SELECTING EARLY WARNING INDICATOR TO IDENTIFY CORPORATE SECTOR DISTRESS: EFFORTS TO STRENGTHEN CRISIS PREVENTION

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SELECTING EARLY WARNING INDICATOR TO IDENTIFY CORPORATE SECTOR DISTRESS: EFFORTS TO STRENGTHEN CRISIS PREVENTION

Arlyana Abubakar¹, Rieska Indah Astuti², Rini Oktapiani³

Abstract

This research aims to develop early warning indicator (EWI) which can provide earlier signal on financial distress in corporate sector. Therefore, effort to prevent deeper deterioration can be anticipated early and financial system stability remains resilient. In the first phase, based on corporate financial report, indicator candidates are grouped into four categories: liquidity indicator, solvency indicator, profitability indicator, and activity indicator. Indicator selected as EWI is the one which can predict corporate distress event in 2009 Q1 with the least statistical error. Statictics evaluation result shows that in aggregate indicators debt to equity ratio (DER), current ratio (CR), quick ratio (QR), debt to asset ratio (DAR), solvability ratio (SR), and debt service ratio (DSR) can give signal in a year prior to the distress event in 2009 Q1, so that the indicators can become EWI for corporate financial distress.

Key words : early warning indicator, financial distress

JEL Classification : G01, C15

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I. PREFACE

1.1 Background

Several episodes of financial and economic crises provide lessons on the importance of measuring systemic risk in the financial system. Connectivity increase among economic agents is followed by interconnected risk increase through common exposure between those agents. This is shown by analytical result of National Financial Account & Balance Sheet (FABS) up to 2015 Q2 (Attachment) in which there is a high interconnection between non-financial corporate (NFC) sector and financial sector, especially banking. On the other hand, corporate also has high interconnection with external sector which makes it exposed to external risk, among others caused by high corporate foreign debt. Therefore, an early warning indicator is needed as signal that there is financial distress on corporate sector so the effort to prevent increasing systemic risk coming from corporate sector can be anticipated early.

Early warning indicators (EWI) is one of the tools that can be used in the implementation of macroprudential assessment and surveillance. EWI is beneficial to identify risk potentials earlier, to allow authorities to make preventive steps to absorb increasing systemic risk. Therefore, EWI must fulfill several requirements, such as statistically having forecasting ability and able to provide crisis signal or pressure as early as possible, so that authorities have enough time to prepare the required policy (Drehmann, 2013).

Financial distress is a situation where a company is unable to meet payment obligations to third parties (Andrade and Kaplan, 1998). Pranowo et al. (2010) states that indication of a national financial distress is a phenomenon where there are delisting of several public companies in the Indonesia Stock Exchange (IDX) due to liquidity problems such as happened in 1998/1999 Asian financial crisis and 2008/2009 global financial crisis. Other phenomenon which indicates financial distress is the increasing number of companies which are unable to meet obligations to banks as reflected in the rise in bank non-performing loan (NPL), such as happened in 2005 and 2009. Historical data shows that in 2006 there was a banking NPL increase of 11.5% (from 61 trillion rupiah to 68 trillion rupiah) compared to the previous year. In March 2009, there was an NPL increase of 9.4%, from 55.4 trillion rupiah in September 2008 to 60.6 trillion rupiah. Based on the aforementioned
phenomenon and data availability, corporate financial distress in Indonesia is assumed to take place in early 2009.

1.2 Research Scope

The scope of this research covers:

1. This research is part of framework of financial imbalances indicator organization when in 2015 began with EWI for the corporate sector according to data availability.

2. Samples used in this research are non-financial corporates listed in IDX (public listed) with data period of 2014 Q1 to 2015 Q1. Corporates referred to in the next chapters are non-financial corporates.

1.3 Research Purposes

The purposes of this research are as follows:

1. Identifying corporate vulnerabilities signal by using several indicators earlier, to be able to take preventive measures to prevent increasing systemic risk.

2. Completing macroprudential assessment and surveillance, especially related to corporate which then can be implemented to other economic sectors.

1.4 Method of Writing

The organization of this writing is as follows: Chapter I explains the background, scope, purposes and method of writing. Chapter II explains about literature review. Chapter III elaborates on the research methodology used to determine corporate EWI. Estimation result will be discussed on Chapter IV. As closing, Chapter V will explain the conclusion and development area going forward.
II. LITERATURE REVIEW

Vulnerabilities in the corporate sector can be defined as there are risks where corporate financial conditions will decline and continue deteriorating to reach a threshold that can trigger increasing systemic risk (Gray, 2009). A corporate is said to be in financial distress when it cannot fulfill payment obligations to third parties (Andrade and Kaplan, 1998).

Previous several researches have been conducted to predict corporate financial distress. Altman (2000) builds a new model to predict corporate financial distress which is a development from the previous models: the Z-Score model (1968) and Zeta (1977) credit risk model. The information used is corporate financial report analyzed using linear regression model. The financial ratios used as independent variables in the model are working capital/total assets, retained earning/total assets, earning before interest and tax/total assets, market value equity/book value of total liabilities, and sales/total assets.

Platt and Platt (2002) explains the most dominant financial ratios to predict financial distress are EBITDA/sales, current assets/current liabilities, and cash flow growth rate which have negative relations to the possibility corporate will experience financial distress. The bigger the ratios, the smaller the possibility corporate will experience financial distress. Moreover, other financial ratios include net fixed assets/total assets, long-term debt/equity, and notes payable/total assets which have positive relations to the possibility corporate will experience financial distress. The bigger the ratios, the bigger the possibility corporate will experience financial distress.

Fitzpatrick (2004) uses 3 main variables to predict financial distress: corporate asset size, leverage, and standard deviations of assets. While Asquith et al. (1994) uses interest coverage ratio to define financial distress.

Research conducted by the Bank of Japan (BoJ) in Ito et al. (2014) identifies 10 leading indicators which can provide information related to imbalances happening in financial sector activities in Japan. Two of the ten indicators are corporate sector indicators: business fixed investment to GDP ratio and corporate credit to GDP ratio.

In Indonesia, Luciana (2006) finds that financial ratios derived from income statement, balance sheet, and cash flow statement of corporate are significant variables in determining corporate financial distress. Studies were conducted on
corporates listed in IDX in 2000–2001, comprising 43 corporates with positive net income and equity book value, 14 corporates with negative net income and still listed, as well as 24 corporates with negative net income and equity book value but still listed. Analysis used is multinomial logit regression to test the significance of financial ratios coming from three of the financial reports against financial distress.

Pranowo et al. (2010) conducted research related to financial distress on 220 corporates listed in IDX and found that there are 4 most significant indicators in affecting financial distress: current ratio (current assets to current liabilities), efficiency (EBITDA to total assets), leverage (due date account payable to fund availability), and equity (paid in capital). Moreover, research result shows that mining sector experienced the hardest impact of global financial crisis, while agriculture sector is the most resilient and the best in dealing with problems stemming from global crisis.
III. RESEARCH METHODOLOGY

This chapter scrutinized the methodology used to determine EWI from corporate financial distress in Indonesia. The methodology used in the research is a replica of research methodology conducted by the Bank of Japan in Ito et al. (2014) to determine leading indicators of imbalances in financial sector activities in Japan.

3.1. Analysis Framework of Financial Imbalances

This research is part of formulation framework of financial imbalances indicator which is began with EWI formulation study for corporate financial distress according to data availability. EWI formulation analysis is also part of macroprudential assessment and surveillance in analyzing corporate behavior which can create imbalances in the financial system.

*Financial Imbalances is a condition with indication of increasing systemic risk potential due to overreaction from players in Financial System (PDG Macroprudential Policy Draft, Bank Indonesia)

Figure 1. Financial Imbalances Analysis Framework
3.2. Research Data and Determining Distress Event

This research uses individual data of corporates listed in IDX in the 2004 Q4 to 2015 Q1 period. Distress event determination referred to Pranowo et al. (2010) who states that distress period is marked by increasing bank NPL as well as the number of corporate delisting significantly. Pranowo et al. (2010) research result also shows that corporates in Indonesia experienced financial distress in 2009 Q1. This is also supported by Altman Z-Score figure which rose significantly and reached its peak in 2009 Q1.

Source: Bank Indonesia (2014)

Figure 2. Determining Distress Event Based on Altman Z-Score

Figure 2 shows that 2009 Q1 period is the period with highest corporate distress segment, with 49,5% of total corporates listed. The increase in corporate distress segment was caused by the depreciation of rupiah exchange rate and economic slowdown.

The economic slowdown was affected by slowdown in export growth as a result of the 2008 global financial crisis, when there was a decline of exported goods demand from importing countries. This condition impacted corporate revenues in Indonesia, particularly to export-oriented corporates. Moreover, rupiah depreciation in the 2008 Q4 to 2009 Q2 period caused cost production to increase which caused the decline in corporate performance.
Overall, increasing production cost, declining export demand and weakening people’s purchasing power as an impact of economic slowdown and exchange rate depreciation caused corporates to experience performance decline as reflected by the decrease in return on asset (ROA) and return on equity (ROE) respectively by 0.71% and 1.86% from the previous period. Figure 3 shows the exchange rate development as well as corporate performance development as proxied by return on asset (ROA) and return on equity (ROE).

![Figure 3. Rupiah Exchange Rate Development and Indonesian Corporate Performance](source: Bloomberg)

Other phenomena which also show that the 2009 Q1 period was a corporate distress period is NPL increase and the number of corporate delisting as in Figure 4.

![Figure 4. NPL Ratio Development (%) and Delisting Corporates](source: LBU – BI)
Corporate performance decline in the 2009 Q1 period caused increasing credit risks as proxied by NPL value of 0.76% compared to the previous period. Furthermore, the number of delisting corporates also experienced relatively significant increase compared to the previous period, when there were 12 corporates delisting throughout 2009.

3.3. Determining EWI for Corporate Financial Distress

To determine whether an indicator can become EWI, then the indicator must fulfill certain requirements. According to Blancher et al. (2013), an indicator can be grouped as EWI if the indicator can give signal before the period of a crisis takes place. Furthermore, EWI can be separated into leading indicator or near term indicator according to the period when the indicator starts to give signal. An indicator is called leading indicator if it can give signal more than one year before a crisis takes place. While an indicator is categorized as near-term indicator if it can give signal within one year before a crisis takes place.

![Diagram](image)

Source: Blancher et al. (2013)

Figure 5. Early Warning Indicator

Several criteria that must be fulfilled by a certain indicator to be categorized as EWI from corporate financial distress among others are:
1. The indicator can detect imbalances in corporate less than 1 year before the peak distress period which was 2009 Q1.

2. The indicator used can minimize various statistical errors when predicting corporate distress event in 2009 Q1.

These are several phases used to determine EWI of corporate financial distress:

![Determination Framework on EWI of Corporate Financial Distress](image)

**3.3.1. Determining Candidate on EWI of Corporate Financial Distress**

Initial steps made to determine EWI of corporate financial distress are by determining indicator candidates which can provide illustration on corporate financial conditions. The indicator candidates originate from corporate financial statements comprising balance sheet, income statement and cash flow. Categories of indicator candidates used in this research among others are liquidity indicator, solvency indicator, profitability indicator, activity indicator as well as cash flow indicator. These are explanations of indicator candidates used (Wiehle et al. (2005) and Jakubik and Teplý (2011)):
a. Liquidity Indicator

This indicator represents corporate ability in meeting short-term and long-term liabilities with short-term assets. The higher corporate liquidity level, the lower potential of distress happening. Several indicators included as part of liquidity indicator among others are:

1. Current Ratio (CR)

   This ratio is a measurement of short-term liquidity which illustrates comparison between short-term assets and short-term liabilities. Generally, corporates with good performance have bigger current ratio or equal to 1. A corporate with current ratio lower than 1 represents a negative value of net working capital, therefore the corporate will face financial distress. Current ratio is determined by the following equation:

   \[
   \text{Current Ratio} = \frac{\text{Current Asset}}{\text{Current Liabilities}}
   \]

2. Quick Ratio (QR)

   This ratio is the measurement of short-run liquidity which illustrates liquidity status of a corporate. Mathematically, the ratio can be calculated with this equation:

   \[
   \text{Quick Ratio} = \frac{(\text{Cash} + \text{Short Term Account Receivable})}{\text{Current Liabilities}}
   \]

   The main focus of this ratio is liquid asset value (cash plus short-term account receivable) owned by a corporate. The low value of a corporate liquid assets signals that the corporate will face liquidity problems in short term. Moreover, low liquid asset value also represents the number of inventory value owned by corporate in which generally more than 50% of inventory is funded by liquid assets. A high inventory value owned by a corporate represents ownership of a greater liquid asset, which can be source of vulnerabilities to corporate because of exposure to liquidity risk.

b. Solvency Indicator

This indicator explains corporate ability to fulfill long-term liabilities. High debt ratio value and a long debt repayment period will cause high corporate distress potential. Several indicators which fall under solvency indicator group among others are:
1. Debt to Equity Ratio (DER)

   This ratio measures the proportion of corporate financing originated from debt and equity in its capital structure. Moreover, this ratio is also measurement of corporate financial leverage in which high leverage value without an increase of sustainable profit will cause corporate to face financial distress.

2. Debt to Asset Ratio (DAR)

   This ratio measures how much corporate assets can cover financing originating from both short and long-term debt. Higher DAR value implies that the assets owned are insufficient to cover liabilities so that the corporate is facing solvability issues.

3. Interest Coverage Ratio (ICR)

   ICR illustrates corporate long-term solvability as well as measuring the efficiency level of a corporate in covering interest expense derived from long-term and short-term liabilities. Mathematically ICR can be calculated with this equation:

   
   \[ \text{Interest Coverage Ratio (ICR)} = \frac{\text{Earning Before Interest and Tax (EBIT)}}{\text{Interest Expense}} \]

   Generally, low ICR value implies that a corporate experiencing solvability issue because the obtained revenue is insufficient to cover interest expense of liabilities.

4. Solvability Ratio (SR)

   This ratio measures corporate ability in covering all liabilities both short and long-term liabilities. The ability is measured by asset ownership especially liquid assets. Low solvability ratio reflects corporate is facing solvability issue because asset ownership is insufficient to cover all liabilities. SR can be calculated through this equation:

   \[ \text{Solvability Ratio (SR)} = \frac{\text{Total Asset}}{\text{Total Liabilities}} \]

5. Debt Service Ratio (DSR)

   This ratio measures corporate ability in meeting risky liabilities covering debt installment and interest installment. That ability is measured based on corporate earnings before subtracted by interest payments, taxes, depreciation and amortization. DSR can be calculated with this equation:
Debt to Service Ratio (DSR) = \frac{(Current\ Liabilities+Interest\ Expense)}{Earning\ Before\ Interest,\ Tax,\ Depreciation\ and\ Amortization (EBITDA)}

The higher DSR value reflects that corporates do not have enough gross earning to cover debt risk owned either short-term liabilities or debt installments or interest installments. This condition causes corporate to face solvability issue.

c. **Profitability Indicator**

This indicator explains how corporate maximizes profit by using existing input. The higher corporate profitability then the lower the potential of corporate distress. Several indicators included in profitability indicator group among others are:

1. **Gross Profit Margin (GPM)**

   This ratio measures the number of gross profit received by corporate from sales of current period. Gross profit margin can be determined by the equation:

   \[
   \text{Gross Profit Margin (GPM)} = \frac{\text{Gross Profit}}{\text{Sales}} \times 100 = \frac{(Sales-Cost\ of\ Sales)}{Sales} \times 100
   \]

   The lower this ratio goes implies that the cost spent for sales is bigger than the sales received by corporate. This reflects a corporate is experiencing a profit or performance decline.

2. **Return on Asset (ROA)**

   Profitability indicator that are commonly used to evaluate a corporate performance is return on asset (ROA). This ratio measures comparison between corporate net income and total assets. The higher ROA value reflects the higher net income received by maximizing fixed asset efficiently.

3. **Return on Equity (ROE)**

   This indicator measures comparison between corporate net income and shareholder’s equity. The higher ROE value, implies the higher return shareholders will receive.

d. **Activity Indicator**

This indicator measures efficiency of corporate from using several inputs. Corporate is considered ideal if using effective input to gain maximum profit. The
lower a corporate efficiency level then the higher the potential of corporate distress. Several indicators included in activity indicator category among others are:

1. **Inventory Turnover (I\_Turn)**

   This ratio measures correlation between sales and inventory of corporate. Inventory Turnover can be calculated using this equation:

   \[ \text{Inventory Turnover (I\_Turn)} = \frac{\text{Sales}}{\text{Inventory}} \]

   This ratio can also be used to measure corporate efficiency on inventory sales. The higher this ratio goes implies corporate is more efficient in managing inventory. On the contrary, low ratio signals the large amount of unsold inventory which causes the cash used to purchase inventory eroded and corporate will face issues in cash flow.

2. **Asset Turnover (A\_Turn)**

   This ratio explains how efficient a corporate in utilizing assets to gain revenue. The higher this ratio implies that corporate has used assets efficiently. A too extreme asset turnover value implies that the corporate is lacking productive assets that it is unable to maximize potential gains. Mathematically turnover asset value can be determined by this equation:

   \[ \text{Asset Turnover (A\_Turn)} = \frac{\text{Sales}}{\text{Total Asset}} \]

   Other than the aforementioned indicators, another indicator which can be used as EWI candidate that represent corporate cash flow is capital expenditure to depreciation and amortization ratio. This ratio compares investment in fixed asset or capital expenditure with depreciation and amortization value in current period. The higher this ratio goes implies corporate is in expansion in which there is more cash used for new investment rather than depreciation and amortization.

   Furthermore, EWI will be determined for aggregate or sectoral. Sector determination is adjusted to categorization of corporate sector in Indonesia Stock Exchange (IDX):

   1. Agriculture Sector (JAKAGRI)
   2. Base and Chemical Industry Sector (JAKBIND)
   3. Consumer Goods Industry Sector (JAKCONS)
   4. Infrastructure, Utility, and Transportation Sector (JAKINFR)
   5. Various Industries (JAKMIND)
6. Mining Sector (JAKMINE)
7. Property and Real Estate (JAKPROP)
8. Trade, Service and Investment (JAKTRAD)

3.3.2. Determining Trend and Threshold

To determine whether indicator candidates used in this research meet EWI criteria, the initial step conducted is by analyzing the trend of each indicator. The trend analysis is conducted to see how far an indicator deviates from its long-term trend and identify if the deviation surpasses threshold. Deviation which surpasses threshold, either lower or upper threshold, will determine if the indicator can detect potential of distress event on Indonesian corporates. Several stages from trend analysis and indicator threshold determination are as follows:

1. Calculating Long-Term Trend

Long-term trend of indicator candidates is calculated using two methodologies: (i) one sided HP filter with smoothing parameter (λ) of 1,600 considering the data used is quarterly data (Drehman, 2011) and (ii) backward moving average (MA) for 1, 2 or 3 years. The use of MA is focused on 3 year backward MA because it is more effective in illustrating short-term fluctuations (Ito et al., (2014) in Surjaningsih et al., (2014)). The stipulation of trend calculation methodology is based on several factors such as time series characteristic from each indicator as well as statistical evaluation result which minimizes several statistical errors.

2. Calculating Gap Indicator

After conducting trend analysis, the next step is calculating gap of each indicator candidate. This step is made to know how much an indicator deviates from long-term trend. The gap value is difference between indicator actual value \(x_i\) and long-term trend value \(x_i^T\).

\[
gap = (x_i - x_i^T)
\]

3. Calculating Standard Deviation (Root Mean Square)

In identifying whether an indicator provides distress signal, what should be done is analyzing indicator historical movement as well as comparing with certain threshold. To know the optimum threshold value which provides information on signal given by indicator, then several threshold levels are made.
The threshold level is determined by standard deviation value (root mean square/RMS) from each indicator which is calculated using this equation:

$$\sigma \text{ (RMS)} = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N}(x_i - x_i^T)^2}$$

4. Calculating Threshold (Upper and Lower Threshold)

The threshold level formed both upper or lower threshold is multiplication of standard deviation value ($\sigma$). The upper and lower threshold are calculated with this equation:

Upper Threshold: $x_i^T + k \sigma$

Lower Threshold: $x_i^T - k \sigma$

$x_i$ is the indicator actual value and $x_i^T$ is the indicator trend value produced either by one sided HP Filter ($\lambda=1.600$) or 3 year backward MA. While $k$ is multiplier factor of standard deviation used to make simulation on the determination of best threshold value in detecting distress signal. The value of $k$ varies from 1, 1.25, 1.5, 1.75, and 2.

An indicator is said to be given distress signal if the actual value surpasses upper threshold or lower threshold before distress event.

Actual value above upper threshold: $x_i > (x_i^T + k \sigma)$

Actual value below lower threshold: $x_i < (x_i^T - k \sigma)$

3.3.3. Statistical Evaluation

Basically indicators which are selected as EWI, can only provide signal before a distress event and cannot give signal out of that period. The condition that could happen is, the indicator gives signal and distress event happens (correct signal A) or indicator does not give signal at all and distress event does not happen (correct signal D).

In several researches, there is an indicator which is unable to give signal correctly, in which it gives signal but distress event does not happen (type II error/risk of issuing false signal [B]) or indicator does not give signal but distress event happens (type I error/risk of missing crisis [C]). The condition is briefly illustrated in the table below:
Table 1. Statistical Errors

<table>
<thead>
<tr>
<th>Table of Statistical Errors</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress Event</td>
<td>No Stress Event</td>
</tr>
<tr>
<td>Predicted Signal Issued</td>
<td>Correct Signal (A)</td>
</tr>
<tr>
<td>No Signal Issued</td>
<td>Type I Error (C)</td>
</tr>
</tbody>
</table>

Source: Ito et al. (2014)

Statistical evaluation on several selected EWI in this research adopts statistical method used by Ito et al. (2014) to evaluate financial activity index (FAIX) in Japan. Using the method, the threshold level that will minimize “loss” will be determined in which loss itself is the weighted average of type I error and type II error probabilities. The loss function calculation formula can be written as follows:

\[ L(\mu, \tau) = \mu P T_1(\tau) + (1 - \mu)(1 - P) T_2(\tau) \]

\[ P = \frac{A + C}{A + B + C + D}, \quad T_1(\tau) = \frac{C}{A + C}, \quad T_2(\tau) = \frac{B}{B + D} \]

A, B, C, and D is related to the number of periods happening when an indicator gives signal and distress happens (A), an indicator gives signal but distress does not happen (B), an indicator does not give signal but distress happens (C), and an indicator does not give signal and distress does not happen (D). \( L(\mu, \tau) \) is the loss obtained by regulator based on certain regulator preference parameter (\( \mu \)) and threshold value.

Regulator preference parameter (\( \mu \)) value can vary from 0 to 1, with \( \mu = 0.5 \) value implies that regulator minimizes type I and type II error value in balance while \( \mu > 0.5 \) value indicates that regulator prefers to minimize type I error rather than type II error. \( P \) is the ratio of comparison between number of periods when indicators provide signal with total periods observed. \( T_1(\tau) \) and \( T_2(\tau) \) respectively are type I and type II error probabilities. Besides minimizing loss value, selected EWI is also EWI which has predictive power (1 – type I error) or signal-providing strength above 67%. This could mean that the indicator can give signal accurately at least 2/3 of the occurring stress period.
3.3.4. Robustness Testing

Referring to Ishikawa et al. (2012), robustness testing of EWI can be made by observing historical behavior of the EWI by analyzing the degree of real time estimation problem to the period distress occurs. Moreover, robustness testing to EWI is conducted by using standard deviation value or root mean square (RMS) to the period when distress occurs, to then be decided which is the best threshold in giving signal. An EWI is said to be robust if the statistical evaluation result of historical behavior can minimize loss as gotten from EWI selection analysis result by using all samples. Significantly different statistical value between out of sample testing (robustness check) and EWI selection analysis (all sample) implies model contains real time estimation problem and model is considered not robust.
IV. RESULT ANALYSIS

4.1. Statistical Evaluation Result

To obtain EWI using the aforementioned methodology, a formulation indication of stress condition from each indicator is needed as summarized in Table 2. EWI candidates are financial ratios originated from corporate financial report comprising balance sheet, income statement, and cash flow (Pranowo et al., 2010). The indicators are then grouped into four categories (Jakubik and Teply, 2011), which are liquidity indicators, solvency indicators, profitability indicators, and activity indicators.

<table>
<thead>
<tr>
<th>Indikator Kondisi Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR &lt; Lower Threshold</td>
</tr>
<tr>
<td>QR &lt; Lower Threshold</td>
</tr>
<tr>
<td>DER &gt; Upper Threshold</td>
</tr>
<tr>
<td>DAR &gt; Upper Threshold</td>
</tr>
<tr>
<td>ICR &lt; Lower Threshold</td>
</tr>
<tr>
<td>SR &lt; Lower Threshold</td>
</tr>
<tr>
<td>DSR &gt; Upper Threshold</td>
</tr>
<tr>
<td>GPM &lt; Lower Threshold</td>
</tr>
<tr>
<td>ROA &lt; Lower Threshold</td>
</tr>
<tr>
<td>ROE &lt; Lower Threshold</td>
</tr>
<tr>
<td>I_Turn &lt; Lower Threshold</td>
</tr>
<tr>
<td>A_Turn &lt; Lower Threshold</td>
</tr>
<tr>
<td>C_DA &lt; Lower Threshold</td>
</tr>
</tbody>
</table>

Table 2. Summary of EWI Candidates on Corporate Financial Distress

Source: Jakubik and Teply (2011)

Analysis result of selected indicators is then presented in statistical or graphic tabulation. Based on Table 3 information on noise to signal ratio (NSR) analysis result shows that long-term trend obtained with one sided HP filter method is better in giving signal on distress compared to moving average. The result is applicable to all indicators with accurate prediction above 67% and minimum statistical error compared to other indicators.

Statistical evaluation (Table 3) shows several indicators which can give signal on distress in NFC sector in aggregate among others are debt to equity ratio (DER)
as leading indicator as well as current ratio (CR), quick ratio (QR), debt to asset ratio (DAR), solvability ratio (SR), and debt service ratio (DSR) which are near term indicators. Historically, DER is proven able to provide signal consistently within one year before distress event in 2009 Q1 with signal accuracy in capturing distress more than 67% (leading). While other indicators tend to be near term because it gives signal in a relatively shorter time period which is one year before distress occurs.

In sectors, there are 4 leading indicators: DER (agricultural sector, various industries and property & real estate), DSR (base and chemical industry), DAR (various industry), and asset turnover (trade, service, and investment sector). Moreover, there are several sectors having near term indicator, such as agricultural sector (capital expenditure to depreciation and amortization); infrastructure, utility, and transportation sector (interest coverage ratio, inventory turnover, and asset turnover); various industry (SR); mining sector (ROA and ROE); trade, service and investment sector (QR).

<p>| Table 3. Statistical Evaluation of EWI Candidates on Corporate Financial Distress |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th><strong>Indicator</strong></th>
<th><strong>Kategori</strong></th>
<th><strong>Model</strong></th>
<th><strong>Trend</strong></th>
<th><strong>Threshold</strong></th>
<th><strong>Predictive Power</strong></th>
<th><strong>Loss</strong></th>
<th><strong>First Signal</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AGGREGATE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>Liquidity Indicator</td>
<td>μ = 0.5</td>
<td>one-sided HP filter</td>
<td>1σ (lower)</td>
<td>80%</td>
<td>0.111</td>
<td>2008Q1</td>
</tr>
<tr>
<td>QR</td>
<td>Liquidity Indicator</td>
<td>μ = 0.5</td>
<td>one-sided HP filter</td>
<td>1σ (lower)</td>
<td>80%</td>
<td>0.042</td>
<td>2008Q2</td>
</tr>
<tr>
<td>DER</td>
<td>Solvency Indicator</td>
<td>μ = 0.5</td>
<td>one-sided HP filter</td>
<td>1σ (upper)</td>
<td>80%</td>
<td>0.095</td>
<td>2008Q4</td>
</tr>
<tr>
<td>DAR</td>
<td>Solvency Indicator</td>
<td>μ = 0.5</td>
<td>one-sided HP filter</td>
<td>1σ (lower)</td>
<td>80%</td>
<td>0.107</td>
<td>2009Q2</td>
</tr>
<tr>
<td>SR</td>
<td>Solvency Indicator</td>
<td>μ = 0.5</td>
<td>one-sided HP filter</td>
<td>1σ (lower)</td>
<td>80%</td>
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<td>2009Q2</td>
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<tr>
<td>DSR</td>
<td>Solvency Indicator</td>
<td>μ = 0.5</td>
<td>one-sided HP filter</td>
<td>1σ (upper)</td>
<td>80%</td>
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<td>0.048</td>
<td>2009Q2</td>
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<td>2009Q2</td>
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<td>2009Q2</td>
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<td>80%</td>
<td>0.048</td>
<td>2009Q2</td>
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</tbody>
</table>

Source: author calculation | Leading Indicator | Near-Term Indicator | 20
4.2. **Selected EWI Graphics**

Visually, the graphics below can provide illustration on each indicator’s ability in providing signal before distress event occurs. Red vertical line indicates the beginning of a distress while the shaded area is the period identified by each indicator as distress period. This is signified by indicator value which surpasses the set threshold based on statistical evaluation on the period.

Figure 7 shows that in aggregate CR, QR, DER, DAR, SR, and DSR are able to give early signal on distress potential with accurate prediction above 80%. Among the 6 indicators, only DER which started to provide signal more than one year before distress in 2007 Q4. Data on 2015 initial position shows that corporate financial conditions are in safe level hence it is forecast that within one year corporate financial condition will remain in secure condition. Banking can continue channeling loans to real sector to propel the economy which is then expected to increase economic growth.

---

Based on Figure 8 to Figure 15, an information is obtained that each sector in corporates has different EWI. There are indicators which can be EWI of a sector, but cannot provide distress signal for other sectors. This is because of different business characteristics among sectors. Solvency indicators, such as DER, DAR,
DSR, and SR remain dominant indicators of EWI in various sectors: agriculture, base and chemical industry, various industry, and property & real estate. It is different to mining sector in which distress signal is given by profitability indicators, which are ROA and ROE, as well as trade, service, and investment sector which is dominated by activity indicators (inventory turnover and asset turnover) and liquidity indicator (quick ratio). Generally, DER can become EWI which can represent corporate financial condition in aggregate or sectors. However, monitoring and assessment to other complementary indicators are still needed, particularly to sectors having high interconnection with financial sector.

![Debt to Equity ratio (DER)](image)

Figure 8. Selected Agriculture Sector EWI

![CapEx to Dep_Amor Ratio (C_DA)](image)

Figure 9. Selected Base and Chemical Industry Sector EWI

![Debt Service Ratio (DSR)](image)

![Interest Cov. Ratio (ICR)](image)

![Inventory Turnover (I_Turn)](image)

![Asset Turnover (A_Turn)](image)

Figure 10. Selected Infrastructure, Utility, and Transportation Sector EWI
Figure 11. Selected Various Industry Sector EWI

Figure 12. Selected Mining Sector EWI

Figure 13. Selected Real Estate and Property Sector EWI

Figure 14. Selected Trade, Service, and Investment Sector EWI
4.3. **Robustness Testing Result**

To ensure the result obtained is robust, a robustness testing is made to analyze the degree of real time estimation problem until the period of distress occurring based on the EWI historical behavior (Ishikawa et al., 2012). An EWI is said to be robust if the statistical evaluation result from the historical behavior can minimize loss as received by the EWI selection analysis result using all samples. Significantly different statistical value between out of sample testing (robustness check) and EWI selection analysis (all sample) implies the model contains real time estimation problem and is considered not robust.

**Assessment for all period**

**Robustness to real time estimation problem**

- The end of 2009Q1 -

*Current Ratio (CR)*

*Quick Ratio (QR)*

*Debt to Equity ratio (DER)*
Debt to Asset Ratio (DAR)

Solvability Ratio (SR)

Debt Service Ratio (DSR)

Figure 15. Comparison of Selected EWI Performance: All Samples vs Real Time Estimation Problem

Overall, robustness testing result shows that indicators are quite robust in providing signal before distress event period. Based on Table 4 it can be seen that the loss produced by out of sample tends to be smaller if compared to analysis of all samples with relatively similar prediction accuracy.
Table 4. Statistical Evaluation Result Comparison: All Samples vs Real Time Estimation Problem

<table>
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<th>Indicators</th>
<th>Kategori</th>
<th>Model</th>
<th>Trend</th>
<th>Threshold</th>
<th>Predictive Power</th>
<th>Loss</th>
<th>First Signal (Distress: 2009Q1)</th>
<th>Predictive Power</th>
<th>Loss</th>
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<td>λ = 1600</td>
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<td>SR</td>
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<td>0.131</td>
<td>2608Q2</td>
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<td>DSR</td>
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</table>

Legend: 
- **Red** Leading Indicator  
- **Green** Near-Term Indicator
V. CLOSING

5.1. **Conclusion**

Based on the analysis result it can be concluded that:

1. Noise to Signal Ratio (NSR) analysis result shows that long-term trend obtained by one sided HP filter method is better in giving signal of distress compared to moving average.

2. Statistical evaluation on several EWI candidates for corporate financial distress shows that several indicators which can give early signal on distress or vulnerabilities in non-financial corporate sector in aggregate among others are debt to equity ratio (DER) as leading indicator as well as current ratio (CR), quick ratio (QR), debt to asset ratio (DAR), solvability ratio (SR), and debt service ratio (DSR) as near term indicator.

3. For sectors, there are 4 leading indicators: (a) DER for agricultural sector, various industry, and property & real estate sector; (b) DSR for base and chemical industry; (c) DAR for various industry sector; and (d) asset turnover for trade, service, and investment sector.

4. There are several sectors having near term indicator, among others (a) for agriculture sector is capital expenditure to depreciation and amortization; (b) for infrastructure, utility, and transportation sector is interest coverage ratio, inventory turnover, and asset turnover; (c) for various industry is solvability ratio (SR); (d) for mining sector is return on asset (ROA) and return on equity (ROE); and (e) for trade, service and investment sector is quick ratio (QR).

5. The identified early warning indicator (EWI), both in sector or aggregate, can be used to identify corporate sector distress. Therefore, the effort to prevent increasing risk which can trigger financial crisis can be anticipated early and financial system stability remains resilient.

6. Considering the EWI signaling ability identification is based on historical data behavior, which cannot capture behavioral changes of economic players going forward, then EWI utilization should be completed with other indicators.
5.2. Development Area Going Forward

To improve the analysis result, there are several development agendas going forward among others such as:

1. Other methodology utilizations related to EWI formulation needs to be studied among others by using area under receiver operating characteristic (AUROC) curves to improve the analysis result obtained in this research.

2. The methodology then can be applied to other economic sectors to obtain a complete financial activity indicator and heatmap.


APPENDIX

Network Analysis Result Based on Financial Account and Balance Sheet Data

Gross Exposure 2015Q2

Net Exposure 2015Q2

Source: Bank Indonesia