borrowing, liquidity worsens, which may ultimately lead to defaults. Liquidity is usually measured by current ratio, quick ratio and debt to asset ratio. Current ratio and quick ratio are used to measure short-term liquidity, while debt to asset ratio is used to measure long-term solvency. The higher the debt to asset ratio, and the lower the current ratio and quick ratio, the higher the burden for debts and interests, the more difficult it is to sustain the operation.

Profitability

Many listed companies are low in profitability due to drastic competition or lack of corporate governance. If the situation is not improved, in the end, they may turn into special treatment companies. Profitability is usually measured by net asset income ratio, return on assets, profit margin ratio and gross margin ratio. The first three ratios are important measures of operational effectiveness, and the fourth reflects the profitability on core operations. The higher the measures, the stronger the profitability and the lower the likelihood of operation failure.

Operational efficiency

Quite a few listed companies in China cannot use their assets efficiently, which led to the problems in accounts receivables and inventory: (1) large accounts receivables with old accounts; (2) overstocking of inventories. Operational efficiency is usually measured by assets turnover ratios, or to be more specific, by accounts receivable turnover ratio and inventory turnover ratio. The higher the turnover ratios, the higher the operational efficiency.

Growth

The growth of ST companies in China is slow. Even worse, a few companies regress in growth, indicated by: (1) a huge decrease in revenues and earnings, and (2) a huge decrease in the scale of assets. Growth is usually measured by growth of total assets and the growth of net assets. In other word, the growth measures indicate the accumulation and expansion of capital. The higher the measures, the more adequate the shareholders' equity and capital, the lower the likelihood of operation failure.

Factor structure

The factor structures of ST companies in China are likely not normal, especially with disproportionately high cost and expense and unreasonable asset structure. To measure the weight of cost or expense to revenue, period expenses to sales ratio, cost of sales to sales ratio, administrative expenses to sales ratio, and net operating income to net income ratio are frequently used. To measure the weight of long-term assets to the total assets, long-term assets ratio is often used.

Cash flows

Some ST companies in China have poor cash flows due to chaos in operations and misappropriations of funds. When the operations do not generate enough revenue, the cash flow weakens. Cash flows condition is usually measured by cash to current liabilities ratio, cash to total liabilities ratio and cash to total assets ratio. The higher the measures, the higher the adequacy of cash flows and the company is more capable of generating cash flows from the assets. Base on the above discussion of the six groups of financial measures, we selected 26 potential financial measures as listed in Table 3.

Table 3 Potential financial measures by groups

Factor	Measure (Variable)	Formula
Liability	Current Ratio (X_1)	Current Assets/Current Liabilities
	Quick Ratio (X_2)	(Current Assets-Inventory)/Current Liabilities
	Working Capital Ratio (X_3)	(Current Assets-Current Liabilities)/Total Assets
	Debt to Assets Ratio (X_4)	Total Liabilities/Total Assets
	Debt to Equity Ratio (X_5)	Total Liabilities/Total Shareholders' Equity
Profitability	Net Assets Income Ratio (X_6)	Net Income/Weighted Average of Shareholders' Equity
	Return on Assets 1 (X_7)	Net Income/Average Total Assets
	Return on Assets 2 (X_8)	EBIT/Average Total Assets
	Profit Margin Ratio (X_9)	Net Income/Sales Revenue
	Gross Margin Ratio (X_{10})	(Sales Revenue-Cost of Sales)/Sales Revenue
Operational efficiency	Assets Turnover (X_{11})	Sales Revenue/Average Total Assets
	Accounts Receivable Turnover (X_{12})	Sales Revenue/Average Accounts Receivables
	Inventory Turnover (X_{13})	Sales Revenue/Average Inventory
	Current Assets Turnover (X_{14})	Sales Revenue/Average Current Assets
Growth	Sales Growth Rate (X_{15})	(Sales _t -Sales _{t-1})/ Sales _{t-1}
	Total Assets Growth Rate (X_{16})	(Total Assets _t - Total Assets _{t-1})/ Total Assets _{t-1}
	Shareholders' Equity Growth Rate (X_{17})	(Shareholders' Equity _t - Shareholders' Equity _{t-1})/ Shareholders' Equity _{t-1}
	Net Income Growth Rate (X_{18})	(Net Income _t - Net Income _{t-1})/ Net Income _{t-1}
Cash flows	Cash to Current Liabilities Ratio (X_{19})	Cash Flows from Operations/Current Liabilities
	Cash to Total Liabilities Ratio (X_{20})	Cash Flows from Operations/Total Liabilities
	Cash to Total Assets Ratio (X_{21})	Cash Flows from Operations/Total Assets
Factor structure	Net Operating Income to Net Income Ratio (X_{22})	Net Operating Income/Net Income
	Period Expenses to Sales Ratio (X_{23})	SG&A/Sales Revenue
	Cost of Sale to Sales Ratio (X_{24})	COS/Sales Revenue
	Administrative Expenses to Sales Ratio (X_{25})	Administrative Expenses/Sales Revenue
	Long-Term Assets Ratio (X_{26})	Long-Term Assets/Total Assets

Iv. Sample and Data

There are 200 listed companies selected, with 100 in the ST test sample and another 100 in the control sample composed of regular firms. At the end of Dec 31, 2008, there were 154 ST companies, with 39 *STs and 115 STs. Companies in the financial industry are excluded. Companies with B or H shares are deleted. Specially treated companies due to other than business failures are excluded. We only retain those companies with available financial data from 2005 to 2007. Therefore, we have 100 sample firms.

The control sample is selected based on the rating system by the magazine of *Listed Companies*. All listed firms will be ranked based on an overall score, which is calculated by the sum of rankings in total assets, market capital and operating income. For example, a company ranks at 10th place is given 10 as the ranking. In the list of companies with overall score, we select the first 200 with lowest scores (or highest performance), then the companies with lower than 10% of their net assets income ratio are deleted. Among the remaining list, we select the top 100 companies as the control group. All financial data are publicly available from Shanghai Stock Exchange and Shenzhen Stock Exchange.

V. Empirical Tests and Analyses

The purpose of this study is to identify the indicators of business failure. To test the association of the potential measures with business failure, we use the t-test to examine whether the value of each measure is significantly different between the sample firms (ST firms) and control firms (regular firms). Table 4 presents the results. In Table 4, there are differences in several measures between the sample and control firms. (1) Liquidity: the current ratio and quick ratio of the sample firms are lower than those of the control firms which is consistent with the lower liquidity in sample firms.

However, the differences are not significant at 5% level; (2) Profitability: the net assets income ratio, and return on assets (1 and 2) of the sample firms are significantly lower than those of the control firms, which is consistent with the lower profitability in sample firms; (3) Operation efficiency: the assets turnover and current asset turnover of the sample firms are significantly lower than those of the control firms, which is consistent with the lower operation efficiency in sample firms; (4) Growth: the assets growth rate and shareholders' equity growth rate of the sample firms are significantly lower than those of the control firms, which is consistent with the lower growth in sample firms; (5) Cash flows: the cash flows to total assets ratio of the sample firms is significantly lower than those of the control firms, which is consistent with the lower cash flows in sample firms; (6) Factor structure: the ratio of period expenses to sales revenue is significantly higher, which is consistent with the fact that there are differences in factor structure between the sample firms and control firms.

Table 4. Descriptive Statistics of the financial measures for the sample firms (ST) and control firms (regular)

Variables	Mean		t-test	
	Sample firms (ST)	Control firms (regular)	t-value	p-value
Current Ratio (X_1)	1.5004	3.1371	-1.422	0.163
Quick Ratio (X_2)	1.1498	2.6225	-1.304	0.200
Working Capital Ratio (X_3)	80.8585	42.5889	0.579	0.566
Debt to Assets Ratio (X_4)	0.1560	0.2205	-1.601	0.117
Debt to Equity Ratio (X_5)	103.1342	103.6826	-0.031	0.975
Net Assets Income Ratio (X_6)	-0.4342	11.949	-3.403	0.002**
Return on Assets 1 (X_7)	0.7506	6.4099	-4.667	0.000**
Return on Assets 2 (X_8)	2.4162	9.0210	-4.886	0.000**
Profit Margin Ratio (X_9)	-10.2657	8.5011	-1.265	0.213
Gross Margin Ratio (X_{10})	23.8233	25.0978	-0.467	0.643
Assets Turnover (X_{11})	0.3971	0.7152	-3.140	0.003**
Accounts Receivable Turnover (X_{12})	4.6192	9.3013	-1.552	0.129
Inventory Turnover (X_{13})	5.9469	4.7510	0.408	0.685
Current Assets Turnover (X_{14})	0.7480	1.2805	-2.714	0.010**
Sales Growth Rate (X_{15})	36.9326	20.3153	0.437	0.665
Total Assets Growth Rate (X_{16})	9.9709	26.4372	-2.532	0.015**
Shareholders' Equity Growth Rate (X_{17})	8.1539	34.9032	-2.179	0.035**
Net Income Growth Rate (X_{18})	14.7415	7.6829	0.203	0.840
Cash to Current Liabilities Ratio (X_{19})	0.0338	0.1224	-0.662	0.512
Cash to Total Liabilities Ratio (X_{20})	0.0308	0.0934	-0.513	0.611
Cash to Total Assets Ratio (X_{21})	1.2612	6.3110	-2.455	0.019**
Net Operating Income to Net Income Ratio (X_{22})	0.0011	0.6026	-1.459	0.153
Period Expenses to Sales Ratio (X_{23})	32.0413	15.6490	1.702	0.097
Cost of Sale to Sales Ratio (X_{24})	76.1767	74.7500	0.523	0.604
Administrative Expenses to Sales Ratio (X_{25})	16.4834	8.3036	2.054	0.047**
Long-Term Assets Ratio (X_{26})	0.5612	0.5905	-0.92	0.363

Note: ** stands for the test is significant at 5% level.

Based on the results from the comparison of financial measures between the sample firms and control firms, we select the measures for further analysis based on the criterion: the difference in the selected measures between the two firm groups must be significant at 0.25 level⁴ or lower. There are 16 variables, which are, X_1 , X_2 , X_4 , X_6 , X_7 , X_8 , X_9 , X_{11} , X_{12} , X_{14} , X_{16} , X_{17} , X_{21} , X_{22} , X_{23} and X_{25} . We use logistic regression to test whether a variable of interest is associated with the likelihood of business failure of listed companies. When the correlation between independent variables increases, logistic regression will be subject to the problem of multicollinearity.

⁴ We set the significance level of 0.25 or lower as the threshold in order to retain as many potential measures relevant to business failures as possible for the following factor analysis. Only when the difference in a financial measure between the sample and control groups is not significant at 0.25 level, will it be excluded.

In light that there are probably high correlations between similar financial measures, we implement factor analysis on all the 16 selected financial measures to constrain the information into relatively independent factors. Then, we run the logistic regression on the factors and analyze the results.

Table 5 is to test and see whether a factor analysis is valid. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.624⁵, and the Bartlett's test of approx. Chi-Square sphericity is significant, which means there are strong correlations between variables. Therefore, a factor analysis is appropriate.

Table 5. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.624
Bartlett's Test of Approx. Chi-Square	1533.836
Sphericity df	120
Sig.	.000

Table 6 presents the results of the factor analysis. As we can see from the table, the eigenvalues of the six factors are higher than 1, and the cumulative variance is almost 85%, which means the raw information is retained by the six factors well.

Table 6. Total Variance Explained

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
F ₁	3.871	24.196	24.196
F ₂	2.339	14.617	38.813
F ₃	2.142	13.387	52.200
F ₄	2.035	12.719	64.919
F ₅	1.937	12.108	77.026
F ₆	1.189	7.431	84.458

Table 7 presents the factor loading, i.e., the correlation matrix between variables and the factors. As seen from this table, (1) X₆, X₇, X₈ and X₉ contribute most to F₁, indicating that F₁ mostly reflects the profitability condition; (2) X₁, X₂ and X₄ contribute most to F₂, indicating that F₂ mostly reflects the liquidity condition; (3) X₁₁ and X₁₄ contribute most to F₃, indicating that F₃ mostly reflects the operation efficiency; (4) X₂₃ and X₂₅ contribute most to F₄, indicating that F₄ mostly reflects the expense structure; (5) X₁₆ and X₁₇ contribute most to F₅, indicating that F₅ mostly reflects the growth condition; (6) X₂₂ contribute most to F₆, indicating that F₆ mostly reflects the profit structure.

Table 7. Factor Loading Matrix (Rotated)

Variable	Factors					
	F ₁	F ₂	F ₃	F ₄	F ₅	F ₆
X ₆	0.935	9.314E-03	0.208	3.792E-03	0.144	-3.52E-03
X ₉	0.901	3.861E-02	-0.161	0.103	7.237E-02	-2.15E-02
X ₇	0.829	3.139E-02	0.389	-1.25E-03	0.258	6.474E-02
X ₂₁	0.803	-0.160	0.129	2.623E-02	-1.56E-02	5.875E-02
X ₈	0.787	-2.52E-02	0.458	-3.74E-02	0.247	3.892E-02
X ₁	-2.55 E-02	0.976	-2.45E-02	-2.22E-03	-6.82E-02	-4.57E-02
X ₂	-3.20 E-02	0.971	-2.56E-02	-4.34E-03	-7.52E-02	-6.21E-02
X ₄	-4.83E-02	0.617	-0.201	7.738E-02	0.271	0.396
X ₁₁	0.284	-4.94E-02	0.880	0.170	9.346E-02	0.120
X ₁₄	0.224	-0.131	0.849	0.317	-4.54E-03	6.853E-02
X ₂₃	4.224E-02	5.377E-02	0.179	0.944	-3.49E-02	0.182
X ₂₅	7.889E-03	-1.77E-02	0.184	0.938	6.535E-02	9.026E-03
X ₁₇	0.125	3.193E-02	7.172E-02	3.642E-02	0.913	2.748E-02
X ₁₆	0.250	-6.22E-02	3.877E-02	-1.81E-02	0.892	5.451E-02
X ₂₂	-4.48E-02	-4.95E-02	0.287	-7.22E-02	0.197	0.697
X ₁₂	0.137	5.926E-02	-5.85E-02	0.331	-0.138	0.689

⁵ 0.5 is the threshold value of the test commonly used. If the test value is below 0.5, then factor analysis is not preferred.

Table 8 presents the factor loading matrix from the factor analysis. The factor pattern matrix represents the linear combination of the financial measures, which will be used to calculate the values of factor variables for each observation. Based on the loading information in the table, the six factor variables can be represented as follow:

$$\begin{aligned}
 F_1 &= 0.003X_6 + 0.002X_9 + 0.008X_7 + 0.270X_{21} + 0.184X_8 + 0.157X_1 + 0.339X_2 - 0.078X_4 \\
 &+ 0.087X_{11} - 0.079X_{14} - 0.031X_{23} - 0.084X_{25} + 0.260X_{17} - 0.089X_{16} - 0.003X_{22} - 0.030X_{12} \\
 F_2 &= 0.437X_6 + 0.436X_9 + 0.226X_7 + 0.023X_{21} + 0.045X_8 + 0.029X_1 + 0.001X_2 - 0.050X_4 \\
 &- 0.032X_{11} + 0.010X_{14} - 0.035X_{23} + 0.010X_{25} - 0.064X_{17} - 0.038X_{16} + 0.002X_{22} - 0.020X_{12} \\
 F_3 &= 0.091X_6 + 0.093X_9 - 0.130X_7 - 0.044X_{21} + 0.091X_8 + 0.150X_1 - 0.298X_2 + 0.493X_4 \\
 &- 0.177X_{11} + 0.458X_{14} - 0.069X_{23} - 0.021X_{25} - 0.092X_{17} + 0.139X_{16} - 0.067X_{22} - 0.051X_{12} \\
 F_4 &= 0.022X_6 - 0.021X_9 + 0.009X_7 - 0.017X_{21} - 0.060X_8 - 0.089X_1 + 0.106X_2 - 0.070X_4 \\
 &+ 0.080X_{11} + 0.027X_{14} + 0.023X_{23} + 0.051X_{25} - 0.005X_{17} - 0.201X_{16} + 0.487X_{22} + 0.519X_{12} \\
 \\
 F_5 &= 0.040X_6 - 0.042X_9 + 0.132X_7 - 0.040X_{21} + 0.026X_8 + 0.023X_1 - 0.056X_2 - 0.022X_4 \\
 &- 0.158X_{11} - 0.058X_{14} + 0.495X_{23} + 0.527X_{25} + 0.120X_{17} + 0.030X_{16} - 0.007X_{22} + 0.007X_{12} \\
 \\
 F_6 &= 0.095X_6 - 0.110X_9 + 0.315X_7 - 0.030X_{21} + 0.004X_8 - 0.017X_1 - 0.025X_2 - 0.000X_4 \\
 &+ 0.622X_{11} - 0.055X_{14} - 0.041X_{23} - 0.089X_{25} + 0.060X_{17} + 0.634X_{16} + 0.002X_{22} - 0.174X_{12}
 \end{aligned}$$

Table 8 Factor Pattern Matrix

Variable	Factor					
	F ₁	F ₂	F ₃	F ₄	F ₅	F ₆
X ₆	.003	.437	.091	-.022	-.040	-.095
X ₉	.002	.436	.093	-.021	-.042	-.110
X ₇	.008	.226	-.130	.009	.132	.315
X ₂₁	.270	.023	-.044	-.017	-.040	-.030
X ₈	.184	.045	.091	-.060	.026	.004
X ₁	.157	.029	.150	-.089	.023	-.017
X ₂	.339	.001	-.298	.106	-.056	-.025
X ₄	-.078	-.050	.493	-.070	-.022	.000
X ₁₁	.087	-.032	-.177	.080	-.158	.622
X ₁₄	-.079	.010	.458	.027	-.058	-.055
X ₂₃	-.031	-.035	-.069	.023	.495	-.041
X ₂₅	-.084	.010	-.021	.051	.527	-.089
X ₁₇	.260	-.064	-.092	-.005	-.120	.060
X ₁₆	-.089	-.038	.139	-.201	.030	.634
X ₂₂	-.003	.002	-.067	.487	-.007	-.002
X ₁₂	-.030	-.020	-.051	.519	.007	-.174

We use the following logistic model to test the relation between the likelihood of business failure and the potential financial factors. The dependent variable ST is a dummy variable, equal to 1 if the firm is from the ST sample, and zero otherwise.

$$\text{Pr ob}(ST = 1) = f(\beta_0 + \beta_1 * F_1 + \beta_2 * F_2 + \beta_3 * F_3 + \beta_4 * F_4 + \beta_5 * F_5 + \beta_6 * F_6 + \varepsilon), \text{ where}$$

$$f(\beta' X) = \frac{e^{\beta' X}}{1 + e^{\beta' X}}$$

The results of the logistic regression are presented in Table 9. According to the results, F₁, F₂, F₃ and F₅ are significant, which means that the factors of profitability, liquidity, growth and profit structure are significantly associated with the likelihood of operation failure for public companies.

Table 9. Results of the Logistic Regression

	B	S.E.	Wald	df	Sig.	Exp (B)
F ₁	-3.522	1.094	10.372	1	0.001	0.030
F ₂	-2.104	0.920	5.226	1	0.022	0.122
F ₃	-1.175	0.457	6.617	1	0.010	0.309
F ₅	-0.622	0.331	3.539	1	0.060	0.537
Constant	-0.317	0.341	0.868	1	0.352	0.728

Therefore, we retain the significant factors in the model to predict the likelihood of operation failure. The likelihood of operation failure P is calculated based on the following equation. If P is higher than 0.5, then the firm is more likely subject to operation failure. Otherwise, it is more likely to be a regular firm.

$$P = \frac{\exp(-0.317 - 3.522 F_1 - 2.104 F_2 - 1.175 F_3 - 0.622 F_5)}{1 + \exp(-0.317 - 3.522 F_1 - 2.104 F_2 - 1.175 F_3 - 0.622 F_5)}$$

To test the success rate of the model in predicting operation failure, we calculate the predicted likelihood of failure and see whether it is consistent with the real operational condition of the firm. Table 10 presents the frequency of operation failure by prediction with the real occurrence side by side for both samples. According to the table, the model makes correct predictions of operation failure 76 out of 100 times, and accurate predictions of operation success 85 out of 100 times. The overall accuracy of the model in predicting business failures is over 80%.

Table 10 Frequency of operations failures by prediction

Sample	Predicted		Subtotal	Accuracy of prediction	Overall accuracy of prediction
	Failures	Success			
ST firms	76	24	100	76%	80.5%
Control firms	15	85	100	85%	

Therefore, we can use the model to help predict and identify potential business failures. In particular, the likelihood of business failure (P) calculated from the model is the measure to examine. The higher the value of P, the more likely the firm will run into business failure. P value can be a very useful tool to measure the risks faced by public companies. It usually takes time to detect potential risks of business failure. The value of P can facilitate the timely identification of risks, so that managers, creditors and regulators are able to take prompt actions to fix the problems.

Vi. Conclusions

The purpose of this study is to identify the internal factors, especially financial measures that may be associated with the business failures of public companies in China, and to construct a prediction model for business failures in Chinese capital market. We use the occurrence of special treatment as a proxy for business failures, because bankruptcy usually does not follow business failures and is not an applicable measure of it in China. First, we identified 26 potential financial measures that we believe are associated with business failures. Then, we selected 16 of them that are most likely to correlate with the occurrence of business failures. After a factor analysis, the group of financial factors was further downsized to six. They are profitability, liquidity condition, operation efficiency, expense structure, growth condition and profit structure. In the logistic regression, only the factors of profitability, liquidity, growth and profit structure are significantly associated with the likelihood of operation failure for public companies. Therefore, we include the four factors with their corresponding coefficients in the logistic regression and come up with a prediction model for business failures. In order to test the success rate of the model in predicting failures, we calculate the predicted likelihood of failure and see whether it is consistent with the real operational condition of the firm. The overall accuracy of the model in predicting business failures is over 80%, which supports that the prediction model is useful.

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