Financial data Conformance to Benford's Law and its impact on Audit Fees

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Keywords: Benford's law; Audit fees; Accounting fraud

Abstract. By Adopting the newest concept of FSD score sourcing from the usage of Benford's law, we include it as one of the decisive variables in the audit fees model designed in the 1980s. We want it to represent the probability of the occurrence of accounting fraud for the listed Chinese companies in A share market and then verify its relationship with audit fees. Our result shows good compliance with financial data to Benford's law and there is no evidence indicating the association between audit fees and FSD scores.

1. Introduction

Auditors ensure the fairness of the accounts for the shareholders of the business. Their job is to reduce the mistakes in annual reports and supervise or review the economic activities in the daily business operation. One of their major responsibilities is to guarantee the authenticity, correctness, compliance, legality and efficiency of the audited entity's financial information. Benford's law, showing that in a pile of data from real life, the probability of the number with 1 as the first digit is about 30% of the total number, which is close to 3 times of the expected value of 1 / 9 from intuition. To generalize, the larger the number is, the lower the probability that the number with its first digit will appear. In this way, we suppose that with the help from Benford's Law, it can help auditors detect data manipulation as well as accounting irregularities. As for our studies, we are going to examine whether the usage of Benford's Law will minimize audit uncertainty and boost audit performance, by establishing an empirical model of Chinese companies from 2007 to 2018. Mainly we want to verify the relationship between the FSD score based on the Kolmogorov-Smirnoff statistic(abbreviate as KS statistic later), the mean absolute deviation(abbreviate as MAD statistic) and the audit fees by assuming that the higher the deviation, the larger amount of fees will be charged by the auditing firms as premium to compensate the potential risk. Evidence from the validation text can tell that generally speaking, Chinese firms in A share market conform to Benford's law. Therefore, other factors that were included in the studies of the relevant field will also be considered when we estimate the firm's size or the location of the listing firm.

2. Literature Review

FSD Score was first introduced by Amiram basing on the theory of Benford's law. For him, he proposed a new indicator for discovering accounting manipulation due to the malfunction of existing models in detecting fraudulent behavior. According to him, the accrual-based techniques are usually less accurate when coming across case with the complicated transaction. Hence, he wanted to reconstruct an alternative indicator to reflect the chance of errors or irregularities in financial statements basing on Benford's law, which does not hinge on the accounting concept but merely examines the frequency of each digit within the numbers [1].

In 1938, Benford verified that for each random number in a large enough sample, the distribution

  DOI: 10.25236/ic3er.2019.059

of the first digit of each number will follow a regular mathematical distribution.[2] Before him, it was said that American scientist Simon Newcomb has already discovered this pattern by observing the first 100-200 page of a book was more easily worn out in the library. Later, Dr. Mark J. Nigrini has been the first one to use this pattern to detect accounting fraud in financial statements in his paper "The Detection of Income Tax Evasion Through an Analysis of Digital Frequencies."[3]. For him he discovered that those authentic-looking but human-created numbers will be very less likely to follow Benford's law distribution and he proposes that this principle can be applied for testing those risky or suspicious accounting data Specifically, the first digit d of a number from the random number set is going to follow:

$$P_{(d_1)} = \log(1 + 1/d_1)$$
$$P(d_2) = \Sigma \log(1 + 1/(d_1 d_2))$$
$$p(d_l d_2) = \log(1 + 1/(d_1 d_2))$$

In the equation, $P(d_1)$ is the frequency of the initial digit and $P(d_2)$ is the second digit, etc. That is to say, if we pluck the real number from a case, the first digit is supposed to follow the theoretical distribution of the following table.

Table 1. Benford's Distribution

Digit	1	2	3	4	5	6	7	8	9
Theoretical distribution	0.3010	0.1761	0.1249	0.0969	0.0792	0.0669	0.0580	0.0512	0.0458

Following Nigrini, Benford's law has been further applied in the empirical investigation of accounting or auditing researches. In the year of 2004, Durtschi also revealed that data from "transaction-level" accounts, like sales or expenses would generally follow the distribution. [4]

As for influential factors of auditing fees, different scholars have raised their own opinions based on the development of modern accounting theories. Simunic was the first one to establish the model for auditing fees—he put clients numbers, complication degree of the business, corporate governance structure as well as earning management, risky level as the most decisive variables in the model[5]. Later more factors have been added into the calculation by various scholars. Houston in 1999, Heninger in 2001, Kinney in 2004 have all extended the audit fees model and in most of the cases, earning management as well as firm size has been the most significant variables in deciding the total auditing fee of a firm.

Chinese Scholar Huangying has been the first one to introduce FSD score into the detection of financial Statement Conformance to Benford's Law and its relationship with Audit Fees, after the concept has been put up by Amiram in 2005. According to her, FSD_MAD and total income generated from foreign subsidiaries are both significant decisive in deciding the auditing fees, while others such as market to book ratio or internal control level is less decisive [6]. Following her, we will also adopt this ideal in designing the model.

3. Sample Selection and Estimation Method

3.1. FSD score

Firstly, we need to calculate FSD_MAD and FSD_KS.

We use the Kolmogorov-Smirnoff (KS) statistic to measure the maximum variance, or cumulative difference from digit 1 to 9 between digit 1 to 9. Absolute Deviation (MAD) can also investigate the conformity of Benford's law to an individual firm-year. These two indicators are utilized to indicate the difference between the sample distribution as well as Benford's distribution.

$$FSD\_KS = \max\left|\sum_{i=1}^{i=K} (AD_i - ED_i)\right| = \max(|AD_1 - ED_1|, |(AD_1 + AD_2) - (ED_1 + ED_2)|, \ldots, (AD_1 + AD_2 + \cdots + AD_9) - (ED_1 + ED_2 + \cdots + ED_9))| \quad (1)$$

$$FSD\_MAD = \left(\sum_{i=1}^{i=K} |AD_i - ED_i|\right)/K \quad (2)$$

AD=the actual distribution of initial digit from a given sample

ED=expected value of the theoretical distribution from Benford's law

3.2. Audit fee model

To verify the relationship between the probability of accounting manipulation and the audit fee, we also include some dominant variables from Simunic [5] and Houston [7] to polish the model. The following regression equation will be applied into our estimation.

$$LN\_AFEE = \alpha + \beta\_1\ FSD\_MAD + \beta\_2\ LN\_ASSET + \beta\_3\ FINCOM + \beta\_4\ ABS\_RESIDUAL + \beta\_5\ INVREC + \beta\_6\ LEVERAGE + \beta\_7\ ROA + \beta\_8\ LOSS + \beta\_9\ BIG\_4 + \beta\_10\ MB + \beta\_11\ Shrz + \beta\_12\ area + \beta\_13\ disclosing + \beta\_14\ insititution + \beta\_15\ audit\_opinion + \beta\_16\ connected + \varepsilon$$

Table 2. Variable Definition

Variable	Definition
LN_AFEE	Nature log of the total cost of audit fees
FSD_MAD	Mean Absolute Deviation between actual distribution and BL
LN_ASSET	Nature log of the total asset
FINCOM	Total revenue sourcing from foreign subsidiaries
ABS_RESIDUAL	Absolute value of the residual from the modified Jones model
INVREC	inventory (INVT) and receivables (RECT) scaled by total asset
LEVERAGE	Total debt scaled by total asset
ROA	Total net income scaled by total asset
LOSS	Dummy variable, if revenue for the current year<0, it equals 1
BIG4	Dummy variable, if audit firm is Big 4 company, it equals 1
MB	Market to Stockholders' Equity (MKVALT/SEQ)
SHRZ	Second to fifth largest shareholder's share divided by first largest shareholder's share
AREA	Location of the firm which divided into Eastern, middle and Western China respectively
DISCLOSING	If a firm discloses the internal control situation in its audit report, it equals 1
INSTITUTION	The proportion of institutional investor in the firm (%)
AUDIT_OPINION	Equal to 1 if auditor issues a standard unqualified opinion of a firm, otherwise it is 0
CONNECTED	The nature log of the connected transaction amount

We use the natural logarithm to smooth the data, and we suppose that the number of subsidiaries or its transaction will complex the audit job [6], which can be an indicator for the complication of an auditor's task. Also, with more inventories in storage and more receivable not yet collected, the auditor is tending to spend more time on it. Thus, as their service remuneration, we guess there is a positive relationship between it and the audit fees. Variables like connected transaction as well as leverage are also representing the complexity of the audit job. At the same time, we also include ROA, the absolute value of the residual from the modified Jones model to represent the earning management level of the firm [8]. We are expecting to have a positive correlation between this factor and the dependent variable. According to Wang jian, Wang wei and Zhu zhaozhen in 2018, earning transparency can also exert different influence on audit fees, accordingly we take disclosing information into consideration [9]. We suppose that a firm with perfect internal control system as well as well-functioned disclosure regulation will have lower litigation risk in the future. Furthermore, audit risk needs to be rewarded. So, if a firm does not receive a standard unqualified opinion in previous year, auditors need risk premium as a compensation for the exposure to possible accounting scandal or litigation risk [10]. Other factors, like Z value, proportion of institutional investor can be explained as the internal corporate governance structure. What's more, we also consider the firm's size according to the research from Simunic [5] and Houston [7]. If there is a large company as the audit object, correspondingly there might be a upward trend for the audit fees. Finally, if a firm hires Big 4, namely, Deloitte Touche Tohmatsu Limited, PricewaterhouseCoopers, Ernst & Young and KPMG as their auditor, it is more likely that they will charge a higher fee due to their good reputation as well as strong competitive position in the industry.

3.3. Sample selection

We will include all listing firms of A share from the year of 2007 to 2018. The reason for excluding the period from 1990-2006 is due to the deficiency and malfunction of accounting regularities in mainland China. Also, during that time, the law changed at a high frequency. Therefore, we select 2007 when the *Corporate Accounting Code* was issued and applied as the starting point of our data collection.

All the data used in the calculation will be collected from CSMAR, we will use STATA for estimation and all non-indicator control variables will be winsorized at the 1% and 99% levels to eliminate the influence of outliers.

4. Descriptive Analysis

First, we look at the trend for audit fee in these years. We can see that from the year 2007 to 2016, the audit fee changes from smoothness to the acuteness and later year 2018 witnessed a slight decline of it.

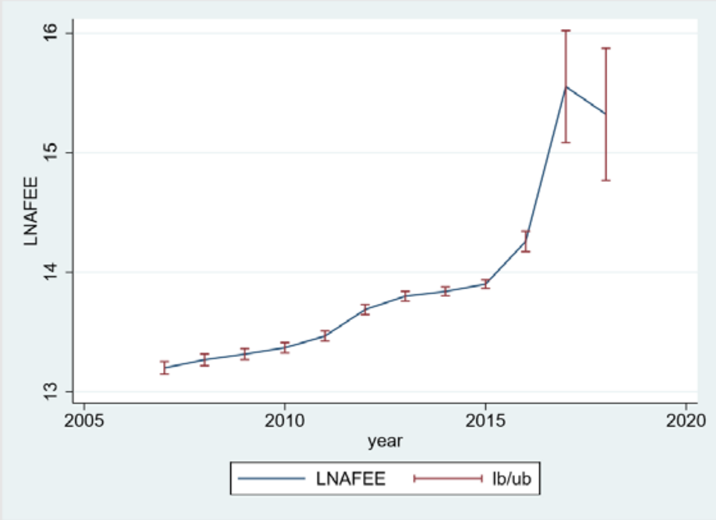

Figure 1. Time Trend for the nature logarithm of audit fees

For the descriptive statistic, the median value of ln_AFEE is 9.21, this is far smaller than the same statistic in Huang ying's study (14.32 with a sample set of 75133 firm-year observations) and the mean value of (14.23 with a sample set of 7661 firm-year observations) reported in the Duellman because their coverage period is previous to us (2000-2014 and 2000-2010 respectively). The LN_ASSET of our study is larger than that in Duellman and Huang (16.16) with a smaller standard deviation (1.417). This may be due to the exchange rate difference between the calculated units or can serve as the evidence of the inclusion of larger firms in our sample. Moreover, the mean value of Loss is 0.1350, indicating that approximately 13.5% firm-year reports negative revenue. The variable Big_4 scores 0.062 and there is only 6.2% of firms will invite big 4 as their auditor. Interestingly, the mean value of variable "audit opinion" scores as high as 0.9685, meaning that nearly there was 97% chance for a listing company to receive a qualified audit opinion.

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
KS_all	11067	.096	.04	.018	.402
MAD_all	11067	.032	.009	.007	.114
LN_ASSETS	11067	22.131	1.417	16.161	30.732
ABS_RSST	11067	1.69e+08	8.36e+09	-4.32e+11	1.73e+11
LEVERAGE	11067	.482	1.195	0	96.959
INVREC	11067	.231	.176	0	.945
MB	11067	.006	.105	0	7.316
ROA	11067	.069	1.142	0	108.366
Connected_~s	11067	15.866	2.805	0	27.646

Big_4	11067	.063	.242	0	1
LNAFEE	11067	13.677	.816	9.21	19.218
institution	11067	6.854	8.045	0	73.84
disclosing	11067	.594	.491	0	1
Shrz	11067	15.4	33.706	1	1080.102
Audit_opin~n	11067	.969	.175	0	1
Loss	11067	.135	.342	0	1
area	11067	2.525	.751	1	3

We also present the Pearson correlations table as follow. For most of the variables, their correlation with the others are pretty small except MAD and KS as well as Big_4 and Ln_afee. From this point of view, we should not both include MAD and KS into the estimation as they are all representative of probability in accounting misconduct. For Big_4 and Ln_afee, we can justify that it is due to the high-quality job of those big-name company are more likely to charge a higher fee, which is also in accordance with our presumption.

Table 4. Matrix of correlations for all variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1 KS_all	1.000																
2 MAD_all	0.673	1.000															
3LN_ASSETS	-0.114	-0.158	1.000														
4ABS_RSST	0.019	0.022	-0.100	1.000													
5LEVERAGE	-0.003	-0.012	0.012	-0.007	1.000												
6 INVREC	-0.043	-0.050	-0.064	0.199	0.037	1.000											
7 MB	0.020	0.023	-0.068	-0.001	0.013	-0.018	1.000										
8ROA	0.040	0.035	-0.065	-0.001	0.239	-0.017	0.020	1.000									
9Connected_trans	-0.004	-0.019	0.218	0.004	0.034	-0.007	-0.008	0.001	1.000								
10 Big_4	-0.040	-0.049	0.443	-0.133	0.017	-0.083	-0.011	-0.004	0.084	1.000							
11 LNAFEE	-0.084	-0.119	0.761	-0.105	0.033	-0.140	-0.018	-0.013	0.168	0.530	1.000						
12 institution	-0.019	-0.040	0.172	0.010	-0.002	0.005	0.004	0.008	0.029	0.065	0.097	1.000					
13 disclosing	-0.008	-0.029	0.202	-0.024	-0.019	-0.116	-0.004	-0.011	0.015	0.110	0.297	-0.006	1.000				
14 Shrz	0.001	0.000	0.087	0.002	0.018	-0.002	-0.011	-0.008	0.000	-0.008	0.018	-0.130	-0.022	1.000			
15 Audit_opinion	-0.034	-0.031	0.125	0.001	-0.134	0.034	-0.065	-0.093	0.004	0.025	0.042	0.067	0.039	0.014	1.000		
16 Loss	0.016	0.022	-0.129	-0.001	0.075	-0.006	0.024	0.039	0.013	-0.045	-0.054	-0.101	-0.031	0.010	-0.205	1.000	
17 area	0.001	0.002	0.029	-0.001	-0.006	0.020	-0.025	0.003	0.006	0.093	0.098	-0.011	0.008	-0.035	0.028	-0.032	1.000

5. Regression Model Results

Firstly, we assume that there is no individual effect and directly applied the simple linear regression model to estimate the result. As we can see, the result is basically the same for both MAD and KS, which are not significant in their model respectively. Also, connected transaction volume, as well as the modified jones model, are not significant. In this model, “Big 4” and “MB” are the most decisive variable in exerting influence on the audit fee. However, if we applied the fixed-effect model in processing data, we will conduct the Wald test simultaneously to verify the null hypotheses about all individual effects equal to zero. The test, as shown in the table, strongly refuse H_0 and therefore FE is significantly better than pool OLS. We can further verify it by applying LSDV method while due to a large number of firms, we will not show the result here in this paper. Then we conduct another comparison between the random effect model (RE) and pool OLS by using the Breusch-pagan test to examine whether or not we should include the time effect into consideration.

Table 5. Descriptive statistics of MAD and KS - by (year)

	KS_all	MAD_all
2007	.095	.032
2008	.097	.032
2009	.092	.031
2010	.099	.033
2011	.098	.033
2012	.098	.033
2013	.097	.032
2014	.094	.032

2015	.095	.031
2016	.089	.03
2017	.077	.027
2018	.07	.027

Table 6. Simple Linear regression result

LNAFEE	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
institution	-0.003	0.001	-4.95	0.000	-0.004	-0.002	***
Connected_trans	0.002	0.002	1.11	0.269	-0.001	0.005	
ROA	0.017	0.004	4.17	0.000	0.009	0.025	***
Shrz	-0.001	0.000	-6.43	0.000	-0.001	-0.001	***
MAD_all	-0.462	0.504	-0.92	0.360	-1.450	0.527	
LN_ASSETS	0.372	0.004	94.94	0.000	0.365	0.380	***
ABS_RSST	0.000	0.000	-0.91	0.363	0.000	0.000	
LEVERAGE	0.008	0.004	1.98	0.048	0.000	0.016	**
MB	0.197	0.044	4.51	0.000	0.112	0.283	***
0b. Big_4	0.000	.	.	.	.	.	
1.Big_4	0.777	0.021	36.55	0.000	0.735	0.818	***
0b. disclosing	0.000	.	.	.	.	.	
1.disclosing	0.237	0.010	24.83	0.000	0.218	0.256	***
0b.Audit_opinion	0.000	.	.	.	.	.	
1.Audit_opinion	-0.166	0.027	-6.10	0.000	-0.219	-0.113	***
0b. Loss	0.000	.	.	.	.	.	
1.Loss	0.076	0.014	5.49	0.000	0.049	0.103	***
Constant	5.408	0.089	60.63	0.000	5.233	5.583	***

Mean dependent var	13.677	SD dependent var	0.816
R-squared	0.652	Number of obs	11067.000
F-test	1594.997	Prob > F	0.000
Akaike crit. (AIC)	15232.772	Bayesian crit. (BIC)	15327.825

**** p<0.01, ** p<0.05, * p<0.1*

Finally, it is the Hausman test, we add the time trend into the FE model while time t is not significant in this case (the P value is 0.56). Then we generate a dummy time variable to form a two-way FE. We chose the year of 2007 as the base and test for the joint significance for the time variable. At this time the null hypothesis that there is no time effect in it has been significantly refused. In this way we are confident enough to include the time effect into consideration. For this time, we can see that, KS score is still not significant at 5% confidence interval, and connected transaction volume, as well as Z score, are also under the same circumstance if two-way fixed-effect model was applied.

What is noticeable is that the time effect has been pretty significant at this time, the coefficient has soared up rapidly since 2012. For all the other control variable, Ln_Assets representing the firm's size effect is equals to 0.229, indicating that for every unit increase in the total asset, there will be a corresponding 0.23% increase in the audit fees. For INVERC representing the proportion of inventory and receivables over the total asset, the coefficient is equals to -0.29, which is totally on contrary to our expectation. According to the result, there is a significant negative correlation between the complexity of the audit job and the fees they charged. The explanation could be the same reason given by Fan and Fu in 2017, that the listed companies in China with higher proportion in inventory and receivables are usually those "traditional firms" that are suffering from capital chain rupture or short of cash. For them, the recruitment of high-quality auditing team will be a huge cost and indeed they do not care about the quality of auditing as well. On the other hand, the high potential litigation risk would also be a hurdle for those big-name international accounting firm to deal with the case, finally, this will be a vicious circle.

For the factor variable, "Big 4" has been the most decisive and significant one followed by the disclosing factor. The result of variables is compatible with the prior study of Huang in 2014, which is also in consistency with our presumption that the audit firm with higher reputation will charge a higher fee on its job. Furthermore, if a firm discloses more information on its auditing report then the audit firm is supposed to spend more effort on its job, resulting in a positive coefficient for the equation. The R-squared of our regression is as high as 0.60, which is a considerable value. And again, Stata systematically ran another F test to verify the time effect on our model, the probability is still equating to zero.

Table 7. Regression results of two-way fixed effect model

LNAFEE	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
KS_all	0.105	0.079	1.33	0.183	-0.049	0.259	
LN_ASSETS	0.229	0.014	16.34	0.000	0.201	0.256	***
ABS_RSST	0.000	0.000	4.42	0.000	0.000	0.000	***
LEVERAGE	0.011	0.002	6.22	0.000	0.007	0.014	***
INVREC	-0.298	0.037	-8.12	0.000	-0.370	-0.226	***
MB	0.043	0.018	2.37	0.018	0.007	0.078	**
ROA	0.002	0.001	1.81	0.071	0.000	0.004	*
Connected_trans	0.001	0.001	0.80	0.426	-0.001	0.003	
Shrz	0.000	0.000	-0.03	0.976	0.000	0.000	
institution	-0.001	0.001	-2.06	0.040	-0.003	0.000	**
2007b.year	0.000	.	.	.	.	.	
2008.year	0.047	0.016	2.94	0.003	0.016	0.079	***
2009.year	0.065	0.016	4.11	0.000	0.034	0.096	***
2010.year	0.100	0.016	6.06	0.000	0.068	0.132	***
2011.year	0.173	0.018	9.50	0.000	0.137	0.209	***
2012.year	0.344	0.019	18.12	0.000	0.307	0.382	***
2013.year	0.419	0.019	22.04	0.000	0.382	0.457	***
2014.year	0.472	0.020	23.32	0.000	0.432	0.511	***
2015.year	0.513	0.021	24.88	0.000	0.472	0.553	***
2016.year	0.547	0.026	21.14	0.000	0.496	0.598	***
2017.year	0.491	0.074	6.60	0.000	0.345	0.636	***
2018.year	0.571	0.092	6.22	0.000	0.391	0.751	***
0b. Big_4	0.000	.	.	.	.	.	
1.Big_4	0.191	0.071	2.71	0.007	0.053	0.329	***
0b. disclosing	0.000	.	.	.	.	.	
1.disclosing	0.088	0.007	13.12	0.000	0.075	0.101	***
0b. Audit opinion	0.000	.	.	.	.	.	
1.Audit_opinion	-0.055	0.023	-2.39	0.017	-0.100	-0.010	**
Constant	8.327	0.296	28.11	0.000	7.746	8.908	***

Mean dependent var	13.677	SD dependent var	0.816
R-squared	0.602	Number of obs	11067.000
F-test	.	Prob > F	.
Akaike crit. (AIC)	-2578.205	Bayesian crit. (BIC)	-2402.724

*** *p*<0.01, ** *p*<0.05, * *p*<0.1

6. Conclusion

The result in my tests reveals that sample data from the financial statement of China listing companies follow Benford's law. More than 92% of firm-year observations confirms the expected distribution, which is much higher than that of American firms in Huang's study (Huang, 2014). Nevertheless, neither FSD_MAD nor FSD_KS is positively associated with the dependent variable audit fees. We adopt the concept of FSD and use this proxy to estimate the probability of accounting errors or earning management. However, in my paper, we failed to find a significant association between FSD as well as audit fees at 1% significance level.

From the regression, we can tell that among all the control variables, the most significant one is INVREC representing both the litigation risk as well as the complexity of the job, followed by the nature log of the total asset to indicate the firm's size, and the " big4", "disclosing" dummy variables. All the time effect except year 2007 is significant in our estimation model. This result is generally conforming to the prior studies and our presumption.

There are also defects in our research. The first one is about endogeneity, which cannot be easily solved by simply expanding the model exoplanetary variables. In our error term ε_t, we include all factors influence that might contribute to our dependent variable except control variable X and the independent variable. However, we did not find adequate instruments that are related as well as exogenous for utilizing an instrumental variable estimation in our model. The second problem is about the limited access to some data. In previous researches conducted by foreign scholars, they usually included some variables such as corporate governance or earning opacity, which is uneasy to collect from Chinese listing firms while they all appeal as significant in their models. Also, the sample size was significantly lost due to the merger of different data set as well as a large number of missing values, which might cause biases in the final result. The last problem is the significance of FSD. We failed to establish the association between it and the audit fees, which might be caused by its autocorrelation with the other variables and dropped systematically by Stata. However, it definitely does not mean that it is not an important measurement for audit quality and an indicator of inefficient audit effort. On the contrary, the results are still meaningful for the regulators in approaching the probability of accounting errors and irregularities in financial data.

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