IFC-ECCBSO-Bank of Spain Workshop on "New insights from financial statements"

17 October 2024

A study on complementary indicators to the ICR for identifying distressed firms[1]

Jiyoung Choi, Sejong Lee, and Hye Won Shin,
Bank of Korea

[1] This contribution was prepared for the workshop. The views expressed are those of the authors and do not necessarily reflect the views of the European Committee of Central Balance Sheet Data Offices (ECCBSO), the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

A study on Complementary Indicators to the ICR for Identifying Distressed Firms

Sejong Lee[1], Hye Won Shin[2], Jiyoung Choi[3]

Abstract

This study aims to examine the practical issues associated with the ICR widely used for identifying distressed firms and, based on prior research, to find an appropriate alternative indicator. The ICR calculated as operating profit divided by interest expenses, is commonly used to determine a distressed firm. However, the ICR is undefined when interest expenses are zero. And when interest expenses are very low, even small changes in profit levels can significantly alter the assessment of the firm's operating status. Thus, this study identifies complementary indicators to the ICR. To achieve this, the study examines the desirable characteristics of indicators for identifying distressed firms, reviews various alternative indicators used in existing research, and evaluates their applicability in light of these desirable characteristics. The results suggest that the return on operating assets (ROOA) or the return on net operating assets (RNOA) could serve as robust complementary indicators to the ICR for identifying distressed firms.

Keywords: Distressed firms, Zombie firms, ICR (Interest Coverage Ratio), ROOA (Return on Operating Asset), RNOA (Return on Net Operating Asset)

JEL classification: L25, M20, M40

Contents

1 Associate Professor, Business School University of Seoul, E-mail: lee0819@uos.ac.kr

2 Senior Economist, The Bank of Korea, E-mail: hw.shin@bok.or.kr

3 Economist, The Bank of Korea. Korea, E-mail: cjy486@bok.or.kr

Disclaimer: The views expressed in this article do not necessarily reflect those of Bank of Korea.

1. Introduction

A company's Interest Coverage Ratio (ICR) is defined as operating income divided by interest expense. If the ICR is greater than 1, it indicates that the company can cover its interest payments with operating income and maintain normal operations. Conversely, a low ICR suggests that sustaining normal business activities may be challenging. In principle, the ICR is used as one of the indicators to assess a company's profitability. Due to its relatively simple calculation and high comprehensibility, it is widely used in previous studies and reports to identify distressed firms.

The Bank of Korea (June 2015) defines marginal firms as those with an ICR of 1 or less for three consecutive years. Additionally, the Bank of Korea (June 2024) classifies firms with an ICR below 1 as vulnerable firms in terms of ICR. The Bank compiles and publishes the changes in the proportion of these vulnerable firms each year.

However, specifically, relying solely on the ICR to calculate the proportion of distressed firms or to analyze a company's vulnerability poses the following issues:

First, a company's interest expense can be zero not only when the company has no borrowings and therefore incurs no interest expense, but also when all borrowing interest is capitalized and interest expense is included as part of depreciation. In such cases, the denominator of the ICR becomes zero and the indicator itself would be undefined, which raises concerns about its universal applicability. This issue is less pronounced when analyzing relatively small samples, such as listed companies, but it becomes a major problem when surveying large samples, such as nationwide business survey.

For example, according to a press release by the Bank of Korea (2023), of 910,206 companies surveyed in the Financial Statement Analysis for 2022, 441,958 companies, or 48.6%, reported zero interest expense. This means that nearly half of all companies would be excluded from an ICR-based analysis of distressed firms in Korea. Thus, if policymakers use the ICR to assess changes in distressed firms without considering its limited applicability, the results could be distorted.

Furthermore, even if a company's interest expense is not zero, but close to zero, the stability and continuity of the ICR indicator can be compromised. The ICR, as a continuous indicator, should ideally reflect profitability. However, the operating income (the numerator) can have both positive and negative values, so for a company with a small interest expense, the magnitude of the ICR can change dramatically as soon as the sign of the company's operating income changes from negative in one year to positive in the next. This means that a company that is judged to be in a very severe vulnerable situation according to the ICR can change its judgment to a good company in the next year with only a small improvement in operating profit.

Therefore, it is necessary to find an alternative or complementary indicator that can address the limitations of the ICR in identifying distressed firms. In other words, the complementary indicator should be able to determine whether a company is a distressed company by covering all 48.6% of companies

that do not have a defined ICR as of 2022, and should have stability that does not change significantly due to small changes in corporate profits. In addition, since the ICR has been widely used to determine distressed firms, it should be consistent with the purpose of the existing ICR and reflect the actual level of business activity of the company.

Therefore, this study examines the conditions that should be met by the distressed firm judgment indicators as a complementary indicator to the ICR from a practical perspective, and examines the indicators that can be used to judge distressed firms (hereinafter referred to as Distressed Firm Indicators) based on various previous studies.[4] As a result, we proposed ROOA(Return On Operating Assets) or RNOA(Return on Net Operating Assets), which is defined as a complementary indicator that is consistent with the purpose of the ICR and can compensate for the shortcomings of the ICR in determining distressed firms, by modifying the previous research.

This study is organized as follows. In Chapter 2, we reviewed the indicators that can be used to determine distressed firms from the literature and summarized the desirable characteristics of the indicators. Chapter 3 analyzes the characteristics of each candidate indicator in light of the desirable characteristics of a complementary indicator. Chapter 4 concludes by proposing an indicator that can compensate for the shortcomings of the ICR based on the analysis in Chapter 3.

2. Overview of Distressed Firm Indicators

2.1 Review of the determinants of distressed firms

2.1.1. ICR

The ICR is one of the indicators of a company's profitability and measures the ability of a company's operating income to cover interest expenses. Also known as ICR, it is calculated by dividing a company's operating income by its interest expense. The calculation method for the ICR for the year is as follows.

$$\text{Coverage}_{i,t} = \frac{\text{Operating Income}_{i,t}}{\text{Interexp}_{i,t}}$$

$\text{Coverage}_{i,t}$: ICR at year t for firm i $\text{Operating Income}_{i,t}$: Operatinng Income at year t for firm i

$\text{Interexp}_{i,t}$: Interest expense at year t for firm i

If the ICR is less than 1, it means that the interest expense is greater than the operating income, and the company is classified as a distressed company that cannot cover interest from its operating activities. In

4 Different studies have used the terms zombie, marginal, distressed firms, but for the purposes of this study, we will refer to them as distressed firms.

addition, a larger ICR indicates that a firm's operating income significantly exceeds its interest expense and can be used as a continuous indicator of a firm's profitability. Adalet McGowan et al. (2018) classify firms with ICRs below 1 for three consecutive years as distressed firms, citing high comparability as an advantage of using ICRs as the main criterion. Alvarez et al. (2023) classified a firm as a distressed firm if it has been established for more than five years, has an ICR of 1 or less, and has experienced capital erosion for more than three consecutive years.

2.1.2 Caballero et al. (2008): CHK

It is an indicator of distressed firms introduced in Caballero et al. (2008) and defined based on the idea that distressed firms tend to be prolonged through low policy interest rates. In this study, we refer to it as the CHK indicator after the initials of the authors' last names Caballero, Hoshi, and Kashyap. It combines a firm's debt structure with the market interest rate to calculate the minimum required interest rate, and if a firm's actual interest rate is lower than the minimum required interest rate, it is classified as a distressed firm because it is prolonging its life with low-interest loans from financial institutions. The specific calculation of a firm's minimum required interest payment R* is as follows.[5]

$$R*_{i,t} = rs_{t-1}BS_{i,t-1} + \left(\frac{1}{5}\sum_{j=1}^{5} rl_{t-j}\right)BL_{i,t-1} + rcb_{\text{min over last 5 years, t}} \times Bonds_{i,t-1}$$

$R*_{i,t}$: minimum required interest rate at year t for firm i

rs_{t-1}: short − term market interest rate at year $t-1$, treasury bond rate 1 year

$BS_{i,t-1}$: short − term borrowings at year $t-1$ for firm i

rl_{t-j}: long − term market interest rate at year $t-j$, treasury bond rate 5 year

$BL_{i,t-1}$: long − term borrowings at year $t-1$ for firm i

$rcb_{\text{min over last 5 years, t}}$: minimum corporate bond rate over last 5 years t years ago, CP interest rate

$Bonds_{i,t-1}$: bonds outstanding at $t-1$ year for i firm . corporate bonds among liabilites

In addition, the firm's minimum required interest rate (Rminrate) and the firm's paid interest rate (Rrate) are calculated as follows using the firm's borrowing structure and the firm's minimum required interest payment R*.

$$Rminrate_{i,t} = R*_{i,t}/(BS_{i,t-1} + BL_{i,t-1} + Bonds_{i,t-1})$$

[5] In fact, Caballero et al. (2008) used the prime rate, which is the preferential interest rate for banks, to calculate the minimum required interest payment, but we used the treasury bond rate due to the lack of general statistics on the prime rate in Korea. Therefore, the measure of CHK in this study is likely to be more conservative than that in Caballero et al. (2008).

$$\mathrm{Rrate}_{i,t} = \text{Interest expense}_{i,t} / (\mathrm{BS}_{i,t-1} + \mathrm{BL}_{i,t-1} + \mathrm{Bonds}_{i,t-1})$$

The CHK indicator shows that when a firm's paid interest rate (Rrate) is less than the minimum required interest rate (Rminrate), the firm is assumed to be prolonging its existence by borrowing from financial institutions at low interest rates. In this case, the firm is categorized as a distressed firm.

2.1.3 Fukuda and Nakamura (2011): FN

This indicator is introduced in Fukuda and Nakamura (2011) and is referred to as the FN indicator after the first letter of the authors' last names. Fukuda and Nakamura (2011) basically use the CHK indicator to determine distressed firms, but they point out the following two aspects as shortcomings of the existing CHK indicator.

First, there is a possibility that the CHK indicator may classify a firm as a distressed firm based on the level of financing rate alone, regardless of the firm's soundness, and second, there is a possibility that a firm whose debt continues to increase due to management problems may not be classified as a distressed firm if the financing rate is above a certain level. Therefore, this study follows the methodology of Fukuda and Nakamura (2011) and uses the CHK indicator, but additionally considers the following two criteria.

First, if a firm's operating income was greater than the minimum required interest payment, it was excluded as a distressed firm, even if it was a distressed firm under the CHK criteria. Second, if a firm's total borrowing liabilities were more than half of its assets and its borrowing liabilities were increasing, it was further included as a distressed firm even if it was not a distressed firm under CHK.[6]

2.1.4 Acharya et al. (2020): ACEE

This indicator was introduced by Acharya et al. (2020) and is referred to as the ACEE indicator after the authors' last names. ACEE uses both the ICR and the debt-to-equity ratio (leverage) to determine distressed firms, and also includes the low borrowing rate considered in the CHK and FN indicators. According to ACEE's criteria, a company is classified as distressed if it meets both of the following criteria

First, based on the ICR and debt-to-equity ratio, the ICR is less than the industry-year median and the leverage ratio is greater than the industry-year median. Second, the magnitude of interest expense/borrowed debt (i.e., interest rate) is smaller than the magnitude of the interest rate for blue-chip companies.[7]

---

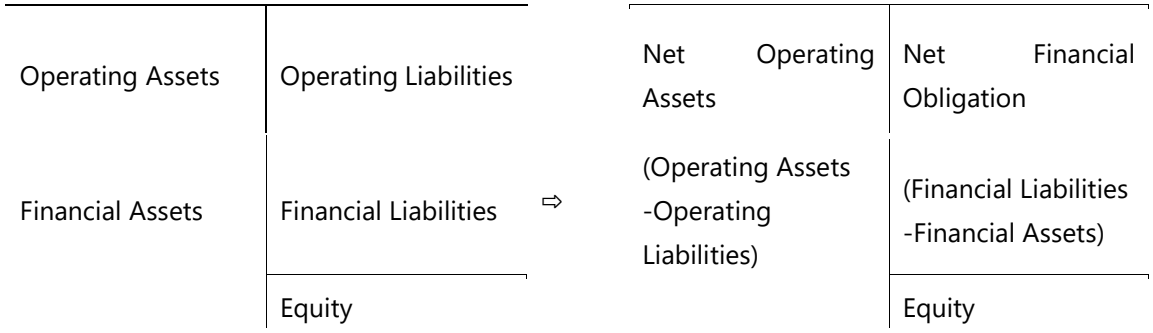
[6] In this study, we measure a firm's total borrowing liabilities as "short-term borrowings + current long-term liabilities + corporate bonds + long-term borrowings + finance lease liabilities", referring to Fukuda and Nakamura (2011).

[7] In addition, Acharya et al. (2020) determined that the second criterion is satisfied if the interest rate is lower than the interest

2.1.5 RNOA and ROOA

Return on Net Operating Assets (RNOA) is a metric originally used by Penman and Zhang (2002), which is defined as operating income divided by Net Operating Assets. Penman and Zhang (2002) tracked changes in RNOA based on the quality of earnings, where Net Operating Assets is computed by subtracting operating liabilities from operating assets, and can be measured by reclassifying the statement of financial position as follows

Reclassification of the statement of financial position Figure 1



As shown in the figure 1 above, a typical statement of financial position shows assets on the left-hand side of the balance sheet and liabilities and equity on the right-hand side of the balance sheet. Assets can be further categorized into Operating Assets, which are used in a company's primary operating activities, and Financial Assets, which represent the company's holdings of financial assets, while liabilities can similarly be categorized into Operating Liabilities, which are liabilities incurred in the company's operating activities, and Financial Liabilities, which represent the company's obligations. When both Operating Assets and Operating Liabilities are moved to the debit side, Operating Liabilities are represented as a subtraction from Operating Assets, and the indicator of Operating Assets minus Operating Liabilities is defined as Net Operating Assets (NOA). On the other hand, if Financial Assets are moved to the right-hand side of the balance sheet, Net Financial Obligation (NFO) is defined as Financial Liabilities minus Financial Assets, and the reclassification of the balance sheet, which was previously expressed as Assets = Liabilities + Equity, is expressed as Net Operating Assets (NOA) = Net Financial Obligation (NFO) + Equity.

Penman and Zhang (2002) measure RNOA using NOA as the denominator and Core Earnings, which is the operating income, as the numerator. This measure of RNOA looks similar to Return on Assets (ROA), which is a common profitability indicator, but unlike ROA, it uses operating income rather than net

rate of companies with a corporate bond rating of AAA or higher, but since there are few companies in Korea with a corporate bond rating of AAA or higher except financial companies, the second criterion is satisfied if the interest rate is lower than the median of companies with a corporate bond rating of AA- or higher for the application of the indicator.

income in the numerator.[8] In addition, total assets, the denominator of ROA, can change even if a company does not conduct any operating activities if it holds borrowed funds in the form of financial assets, whereas NOA, the denominator of RNOA, does not change with changes in financial structure unless the size of the company's operating assets changes.

In this study, RNOA is defined as "operating income - interest expense" divided by NOA, which is a slight modification of Penman and Zhang's (2002) RNOA. By slightly modifying the existing RNOA, interest expense distributed to creditors can be excluded from the return calculation, and the modified RNOA metric has the advantage of being consistent with the ICR that has been widely used in the past. In addition, we further defined Return on Operating Assets (ROOA) using operating assets rather than net operating assets as the denominator to examine its usefulness as an alternative measure to ICR.[9] The RNOA (ROOA) metric is virtually the same as the ICR, and has the advantage that it can be applied even when interest expense is zero, and the metric has continuity.

2.2 Review of the conditions for Alternative Indicator

In light of the above indicators, there are two types of alternative indicators that can be used to determine distressed firms in the literature. First, the CHK, FN, and ACEE indicators are based on the level of financing interest rates of individual firms, assuming that firms on the brink of bankruptcy become distressed if they are supported by social interventions such as low-interest support from policy funds. Second, another approach emphasizes profitability indicators, particularly the ICR, as low profitability is often a key sign of distress. Considering the practical applicability of complementary indicator, we can summarize the following characteristics of an alternative indicator for determining distressed firms as an alternative to the ICR.

First, and most importantly, the scope of applicable companies needs to be broader than the existing approach using the ICR for universality, i.e., it is necessary to devise an alternative indicator to determine whether a company is a distressed company by including all companies with zero interest expense.

The second is understandability, which requires indicators to be intuitive and simple in concept so that they can be easily understood by non-expert users of the indicators as well as researchers.

The third is affordability, which means that the timely construction of the indicator requires quick organization and aggregation of data. Therefore, it is necessary to design an indicator that can be completed in a short time without requiring overly complex additional data.

The fourth is that there should be no discontinuity in the indicator that may occur when using the ICR as an indicator for determining distressed firms, such as excessive fluctuations in the judgment of the

---

[8] Of course, there are also ways to calculate ROA that use operating income as the numerator rather than net income.

[9] Referring to Penman (2010), operating assets and operating liabilities were measured as follows

- Operating assets: Total assets - Financial assets (Financial assets: cash and cash equivalents + short-term financial assets + long-term financial assets, except that cash equal to 0.5% of sales is classified as operating assets)
- Operating liabilities: Total liabilities - Financial liabilities (Financial liabilities: Short-term financial liabilities + long-term financial liabilities + finance lease liabilities + preferred share capital)

degree of vulnerability of the company. It is desirable for an indicator to not only determine whether a firm is distressed but also continuously reflect the degree of the firm's vulnerability through the size of the indicator.

Fifth, it is necessary to maintain a certain level of consistency with the ICR, which has been widely used as an indicator for determining distressed firms. Therefore, the judgment of distressed firms based on the alternative indicator and the judgment of distressed firms based on the ICR should not be significantly different, so that the existing position regarding the judgment of distressed firms can be maintained.

Sixth, the indicator used to determine distressed firms should reflect the actual level of a firm's activities. In other words, there must be a systematic correlation between the distressed firm indicator and declines in areas such as investment, employment, and productivity, which can occur when a firm is vulnerable.

Based on these six conditions, we reviewed the content and characteristics of the indicators that could be considered as alternative complements to the ICR.

3. Review of the characteristics of Alternative Indicators

3.1 Universality

This is done by verifying that the indicator can be defined for a larger sample than the traditional ICR. The universality of the indicator is measured by the number of companies for which the indicator can be measured among all available observations, and the sample for the analysis was composed of companies in Fnguide's corporate data that met the following conditions

- KOSPI-KOSDAQ companies excluding financials from 2011 to 2022
- December year-end entities only
- No missing assets, liabilities, or equity in the database
- The accounting equation is complete (Assets = Liabilities + Equity)
- Companies with data for two consecutive years

The total number of available firm observations satisfying the above conditions was measured to be 20,813. After reviewing the universality of each indicator, we found that 19,908 firms, or 95.7% of the total, were able to define an ICR. The return on operating assets (ROOA) was applicable to all 20,813 companies, which is 100%, and for the return on net operating assets (RNOA), the number of applicable companies was determined to be 20,510 companies, which is 98.5%, as there are cases where the denominator, net operating assets, has a negative value. For the CHK, FN, and ACEE indicators, 17,941

(86.2%), 17,941 (86.2%), and 18,665 (89.6%) firms, respectively, were measurable, indicating ROOA and RNOA are more common than ICR.

Universality Table 1

Year	Obs	ICR	Return on operating assets (ROOA)	Net Sales Return on Assets (RNOA)	CHK	FN	ACEE
2012	100.0	94.9	100.0	98.5	90.4	90.4	90.1
2013	100.0	94.4	100.0	98.4	89.2	89.2	89.0
2014	100.0	94.0	100.0	98.7	87.9	87.9	88.0
2015	100.0	94.0	100.0	98.4	87.7	87.7	87.4
2016	100.0	92.7	100.0	98.1	85.3	85.3	85.3
2017	100.0	92.8	100.0	99.0	84.7	84.7	84.4
2018	100.0	93.0	100.0	98.4	85.1	85.1	85.3
2019	100.0	99.1	100.0	98.8	84.2	84.2	85.2
2020	100.0	99.4	100.0	98.8	83.9	83.9	97.4
2021	100.0	99.1	100.0	98.6	85.2	85.2	97.4
2022	100.0	99.1	100.0	98.3	84.7	84.7	97.0
Total	100.0	95.7	100.0	98.5	86.2	86.2	89.6

Note: The data is expressed in percentage units.

3.2. Understandability and affordability of metric creation

Compared to the ICR, the understandability of this indicator is not likely to be significantly different for ROOA and RNOA. However, indicators such as CHK, FN, and ACEE are concepts that are discussed in academic papers and are very complicated to create. On the other hand, the affordability of the indicator can be measured by the amount of time and effort invested in creating the indicator, which can be measured by the length of the code for each indicator.[10] In the case of ICR, it can be written in a simple 27 lines of code, and ROOA and RNOA can also be written in less than 100 lines of code, but indicators such as CHK, FN, and ACEE require more than 200 lines of code depending on the indicator. Therefore, from the perspective of the understandability of the indicator and the affordability of the indicator, ROOA or RNOA are appropriate as an alternative indicator.

3.3 Continuity

It is highly unlikely that a distressed firm will suddenly become a sound firm in the following year without any fundamental change, or vice versa. However, if the ICR is used as an indicator for determining

[10] Measured by the length of code in SAS used to analyze the data.

distressed firms, it is possible for a firm with a very small number of interest expenses to experience such a change, which requires an indicator that can compensate for this shortcoming.

Therefore, to determine the continuity of each indicator, we extracted the sample used to determine the universality of the indicator and measured the proportion of the sample that was in the bottom (top) 10% of vulnerability in a given year and changed to the top (bottom) 10% in the following year. However, for the CHK, FN, and ACEE indicators, continuity cannot be determined because they are defined as 0 or 1 values.

Continuity Table 2

Year	ICR	(Extreme Change)	ROOA	(Extreme Change)	RNOA	(Extreme Change)
2013	100.0	0.9	100.0	0.3	100.0	0.4
2014	100.0	0.6	100.0	0.4	100.0	0.6
2015	100.0	0.9	100.0	0.6	100.0	0.8
2016	100.0	0.9	100.0	0.7	100.0	0.8
2017	100.0	0.8	100.0	0.5	100.0	0.8
2018	100.0	0.8	100.0	0.4	100.0	0.3
2019	100.0	0.9	100.0	0.6	100.0	0.8
2020	100.0	1.0	100.0	0.7	100.0	0.5
2021	100.0	0.8	100.0	0.4	100.0	0.2
2022	100.0	0.8	100.0	0.2	100.0	0.2
Total	100.0	0.8	100.0	0.5	100.0	0.5

Note: The data is expressed in percentage units.

As shown in Table 2, the percentage of extreme changes in the ICR indicator is about 0.8%, but the percentage of extreme changes in ROOA and RNOA is about 0.5%, indicating that the percentage of extreme changes in the ROOA and RNOA is smaller.

3.4 Consistency with ICR

Since the ICR has been widely used as an indicator for determining distressed firms, it is also important to check its consistency with the ICR to ensure timely consistency in the determination. Therefore, when defining a distressed firm as one with an ICR of less than 1, we examined how other indicators classify firms as distressed. For this analysis, we used only observations of firms for which the ICR is measurable in the sample used to determine the universality of the indicator, and classified distressed firms as distressed firms if the ROOA and RNOA are less than zero, while the CHK, FN, and ACEE indicators, which are defined as 0 and 1, are classified as distressed firms if they have a value of 1.

Consistency with ICR Table 3

ICR	Obs	Judgment	ROOA	RNOA	CHK	FN	ACEE
Non-Distressed firms	13,450 (100.00%)	Non-Distressed	100.00%	98.81%	76.86%	89.08%	90.23%
		Distressed	0.00%	0.00%	12.39%	0.17%	3.49%
		Unclassifiable	0.00%	1.19%	10.75%	10.75%	6.28%
Distressed firms	6,458 (100.00%)	Non-Distressed	0.03%	0.03%	85.06%	82.73%	86.22%
		Distressed	99.97%	98.41%	4.85%	7.17%	7.45%
		Unclassifiable	0.00%	1.56%	10.10%	10.10%	6.33%

As shown in Table 3, when comparing the classification of distressed firms based on the ICR with other indicators, it was found that in cases where a firm was not considered distressed based on the ICR, the other indicators also judged the firm as non-distressed with a high proportion. However, when a firm is identified as distressed based on the ICR, more than 98% of the time, the ROOA and RNOA also classify the firm as distressed, demonstrating a high degree of consistency with the ICR-based assessment. On the other hand, indicators such as CHK, FN, and ACEE identify less than 10% of firms as distressed. Therefore, based on this consistency analysis with the ICR, the CHK, FN, and ACEE indicators are not considered applicable.

3.5 Relevance to business activities

Due to the characteristics of distressed firms that are difficult to generate normal profits, in order for the distressed firm judgment indicators to be reliable, it is believed that there should be a significant relationship between the indicators of distressed firms and the level of firm business activity. The independent variables are ICR, return on operating assets (ROOA), return on net operating assets (RNOA), CHK, FN, and ACEE, which are the six indicators. Referring to Acharya et at (2019), the dependent variables are six: employment growth rate (employgrowth), productivity(productivity), investment in tangible assets (CAPX), cash asset growth (dcash), debt growth (ddebt), and return on assets (ROA). The dependent variable was set as an indicator at year t+1, in order to observe the relationship between the distressed firm indicators and the following year's firm business activities. The control variables are each firm's size (lnassets), leverage (Leverage), ratio of tangible asset (Tangibility), firm age (lnage), and Market to Book ratio (MTB), and firm fixed effects and year fixed effects were added. The regression equation and the measures of dependent and control variables are as follows.

$$\begin{aligned}\text{Activity}_{i,t+1} = \beta_0 + \beta_1 \text{distress}_{i,t} + \beta_2 \text{lnassets}_{i,t} + \beta_3 \text{Levergae}_{i,t} + \beta_4 \text{Tangibility}_{i,t} \\ + \beta_5 \text{lnage}_{i,t} + \beta_6 \text{MTB}_{i,t} + \text{firmfixed} + \text{yearfixed} + \varepsilon_{i,t}\end{aligned}$$

$distress_{I,t}$: Distressed firm indicator for firm i at year t.

$Activity_{i,t+1}$: Business activitiy indicator for firm i at year $t+1$.

$employgrowth_{i,t+1}$: $\ln(\text{number of employees at } t+1) - \ln(\text{number of employees at t})$ for firm i

$productivity_{i,t+1}$: $\ln(\text{sales at } t+1) - \left(\frac{2}{3}\right) \times \ln(\text{number of employees at } t+1)$

$$- \left(\frac{1}{3}\right) \times \ln(\text{tangible asset at } t+1) \text{ for firm i}$$

$CAPX_{i,t+1}$: $\frac{(\text{tangible asset at } t+1 - \text{ tangible asset at t} + \text{depreciation at } t+1)}{\text{tangible asset at t}}$ for firm i if negative, adjust to 0

$dcash_{i,t+1}$: $\frac{\text{cash at } t+1 - \text{cash at t}}{\text{total asset at t}}$ for firm i . $ddebt_{i,t+1}$: $\frac{\text{debt at } t+1 - \text{debt at t}}{\text{total asset at t}}$ for firm i

$ROA_{i,t+1}$: $\frac{\text{net income at } t+1}{\text{asset at t}}$ for firm i.

$lnassets_{i,t}$: $\ln(\text{asset})$ at t for firm i, $Leverage_{i,t}$: $\frac{\text{debt at t}}{\text{asset at t}}$ for firm i.

$Tangibility_{i,t}$: $\frac{\text{tangible asset at t}}{\text{total asset at t}}$ for firm i, $lnage_{i,t}$: $\ln(\text{year } t - \text{year of establishement})$ for firm i,

$MTB_{i,t}$: $\frac{\text{market capitalization}}{\text{equity}}$ for firm i

The characteristics of distressed firms are expected to be low employment growth, low productivity, low investment in tangible assets, low cash holdings, and low profitability. Therefore, for the continuous variables such as ICR, ROOA, and RNOA, we expect a positive relationship with employment growth rate, productivity, investment in tangible assets, cash flow, and ROA, as the higher the value of these indicators, the better the firm, and the lower the value, the more vulnerable the firm. It is difficult to conclude the relationship between debt growth and the distress indicators as blue-chip firms may repay their debt, but they may also invest through additional financing. On the other hand, for the binary variables CHK, FN, and ACEE, a value of 1 indicates that the firm is classified as a distressed firm, so a negative relationship is expected with employment growth rate, productivity, investment in tangible assets, cash asset growth, and ROA. In addition, it is difficult to say that the vulnerability of a company is the only reason for the increase in debt, so it is difficult to conclude the relationship between debt growth and the distress indicators. In order to analyze the relevance of the determinants of distressed firms to business activities, a sample of 14,702 firms was selected from the Fnguide that met the following criteria

- KOSPI-KOSDAQ companies excluding financials from 2011 to 2022
- December year-end entities only
- No missing assets, liabilities, or equity in the database
- The accounting equation is complete (Assets = Liabilities + Equity)
- Companies with data for two consecutive years
- All six distressed firm determinants used as independent variables are definable
- Firms with no missing dependent and control variables
- Winsorization at the top and bottom 1% to reduce the impact of extremes

Table 4 shows the descriptive statistics of each variable. In the case of Coverage, the mean is very large compared to the median, indicating that the distribution of this ratio is skewed toward the small end. In addition, the mean values of ROOA and RNOA are around 0.025 and 0.042, respectively, suggesting that the profit margin of operating assets earned by the company is 2.5%, and the profit margin of net operating assets excluding operating liabilities is estimated to be 4.2%. In addition, the mean values of CHK, FN, and ACEE indicators are 0.117, 0.027, and 0.055, respectively, indicating that the largest number of firms, 11.7%, are classified as distressed firms according to CHK, while the share of distressed firms is only about 2.7% according to FN.

Descriptive statistics Table 4

Variable	Name	Obs	Mean	Std	p25	p50	p75
Independent	Coverage	14,702	31.66299	117.7512	0.076134	3.386579	13.65355
	ROOA	14,702	0.024931	0.123968	-0.01691	0.026401	0.077282
	RNOA	14,702	0.041883	0.19652	-0.02256	0.03574	0.107498
	CHK	14,702	0.117467	0.321987	0	0	0
	FN	14,702	0.026595	0.160902	0	0	0
	ACEE	14,702	0.05455	0.227108	0	0	0
Dependent	employgrowth	14,702	-0.00168	0.209894	-0.05506	0.006309	0.071417
	productivity	14,702	9.444969	0.983673	8.806624	9.316189	9.930551
	CAPX	14,702	0.205454	0.553763	0	0.033951	0.162192
	dcash	14,702	0.012324	0.078814	-0.01906	0.003928	0.033645
	ddebt	14,702	0.032608	0.166417	-0.03997	0.010692	0.075299
	ROA	14,702	0.001947	0.111211	-0.02285	0.02058	0.05705
Control	lnassets	14,702	19.34726	1.494858	18.29844	19.06587	20.12398
	Leverage	14,702	0.458306	0.195472	0.307475	0.461298	0.602147
	Tangibility	14,702	0.323537	0.187402	0.180481	0.316713	0.451209
	lnage	14,702	3.200093	0.709745	2.833213	3.258097	3.7612
	MTB	14,702	1.690409	1.868921	0.658098	1.106711	1.960307

Table 5 shows the correlation analysis of each variable. The correlations among the six indicators are inconsistent, suggesting that the determination of distressed firms may vary depending on which distress indicator is used.

Correlation analysis Table 5

	Coverage	**ROOA**	**RNOA**	**CHK**	**FN**	**ACEE**	**employgrowth**	**productivity**
ROOA	0.3539*							
RNOA	0.3506*	0.9414*						
CHK	0.2732*	0.1553*	0.1383*					
FN	-0.0638*	-0.1338*	-0.1251*	0.3126*				
ACEE	-0.0688*	-0.0854*	-0.0907*	0.0649*	0.1688*			
employgrowth	0.0530*	0.2036*	0.1924*	0.0170*	-0.0455*	-0.0352*		
productivity	0.004	0.1420*	0.1453*	-0.001	-0.0388*	0.0199*	-0.0447*	
capx	0.0162*	-0.013	0.006	-0.004	-0.011	-0.0313*	0.0947*	0.0249*
dcash	0.0294*	0.016	0.0198*	0.0172*	-0.008	-0.014	0.0420*	0.010
ddebt	0.016	0.0602*	0.0606*	0.005	-0.0262*	-0.0301*	0.1659*	-0.004
ROA	0.2060*	0.5733*	0.5203*	0.1172*	-0.0784*	-0.0316*	0.1882*	0.1840*
lnassets	-0.013	0.1969*	0.1821*	-0.014	-0.0209*	0.1044*	0.0186*	0.4204*
Leverage	-0.3229*	-0.3039*	-0.2531*	-0.2346*	0.0404*	0.1567*	-0.0870*	0.1321*
Tangibility	-0.0886*	0.005	-0.0462*	-0.0307*	0.0382*	0.0954*	-0.012	-0.2897*
lnage	-0.0298*	-0.0589*	-0.0624*	-0.011	0.012	0.0300*	-0.0468*	0.1316*
MTB	-0.007	-0.1607*	-0.1282*	-0.0325*	0.0222*	-0.0294*	0.0293*	-0.2088*

	capx	**dcash**	**ddebt**	**ROA**	**lnassets**	**Leverage**	**Tangibility**	**lnage**
ROOA								
RNOA								
CHK								
FN								
ACEE								
employgrowth								
productivity								
capx								
dcash	0.0468*							
ddebt	0.3269*	0.2284*						
ROA	-0.0364*	0.0653*	-0.003					
lnassets	-0.1089*	-0.0733*	-0.0437*	0.2210*				
Leverage	-0.0632*	-0.0248*	-0.1513*	-0.1966*	0.2135*			
Tangibility	-0.2942*	-0.0223*	-0.0256*	0.0592*	0.1383*	0.2036*		
lnage	-0.0954*	-0.0467*	-0.0573*	0.0350*	0.2358*	0.0630*	0.0886*	
MTB	0.1206*	0.0999*	0.0450*	-0.1663*	-0.2574*	0.0584*	-0.1301*	-0.1669*

Note: * denotes statistical significance at the 5% level.

As shown in Table 6, the analysis of the relationship between ICR and business activity variables shows that there is a significant positive relationship with employment growth, cash asset growth and profitability, and no significant relationship with other dependent variables. This suggests that the relationship between ICR and business activity is not always consistent.

Distress Indicators and their relation to business activities Table 6

Independent variables	Dependent variables					
	employgrowth	**productivity**	**CAPX**	**dcash**	**ddebt**	**ROA**
Coverage	0.000***	0.000	0.000	0.000**	-0.000	0.000***
	(0.008)	(0.232)	(0.416)	(0.010)	(0.889)	(0.000)
ROOA	0.347***	0.524***	0.215**	0.040***	0.010	0.247***
	(0.000)	(0.000)	(0.019)	(0.001)	(0.669)	(0.000)
RNOA	0.191***	0.273***	0.129**	0.020***	0.003	0.133***
	(0.000)	(0.000)	(0.024)	(0.005)	(0.826)	(0.000)
CHK	-0.014**	0.027*	-0.004	0.007***	-0.013**	0.007***
	(0.036)	(0.062)	(0.798)	(0.007)	(0.012)	(0.007)
FN	-0.046***	-0.033	-0.004	0.000	-0.013	-0.011*
	(0.002)	(0.306)	(0.885)	(1.000)	(0.223)	(0.074)
ACEE	-0.018*	-0.042**	0.014	-0.002	-0.002	-0.006*
	(0.056)	(0.035)	(0.423)	(0.547)	(0.805)	(0.080)

Note: Asterisks, *, ** and ***, denote statistical significance at the 10%, 5%, and 1% levels.

In the case of relationship analysis between ROOA and firm business activity variables, the results show a significant positive relationship with all business activities and no significant relationship with debt growth. These results suggest that ROOA is closely related to business activities, as higher ROOA means higher future employment, investment, productivity, cash asset, and profitability.

As with ROOA, the RNOA analysis shows a significant positive relationship with business activities and no significant relationship with debt growth. It can be seen that RNOA is also closely related to business activities.

Since CHK indicator is classified as a distressed firm when it has a value of 1, a negative relationship is expected with each business activity variable except debt growth. As expected, a significant negative relationship is observed with employment growth but no significant negative relationship is observed with other business activity indicators, and a significant opposite sign is observed with productivity and profitability (ROA). This result suggests that using the CHK indicator as an indicator of distressed firms may not reflect the actual business activity.

In regards to FN indicator, when the FN indicator has a value of 1, it is classified as a distressed firm. Thus, a negative relationship is expected with each business activity variable except for debt growth. As expected, a significant negative relationship was observed with employment growth and ROA, but no significant relationship was observed with other business activity indicators.

The ACEE indicator is also an indicator that is categorized as a distressed firm when it has a value of 1. As expected, there is a significant negative relationship with employment growth, productivity, and ROA, but no significant relationship was observed with other dependent variables. The results of the analysis are more in line with expectations than the CHK and FN indicators in the previous analysis. However, it is still limited in terms of significance to be used as an indicator of distressed firms.

3.6. Comprehensive judgment of each metric

After analyzing the complementary indicators to the ICR based on universality, understandability, affordability, continuity, consistency with the ICR and relevance to the firm business activities, which have been proposed as desirable criteria for identifying distressed firms, we believe that ROOA and RNOA can be used as a strong alternative.

4. Conclusion and Implications

In this study, we examine the indicators for determining distressed firms that can compensate for the shortcomings of the ICR, which is widely used to determine distressed firms but has limitations in terms of universality and continuity. For this purpose, we examined six indicators for determining distressed firms based on prior research, and constructed each indicator for KOSPI and KOSDAQ-listed companies. We defined the attributes of desirable distressed firm indicators as universality, understandability, affordability, continuity, consistency with ICR, and relevance to firm business activities, and judged each indicator based on the above attributes. As a result, we found that ROOA and RNOA are two indicators that have less problems with the universality and continuity of the ICR, but are more consistent with the ICR and have significant relevance to various firm business activities. Therefore, we believe that both ROOA and RNOA can be applied as a substitute for the ICR for distressed firms.

While both ROOA and RNOA are generally appropriate alternatives for ICRs, each has its own limitations.

First, in the case of ROOA, the idealized analysis results, but there is a lack of theoretical basis, as there are no prior studies or textbooks using similar indicators. On the other hand, RONA has the advantage of having a theoretical basis due to the existence of studies and textbooks using similar indicators, but it has the problem of universality that it cannot be applied when net operating assets have a negative value.

Therefore, it is very difficult to define a perfect substitute for the ICR and there is a possibility of inconsistency with existing studies if the standard of distressed firms is suddenly changed. Therefore, it is recommended to consider using indicators such as RNOA and ROOA as verification or supplementary indicators in addition to the existing ICR, rather than changing the standard of distressed firms completely.

A limitation of this study is the restriction of the analysis to listed companies. While this study acknowledges that the reported limitations of the ICR are significant in terms of the universality and attempts to identify alternative indicators to replace it, due to data access limitations, the study is limited to listed companies only and thus does not directly demonstrate the most important issue of the universality of the ICR.

References

Acharya, V.V., Crosignani, M., Eisert, T., and Eufinger, C.(2020). Zombie credit and (dis-)inflation: evidence from Europe. *NBER Working Paper* 27158.

Acharya, V.V., Eisert, T., Eufinger, C., and Hirsch, C.(2019). Whatever It Takes: The Real Effects of Unconventional Monetary Policy, *The Review of Financial Studies* 32, 3366-3411.

Adalet McGowan, M., Andrews, D., and Millot, V.(2018). The walking dead? Zombie firms and productivity performance in OECD countries. *Economic Policy* 33, 685-736

Álvarez, L., García-Posada, M., and Mayordomo, S.(2023). Distressed firms, zombie firms and zombie lending: A taxonomy. *Journal of Banking & Finance* 149, 106762

Bank of Korea (June 2015). *Financial Stability Report*. Bank of Korea.

_____ (2023). *2022 Annual Financial Statement Analysis* Results. Bank of Korea press release (October 25).

_____ (June 2024). *Financial Stability Report*. Bank of Korea.

Caballero, R. J., Hoshi, T., and Kashyap, A. K.(2008). Zombie Lending and Depressed Restructuring in Japan. *The American Economic Review* 98, 1943-1977

Fukuda, S.-i., and Nakamura, J.-i.(2011). Why Did 'Zombie' Firms Recover in Japan? *The World Economy* 34, 1124-1137

Penman, S. H., and Zhang, X.-J.(2002). Accounting Conservatism, the Quality of Earnings, and Stock Returns. *The Accounting Review* 77, 237-264

Penman, S. H.(2010), Financial Statement Analysis and Security Valuation (Fourth Edition),

BANK OF KOREA

A study on Complementary Indicators to the ICR for Identifying Distressed Firms

Hyewon Shin(hw.shin@bok.or.kr)

* The contents of this presentation are the views of the author and do not necessarily reflect the official views of the Bank of Korea.

◆ Table of Contents

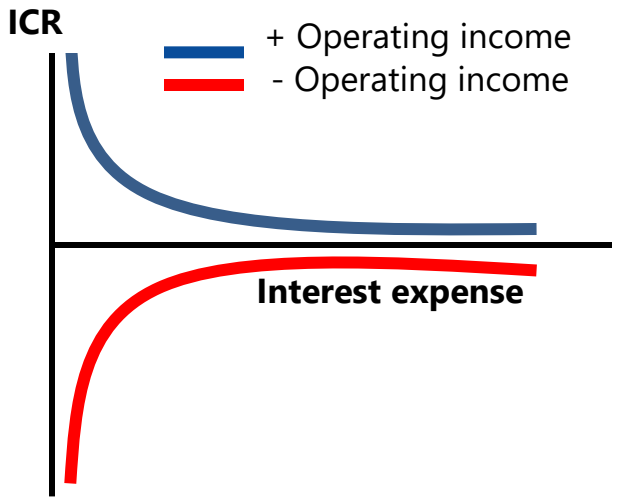
Ⅰ. Introduction : ICR and its limitation

What is ICR (Interest Coverage Ratio)?

- **Definition** : Operating income / interest expense
- **Meaning** : If the ICR is above 1, the company can cover interest expenses and maintain normal operations. Widely used to assess a company's profitability and to identify distressed firms.
- **Limitations** : When interest expense is zero, the ICR becomes undefined. According to the Bank of Korea (2023), 48.6% of 910,206 companies surveyed in 2022 had zero interest expenses, making ICR unusable for them.

Unreliability of ICR

- **When interest expense is small**: A small change in operating income can lead to dramatic changes in the ICR.
- **Problem**: Companies may switch from being classified as distressed to sound (or vice versa) based on minor profitability changes, compromising the stability of the ICR.



Ⅰ. Introduction : Need for an ICR Complementary Proposal

Why We Need an Alternative to ICR?

- **Limitations** : Excluding 48.6% of companies with zero interest expenses from the analysis can lead to distorted policy decisions.
- **Need for a Complementary Indicator**: A stable indicator applicable to all companies, even those with minor changes in profitability

Proposed Alternative Indicator

- **Objective** : To find an indicator that aligns with the ICR's purpose but overcomes its limitations.
- **Proposed Indicators**: ROOA(Return on Operating Assets), RNOA(Return on Net Operating Income)

Ⅱ. Overview of Distressed Firm Indicators

1. Literature Review

❖ First, an individual company is a distressed firm based on the level of its financing interest rate, assuming that a company becomes a distressed firm if it is prolonged by social intervention such as low-interest support from policy funds.

- **Caballero et al. (CHK, 2008)** : If actual interest rate($Rrate_{i,t}$) >minimum required interest rate($Rminrate_{i,t}$), the firm is considered zombie firm because it is being sustained by low-interest loans from financial institutions.

- **Fukuda and Nakamura (FN, 2011)** : Building on the work of Caballero et al. (2008) by excluding zombie firms if a firm's operating income > minimum required interest expenses, and including zombie firm if total borrowing liabilities are more than half of assets and borrowing liabilities are increasing

- **Acharya et al. (ACEE, 2020)** : ⓐ zombie firm if a firm's ICR < the industry-year median and its debt-to-equity ratio > the industry-year median ⓑ the firm's financing rate < financing rate of blue-chip firms like CHK and FN

Ⅱ. Overview of Distressed Firm Indicators

1. Literature Review

❖ Second, low profitability is an indicator of distressed firms, and the methodology focuses on profitability indicators, especially ICR, to identify distressed firms.

- **The Bank of Korea** : distressed firms with an ICR <1 in its Financial Stability Report (2023)
- **Adalet McGowan et al. (2018)** : identified firms with ICR of 1 or less for three consecutive years as zombie firms, citing high comparability as an advantage of focusing on ICR.
- **Alvarez et al. (2023)** : classify a firm as distressed if it has been in existence for more than five years, has an ICR of less than or equal to one, and has three or more consecutive years of capital erosion.

Ⅱ. Overview of Distressed Firm Indicators

Summary

Method	Pros	Cons
Based on Financing Interest Rate (CHK, FN, ACEE)	- Reflects real-world functioning of distressed firms. - Considers market interest rates.	- Requires detailed analysis of each company's data. - Vulnerability is a discrete variable (0 or 1), making continuous assessment difficult.
Based on ICR (ICR)	- Easy to understand and compare across companies. - Practical for real-world application.	- Undefined for companies with zero interest expense. - High volatility if operating income fluctuates, especially for firms with very low interest expenses.

Ⅱ. Overview of Distressed Firm Indicators

2. Measurement of Distressed Firm indicator

❖ **Interest Coverage Ratio (ICR)** : $Coverage_{i,t} = \frac{Operating\ Income_{i,t}}{interexp_{i,t}}$

❖ **Caballero et al.(2008, CHK)** : $Rrate_{i,t} < Rminrate_{i,t}$

$Rminrate_{i,t} = R^{*}_{i,t} / (BS_{i,t-1} + BL_{i,t-1} + Bonds_{i,t-1})$

$Rrate_{i,t} = Interestexpense_{i,t} / (BS_{i,t-1} + BL_{i,t-1} + Bonds_{i,t-1})$

❖ **Fukuda and Nakamura (FN, 2011)** : Based on CHK

(-) Non-distressed : Operating income > minimum required interest expenses

(+) Distressed : Total borrowing liabilities > half of assets / borrowing liabilities are increasing

❖ **Acharya et al.(ACEE, 2020)**

ICR and leverage ratio < industry-year median.

interest expense/borrowing liability (i.e., interest rate) < interest rate of a blue-chip company

interest rate < interest rate of a company(a corporate bond rating of AAA or higher) like CHK

Ⅱ. Overview of Distressed Firm Indicators

2. Measurement of Distressed Firm indicator

❖ **Penman and Zhang(2002) : RNOA, ROOA**

$$RNOA = (Operating\ income\ - interest\ expense)\ /net\ operating\ assets$$

- For this study, Penman and Zhang's (2002) RNOA has been slightly modified to exclude interest expenses paid to creditors from the return calculation. This modification aligns the RNOA with the widely used ICR.

$$ROOA = (Operating\ income\ - interest\ expense)\ /operating\ assets$$

- We additionally define Return on Operating Assets (ROOA) using operating assets rather than net operating assets as the denominator to examine its usefulness as an alternative measure to ICR.

Net operating assets can be measured by reclassifying the statement of financial position as follows

Financial Statements

Operating Assets Financial Assets	Operating Liabilities Financial Liabilities
	Equity

Reclassified Financial Statements

Net Operating Assets (Operating Assets – Operating Liabilities)	Net Financial Obligation (Financial Liabilities – Financial Assets)
	Equity

Operating assets: Total assets - Financial assets
Operating liabilities: Total liabilities - Financial liabilities

Ⅱ. Overview of Distressed Firm Indicators

3. What the indicators for determining a distressed firm should look like?

- We summarize the characteristics of a distressed firm determinant that could serve as an alternative to ICR . We reviewed the characteristics of each judgment indicator considering the above conditions.

Characteristic	Description
1. Universality	Includes all firms, even those with no interest expenses, unlike the interest coverage ratio.
2. Understandability	Simple and easy to understand for both experts and non-experts.
3. Affordability	Quick to compile and release without excessive complexity.
4. Continuity	Shows a clear relationship between indicator changes and firm vulnerability
5. Consistency with ICR	not differ significantly from the traditional ICR
6. Relevant to Business	reflect the company's actual business activities.

Ⅲ. Characteristics of Alternative Indicators

1. Universality

- **Data Source:** FnGuide
- **Scope:** KOSPI-KOSDAQ companies (excluding financials) from 2011 to 2022
- **Conditions:**
  December year-end entities
  Complete accounting equation (Assets = Liabilities + Equity)
  No missing data for assets, liabilities, or equity
  Companies with data for two consecutive years

Indicator	Obs	Percentage
ICR	19,908	95.7%
ROOA	20,813	100%
RNOA	20,510	98.5%
CHK	17,941	86.2%
FN	17,941	86.2%
ACEE	18,655	89.6%
Total	20,813	100%

Ⅲ. Characteristics of Alternative Indicators

2-1. Understandability

- **ICR**: Widely used in financial analysis.
- **ROOA** : Introduced primarily in academic literature and some textbooks.
- **RNOA :** Derived from ROOA
- **CHK, FN, ACEE**: Available only in academic papers

	ICR	ROOA	RNOA	CHK	FN	ACEE
Understandability	High	Medium	Medium	Low	Low	Low

2-2. Affordability

- **ICR**: Created with 27 lines of simple code.
- **ROOA & RNOA**: Require less than 100 lines of code.
- **CHK, FN, ACEE**: Require 200+ lines of code, depending on the indicator.

	ICR	ROOA	RNOA	CHK	FN	ACEE
Length of Code	27	60	92	168	223	129
Affordability	High	Medium	Medium	Low	Low	Low

Ⅲ. Characteristics of Alternative Indicators

3. Continuity

To assess the reliability of indicators, measure the percentage of companies that shifted from the bottom (top) 10% to the top (bottom) 10% the following year. We tracked definable companies over two consecutive years.

- **Indicators with Issues**: CHK, FN, and ACEE cannot determine continuity due to their binary definitions (0 or 1).

- **Extreme Change** : Interest Coverage Ratio (ICR): 0.8%, ROOA and RNOA: 0.5%

Indicators defined as 0 or 1 cannot determine continuity; thus, ROOA and RNOA are considered excellent for continuity.

Ⅲ. Characteristics of Alternative Indicators

4. Consistency with ICR

- **Conditions:** Classify a company as distressed if ICR <1, using only measurable ICR observations. ROOA and RNOA are distressed if <0, while CHK, FN, and ACEE (0,1) are distressed if 1.

- **Results:** Any company that can measure ICR can also measure ROOA. However, for other indicators, there are many that are impossible to measure. If a company is judged as a distressed firm based on the ICR, the indicators of ROOA and RNOA are judged as distressed by more than 98%, while the share of other indicators is less than 10%.

ICR	Obs	Judgment	ROOA	RNOA	CHK	FN	ACEE
Non-distressed	13,450 (100%)	Non-distressed	100.0%	98.81%	76.86%	89.08%	90.23%
		Distressed	0%	0%	12.39%	0.17%	3.49%
		Unclassifiable	0%	1.19%	10.75%	10.75%	6.28%
Distressed (ICR <1)	6,458 (100%)	Non-distressed	0.03%	0.03%	85.06%	82.73%	86.22%
		Distressed	99.97%	98.41%	4.85%	7.17%	7.45%
		Unclassifiable	0%	1.56%	10.10%	10.10%	6.33%

Ⅲ. Characteristics of Alternative Indicators

5. Relevance to business activities

■ Multiple linear regression analysis

$$Activity_{i,t+1} = \beta_0 + \beta_1 distress_{i,t} + \beta_2 lnassets_{i,t} + \beta_3 Leverage_{i,t} + \beta_4 Tangibility_{i,t} + \beta_5 lnage_{i,t} + \beta_6 MTB_{i,t} + firmfixed + yearfixed + \varepsilon_{i,t}$$

- Independent variable : ICR, ROOA, RNOA, CHK, FN, and ACEE
- Dependent variable: employment growth, productivity, investment in tangible asset, cash assets growth, debt growth, and ROA.
- Control variable : firm size, leverage, tangible asset ratio, firm age, and MTB ratio.

Ⅲ. Characteristics of Alternative Indicators

5. Relevance to business activities

- **Results :** For the ICR, the expected sign appears only in some analyses. However, ROOA and RNOA consistently show the expected sign, except in debt growth. For discrete variables CHK, FN, and ACEE, the expected sign is also seen in some analyses.

Distress Indicators and their relation to business activities

Independent variables	Dependent variables					
	employgrowth	**productivity**	**CAPX**	**dcash**	**ddebt**	**ROA**
Coverage	0.000***	0.000	0.000	0.000**	-0.000	0.000***
	(0.008)	(0.232)	(0.416)	(0.010)	(0.889)	(0.000)
ROOA	0.347***	0.524***	0.215**	0.040***	0.010	0.247***
	(0.000)	(0.000)	(0.019)	(0.001)	(0.669)	(0.000)
RNOA	0.191***	0.273***	0.129**	0.020***	0.003	0.133***
	(0.000)	(0.000)	(0.024)	(0.005)	(0.826)	(0.000)
CHK	-0.014**	0.027*	-0.004	0.007***	-0.013**	0.007***
	(0.036)	(0.062)	(0.798)	(0.007)	(0.012)	(0.007)
FN	-0.046***	-0.033	-0.004	0.000	-0.013	-0.011*
	(0.002)	(0.306)	(0.885)	(1.000)	(0.223)	(0.074)
ACEE	-0.018*	-0.042**	0.014	-0.002	-0.002	-0.006*
	(0.056)	(0.035)	(0.423)	(0.547)	(0.805)	(0.080)

Note: Asterisks, *, ** and ***, denote statistical significance at the 10%, 5%, and 1% levels.

Ⅳ. Conclusion and Implications

Comprehensive judgement of indicators

Indicator	Universality	Understandability	Understandability	Continuity	Consistency with ICR	Relevance to Business Activities
Coverage	Medium	High	High	High	High	Medium
ROOA	High	Medium	Medium	High	High	High
RNOA	Medium	Medium	Medium	High	High	High
CHK	Low	Low	Low	Low	Low	Low
FN	Low	Low	Low	Low	Low	Low
ACEE	Low	Low	Low	Low	Low	Medium

- As an complementary indicator for ICR, ROOA appears to be the most desirable indicator, but there is no existing research or textbook that uses this metric.
- On the other hand, RNOA has a theoretical basis, and while it has the problem of being inapplicable when net operating assets are negative, it seems to be a good overall indicator.
- No indicator is perfect, so rather than changing the indicator for distressed firms right away, we're going to consider using indicators such as RNOA or ROOA alongside ICR.

Thank you.