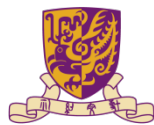


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Benford's Law and Financial Statement Management in the Chinese Stock Market

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1. Introduction

In Chinese stock market, the data manipulation, misestimations, mistakes, or biases happen in financial statements disclosure. This paper is aimed to detect Chinese stock market financial statement degree of errors using Benford's Law according to Amiram (2015). The Financial Statement Divergence Score (FSD Score) based on the mean absolute deviation statistic as used to the distribution of the leading digits of the data in annual financial statements of Chinese stock market in 2000 to 2016. Comparing FSD Score with the theoretical expected distribution defined by Benford's Law, we can draw the overall conclusion that financial statements in Chinese stock market has conformity with Benford's Law.

2. Sample Selection, variable measurement, and descriptive statistics

2.1 Sample Selection and Variable Measurement

The paper selects data from CSMAR Chinese Listed Firms Research Series database. From 2000/01/01 to 2016/12/31, the paper gets data from Financial Statements (balance sheet, income statement, and statement of cash flows-direct method), Financial Indices, Dividend Distribution, and CSRC's Enforcement Actions databases, with CSRC Industry classification 2001 edition company codes, which divides listed companies into Industry A-M. Variables with missing values are deleted. In addition, use *winsor* function in STATA to delete outliers, keeping data in 1% to 99% level. The paper removes firms with negative total assets. The paper uses FSD Score based on the MAD statistics to test conformity of the large samples' empirical distribution of annual financial statements to Benford's distribution. Moreover, the FSD Scores based on the KS Statistics are used to test individual firm-years, which require critical values to access conformity. According to Amiram (2015), "for the distribution that generally follows Benford's Law to diverge from the law, certain types of errors have to be introduced to the data in a way that makes the distribution of base 10 log less smooth or less symmetric."

2.2 Descriptive Statistics

Table1 Panel A provides descriptive statistics for the firms from 2000-2016. The FSD Score mean is 0.0018421 with a standard deviation of 1.083. Panel B presents Spearman correlations above the diagonal and Pearson correlations below the diagonal. Panel C groups

firm-years by the number of line items available to calculate the FSD Score and examines the average FSD Score for firm-years in the top and bottom 1% of line items available, as well as the average FSD Score for firm-years by terciles. It cannot show the monotonical increasing or decreasing tendency. Panel D groups firm-years by total assets, indicating that the FSD Score is decreasing with firm size (AT) generally.

3.Establishing Conformity

3.1 Aggregate and firm-year conformity to Benford's Law

Table2 investigates how the aggregate empirical distribution of numbers reported in financial statements confirms to Benford's Law. The FSD Score is calculated by measuring the frequencies of the first digits from all firm-years in the sample. In the aggregate, the FSD Score is 0.0018421, which is below 0.006. According to Nigrini, M. (2012), 0.006 is the benchmark to consider whether the very large samples close to conformity to the law. Panel B and C of Table2 show similar results when examining aggregate financial results by industry based on the CSRC industry classification and by fiscal year. This table supports the conjecture that China stock market distribution of leading digit conforms to Benford's Law.

Table3 examines individual firm-year conformity to Benford's Law. The FSD Score is based on the KS statistics is used because it enables us to assess whether the financial statements for a given firm-year adhere to the law. Panel A shows that 18,735 firms, or 92.27% confirms to the law. Figure3 shows examples of empirical distributions for 2014 Zhangzidao (002069), 2012 Wanfushengke (300268), and 2010 Lvdadi (002200). The leading digits distributions of these three do not confirm to Benford's distribution, which overall divergence from Benford's distribution. As a consequence, the financial fraud can be detected by leading digits distributions graphs. The Panel B shows 97.46%, 85.76%, and 96.65% of firm-year balance sheets, income statements, and cash flow statements conform. Panel C sorts firms by CSRC industry and shows a minimum conformity of 90.88% for all firms in a given industry and a maximum conformity of 96.84%. Panel D sorts firms by fiscal years from 2001 to 2016 and shows all years between 89% to 100% conformity. In conclusion, Table 3 supports that a majority of firm-year empirical distributions confirm to Benford's Law.

3.2Conformity to Benford's Law: financial statement partitions and firm characteristics

Table4 Panel A individually measures the aggregate FSD Score for the balance sheet, income statement, and statements of cash flows for all firm-year in sample. The paper finds that on average the aggregate FSD Score for the income statement diverges the most from the Benford's Law, which indicates that the income statement contains more errors as compared to the balance sheet and statement of cash flows.

Table4 Panel B categorizes line items based on where they fall in the appropriate subsections of the financial statements. The data shows that, on average, liability and equity accounts contain a relatively higher level of errors than assets accounts. Moreover, income accounts, on average, have higher FSD Scores than the expense accounts, indicating that income accounts contain a relatively higher level of errors.

Table5 segments firm-years into terciles based on FSD Score, calculates the means of various firm characteristics based on this segmentation, and reports the significance level of the difference between terciles 1 and 3. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. The paper finds that firms with higher FSD Scores tend to be smaller and growing.

3.3 The relation between Benford's Law and existing measures of reporting quality

To demonstrate the types of firm behavior associated with the FSD Score, the paper examines the relation between the FSD Score and proxies for accruals-based earnings management in Table6. Panel A presents univariate analysis by dividing firm-years into terciles based on the FSD Score and calculating the means of these proxies for each tercile. The paper finds that firms with higher FSD Score tend to have less working capital accruals. Panel B presents multivariate analysis on the relation between the FSD Score and proxies for accrual-based earnings management.

3.4 Accounting and Auditing Enforcement Releases

Table 10 provides evidence that whether the FSD Score predicts material misstatements. If the China Auditing Team does indeed detect all firms that make material misstatements, then the coefficient is positive. However, column (1) of Table10 indicates that the coefficient on the contemporaneous FSD Score is negative. According to Amirman (2015), AAER firms ran out of room to manipulate, their FSD Score decrease. Column (2) illustrates that FSD Scores from one year before the misstatements period negatively predict the material

statements. On the other hand, column (3) demonstrates that FSD Score from two years before the misstatements period positively predict the material statements. According to Amirman (2015), “contingent on having the ability to manipulate, the FSD scores of AAER firms should be positively associated with material statements.” Hence, CSRC’s ability to detect financial statements fraud should make effort to improve. These data reveal that listing firms can evade detection of financial statements errors until they run out of manipulation room. But these firms still can be detected by divergence distributions of leading digits from Benford’s Law.

4. Summary and Conclusion

The FSD Score, based on the divergence from Benford’s Law, which states that the first digits of number from one to nine appear with decreasing frequency. This measures has advantages for measuring accounting quality, such as not requiring time-series, cross sectional, or forward-looking information.

The paper finds over 90% of Chinese listing firms confirm to Benford’s Law in all industries and years. In aggregate level, the financial statement numbers from balance sheet, income statement, and statement of cash flows confirm to the law as well. The income statement has the biggest deviation from Benford’s Law. On average, liability and equity accounts contain a relatively higher level of errors than assets accounts. Income accounts, on average, have higher FSD Scores than the expense accounts. When it comes to firm characteristic, the paper finds that firms that diverge from Benford’s Law tend to be smaller and growing. The measurement from Modified Jones Model have a negative relationship with FSD Score. Additionally, the FSD Score for the firms with material misstatements as defined by CSRC AAERs is high two years before the misstatement period.

5. Appendix

Table1: Descriptive Statistics

Variable	N	Mean	Std Dev	Q1	Median	Q3
FSD_Score	20305	0.0018421	0.0020114	0.0009398	0.0018421	0.0021796
JONES_RESID	576	0.0491194	1.082985	-0.078911	-0.007976	0.0721371
LOSS	20305	0	0	0	0	0
CH_CS	61618	14.1178	2770.406	-0.844704	-0.059064	0.3185875
CH_ROA	27259	-0.010963	7.786867	-0.02686	-0.00175	0.0178422
SOFT_ASSETS	20305	0.7756327	4.314085	0.3665386	0.5450555	0.7367852
ISSUE	20305	0.1664615	0.3725035	0	0	0
SALES_GROWTH	30202	5.853191	779.849	-0.034133	0.1169979	0.3008107
DIV	20305	0.9576951	0.2012887	1	1	1
AGE	11982	4.947171	4.099277	2	4	8
MKT_VAL	33012	13.80799	14.04697	5.88	9.86	16.57
MTB	33005	0.0003145	0.057135	3.32E-09	8.63E-08	2.03E-08
RET_VOL	32676	0.1445297	0.1414475	0.0923238	0.121833	0.1652656
PE	25248	70.24917	2743.449	8.272497	19.3307	45.80646
AT	33611	3.53E+10	5.27E+10	1.04E+09	2.19E+09	5.22E+09

Panel B: Correlation Matrix

	JONES_RESID	LOSS	PE	AT	MKT_VAL	RET_VOL	MTB
FSD_Score	-0.00278	0	0	0	0	-0.00011	-0.037
JONES_RESID	-	0	-0.0011	0	0	-0.487	0.3876
LOSS	-	-	-	-	-	-	-
PE	-3.478	0	-	0	0	287.6093	-36.3282
AT	-5.39E+09	0	5376289	-	1.24583	3.25E+08	2.30E+10
MKT_VAL	5.38E+09	0	-4527221	0.27183	-	1.24E+10	-6.30E+10
RET_VOL	-0.0385	0	0	0	0	-	-0.06243
MTB	0.6598	0	0.0065	-0.00124	0	-0.6734	-

		Average number of lines items	Number of firm-year	Average digit distributions									FSD_Score
				1	2	3	4	5	6	7	8	9	
Panel C:FSD_Score by number of financial statement line items													
Top 1% of line items		121	176	0.3087	0.1743	0.1252	0.0936	0.0816	0.0637	0.0524	0.0543	0.0429	0.0288
top tercile		234	6453	0.2873	0.1726	0.1255	0.0987	0.0803	0.0615	0.0518	0.0596	0.0482	0.0297
middle tercile		354	5362	0.2876	0.1773	0.1257	0.0932	0.0831	0.0683	0.0529	0.0527	0.0484	0.0305
bottom tercile		165	8632	0.3028	0.1752	0.1264	0.0917	0.085	0.0602	0.0583	0.0518	0.0436	0.0309
bottom 1% of firms		293	189	0.3062	0.1762	0.1238	0.0928	0.0873	0.0629	0.0511	0.0587	0.0485	0.0264
overall		189	17683	0.2771	0.1627	0.1258	0.0976	0.0826	0.0616	0.0599	0.0541	0.0448	0.0387
		Average Assets	Number of firm-year	Average digit distributions									FSD_Score
				1	2	3	4	5	6	7	8	9	
Panel D:FSD_Score by firm assets													
Top 1% of line items		362000	176	0.03098	0.1782	0.1209	0.1037	0.0873	0.0662	0.0519	0.0599	0.0428	0.0294
top tercile		28170	6352	0.02792	0.1795	0.1283	0.0963	0.0792	0.0683	0.0523	0.0601	0.0441	0.0334
middle tercile		4735	6352	0.03188	0.1763	0.1834	0.0973	0.0863	0.0793	0.0592	0.0524	0.0483	0.0286
bottom tercile		736	4627	0.02393	0.1776	0.1396	0.1047	0.0736	0.0621	0.0538	0.0585	0.0491	0.0309
bottom 1% of firms		47	187	0.03029	0.1733	0.1265	0.0938	0.0892	0.0614	0.0595	0.0543	0.0498	0.0395
overall		10263	17862	0.03216	0.1748	0.1284	0.1077	0.0716	0.0702	0.0592	0.0518	0.0452	0.0299

Table2: Aggregate Conformity to Benford's Law

Number of firm-years		Aggregate FSD_Score	
Panel A:FSD_Score for all firm-year's financial statement numbers			
20305		0.0018421	
Industry	Number of firm-years	Aggregate FSD_Score	
Panel B:FSD_Score for all financial statement numbers, by industry			
A	303	0.003911	
B	609	0.0014144	
C	10308	0.0005795	
D	867	0.0023639	
E	544	0.0015585	
F	707	0.0010151	
G	2984	0.0022381	
H	1305	0.0007307	
J	1187	0.0010065	
K	1037	0.0025717	
L	296	0.0030837	
M	158	0.0044043	
Panel C:FSD_Score for all financial statement numbers, by years			
Fiscal year	Number of firm-year	Aggregate FSD_Score	
2000	2	0.0019532	
2001	3	0.0016527	
2002	1	0.0017662	
2003	1	0.002622	
2004	1	0.0018437	
2005	-	-	
2006	2	0.0013834	
2007	1503	0.002096	
2008	1547	0.0020219	
2009	1711	0.0019453	
2010	2078	0.0018784	
2011	2275	0.0018023	
2012	2504	0.0018057	
2013	2545	0.0017872	
2014	2662	0.0017593	
2015	2846	0.0017335	
2016	624	0.0017449	

Table3: Firm-year conformity to Benford's Law			
Panel A: Number of firm-years conforming to Benford's Law			
Firm-years confirming		Percent confirming	
18,735		92.27	
Panel B: Number of firm-years confirming to Benford's Law by financial statement			
Financial Statement	Firm-years confirming	Percent Confirming	
Balance Sheet	19,799	97.46	
Income Statement	19,381	85.76	
Cash Flow Statement	24,327	96.65	
Panel C: Number of firm-years confirming to Benford's Law by industry			
Industry	Firm-years confirming	Percent confirming	
A	282	93.07	
B	572	93.92	
C	9,421	91.4	
D	793	91.46	
E	513	94.3	
F	665	94.06	
G	2,742	91.89	
H	1,218	93.33	
J	1126	94.86	
K	981	96.4	
L	269	90.88	
M	153	96.84	
Panel D: Number of firm-years confirming to Benford's Law by fiscal year			
2000	2	100	
2001	3	100	
2002	1	100	
2003	1	100	
2004	1	100	
2005	-	-	
2006	2	100	
2007	1503	94.14504	
2008	1547	94.31157	
2009	1711	91.8761	
2010	2078	89.07603	
2011	2275	90.72527	
2012	2504	91.29393	
2013	2545	93.24165	
2014	2662	93.01277	
2015	2846	92.93746	
2016	624	93.58974	

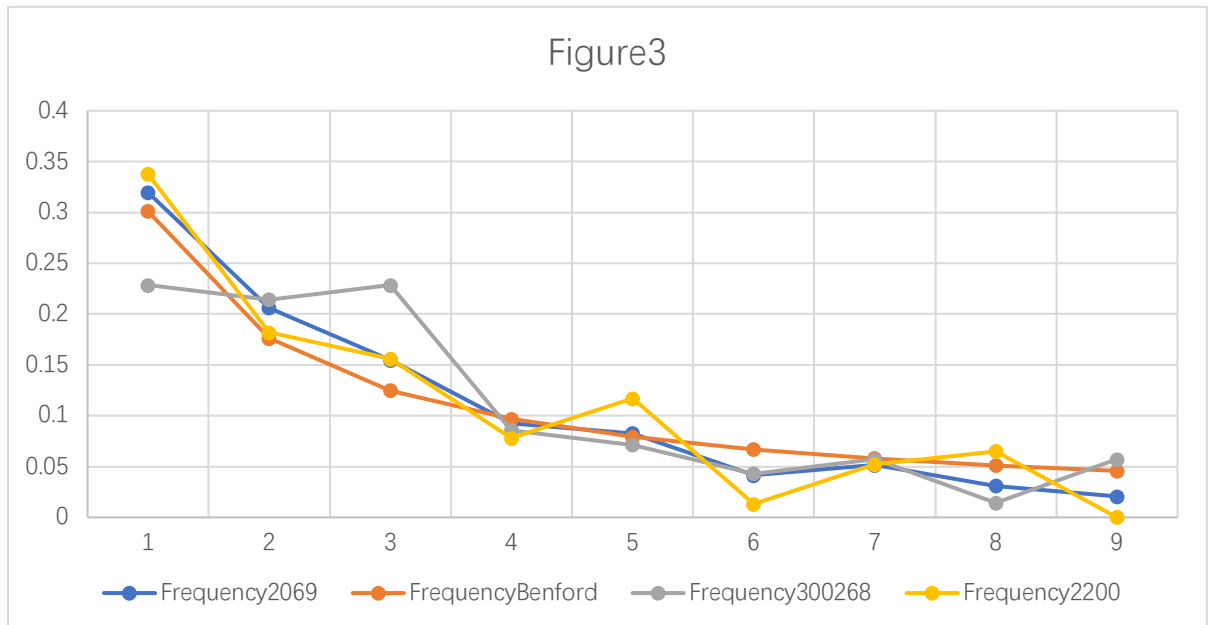


Table 4:Aggregate FSD_Score by financial statement characteristics and line items

Financial Statement	Number of accounts	Aggregate FSD_Score
Panel A:Aggregate FSD_Score by financial statements		
Balance Sheet	126	0.0005075
Income Statement	60	0.0021024
Cash Flow Statement	50	0.0013568
Panel B:Aggregate FSD_Score by financial statement subcategory		
<i>Balance Sheet</i>		
Asset	59	0.00068
Liabilities	48	0.0016018
Equity	18	0.0015441
<i>Income Statement</i>		
Expense	26	0.0006768
Income	19	0.0017018

Table 5:Firm Charateristics based on FSD_Score

Variables	Top tercile	Middle tercile	Bottom tercile	Notes
AGE	3.2424242	3.3484848	2.8484848	***
CH_CS	0.5026532	0.1325571	0.27239408	***
CH_ROA	0.0178746	0.0079847	0.01972367	
DIV	1	1	1	***
ISSUE	0.1969697	0.18181818	0.10606061	***
MKT_VAL	6.801E+09	9.789E+09	10640000000	***
MTB	3.64E-08	3.56E-08	6.21E-08	***
PE	31.821631	33.80617	25.924378	
RET_VOL	0.1784247	0.1866788	0.19404243	***
SALES_GROWTH	0.3706057	0.3919068	0.26801616	***

Table6: FSD_Score and reporting quality			
Variable	Tercile by FSD_Score		
	Top tercile	Middle tercile	Bottom tercile
Panel A:Univariate evidence			
Accrual Quality			
ABS JONES_RESID	0.0038996	0.17611841	0.07697
Earnings Quality			
LOSS	0	0	0
Panel B:Multivariate evidence			
Variable	FSD_Score		
ABS_JONES-RESID	0.0854637		
	-0.00031		
Loss	0		
	-		
Constant	1.997021		
	2.029461		
Observations	565		
R-squared	0.0005		

Table10: FSD_Score and material misstatements			
Variables	AAER		
	(1)	(2)	(3)
FSD_Score	-5.762		
	-3.58		
FSD_Score(t-1)		-5.345	
		-3.43	
FSD_Score(t-2)			1.234
			-4.54
ABS_JONES_RESID	-0.349	-0.376	-0.323
	-0.33	-0.33	-0.33
CH_CS	-0.128	-0.134	-0.132
	-0.004	-0.004	-0.004
CH_ROA	0.487	0.473	0.428
	-0.39	-0.38	-0.37
SOFT_ASSETS	0.007	0.007	0.007
	-0.05	-0.05	-0.05
ISSUE	-0.001	-0.003	-0.001
	-0.17	-0.17	-0.17
MTB	0.349	0.321	0.336
	-0.27	-0.27	-0.27
AT	0	0	0
	0	0	0
Constant	-4.674	-5.974	-4.539
	-0.33	-0.33	-0.33

6.References

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