Research on the Applicability of MScore and FScore Models to U.S.-Listed Chinese Stocks

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Abstract

In recent years, the U.S. Securities and Exchange Commission (SEC) has also launched an increasing number of investigations into accounting fraud by U.S.-listed Chinese companies. According to the statistics, from year 2000 to year 2020, a total of 464 Chinese concept stock companies entered the American capital market, raising a total of 74.1 billion dollars through its IPO. Luckin Coffee is undoubtedly one of the most talked about Chinese stocks recently. Earlier, the well-known short-selling agency Muddy Waters released a short-selling report on Luckin Coffee, accusing its financial report of fraud. Such a common phenomenon of Chinese concept stocks fraud makes our group want to explore whether MScore and FScore can be used to predict whether there is financial fraud. Our group used the same year's MScore and FScore to compare the non-counterfeiting companies in the same industry and the accused cost company and found that both MScore and FScore Model's performances on predicting financial fraud is not that well no matter from industry aspect or time aspect. There are two main reasons for this phenomenon 1) due to the differences in Chinese and American accounting standards, the financial statements of Chinese enterprises are not completely disclosed in accordance with the American accounting standards; 2) the enterprise is headquartered in China, which causes the enterprise to operate according to the Chinese rules and regulations, and the operation mode, profit mode, tax mode and other modes.

Keywords: *Financial fraud; Chinese concept stocks; MScore Model; FScore Model*

1. Introduction

1.1 Research background

With the continuous implementation of economic globalization, accounting, as a business language, is also constantly marching and deepening its pace of globalization. In the meanwhile, financial fraud has become one of the problems plaguing the world. According to the statistics, from year 2000 to year 2020, a total of 464 Chinese concept stock companies entered the American capital market, raising a total of 74.1 billion dollars through its IPO, which is accounted for 13% of the total amount raised by the IPO in American capital market [1]. Considering that, on one hand, both large investment institutions in the US and those scattered individual investors play a significant role in converging such sufficient funds so that it gives many developing companies rare access to finance, on the other hand, China has stricter requirements for companies' listing conditions than the US's, more and more Chinese companies are attracted to the US capital markets. However, several US-listed Chinese companies have been accused of accounting fraud, which sparks a crisis of confidence in Chinese Concept Stock Companies among investors in the US capital market.

Facing with it, the researcher designs our paper to figure out whether the two popular Models, which are MScore Model from Beneish and FScore Model from Dechow, can be suitably used to predict the financial fraud of Chinese companies listed in the United States [2,3].

1.2 Paper design

Financial fraud, from a macro point of view, destroys the orderly operation of the capital market. Meanwhile,

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from a micro point of view, it damages the interests of individual and institutional investors. Therefore, it is necessary and meaningful to predict, detect and prevent financial fraud. This paper focuses on the detect stage and is trying to analyze whether MScore and FScore models can effectively predict financial fraud of Chinese concept stock enterprises. In the work, the main body can be divided into several parts. The first part is a short but concise introduction of the MScore and FScore Models that the researcher mainly discussed in our paper. The second part shows our data resources and following it is our detailed calculation and analysis, which combines the theory of the Models with several specific companies' financial statistic. In the fourth part, the researcher introduce T-test to figure out whether these two models are effective from both industry perspective and time perspective. Our conclusion comes within the final part.

Reference to *The Kinney Three Paragraphs (and more) for Accounting Ph.D. Students*, the researcher define our x as "financial factors and its abnormal variation" and y as "the deviation of financial statements from reality". To make x and y more operational, the researcher define X as "MScore & FScore" and Y as "possibility of financial fraud". Other factors like Vs are defined as "industry, size, policies" and Zs is defined as "Acquisitions".

2. Model introduction and limitations

MScore was proposed by Beneish while FScore was proposed by Dechow (2011). For MScore, exceeding -2.2 indicates the fraud of the company [4]. For FScore, exceeding 1 indicates above normal risk of fraud, and exceeding 2.45 indicates high risk of fraud. MScore uses 8 indicators. DSRI tests the balance of receivable and sales. The rapid increase of DSRI indicates that the receivable keeps increasing. GMI means gross profit margin. Companies may try to balance profit to window dressing the financial statement. AQI means asset quality index, and this indicator tests the unsure part of long-term asset like land and intangible asset. SGI means sales growth index, and management may manipulate this to make investors trust their company a bright future. DEPI means depreciation index, and income can be manipulated through the unreasonable depreciation of the PPE. SGAI means sales general and administrative expenses index, these may be lower than the actual number to make the profit look better as well. LVGI means leverage index, which shows the ratio of total liability and total asset. This may also relate to the fraud. TATA means total accruals to total assets. FScore uses 7 indicators. They are change in non-cash net operating assets, change in receivables, change in inventory, percentage soft assets, change in cash sales, change in return on assets and debt or equity issuance.

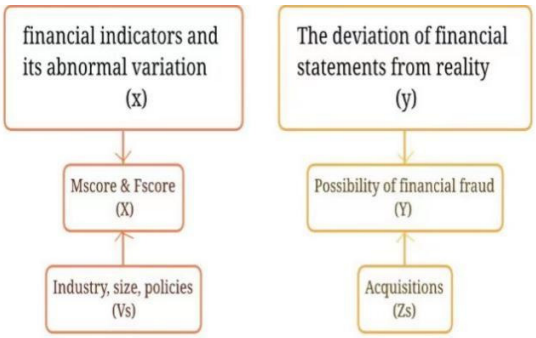

Figure 1 MScore& FScore

In western countries, these two models have been proved useful and been widely used in indicating the fraud. However, whether the two models are useful for Chinese companies listed in American haven't been proved. Some researchers discovered that these models are not that useful for Chinese listed companies, and C-score proposed by Chinese researchers Qian Ping and Luo Mei is more useful [5,6].

The reasons for the inaccuracy of MScore and FScore are shown below.

1. These models were proposed based on the data of American listed companies.

2. These models may become out of date because of the rapid development of the market. The managements and accountants of the companies may come up of new methods to window dressing their financial statements.

3. Both of the models only consider parts of the financial statement which are important in indicating the fraud, but other parts ignored.

It's supposed that M and F Score are not suitable for indicating because the limitations of these two models. But it needs to be test whether they are suitable for indicating.

3. Data resources

This research selects 7 US-listed Chinese concept stocks and companies in the same industry that had no fraudulent evidence for data analysis. The data sources mainly are chosen from their official website of the Securities and Exchange Committee (SEC) and the widely used website Yahoo Finance. Both are official, professional and reliable data sources. In addition, since there are a company's financial statements that cannot find the corresponding data on the official website, it uses the data on eastmoney.com.

4. Data analysis

4.1 Luckin Coffee

Luckin Coffee (NYSE:LK), founded in October

2017, has now become the largest coffee chain brand in China. On May 17th 2019, Luckin was listed on the NASDAQ. On April 2nd of the following year, Luckin issued a public notice, admitting that it had 2.2 billion CNY of fraudulent transactions. Due to it, its share price plunged 80% [5]. In June of the same year, Luckin was delisted from NASDAQ. In the following analysis, considering that LK is in the restaurant chain industry focusing on coffee, research chose Starbucks (NYSE: SBUX) and TATA coffee (NYSE: TACO) as the comparison companies for Luckin coffee.

Table 1 Luckin Coffee& Starbucks& TATA coffee

	LK			SBUX			TACO		
	2019	2020	2021	2019	2020	2021	2019	2020	2021
DSRI	0.3895	1.0297	0.1623	0.5772	1.5415	0.6572	0.7672	1.3015	0.7641
GMI	1.2385	1.1537	1.404	1.2201	0.9147	1.4146	1.0672	0.9885	0.9931
AQI	0.402	4.9502	0.8326	1.564	0.6597	0.9147	0.8659	0.9211	0.9539
SGI	3.5981	1.3334	1.9748	1.0724	0.8872	1.2357	1.151	1.0898	1.1469
DEPI	0	0	0	0.9815	1.9426	1.0019	1.4626	0.835	0.9216
SAI	-1.8427	0.302	1.7568	0.967	1.0379	0.9312	1.003	0.8864	0.9798
LVGI	1.6364	0.9073	1.2469	1.4748	0.8306	0.9256	1.0512	0.9715	0.9214
TATA	0.0277	-0.1609	0.0457	-0.0227	0.0355	-0.0468	0.0295	-0.0394	-0.0401
MScore	-0.5444	-1.1957	-2.3476	-2.7185	-1.9417	-2.5835	-2.4041	-2.3349	-2.7558

Assuming that the standard M>-2.22 is appropriate for this group analysis. In 2019, LK's MScore is -0.54, which accurately predicts that there is a high risk of fraud. From then on, the overall trend of LK's MScore is obviously showing a trend of continuous improvement, from -0.54 in 2019 to -1.20 in 2020 and finally ends up with -2.35 in 2021. This trend means that LK's MScores are gradually returning to the normal level, which may be relative to the enhance of management and internal supervision, correction of previous errors, etc.

However, SBUX's and TACO's MScores enjoy a different trend from LK's in these years. Firstly, they increase slightly from 2019 to 2020. Then after peaking in 2020, they mildly fall down from 2020 to 2021. The similarity between SBUX's and TATA's MScore trend might come from the overall changes of the whole coffee retail industry. At the same time, the difference between theirs and LK's might prove that MScore Model really indicates some anomaly of LK to some extent.

Table 2 Luckin Coffee & SBUX & TACO

	LK		SBUX		TACO	
	2020	2021	2020	2021	2020	2021
rsst_acc	-0.2194	-0.0413	-0.1419	0.0164	0.0211	0.0068
ch_rec	0.0004	0.0154	0.0154	-0.0086	0.0213	-0.0084
ch_inv	-0.0115	0.0294	0.0009	0.0017	0.0136	0.0033
soft_assets	0.2596	0.2268	0.3625	0.3291	0.6989	0.6921
ch_cs	0.3473	0.9354	-0.1067	0.2335	0.037	0.2063
ch_roa	-0.1089	0.6492	-0.1277	0.1002	0.0019	0.0131
issue	1	0	1	1	0	0
predictive value	-6.3754	-7.8481	-6.118	-6.2729	-6.4188	-6.5122
FScore	0.4595	0.1055	0.594	0.509	0.44	0.4008

Not only the MScore itself but also each variable contained in worth further exploration. Taking each variable in MScore Model into account, it is evident that its SGI is abnormally high in 2019, with 3.60, which is almost three times of that in 2020. From the accounting sense, the higher the SGI is, the more likely that manipulation takes place. 2019 is when LK started to counterfeit sales, which is matched with the unusually high SGI in the model. While SBUX's SGIs enjoy a smooth trend of these years. This phenomenon would be understood by further thinking of their own situation. Luckin made up fake transactions to beautify its sales so that they can gain and maintain investors' confidence, which leads to continuously abundant investment. While

Starbucks is already a mature company, so it doesn't have such pressure to manipulate its sales performance. Another abnormal variable is SAI. The SAIs of LK violently fluctuated in these three years, which may be relative to two factors. On one hand, the number of sales may be manipulated, which has been discussed above. On the other hand, managers also usually take advertising expense as a flexible tool to manipulate. According to the market research statistic, LK overstated advertising expenses by 336 million CNY in the third quarter of year 2019 [1], which fits the inference.

SBUX's and TATA's FScore both show a steady trend of these years, while LK's enjoys a larger change from 2020 to 2021. Even so, its FScore is still less than 1, which means some factors of LK itself drives the big change but not led it to be a significant high risks level. Meanwhile, LK is a neonatal company which was founded in 2018 and listed in 2019. Because of the listing, the calculation of MScore can only start from 2019. Therefore, it's hard to make a conclusion about whether the FScore Model can predict the possibility of fraud of LK effectively.

4.2 Shengda Tech Incorporation

Taking Shengda Tech Incorporation (SDTH Inc.) for example, which is a high-tech company manufacturing and marketing of nano precipitated calcium carbonate ("NPCC"), made fraud in its financial statements. It is said that Shengda Tech's 2010 financial statement does not follow the GAAP and perform in a formal format [8], which means that only three years of MScore and F-scores are available for reference in Table 3. In addition, the control company is similar industry and widely known company in U.S.A. stock market: Minnesota Mining and Manufacturing Corporation (3M).

Table 3 Shengda Tech Incorporation & Minnesota Mining and Manufacturing Corporation

SDTH Inc.				3M			
	2007	2008	2009		2007	2008	2009
DSRI	0.6954	0.6351	0.5456	DSRI	1.0156	0.92	1.1116
GMI	0.9288	1.0298	1.0084	GMI	1.0201	1.0188	0.9879
AQI	0.7342	1.4583	0.7618	AQI	1.124	0.9914	0.9923
SGI	2.123	1.7641	1.239	SGI	1.0671	1.033	0.9151
DEPI	1.7558	0.9082	0.9455	DEPI	1.1065	0.9675	1.0625
SAI	0.6208	0.7202	1.138	SAI	1.0302	0.9079	1.0084
LVGI	0.8009	0.456	1.0815	LVGI	0.9665	1.1339	0.8514
TATA	0.4776	0.2579	0.1488	TATA	0.0481	0.0519	-0.0006
MScore	0.5483	-0.5113	-2.1373	MScore	-2.1019	-2.3066	-2.411

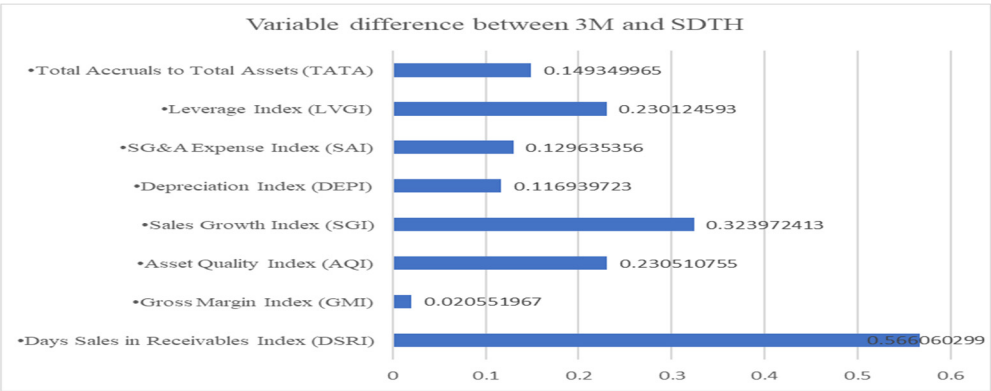

Figure 2 the difference of Minnesota Mining and Manufacturing Corporation & Shengda Tech Incorporation

First of all, Shengda Tech's MScore in 2009 is higher than -2.2 which is indicating that there could be a potential manipulator while 3M's is lower than -2.2 in 2009. Second, pay enough attention to some specific indicators. By comparing the differences between various indicators of Shengda Tech and 3M Corporation, the reasons why may cause great differences in MScore are found, which showed in figure 1. After multiplying relevant coefficient, the results are totally different which is showed in figure 2. It is obvious that, before multiplying the coefficient, DSRI is most significant indicator. However, after multiplying the coefficient respectively, the most significant indicator transfers to TATA. So, TATA could be one of the reasons that make

the MScore higher than normal. To be specific, the higher the level of accrued profits, the greater the possibility of profit manipulation. This result is consistent with the March 15, 2010, to March 15, 2011 class action against Shengda Tech that Shengda Tech was operating with material deficiencies in its internal controls.

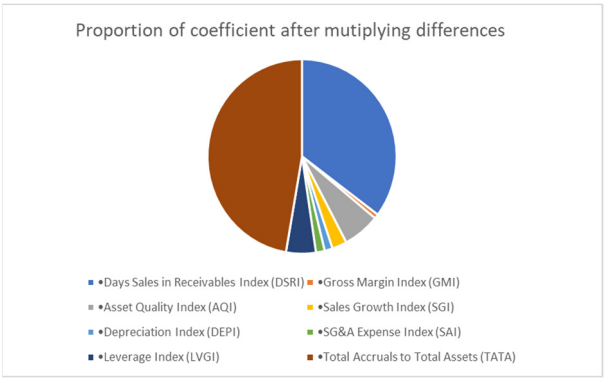

Figure 3: the proportion of coefficient after multiplying differences

Then, pay some attention to FScore. FScore means that an FScore of 1.5 indicates that a company is 150% more likely to be a fraudulent reporter than a randomly selected company. Both companies' FScore is not higher than 1 means that they are not under manipulation. SDTH's FScore is even much lower 3M's FScore in 2009.

For similarities, figure 4 shows that both companies have the tendency to reduce their FScore while Shengda Tech has much more significant degree because it drops from 0.8329 to 0.4358. According to reports at the time, it was caused by the global financial crisis in 2008.It is found that many firms engage in transactions-based earnings management. That is, they front-load their sales and engage in unusual transactions at the end of the quarter (GMT research, n.d.). This type of misstatement may increase cash sales, thus providing an explanation for this finding. So, the FScore seems not appropriate for detecting the company has been manipulated.

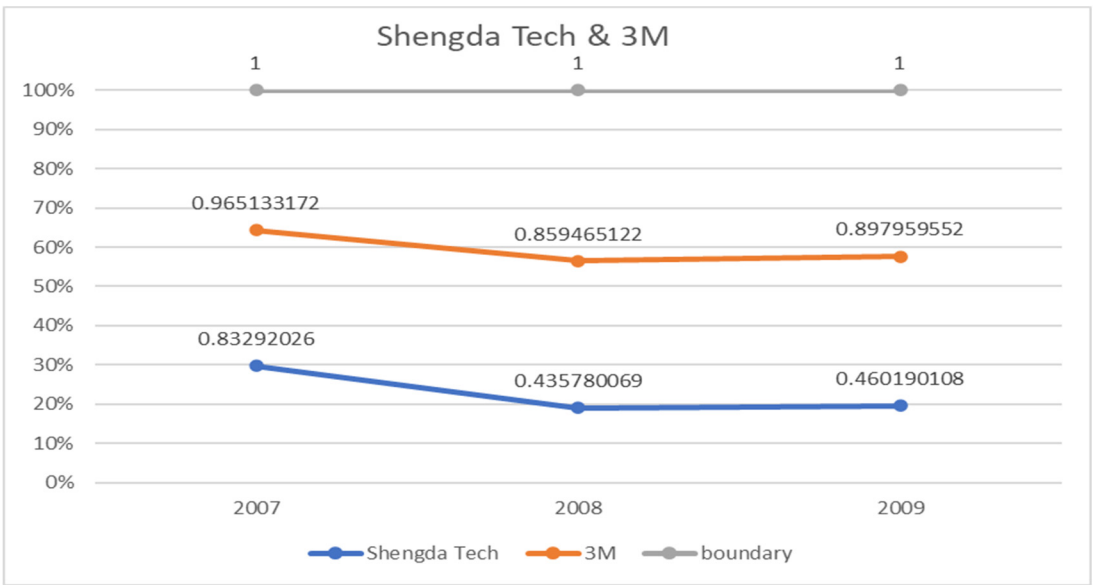

Figure 4 reducing the Fscore

4.3 Tomorrow Advancing Life

Tomorrow Advancing Life (NYSE: TAL) is an educational technology company, formerly known as Xueersi, which was founded in 2003 and listed on the NYSE in 2010. In 2017. On April 8, 2020, TAL announced that, during its routine internal audit, its employees had been found to have falsified sales. Affected by this news, TAL's shares fell more than 28% after hours. The employee was suspected of conspiring with outside suppliers to falsify contracts and other documents and falsely inflate Light Class sales, which accounted for 3% to 4% of the company's total revenue in fiscal 2020 [9]. Here below are analyses based on TAL and its comparison company New oriental Education & Technology Group (NYSE: EDU), which is also a comprehensive education group without any detected fraud yet.

Table 4 Tomorrow Advancing Life& New oriental Education & Technology

TAL							EDU					
	2016	2017	2018	2019	2020	2021		2017	2018	201	2020	2021
DSRI	11.442	0.780	0.573	0.692	0.853	0.592	DSRI	0.732	0.6995	0.8205	1.095	1.735
GMI	1.0477	3.294	0.221	1.274	0.989	1.0129	GMI	1.0013	1.034	1.0159	0.999	1.0617
AQI	2.2494	1.0821	0.853	2.521	0.514	0.584	AQI	1.025	1.3636	0.9474	2.324	0.822

SGI	1.4216	1.690	1.644	1.494	1.2771	1.373	SGI	1.2179	1.3594	1.2652	1.156	1.195
DEPI	0.8146	0.865	0.924	0.8118	0.985	1.0106	DEPI	1.035	1.0955	0.8472	0.962	0.87
SAI	1.0055	0.981	0.981	1.1327	1.213	1.2361	SAI	0.966	1.0447	0.9985	0.974	1.099
LVGI	0.9844	1.073	0.737	0.069	16.84	1.049	LVGI	1.054	1.0757	1.0299	1.2319	0.899
TATA	0.1228	0.137	0.1145	-7E-	-	0.139	TATA	0.1116	-	-	0.123	0.125
M-score	8.5899	-0.213	-2.152	-1.306	-8.223	-2.086	M-score	-2.007	-2.3827	-2.4517	-1.219	-1.078

For MScore: A glimpse at the overall trend of EDU's MScore will shows that it stays at a stable level around -2.28 from 2017 to 2019, following with a mild increase to around -1.15 from 2020 to 2021. However, TAL's MScores are showing a completely different trend, which seems like a continuous-violent fluctuation. Applying the standard that MScore larger than -2.22 will indicate that there is a risk of fraud, then it would not be difficult to find that TAL may enjoy high risk of fraud from 2016 to 2021 except 2020, according to its MScore are 8.59, -0.21, -2.15, -1.31 and -2.09 respectively. It's quite ridiculous that the year fraud actually occurred is not included, which, to some extent, declaring that MScore Model is not that exact in predicting the fraud of TAL. The unreasonably high MScore of 2016 indicates an extremely high risk of fraud, which is not coincided with its actual situation. This could reinforce our opinion that MScore Model is not that useful to TAL.

Table 5 Tomorrow Advancing Life & New oriental Education & Technology Group

	TAL					EDU			
	2017	2018	2019	2020	2021	2018	2019	2020	2021
rsst_acc	0.1411	0.2942	0.0175	-0.0286	0.1458	0.0442	-0.028	0.1556	0.1775
ch_rec	0.0006	-0.0001	0	0	-0.0001	-0.4752	0.2806	0.0002	0.0005
ch_inv	0.0015	0.001	0.0001	0.0008	0.0015	0.0024	-0.003	0.0004	0
soft_assets	0.6585	0.6861	0.9589	0.5978	0.69	0.6398	0.5812	0.5405	0.573
ch_cs	0.6961	0.6457	0.4942	0.2771	0.3738	-0.3002	-0.539	0.1555	0.194
ch_roa	-0.0342	0.0019	-0.0797	0	0	-0.0187	-0.033	0.0186	-0.0338
issue	1	1	1	1	1	1	1	1	1
predictive value	-5.2951	-5.1641	-4.7935	-5.655	-5.3177	-6.7903	-5.094	-5.6613	-5.5239
FScore	1.349	1.5366	2.2203	0.9426	1.3189	0.3036	1.6484	0.9368	1.0742

For FScore: Applying the standard that FScore > 1 indicates abnormal risk of fraud, TAL's FScore indicates financial fraud almost in every year. It performed so bad that it shows risk of fraud in every year except the right one. Taking TAL's and EDU's FScore simultaneously into account, both reveal a semblable trend that their scores are floating up and down. The only difference between this is the range of fluctuation, with 1-2 for TAL and 0-1 for EDU respectively. According to this, no matter TAL or EDU is chosen as subject, from year-by-year aspect, its FScore can't tell the difference of each year's possibility of having fraud behavior, which proves the uselessness of FScore model to these two companies.

All in all, the smooth variation of TAL's year by year FScore shows that FScore Model is not that effective in predicting fraud behavior of it. At the same time, though its MSocre differs a lot year by year, it cannot make an accurate prediction. In other words, the year-by-year drastic change of its MScore can't draw a clear picture to predict its performance.

4.4 Duoyuan Global Water and Gaotu

The data of Duoyuan Global Water and Gaotu which did fraud is chosen to analyze, and two other companies' data is also selected to compare in the same industry. Both two companies have a lack of data and only the data of three years can be found. So, the final result only contains the data of fraud year. As a result, these two companies' data is excluded in T-test in the next part for accuracy.

Duoyuan Global Water which aims at dealing with wasted water was accused in 2011 of manipulating its financial report, keeping giving wrong data to cheat the investors to gather more fund since it was listed in 2009, and in 2012, Duoyuan Global Water was forbidden to trade in the share market. American Water Works Company's data is selected in the same year to compare.

Table 6 Duoyuan Global Water Inc.& American Water Works Company Inc.

Duoyuan Global Water Inc.&American Water Works Company Inc.				
	2008	2009	2008	2009
•Days Sales in Receivables Index (DSRI)	0.7431	1.084	0.9575	0.9589
•Gross Margin Index (GMI)	0.7969	0.9316	-0.0854	-1.1243
•Asset Quality Index (AQI)	1.4516	1.0341	0.9964	1.0279
•Sales Growth Index (SGI)	1.398	1.3218	1.0554	1.0444
•Depreciation Index (DEPI)	0.93	1.0045	1.0304	0.927
•SG&A Expense Index (SAI)	1.249	1.7724	0.5062	1.3753
•Leverage Index (LVGI)	0.8761	0.2799	1.9993	0.1877
•Total Accruals to Total Assets (TATA)	0.1727	-0.1593	0.0833	-0.0291
MScore	-1.4884	-2.78	-2.8928	-3.5319

MScore is not useful for indicating fraud for this company and FScore successfully indicate fraud of Duoyuan Global Water, but it's still not useful because of the abnormal result of American Water. Duoyuan Global's MScore for 2008 indicates that the financial statement misleads its users. However, the data of 2009 turns to the normal level. Generally, this company manipulated its data through sales and receivable. The sales and receivable of Duoyuan keeps increasing rapidly, but the sales of American Water didn't increase that much and there's not a boom of the industry because American Water is one of the representative companies in this industry and it didn't show the trend. The increase of sales and account receivable leads to high DSRI and GMI, which contributes to the high MScore. Also, both companies lost a lot of money from investing, but Duoyuan may tries to cover the loss from operating cash flow, which increase TATA and increase the MScore in 2008. In 2009, the decrease of AQI and increase of SAI contributes to the decrease of MScore. In 2008, selling and administration expense of Duoyuan is low compared to that of the American Water, but the situation becomes better in 2009.

Table 7 the change of Duoyuan Global Water Inc. & American Water Works Company Inc.

Duoyuan Global Water Inc.&American Water Works Company Inc.				
	2008	2009	2008	2009
•Change in non-cash net operating assets	0.5238	0.1786	0.486	0.4042
•Change in receivables	0.0122	0.1106	0.0002	0
•Change in inventory	0.0576	-0.0247	0.0002	0.0001
•Percentage soft assets	0.6464	0.4124	0.9327	0.925
•Change in cash sales	0.5611	0.2882	0.0586	0.0473
•Change in return on assets	0.053	-0.1634	1.5099	0.3119
•Debt or equity issuance	1	1	1	1
Predict value	0.5238	0.1786	-6.031	-4.9965
Prob	0.0122	0.1106	0.0024	0.0067
FScore	1.7647	1.1492	0.648	1.8151

For the FScore, generally, it indicates fraud for Duoyuan Global. The receivable and sales are too high just like that in MScore. Besides, maybe this industry doesn't need so many inventories thus the inventory level is unreasonable for Duoyuan which contributes to the high level of ch_inv. The FScore of American Water shows that it is not suitable for indicating fraud because the final result of 2009 is 1.82, which means the risk of fraud.

Gaotu, a company aims at providing online courses, is accused of giving wrong data about its sales by giving information of false famous teachers and unreasonably high revenue in 2019 and 2020. The company to compare is Chegg. But both companies have abnormal data and

the same trend during 2019 to 2020, and this may because COVID-19 brings more users, which leads to the huge change of this industry. Both of the models are useless due to the new global trend and maybe they are out of date nowadays.

Table 8 the company of Gaotu&Chegg

	2019	2020	2019	2020
•Days Sales in Receivables Index (DSRI)	0	0	0.7075	0.7143
•Gross Margin Index (GMI)	0.8582	0.992	0.968	1.1387
•Asset Quality Index (AQI)	0.3446	-0.6163	1.4737	1.0488
•Sales Growth Index (SGI)	3.3689	1.3218	1.2798	1.568
•Depreciation Index (DEPI)	1.5277	1.7328	1.984	0.7756
•SG&A Expense Index (SAI)	1.3402	1.646	0.6837	0.3244
•Leverage Index (LVGI)	0.5325	0.8357	0.3325	0.5529
•Total Accruals to Total Assets (TATA)	-0.0695	0.426	0.1735	0.2085
MScore	-0.0536	0.0761	-1.1275	-0.9312
	2019	2020	2019	2020
•Change in non-cash net operating assets	-1.5547	0.437	0.0473	2.4946
•Change in receivables	0	0	-0.0016	0.0009
•Change in inventory	0.0261	0.0116	0	0
•Percentage soft assets	0.852	0.9541	0.4289	0.6811
•Change in cash sales	4.323	2.3689	0.2953	0.5809
•Change in return on assets	0.0087	-0.1971	0.3297	0.4284
•Debt or equity issuance	1	1	1	1
Predict value	-1.5547	0.437	0.0473	2.4946
Prob	0	0	-0.0016	0.0009
FScore	0.9532	4.729	0.5267	5.6703

Both companies show the abnormal high level of sales, which contributes to the abnormal results of MScore and FScore. The SGI in MScore of Gaotu for 2019 and 2020 is 3.37 and 1.32, while that of Chegg is 1.30 and 1.57 and the GMI is also high of both companies. Though both companies show that there's a rapid growth of the company, the sales of Gaotu still seems unreasonable. The trend of FScore is the same, and the change in cash sales is extremely abnormal. The two counterfeiting companies are Longtop Financial Technologies and China-biotics respectively, and the two normal company are Alibaba and Jd.com respectively, all of which belong to the technology industry [10].

4.5 Longtop Financial Technologies

Longtop Financial Technologies (LFP) was listed on the New York Stock Exchange in 2007. In May 2011, it was suspended on suspicion of financial fraud and announced its delisting in August of the same year. Therefore, the researcher has not found the financial statements of 2010-2011, so the researcher can only analyse the company according to the financial statements of 2007-2008, 2008-2009 and 2009-2010. From the results of MScore, if it is greater than - 2.2, it indicates that it is suspected of fraud, then the company only crossed this warning line in 2007-2008; From the results of FScore, the data in the three years are slightly more than 1, indicating that the company has normal risk. The MScore value and FScore value of Longtop Financial Technologies are abnormal: the first is the DSIR value from 2007 to 2008. The reason for the abnormal value is that the sales value of the company in 2007 was only 7645, which is seriously smaller than 65916 in 2008, 106296 in 2009 and 169057 in 2010; The small sales value in 2007 also influence other indicators related to sales calculation, such as SGI, SAI and ch_ cs. The abnormality of DSIR, SGI and SAI indicators directly led to the company's MScore in 2007-2008 being much higher than - 2.2, indicating that it is suspected of serious financial fraud. But the abnormality of ch_cs index did not lead to the abnormality of FScore value in 2007-2008, which indicates that FScore is likely not applicable to this type of enterprise because it cannot predict the counterfeiting problem of the enterprise. For LFP financial fraud motivation, I think there are the following two points. First, the company entered the New York Stock Exchange in 2007, in order to better finance and better attract investors, LFP chose to whitewash its

financial data; Second, the company is a Chinese enterprise listed in the United States and is not familiar with the differences between Chinese and American accounting standards. It can also be seen from its financial statements that it does not explain the differences between Chinese and American accounting standards in its financial annual report, which is also one of the reasons why it is questioned for fraud. As for the way of financial fraud of southeast financing, its gross profit margin is much higher than that of other enterprises in the same industry. As the researcher all know, unless the company has very advanced technology or is in a leading and monopoly position in the industry, the gross profit margin of the company can only be maintained at the industry average level. If the reasons for the high gross profit margin are insufficient, there will be great suspicion of financial fraud.

Table 9 Longtop Financial Technologies&China-biotics&Alibaba&Jd.com

	LFP			China-biotics			Alibaba			JD		
	07-08	08-09	09-10	09-10	10-11	11-12	18-19	19-20	20-21	18-19	19-20	20-21
DSRI	2.7420	0.4530	0.6170	0.3880	0.3220	0.3070	0.1508	0.1178	0.1187	0.0246	0.0265	0.0253
GMI	0.8080	0.3790	0.4130	0.4670	0.5270	1.1870	0.3679	0.3300	0.2951	0.1161	0.1115	0.1059
AQI	-1.0540	-0.0880	-0.3420	-0.9110	0.0010	0.2460	0.5197	0.4086	0.2894	0.1791	-0.1515	0.1291
SGI	8.6050	1.6130	1.5900	1.5010	1.3370	0.5410	1.4869	1.3030	1.4461	1.1957	1.2942	1.3655
DEPI	0.2730	0.2140	0.2060	0.0350	0.0300	0.0180	0.4190	0.4718	0.4838	0.1390	0.1029	0.0918
SAI	3.8740	0.3110	0.3290	0.3400	0.3370	0.0520	0.4029	0.3117	0.3911	0.1619	0.1685	0.1782
LVGI	0.2990	0.1700	0.3430	0.6350	0.1770	0.2290	0.4170	0.3742	0.4461	0.7332	0.8071	0.5947
TATA	0.0130	0.0170	0.0070	0.0080	0.0190	0.0210	0.0054	0.0040	0.0026	0.0028	0.0025	0.0024
MScore	4.6872	-2.8248	-2.8865	-3.4903	-3.0960	-3.3324	-3.1030	-3.3330	-3.3137	-3.8555	-3.9328	-3.6939

4.6 China-biotics

China-biotics was listed on the Nasdaq stock market in 2008. In June 2011, due to the "serious problems" raised by the audit institution, it was unable to submit the 2010-2011 financial statements in time and announced the suspension of trading. Subsequently, the researcher found the financial statements of the company for 2009-2010, 2010-2011 and 2011-2012. However, since the financial statements of some years were not submitted in time, the researcher did not rule out the possibility of issuing them after modification after delisting. According to the results of MScore, the data of the company for three years are about - 3.3, which does not exceed the threshold of - 2.2; From the data of FScore, the company's results are slightly higher than 1, indicating that the company has normal risk.

Table 10 the change of Longtop Financial Technologies&China-biotics&Alibaba&Jd.com

	LFP			China-biotics			Alibaba			JD		
	07-08	08-09	09-10	09-10	10-11	11-12	18-19	19-20	20-21	18-19	19-20	20-21
rsst_acc	0.5323	0.0778	0.2203	0.0341	0.2200	0.3235	0.1934	0.0594	0.0694	-0.0135	0.0606	-0.0393
ch_rec	0.0090	0.0282	0.0756	0.0372	0.0220	0.0291	0.0088	0.0056	0.0094	-0.0222	0.0097	0.0073
ch_inv	0.0014	0.0119	0.0030	0.0030	0.0029	0.0007	0.0043	0.0050	0.0097	0.0566	0.0233	0.0406
soft_assets	0.2148	0.2521	0.4090	0.1222	0.1452	0.4467	0.6861	0.6063	0.5628	0.6164	0.5333	0.4965
ch_cs	8.7090	0.5227	0.3649	0.4037	0.3855	-0.5012	0.4966	0.3131	0.4358	0.2240	0.2768	0.3669
ch_roa	0.0089	0.1277	-0.0176	-0.1962	0.0685	-0.1458	0.0124	0.0290	-0.0303	0.1193	0.0885	-0.1483
issue	1	1	1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
predictive value	-4.5131	-6.2480	-5.6078	-6.2460	-6.3419	-5.6001	-5.2530	-5.5707	-5.5576	-5.7161	-5.7439	-5.6449
FScore	1.0887	1.0626	1.0702	1.0626	1.0616	1.0703	1.0753	1.0707	1.0709	1.0688	1.0684	1.0697

Alibaba was listed on the New York Stock Exchange in 2014, and its listing has been standardized. As a comparison company, the researcher selected three financial annual reports issued by the company since 2018 and analysed its MScore and FScore. From the results of MScore, Alibaba's data is more stable, basically maintained at about - 3.3; From the results of FScore, the data of the company also fluctuated very little at 1.07, indicating that the company also has normal risk.

Jd.com was also listed on the Nasdaq Stock Exchange in 2014 and is also one of the Chinese concept stocks in the technology industry. In July 2015, Jd.com was selected into the Nasdaq 100 index and the Nasdaq 100 average weighted index. We also collected the financial statements of the company for the three fiscal years from 2018 to 2021 and analyzed the data of MScore and FScore. JD's analysis results are highly similar to Alibaba's analysis results. MScore is in a healthy state, which indicates that the company's financial fraud is less likely; FScore is slightly higher than 1, and the data for three years are about 1.07, which indicates that the company has normal risk.

To sum up, using MScore to analyses the three Chinese concept stocks in technology industryy, only Longtop Financial Technologies can show the suspicion of fraud, and the data of the other two companies are normal; For FScore, the data of the three companies are slightly greater than 1, indicating that this model is not suitable for Chinese technology enterprises listed in the United States [2].

5. T-Test

Analysis and judgement of the usefulness of MScore and FScore Models above are based on using the threshold value and the comparison between the fraud company and non-fraud company in each group. In this part, the researcher will use T-Test to figure out whether these two models can really tell some differences from fraud companies to non-fraud companies. We conducted 4 T-Tests in total, which can be categorized as two for MScore Model and two for FScore Model. All of the four T-Test have the same null hypothesis, which is μ-$\mu 0=0$ while the two T-Tests under each model have different orientations.

Considering that the sample data from the data analysis part may not be sufficient to support our T-Test, the supplement statistic of iQIYI, Terena and Fushicopperweld which are shown below.

Table 11 Extra date for T-Test

	iQIYI			Netflix		
	2019	2020	2021	2019	2020	2021
MScore	-2.2208	-3.6640	-2.8448	-2.3012	-2.0782	-1.4953
FScore	-	0.9955	1.6324	-	1.2195	1.6174
	Tarena			China Distance Education Holdings		
	2018	2019	2020	2018	2019	2020
MScore	-3.5607	-3.8312	-	-1.5824	-3.0257	-2.5329
FScore	0.7308	1.0679	-	-	0.2930	0.3186

One of it is the Unequal Variance T-Test, which focuses on the difference between two independent random samples. Define these two random samples as A and B respectively. Then A will be those scores for the year in which fraud occurred and B will be the scores for each of its comparison company's scores in the same year. Considering that each group of comparison companies is in the same industry, then this T-Test can show that whether M or F Model can show the difference between fraud companies and non-fraud companies which are in the same industry. If the null hypothesis is not rejected, then it means that, although someone compares a fraud company's score with another non-fraud company's in the same industry, there won't be significant differences between their scores, which proves that the used model in this comparison is not effective in identifying the risk of fraud from a same industry.

The other one is the Paired T-Test, also named as Correlated T-Test. This test contains two dependent samples C and D. Based on our calculation, C is score in year t, which is the year when fraud occurred. While the situation of D is a little bit more complicated due to the lack of statistic, which means, the researcher need to choose a suitable D in each Paired T-Test the researcher made. For example, if this group of statistic have more scores in year t-1 than in year t+1, then the researcher will choose scores of year t-1 as our D. Considering that this T-Test is based on two dependent samples of a same entity, if the null hypothesis is not rejected, the researcher can draw a conclusion that the used model can't tell the

different possibility of fraud along a company's life.

Here below are the results of our T-Test calculation.

Table 12 T-Test Results

T-Test Results		
	M-Score	F-Score
Unequal Variance	-1.1497	-0.1261
Paired (Correlated)	-0.5143	-1.2305

For the Unequal Variance T-Test, the result of degree of freedom of both models are a non-integer with 4.7832 and 2.8684 respectively, which means the relative T-Test is an approximate T-Test with an approximate degree of freedom of 5 and 3 respectively. With $-t_{\alpha/2}$ is -2.571 and -4.303 respectively, the t of MScore and FScore Model are both larger than each. Therefore, the null hypothesis is not rejected, which indicates that both Model are not that useful in identifying the risk of fraud of companies from a same industry.

For the Paired T-Test, MScore Model and FScore Model's T-Test results equal to -0.5143 and -1.2305 respectively. If the inspection level is chosen as 0.05, the $-t_{\alpha/2}$ will be -2.571 and -2.776 respectively, which are individually smaller than its comparable t. Therefore, the null hypothesis is not rejected, showing that either of them is effective in predicting the possibility of fraud along a company's life.

All in all, no matter from industry aspect or time aspect, both MScore and FScore Model's performances on predicting financial fraud is not that well.

6. Analyzation

We analyzed 7 fraud companies and 8 normal companies. Among the 7 fraud companies, 5 had abnormal MScore, 4 had abnormal FScore, and among 8 normal companies, 4 had abnormal MScore and 5 had abnormal FScore. Gathering all the analysis above, it would be found that MScore Model and FScore Model are both not that effective in predicting the possibility of fraud among Chinese Concept Stock Enterprises. This conclusion is consistent with the result of T-Test. The details are shown in the table below.

Table 13 The result of 7 fraud companies

	Company Names	MScore	FScore
Education industry	TAL	abnormal	abnormal
	Gaotu	abnormal	abnormal
	Chegg	abnormal	abnormal
	EDU	abnormal	abnormal
Wastewater Treatment industry	DGW	abnormal	abnormal
	AWW	normal	abnormal
Technology industry	LFP	abnormal	abnormal
	China-biotics	normal	abnormal
	SDTH	abnormal	normal
	BABA	normal	abnormal
	3M	abnormal	normal
	JD	normal	abnormal
FMCG industry	LK	abnormal	normal
	SBUX	abnormal	normal
	TACO	normal	normal

Table 14 MScore& FScore

MScore		FScore	
applicable	inapplicable	applicable	inapplicable
LFP SDTH LK	Gaotu TAL China-biotics DGW	DGW	TAL Gaotu DGW LK LFP China-biotics

According to the table, the researcher can see that neither MScore nor FScore are suitable for the education industry because whether in fraud companies or normal companies, both their MScore and FScore are abnormal; FScore is not suitable for wastewater treatment industry, but MScore effectively predicts financial fraud; both MScore and FScore look weak for technology industry; in FMCG industry, MScore can identify the fraud partly, but FScore is still useless.

There are several reasons for this phenomenon: the first one is that due to the differences in Chinese and American accounting standards, the financial statements of Chinese enterprises are not completely disclosed in accordance with the American accounting standards; the second point, the enterprise is headquartered in China, which causes the enterprise to operate according to the Chinese rules and regulations, and the operation mode, profit mode, tax mode and other modes, which directly leads to the financial indicators of these enterprises are not applicable to the two models.

7. Conclusions

Preventing the fraud is always a significative and meaningful topic to research. Thus, the researcher think and summarize some possible methods to prevent financial fraud, which are shown below.

1.Improve the relevant supervision system

In recent years, more and more Chinese companies are trying to be listed on the US because its simpler and more realizable listing conditions. The regional distant and the insufficiently strict punishment system of China gives a chance to those malicious companies. Therefore, the researcher should promulgate stricter regulatory requirements and standards to those Chinese conceptual stock.

2.Strengthen the cooperation between governments

Due to the protection of country's confidential statistics, there still be a obstruct interposed between China and the US. But it is undeniable that the researcher could continue to work to remove barriers to an appropriate level.

3.Enhance the quality of external audit

External audit is undoubtedly a well important tool to investigate the quality of a company's financial statements. The external auditors should on one hand improve their professional skills so that they could perceive and recognize more frauds, on the other hand they should strengthen their belief and maintain their work ethic.

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