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Applying Digital Analysis to Investigate the Relationship between Corporate Governance and Earnings Management: An Empirical Analysis of Publicly Listed Companies in Taiwan

Fengyi Lin
National Taipei University of Technology
E-Mail: linfengyi.tw@gmail.com

Sheng-Fu Wu
National Defense University
E-Mail: sheng.fu.wu.tw@gmail.com

ABSTRACT

This study applies Benford's law to examine the earnings of companies publicly listed in Taiwan from 1993 to 2011. The results show that, regardless of whether the company is profitable, the phenomenon of earnings management may be evident. Another interesting finding is that the rounding-of-earnings phenomenon remains popular among Taiwan's publicly listed companies, although the degree of earnings manipulation has declined with the gradual implementation of corporate governance mechanisms. Thus, we recommend that supervisory authorities enhance corporate governance regulations and mechanisms to minimize earnings management.

Keywords: Benford's Law, Earnings Management, Corporate Governance

INTRODUCTION

An earnings management anomaly exists in corporate financial data (Healy and Wahlen, 1999). Healy and Wahlen (1999) believed that managers use subjective judgment in financial reporting or transaction recognition to manipulate financial reports. Excessive earnings management often causes serious corporate fraud. The Subprime Crisis of 2007 pushed the world economy into a crisis, and centuries-old companies, such as Lehman Brothers and Merryl Lynch, either went into bankruptcy proceedings or pursued government ownership, endangering the nation's financial

structure. These cases demonstrate the value of corporate governance. To reduce corporate fraud, numerous countries have enacted laws to strengthen the corporate governance mechanism (the Sarbanes-Oxley Act of 2002 is one vital step toward enhancing the quality of financial statements in the United States). The Taiwanese regulatory authorities have also employed several principles since 2003 to strengthen corporate governance mechanisms.

Various studies have shown that corporate governance and earnings management exhibit reverse relationships (Dechow et al., 1995; Peasnell et al., 2000; Park and Shin, 2004; Jo and Kim, 2007; Marra et al., 2011). Although these relationships have been extensively investigated, few studies have observed the relevant numerical data, instead opting to apply a regression method in the investigations. This study uses Benford's law to examine the relationship between corporate governance and earnings management by observing the real distribution of earnings numbers reported by publicly listed companies in Taiwan.

LITERATURE REVIEW

Benford's Law and Earnings Management

Earnings management refers to the managerial use of procedures or methods to adjust data on financial reports. Earnings management can mislead stakeholders about the firm's corporate performance (Healy and Wahlen, 1999). Numerous studies have shown that managers have an incentive to manipulate earnings to reach specific thresholds (Barth et al., 1999; Skinnner and Sloan, 2001; Matsumoto, 2002). Any earnings management methods applied by managers affect the presentation of financial statements, which are the main resource for outside stakeholders (including investors and creditors) to understand the status of a firm's corporate performance. Hence, data adjustment on financial reports ultimately affects the assessment of a firm by outside stakeholders.

Through an observation of 20 types of data, Benford (1938) demonstrated that the expected distributions of naturally occurring numbers are skewed toward one for the first digits (because zero cannot be a first digit) and zero for the second digit. This distribution of digits has become known as Benford's law, which provides the basis for numerical analysis of a sequence of numbers of a similar nature. A deviation in actual data from these expected frequencies indicates the presence of manipulation (Thomas, 2012). Benford's law has recently become an accepted tool, in both academic literature and practice, for the identification of contrived data (Carslaw,

1988; Thomas, 1989; Herrmann and Thomas, 2005; Lin et al., 2011; Reddy and Sebastin, 2012; Thomas, 2012).

Rodriguez (2004) provided empirical evidence that, in the absence of earnings manipulation, corporate earnings follow Benford's law. Durtschi et al. (2004) further examined the use of Benford's law in the detection of accounting fraud by specifically identifying data sets expected to follow Benford's law and the types of fraud that can be detected.

Thomas (2012) examined the extent to which firms manipulate their financial statement numbers by engaging in earnings management in a post Sarbanes-Oxley Act (SOX) environment. Using 2009 data, Thomas found no evidence of cosmetic earnings management, indicating that the SOX has increased financial statement reliability and reduced earnings manipulation.

The summarized studies have provided clear evidence that Benford's law can be used to analyze earnings manipulation behavior. However, the effects of the development of corporate governance and other changes in the financial reporting environment on earnings management activity have yet to be examined. Therefore, this study investigates the extent of changes on earnings management caused by the development of corporate governance.

HYPOTHESES AND MATHEMATICAL MODEL

Hypotheses

If earnings manipulation is conducted by achieving the key reference point represented by $n \times 10^k$, an abnormal distribution of the digits in the place to the right of the reference point is expected. For example, if the key reference point is the second digit of positive earnings and management tends to distort earnings to achieve this key point, more zeros and fewer nines are expected in the third place of the earnings numbers. Formally, our first hypothesis is stated as follows (in the null form):

Hypothesis 1: The occurrence of numbers in the place to the right of the key reference point in income numbers will conform to the expected distribution and no evidence of managerial efforts to round the earnings numbers will be discovered.

As discussed, corporate governance and earnings management have shown a reverse relationship (Jo and Kim, 2007; Marra et al., 2011). Effective corporate governance mechanisms can substantially increase the difficulty of engaging in earnings management and reduce incentives for management to manipulate earnings. We expect the earnings manipulation level to continue to decline because of the

gradual implementation of corporate governance mechanisms since 2003. To investigate the differences before and after the strengthening of the corporate governance mechanism, the sample was divided into two periods in this study, using 2003 as the division point. Formally, the second hypothesis is as follows:

Hypothesis 2: The degree of earnings manipulation of companies in Taiwan after 2003 will not be significantly weaker than the degree before 2003.

Mathematical Model

Benford's law

To test our hypotheses, we must identify the expected proportions of each of the 10 digits (zero to nine) in each place of the earnings numbers under the null hypothesis. However, the true distribution of the digits without the managerial manipulation of the reported earnings is not publicly observable (Thomas, 1989). Therefore, we must approximate this distribution. Benford's law provides such an approximation (Carslaw, 1988). Benford postulated that the expected proportions or occurrences of a number as the first digit in a number series can be approximated using the following equation:

$$proportion\left(\text{a is the first digit}\right) = \log_{10}(a+1) - \log_{10}(a). \quad (1)$$

Furthermore, the expected proportion of a given number a as the first digit and the number b as the second digit can be found in the following equation:

$$\log_{10}(a + \frac{b+1}{10}) - \log_{10}(a + \frac{b}{10}). \quad (2)$$

Using the established equations and summing all possible a values for any b value produces an overall expected proportion for b as the second digit. This equation is as follows:

$$proportion\left(\text{b is the second digit}\right) = \sum\left(\log_{10}(a + \frac{b+1}{10}) - \log_{10}(a + \frac{b}{10}) \right). \quad (3)$$

The expected proportion of numbers in the third, fourth, and subsequent positions can be similarly derived.

Chi-Square Test

The chi-square test has often been used to test for conformity to Benford's law (Nigrini, 2012). If the chi-square test rejects the hypothesis that the probability of all digits conform to Benford's law, then the entire account warrants further examination. The chi-square test is generally less discriminatory than the individual *z*-test results,

but results in fewer false positives (Durtschi et al., 2004). The chi-square test is as follows:

$$\chi^2 = \sum_{i=1}^{9} \frac{\left[nP_0 - nP_e\right]^2}{nP_0} \qquad \text{for the first digit} \quad (4)$$

$$\chi^2 = \sum_{i=0}^{9} \frac{\left[nP_0 - nP_e\right]^2}{nP_0} \qquad \text{for the other digits} \quad (5)$$

where P_e and P_0 are the observed and expected proportions, respectively. The sample size is represented by n.

Z Statistic

If the chi-square is significant, the number that has deviated from Benford's law and the degree of the deviation can be identified by examining the Z statistic on numbers zero to nine. To perform a significance test of the observed deviations from the expected proportions, we used a normally distributed Z statistic[1]:

$$Z = \frac{\left|P_0 - P_e\right| - \frac{1}{2n}}{\sqrt{\frac{P_0(1-P_0)}{n}}} \qquad (6)$$

Cramer's V

Cramer's V is based on adjusting the chi-square significance to factor out sample size. Cramer's V varies between zero and one; a value close to zero shows little association between the variables whereas values close to one indicate a strong association between the variables. We used Cramer's V to compare different groups' level of deviation from Benford's law using the following equation:

$$\text{Cramer's V} = \sqrt{\chi^2 / n(k-1)} \qquad (7)$$

where n and k are the sample size and number of variables, respectively.

[1] The second term in the numerator is a correction term; it should be applied only when it is smaller than $\left|P_0 - P_e\right|$ (Thomas, 1989).

EMPIRICAL RESULTS

Data

The data used in this study were obtained from the Taiwan Economic Journal (TEJ) database. The analysis includes quarterly net incomes of firms listed on Taiwanese stock exchanges from 1993 to 2011. After deleting incomplete data and extreme values, the final sample consisted of 54,207 positive earnings observations and 13,779 negative earnings observations.

Test of Hypothesis 1

Our first hypothesis predicts an abnormally high frequency of zeros and an abnormally low frequency of nines in the place to the right of the reference point of the earnings numbers. If managers manipulate earnings so that the earnings numbers achieve a key reference point represented by $n \times 10^k$, we expect that abnormally more zeros occur in the second through third places of the positive earnings numbers.

Table 1 lists the distributions of each digit (zero to nine) appearing in the first through third places of positive earnings. The chi-square test values of the first through third places were 33.68, 37.7, and 29.35, respectively. The results reject the hypothesis that the probability of all digits conform to a Benford distribution, indicating that managers have strong incentives to manipulate earnings by exaggerating the earnings numbers. Therefore, we further examined the distribution of the earnings digits.

The distribution of the first digits reveals that numbers three and five were observed more frequently than expected, suggesting that firms are more likely to round the numbers when three or five is used as the first digit. In addition, numbers one, two, and nine were observed less frequently than expected. The lack of these numbers as the first digit suggests that firms are more likely to round the numbers than when any of these numbers is the first digit.

Moreover, consistent with our expectations, significantly more zeros and fewer nines occurred in the second and third places, suggesting that firms might use the first and second digits as reference points. The proportion of zeros as the second digit, expected to be 11.97% of the sample, was actually 4.59% higher, and the *Z* statistic was 3.97. The number nine exhibited a rate of deviation of -5.88% and a *Z* statistic of 4.19, indicating that firms are likely to use the number zero as the key reference point for the second digit, causing the anomaly of more zeros than nines. Similarly, the proportion of zeros as the third digit was 4.72% higher than expected, and the *Z* statistic was 3.71. The proportion of nines was 2.34% lower than expected, and the *Z*

statistic was 1.77. This result concurs with the findings of prior studies (Carslaw, 1988; Thomas, 1989; Herrmann and Thomas, 2005; Lin et al., 2011) and suggests that window dressing is a pervasive phenomenon.

Table 1 Distribution of First through Third Digits in Positive Quarterly Earnings

	number	0	1	2	3	4	5	6	7	8	9	chi-square
First digit (n=54,207)	Observed proportion	-	29.72	17.21	12.87	9.88	8.22	6.81	5.85	5.16	4.28	33.68***
	Expected proportion	-	30.1	17.61	12.49	9.69	7.92	6.7	5.8	5.12	4.58	
	Deviation rate	-	-1.26	-2.27	3.04	1.96	3.79	1.64	0.86	0.78	-6.55	
	Z-statistics	-	**1.95***	**2.46****	**2.65*****	1.5	**2.57****	1.07	0.48	0.5	**3.25*****	
Second digit (n=54,207)	Observed proportion	12.52	11.56	11.06	10.44	10.11	9.63	9.22	8.87	8.58	8	37.70***
	Expected proportion	11.97	11.39	10.88	10.43	10.03	9.67	9.34	9.04	8.76	8.5	
	Deviation rate	4.59	1.49	1.65	0.10	0.80	-0.41	-1.28	-1.88	-2.05	-5.88	
	Z-statistics	**3.97*****	1.27	1.29	0.06	0.64	0.31	0.91	1.3	1.43	**4.19*****	
Third digit (n=54,207)	Observed proportion	10.66	10.4	10.24	9.97	9.72	10	9.91	9.91	9.59	9.6	29.35***
	Expected proportion	10.18	10.14	10.1	10.06	10.02	9.98	9.94	9.9	9.86	9.83	
	Deviation rate	4.72	2.56	1.39	-0.89	-2.99	0.20	-0.30	0.10	-2.74	-2.34	
	Z-statistics	**3.71*****	**2.02****	1.07	0.63	**2.32****	0.15	0.25	0.06	**2.11****	**1.77***	

Notes: *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).

Fewer zeros and more nines are expected in the second digit for firms reporting losses than for firms reporting a profit. The results in Table 2 show that the proportion of zero in the second digit is 8.19% less than expected. The proportion of nine in the second digit is 11.76% more than expected. These results suggest that managers use earning-increasing methods to avoid key reference points when the company incurs a loss. In other words, firms that had true earnings slightly less than $-n \times 10^k$ (with a zero in the second place) increased reported earnings to a number that was slightly greater than $-n \times 10^k$ (with a nine in the second place). For example, firms can enhance earnings of -10,350 to a number such as -9,800.

Table 2 Distribution of First through Third Digits in Negative Quarterly Earnings

	number	0	1	2	3	4	5	6	7	8	9	chi-square
First digit (n=13,779)	Observed proportion	-	29.94	17.68	12.88	9.51	7.95	6.75	5.4	4.97	4.91	10.11
	Expected proportion	-	30.1	17.61	12.49	9.69	7.92	6.7	5.8	5.12	4.58	
	Deviation rate	-	-0.53	0.40	3.12	-1.86	0.38	0.75	-6.90	-2.93	7.21	
	Z-statistics	-	0.4	0.2	1.36	0.69	0.11	0.24	**1.99****	0.75	**1.87***	
Second digit (n=13,779)	Observed proportion	10.99	11.04	10.72	9.89	10.18	9.48	9.26	9.17	9.27	10	58.66***
	Expected proportion	11.97	11.39	10.88	10.43	10.03	9.67	9.34	9.04	8.76	8.5	
	Deviation rate	-8.19	-3.07	-1.47	-5.18	1.50	-1.96	-0.86	1.44	5.82	17.65	
	Z-statistics	**3.53*****	1.28	0.6	**2.06****	0.58	0.74	0.29	0.52	**2.14****	**6.3*****	
Third digit (n=13,779)	Observed proportion	9.98	9.91	9.96	10.13	9.82	10	9.96	10.3	9.83	10.11	5.41
	Expected proportion	10.18	10.14	10.1	10.06	10.02	9.98	9.94	9.9	9.86	9.83	
	Deviation rate	-1.96	-2.27	-1.39	0.70	-2.00	0.20	0.20	4.04	-0.30	2.85	
	Z-statistics	0.76	0.86	0.5	0.28	0.76	0.07	0.05	1.54	0.13	1.1	

Notes: *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).

Overall, these results confirm our expectations that managers of publicly listed companies in Taiwan manipulate earnings by rounding numbers, regardless of their positive or negative earning situations. When a corporation earns a profit, they can round the digit up. When incurring a loss, a corporation can round down.

Test of Hypothesis 2

The sample period was divided into two groups, 1993 to 2002 and 2003 to 2011, to investigate whether differences in earnings management behavior occurred between these two periods. The results, presented in Tables 3, show that the first and second digits in positive quarterly earnings before 2003 and the first through third digits after 2003 revealed that the chi-square is significant. We first looked at the distribution of digits in the second place of the earnings numbers. Our results showed that the proportion of nines as the second digit, expected to be 8.5% of the sample, was

actually significantly lower in both periods. Moreover, the *Z* statistics of nine as the second digit in the first and second periods were 2.65 and 3.24, respectively, implying that the second-place digit was manipulated in both periods.

In addition, we found that the distribution of the third digit in the earnings numbers showed significant differences between the two periods. The third digit was more likely to be manipulated after 2003 (with a chi-square value of 27.17) than before 2003 (with a chi-square value of 9.22). These results show that managers used the first and second digits as reference points to round earnings before 2003. In contrast, the first through third digits were more frequently manipulated after 2003 than before 2003. Therefore, improvements to the corporate governance mechanisms in Taiwan led to less earnings manipulation in publicly listed firms.

In addition, Table 4 reveals the distribution of the second digit in negative quarterly earnings during the two periods.[2] Fewer zeros and more nines than expected occurred in the second digit of negative earnings during both periods.

To provide additional support for our hypothesis, this study calculated the Cramer's V of the first through third digits of the quarterly earnings in the two periods. The chi-square is affected by the size of the sample; to eliminate this issue, we used Cramer's V to compare the level of deviation from Benford's law among different groups. The results are presented in Table 5.

For firms attaining positive earnings, the results show that the Cramer's V of the second and third digits of the samples after 2003 was larger than the samples before 2003. For example, the Cramer's V of the first digit from years 1993 to 2002 was 0.011712, which is larger than the Cramer's V of the first digit from 2003 to 2011 (0.007627). Therefore, the degree of deviation of the first digits from 1993 to 2002 was larger than the degree of deviation from 2003 to 2011. This is likely because the improvement of the corporate governance mechanisms caused earnings manipulation to become more difficult than in the years preceding 2003. Consequently, the adjusted digits moved backwards.

Furthermore, for firms yielding negative earnings, the Cramer's V of all digits in the samples after 2003 was smaller than the Cramer's V of the samples before 2003. In other words, firms with negative earnings prior to 2003 deviated to a larger degree than firms with negative earnings after 2003. Therefore, firms reporting losses appear to reduce their earnings management behavior with the development of corporate governance mechanisms.

[2] Because the chi-square of the third digit in negative quarterly earnings is not significant, we only explain the distribution of the second digit.

The results of calculating the Cramer's V provide empirical evidence that the degree of earnings manipulation of publicly listed companies in Taiwan after 2003 is lower than before 2003.

Table 3 Distribution of First through Third Digits in Positive Quarterly Earnings at Different Periods

	period	0	1	2	3	4	5	6	7	8	9	chi-square
First digit (n=54,207)	1993~2002 (n=20,183)	-	29.6	16.95	12.93	9.98	8.2	7.02	5.93	5.14	4.24	
		-	-1.66	-3.75	3.52	2.99	3.54	4.78	2.24	0.39	-7.42	22.15***
		-	1.54	**2.43****	**1.87***	1.39	1.47	**1.81***	0.79	0.13	**2.26****	
	2003~2011 (n=34,024)	-	29.78	17.36	12.84	9.82	8.23	6.69	5.8	5.18	4.31	
		-	-1.06	-1.42	2.80	1.34	3.91	-0.15	0.00	1.17	-5.90	15.84**
		-	1.27	1.22	**1.89***	0.81	**2.1****	0.03	0	0.52	**2.35****	
Second digit (n=54,207)	1993~2002 (n=20,183)	12.28	11.46	11	10.55	10.32	10	9.17	8.84	8.4	7.98	
		2.59	0.61	1.10	1.15	2.89	3.41	-1.82	-2.21	-4.11	-6.12	17.04**
		1.34	0.31	0.52	0.55	1.36	1.58	0.8	0.96	**1.77***	**2.65*****	
	2003~2011 (n=34,024)	12.67	11.62	11.09	10.38	9.99	9.41	9.25	8.89	8.69	8.01	
		5.85	2.02	1.93	-0.48	-0.40	-2.69	-0.96	-1.66	-0.80	-5.76	30.29***
		3.97***	1.36	1.22	0.34	0.22	1.61	0.53	0.9	0.44	**3.24*****	
Third digit (n=54,207)	1993~2002 (n=20,183)	10.5	10.4	10.17	10.05	9.97	9.92	9.91	9.97	9.77	9.32	
		3.14	2.56	0.69	-0.10	-0.50	-0.60	-0.30	0.71	-0.91	-5.19	9.22
		1.52	1.24	0.34	0.01	0.2	0.27	0.13	0.31	0.43	**2.39****	
	2003~2011 (n=34,024)	10.75	10.4	10.28	9.93	9.57	10.05	9.9	9.88	9.49	9.76	
		5.60	2.56	1.78	-1.29	-4.49	0.70	-0.40	-0.20	-3.75	-0.71	27.17***
		3.51***	1.58	1.08	0.78	**2.76*****	0.4	0.21	0.16	**2.32****	0.38	

Notes: The first number in each cell represents the observed proportion. The other two numbers report the deviation from expected proportion and Z-statistic. The observed, expected proportion and deviation rate are measured as the percentage of the sample. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).

Table 4 Distribution of Second Digit in Negative Quarterly Earnings at Different Periods

	period	0	1	2	3	4	5	6	7	8	9	chi-square
Second digit (n=13,779)	1993~2002 (n=4,406)	10.53	11.48	11.1	10.53	9.53	9.01	8.94	9.17	9.35	10.35	31.26***
		11.97	11.39	10.88	10.43	10.03	9.67	9.34	9.04	8.76	8.5	
		-12.03	0.79	2.02	0.96	-4.99	-6.83	-4.28	1.44	6.74	21.76	
		2.92* **	0.18	0.44	0.19	1.08	1.45	0.87	0.28	1.37	**4.38*** **	
	2003~2011 (n=9,373)	11.2	10.83	10.54	9.59	10.49	9.7	9.41	9.16	9.24	9.84	38.92***
		11.97	11.39	10.88	10.43	10.03	9.67	9.34	9.04	8.76	8.5	
		-6.43	-4.92	-3.13	-8.05	4.59	0.31	0.75	1.33	5.48	15.76	
		2.27 **	**1.69***	1.04	**2.65*** **	1.45	0.08	0.23	0.42	1.63	**4.62*** **	

Notes: The first number in each cell represents the observed proportion. The other two numbers report the deviation from expected proportion and Z-statistic. The observed, expected proportion and deviation rate are measured as the percentage of the sample. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).

Table 5 The Cramer's V of First through Third Digits in Quarterly Earnings at Different Periods

	period	First digit	Second digit	Third digit
positive earnings	1993~2002	**0.011712**	0.009686	0.007124
	2003~2011	0.007627	**0.009946**	**0.009419**
negative earnings	1993~2002	**0.015108**	**0.028076**	**0.018893**
	2003~2011	0.009473	0.021479	0.008664

CONCLUSION

This study examined the earnings of publicly listed companies in Taiwan between 1993 and 2011. Using Benford's law, we investigated whether corporate managers adopt accounting adjustments to engage in earnings management behavior. The results show that, in cases of both positive and negative earnings, publicly listed companies in Taiwan are likely to engage in earnings management. Firms achieving positive earnings that engage in earnings management round the numbers up whereas numbers are rounded down in earnings management by firms yielding negative earnings.

Over the last two decades, corporate governance has attracted a considerable amount of public interest due to the increased instances of corporate fraud both domestically and abroad. Numerous countries have enacted laws to strengthen their corporate governance mechanisms, including Taiwan. This study documents pervasive evidence that managers of Taiwanese firms round their earnings numbers to achieve (or avoid) key reference points, regardless of positive or negative earnings situations. When a corporation earns a profit, they round the digit up. When incurring a loss, a corporation rounds a digit down.

In addition, after controlling for the size effect, we found that the Cramer's V of the second and third digits in the samples after 2003 was larger than in the samples before 2003, whereas the Cramer's V of the first digit revealed the opposite result. In contrast, for firms yielding negative earnings, the Cramer's V of all digits in the samples after 2003 was smaller than in the samples before 2003. Overall, the results show that financial statements' earnings manipulation has become more difficult for managers due to improvements made to the corporate governance mechanisms.

In conclusion, although corporate governance mechanisms have been proactively promoted in Taiwan, publicly listed companies in Taiwan still engage in earnings management behavior through the rounding of digits. However, the degree of earnings manipulation has decreased as corporate governance mechanisms have been gradually implemented. BAs publicly listed companies in Taiwan will fully adopt IFRS in 2013 and the accounting items of financial statements will become more flexible, the importance of vigorous corporate governance mechanisms is increasing. We recommend that the supervisory authority further enhance corporate governance regulations and mechanisms to minimize earnings management.

Although little empirical evidence exists that earnings management behavior is a harmful practice, future research could focus on the means used by management to round the earnings numbers as well as the effect of such behavior on the decision-making ability of financial statement users. Moreover, because of the lack of IFRS data on publicly listed companies in Taiwan, this study cannot examine the influence of adopting IFRS. Future research should also investigate this issue.

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