# Financial Distress Analysis Using Accounting Ratios and Prediction Models as Early Warning Tools: The Case of EMIVAR (2017-2024)

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**Abstract:**

This study examines EMIVAR's financial health from 2017 to 2024, drawing on the company's financial statements to track accounting ratios, alongside three distress prediction models: Altman, Springate, and Zmijewski.

The results indicate financial deterioration. Liquidity declined, profitability stayed weak, efficiency fell, and financial pressure accumulated over the eight-year period. Altman and Springate indicated financial distress, while the Zmijewski scores remained below the distress threshold despite moving closer to it after 2021. For public enterprises with limited external scrutiny, that kind of convergence between ratio analysis and prediction models may be the closest thing available to a reliable early warning.

**Keywords:** accounting ratios; financial distress; prediction models; financial health.

**JEL Classification Codes**: G33, M41.

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## 1. INTRODUCTION

One of the most critical issues in corporate finance is financial distress because of its impact on the firm's continuity, stakeholder confidence, and economic stability. In the literature, financial distress is introduced as a gradual process, not a sudden event caused by persistent weaknesses in liquidity, profitability, operational efficiency, and financial structure (Beaver, 1966; Altman, 1968; Whitaker, 1999). In this context, it has been shown that financial symptoms are detectable several years before a formal failure (Ohlson, 1980; Platt & Platt, 2002).

Financial ratios serve as standardized indicators that assess the firm's performance and allow for longitudinal comparison (Higgins, 2012; Ross, Westerfield, Jaffe, & Jordan, 2019). Short-term solvency is reflected in liquidity ratios while earning capacity is measured by profitability ratios, asset utilization is assessed by activity ratios and financial risk exposure is indicated by leverage ratios (Brigham & Ehrhardt, 2017).

Altman's Z-score and Ohlson's model contributions illustrate the limitations of isolated ratio analysis in predicting financial failure, which encourage the development of distress prediction models that integrate multiple financial indicators into composite measures (Zmijewski, 1984; Springate, 1978; Altman, Iwanicz-Drozdowska, Laitinen, & Suvas, 2017).

In emerging economies, although numerous studies have examined financial distress prediction models, empirical evidence suggests that their consistency and practical usefulness are enhanced when they are applied alongside traditional ratios, providing earlier and more reliable distress signals (Agarwal & Taffler, 2008; Almamy, Aston, & Ngwa, 2016).

Recent studies have demonstrated the usefulness of financial distress prediction models based on accounting data in various contexts; however, most have focused on the accuracy of the models or cross-sectional comparisons, with less attention paid to tracking the progression of financial deterioration within the same enterprise over time using financial ratios and multiple models. This study addresses this gap by combining financial ratios analysis with the Altman, Springate, and Zmijewski models over an eight-year period, with the aim of tracking the evolution and the consistency of financial warning signs.

Accordingly, this study addresses the following research question:

**To what extent can financial ratios and financial distress models jointly diagnose the evolution of financial distress in the case of EMIVAR during the period 2017-2024?**

A related sub-question is therefore formulated as follows: *To what extent are the distress signals generated by the Altman, Springate, and Zmijewski models consistent with one another over the study period?*

### 1.1 Objective of the study

This study aims to analyze the trajectory of EMIVAR during the period (2017-2024), through the combination of accounting ratio analysis and the application of financial distress prediction models. The study seeks to diagnose the firm's financial health through the analysis of liquidity, profitability, activity and leverage indicators. It further aims to assess the degree of consistency among the financial distress signals generated by the Altman, Springate, and Zmijewski models over the study period. It also aims to assess the consistency of traditional accounting ratios with distress prediction models and analyze the cumulative and temporal nature of the firm's financial deterioration while emphasizing the early warning role of these tools in identifying potential issues before they become more severe.

### 1.2 Importance of the study

This study derives its importance from providing an in-depth applied analysis of EMIVAR's position contributing to the literature on financial distress diagnosis in the context of public companies. The empirical importance of this study lies in combining financial ratios with prediction models as early warning tools to enable managers to identify financial distress risks at an early stage, adopting precautionary strategies that aim to improve liquidity management, rationalize financial structure and reinforce operational efficiency before financial conditions deteriorate significantly.

From a broader developmental perspective, the study highlights the importance of embedding a culture of early warning within Algerian public enterprises. Regular financial monitoring can facilitate the early detection of financial deterioration, support timely managerial action, and enhance

financial sustainability.

### 1.3 Methodology

**1.3.1 Research Design:** An integrated analysis combining traditional financial ratios with established financial distress prediction models is suggested by adopting a longitudinal diagnostic case study design to examine the financial distress trajectory of EMIVAR over the period 2017-2024.

**1.3.2 Data Source and Sample:** The dataset included in the empirical analysis is selected from EMIVAR's published financial statements for the period 2017-2024. Initial data is extracted from balance sheet and income statement items. To provide a consistent and comparable dataset suitable for longitudinal financial analysis, ratios and distress prediction scores were calculated using Excel.

**1.3.3 Variables and Measurement:** To operationalize the study objectives, the following variables are employed:

- **Liquidity ratios** (e.g., current ratio, quick ratio) to assess short-term solvency;
- **Profitability ratios** (e.g., return on assets, return on equity, net profit margin) to measure earnings performance;
- **Activity ratios** (e.g., total asset turnover, inventory turnover) to evaluate operational efficiency;
- **Leverage ratios** (e.g., debt-to-equity ratio, interest coverage ratio) to capture financial risk exposure.

**Table 1.** Operational Definitions & Measurement of Financial Indicators

| Category | Indicator | Operational Measurement |
|---|---|---|
| **Liquidity** | ***Current Ratio*** | Current Assets / Current Liabilities |
| | ***Quick Ratio*** | (Current Assets – Inventory) / Current Liabilities |
| **Profitability** | ***Net Profit Margin (NPM)*** | Net Income / Sales |
| | ***Return on Assets (ROA)*** | Net Income / Total Assets |
| | ***Return on Equity (ROE)*** | Net Income / Equity |
| **Activity** | ***Total Asset Turnover (TAT)*** | Sales / Total Assets |
| | ***Inventory Turnover (IT)*** | Cost of goods sold / Inventory |
| **Working capital** | ***Days Inventory Outstanding (DIO)*** | Inventory / COGS × 365 |
| | ***Days Sales Outstanding (DSO)*** | Accounts Receivable / Sales × 365 |
| | ***Days Payable Outstanding*** | Accounts Payable / COGS × 365 |

| | | |
|---|---|---|
| | ***(DPO)*** | |
| | ***Cash Conversion Cycle (CCC)*** | DIO + DSO - DPO |
| **Leverage** | ***Debt-to-Equity Ratio (DER)*** | Total Liabilities / Equity |
| | ***Times Interest Earned (TIE)*** | EBIT / Interest Expense |

**Source:** Compiled by authors based on: (Higgins, 2012), (Brigham & Ehrhardt, 2017), and (Ross, Westerfield, Jaffe, & Jordan, 2019)

In addition, three widely used financial distress prediction models are calculated and analyzed:

- Altman Z-score;
- Springate S-score;
- Zmijewski X-score.

**1.3.4 Research Procedure:** The steps of this study can be summarized as follows:

- Collection of EMIVAR's financial data for the period 2017-2024;
- Calculation of financial ratios and financial distress prediction scores;
- Comparative assessment of distress signals generated by Altman, Springate, and Zmijewski models;
- Descriptive analysis of financial performance trends.

**1.3.5 Analytical Techniques:** Descriptive trend analysis was used to examine the evolution of financial ratios and distress indicators over time. Comparative analysis was also employed to evaluate the consistency of distress signals generated by the Altman, Springate, and Zmijewski models.

## 2. Theoretical Background

### 2.1 Financial Distress: Concept and economic Significance

Financial distress refers to sustained difficulties in meeting financial obligations and deteriorating operating performance (Platt & Platt, 2002). Financial distress particularly affects debt-servicing capacity and the ability to meet operating expenses (Altman, 1968). From this perspective, distress is not an abrupt event but a cumulative result of declining liquidity, weakening profitability, and insufficient asset utilization.

A high probability of financial failure can adversely affect financial costs, stakeholder confidence and managerial flexibility. This makes

financial distress early diagnosis and bankruptcy prevention efforts crucial, especially in economies where bank financing and internal funds are the main sources of funding (Brigham & Ehrhardt, 2017). In this context, the first warning signs of distress commonly observed in firms include declining margins, inefficient asset utilization, and growing dependence on external financing.

**2.2 Financial Ratio Analysis as an Early Warning Tool**

Financial ration analysis is one of the earliest and most widely used techniques for assessing financial health and is based on information contained in financial statements (Beaver, 1966; Higgins, 2012; Ross, Westerfield, Jaffe, & Jordan, 2019). The firm's ability to meet its short-term obligations, for instance, which is often considered among the earliest indicators of financial distress is measured by liquidity ratios, such as the current ratio and quick ratio (Casey & Bartczak, 1985; Platt & Platt, 2002). Long-term financial sustainability reflected in the firm's capacity to generate earnings from its resources, is measured by profitability ratios while activity ratios evaluate the firm's efficient utilization of its assets to generate revenue (Altman, 1968; Zmijewski, 1984; Brigham & Ehrhardt, 2017). The firm's dependence on debt financing and exposure to financial risk are reflected through leverage indicators (Ohlson, 1980; Agarwal & Taffler, 2008). The fact that these ratios may move in different directions within the same period creates the need for multivariate distress prediction models (Altman, Iwanicz-Drozdowska, Laitinen, & Suvas, 2017; Almamy, Aston, & Ngwa, 2016).

**2.3 Financial Distress Prediction Models**

A landmark contribution in this field is Altman's Z-score model, which classifies firms according to their likelihood of financial failure (Altman, 1968; Altman, Iwanicz-Drozdowska, Laitinen, & Suvas, 2017). Other models were introduced following Altman's work. Based on logistic regression, Ohlson (1980) proposed a probabilistic approach, highlighting indicators including firm size, leverage, and performance. The Springate (1978) model focused on refined variable selection, while Zmijewski (1984) proposed a model based on profitability, leverage, and liquidity. Each model operates within a specific context, focusing on particular

indicators (Agarwal & Taffler, 2008; Almamy, Aston, & Ngwa, 2016).

**2.4 Integration of Ratio Analysis and Distress Models**

The combined use of financial ratios and prediction models provides detailed insights into specific dimensions of financial performance, consequently, contributing to a deeper understanding of financial health and distress dynamics (ElBannan, 2021; Whitaker, 1999). In emerging economies, such integration is particularly valuable, where accounting information remains the primary source of financial assessment (Laeven & Valencia, 2018; ElBannan, 2021).

Ratio analysis and distress prediction models are not competing tools; they operate at different levels. Ratios are granular: they provide information about liquidity, profitability, and leverage. Prediction models provide an overall assessment of whether the firm, taken as a whole, looks like it is heading toward failure. Neither answer replaces the other. A firm can look fine on one ratio and still score poorly on the Altman Z-score, and understanding why that gap exists is often where the actual diagnosis happens.

Empirical work on distress prediction has been fairly consistent in its conclusions. Altman et al. (2017) showed that the Z-score remains applicable across countries and industries, not just the US manufacturing context it was built for. Almamy et al. (2016) found that adding cash-flow indicators to traditional ratios improved prediction accuracy in a UK sample. ElBannan (2021) pointed to profitability, leverage, and liquidity as the primary determinants of financial distress in emerging markets. Across these studies, the pattern is similar: accounting information and prediction models tend to perform better when used together than when applied in isolation.

**2.5 Literature Review**

Despite the expanded use of statistical methods, machine learning, and artificial intelligence in predicting financial distress, accounting information remains significant for the early detection of financial deterioration. Zhao, Ouenniche, and De Smedt (2024) emphasized the continued importance of

accounting-based models, while Powell, Dinh, Vu, and Vo (2024) demonstrated that profitability, liquidity, and leverage are important early warning indicators of financial distress. These results support the use of financial ratios for the early detection of financial difficulties.

Evidence from emerging markets indicates the enduring importance of accounting indicators in diagnosing financial distress, taking into account the economic and institutional context. In a study that included 11 MENA countries, ElBannan (2021) found that the most profitable, liquid, and mature companies were less susceptible to financial distress. In the Malaysian context, Mohamad, Azad, and Sifat (2021) showed that accounting information retains predictive value, although combining it with other information improves predictive capability.

Comparative studies suggest that financial distress prediction models do not necessarily provide the same results. Tapa and Ahmad Razif (2021), for instance, found differences in Altman, Springate, and Zmijewski results, despite all three models indicating financial distress. Mulyati and Ilyasa (2020) also confirmed the presence of differences in the findings of predictive models applied to Indonesian companies. These results support the use of several models jointly while assessing the degree of agreement among their results, rather than relying on a single model.

Algerian studies point to an increasing use of financial distress models in assessing local companies. Kalladi and Taleb (2021) applied Altman and Springate models to industrial companies listed on Algiers Stock Exchange: Saidal, NCA Rouiba, and Biopharm. While Meguelati and Boursas (2023) combined financial ratios analysis with several prediction models of financial distress, the findings showed that the models did not produce fully consistent results. Bourmel and Ben Rahmoun (2024) also applied both ratios and Altman and Springate models in analyzing the financial health of NCA Rouiba Company during several years. The studies confirm the relevance of prediction models in the Algerian context, with the probability of the variation in results depending on the model and the company under study.

**Table 2.** Comparative Summary of Previous Studies

| Study | Context | Method/Models | Main Findings | Relevance/Gap |
|---|---|---|---|---|
| **Powell, Dinh, Vu, & Vo (2024)** | ASEAN Firms | *Accounting-based indicators* | Profitability, liquidity, and leverage provide important early-warning signals of financial distress | Confirms the continuing relevance of financial ratios for early detection |
| **ElBannan (2021)** | MENA 11 countries | *Firm and country level factors* | Profitable, liquid, and mature firms were less susceptible to financial distress; contextual factors also mattered | Highlights the importance of accounting indicators and the economic and institutional context |
| **Tapa & Ahmad Razif (2021)** | Asia & Middle East | *Altman, Springate, & Zmijewski* | The three models indicated financial distress, although their results differed | Supports examining the consistency among multiple distress models |
| **Mulyati & Ilyasa (2020)** | Indonesien companies | *Multiple financial distress prediction models* | The models produced different assessments of financial distress | Reinforces the value of using and comparing multiple models |
| **Kalladi & Taleb (2021)** | Algerian listed industrial companies | *Altman & Springate* | Both models were useful in identifying financial distress | Provides evidence on the application of distress models in Algeria |
| **Meguelati & Boursas (2023)** | Biopharm, Algeria | *Financial ratios & multiple distress models* | The models did not provide fully consistent assessments | Shows the relevance of examining model agreement in the Algerian context |
| **Bourmel & Ben Rahmoun (2024)** | NCA Rouiba, Algeria | *Altman & Springate & longitudinal analysis* | The models were useful in identifying financial difficulties over time | Provides longitudinal Algerian evidence, but in a commercially oriented firm |

## 2.6 Research Gap and Positioning of the Present Study:

Although financial distress prediction models are increasingly used in Algeria, available studies focus primarily on listed or commercially oriented companies, whereas the financial deterioration of public enterprises has received less attention from a longitudinal perspective. The current study addresses this gap by analyzing EMIVAR over eight years. It combines financial ratios with Altman, Springate, and Zmijewski models, and examines the extent to which these tools provide consistent early-warning signals over time.

## 2.7 Study limitations

The study is limited to EMIVAR, which restricts the generalizability of its findings to other Algerian enterprises or sectors. It also relies on financial statements for the 2017-2024 period, without qualitative data regarding administrative, organizational, or operational factors.

Consequently, the results reflect EMIVAR's financial condition and do not represent Algerian public enterprises as a whole.

The application of established distress prediction models to EMIVAR should also be interpreted with caution, as these models were developed in corporate and institutional contexts that differ from that of an Algerian public enterprise.

In addition, the correlation analysis should also be interpreted with caution because it is based on only eight annual observations. In addition, some financial ratios overlap structurally with components of the distress models, particularly the Zmijewski model, which incorporates ROA, leverage, and the current ratio. Consequently, these correlations partly reflect model construction and should not be regarded as independent empirical validation.

## 3. Empirical Study

EMIVAR (Entreprise de Mise en Valeur et d'Aménagement Rural) is an Algerian public enterprise based in Ain Arnet, Sétif. Established in 1988, it operates mainly in building, public works, and hydraulics and is affiliated with GRITA (Groupe d'Infrastructures des Travaux Routiers et Ouvrage d'Art) (CACI, n.d).

In this section, data are presented, and financial ratios and distress predictive model scores are calculated and analyzed. The following tables and figures present the results of the analysis.

### 3.1 Financial Ratios

#### 3.1.1 Liquidity Ratios

**Table 3.** Liquidity Ratios

**Billion DZD**

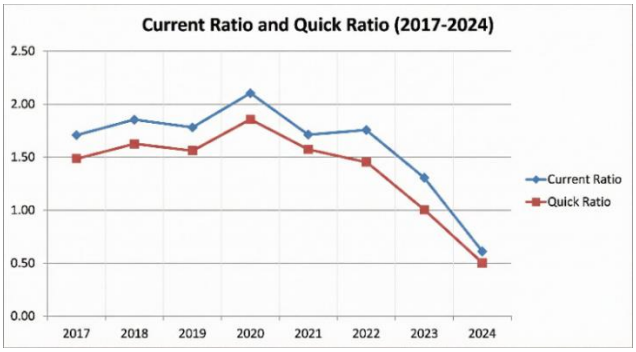
| | Item | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Liquidity Ratios** | Current Assets | 3.07 | 2.90 | 3.15 | 2.78 | 2.61 | 2.60 | 1.44 | 1.61 |
| | Current Liabilities | 1.83 | 1.43 | 1.62 | 1.34 | 1.38 | 1.91 | 1.97 | 2.78 |
| | Inventory | 0.28 | 0.26 | 0.28 | 0.30 | 0.27 | 0.27 | 0.23 | 0.24 |
| | Cash and Equivalent | 0.33 | 0.10 | 0.18 | 0.10 | 0.16 | 0.14 | 0.78 | 0.60 |
| **Current Ratio** | | **1.68** | **2.03** | **1.94** | **2.07** | **1.89** | **1.36** | **0.73** | **0.58** |
| **Quick Ratio** | | **1.52** | **1.85** | **1.77** | **1.85** | **1.70** | **1.22** | **0.61** | **0.49** |

**Source:** Calculated based on EMIVAR Financial Reports (2017-2024)

During the period 2017–2024, EMIVAR's liquidity position gradually

weakened. The current ratio remained at acceptable levels during the early years exceeding 1.5, which means that the company could meet its short-term obligations easily. After 2021, the ratio declined sharply, reaching 0.58 in 2024, indicating significant financial pressure. A similar situation occurred with the quick ratio, which fell from 1.85 in 2018 to 0.49 in 2024, indicating insufficient cash and near-cash resources to cover liabilities without selling inventory. Figure 1. provides a visual representation of these trends over the study period.

**Fig.1.** Liquidity Ratios




**Source:** Excel output; based on Table 3

During the period 2017–2024, EMIVAR's liquidity position gradually weakened. The current ratio remained at acceptable levels during the early years exceeding 1.5, which means that the company could meet its short-term obligations easily. After 2021, the ratio declined sharply, reaching 0.58 in 2024, indicating significant financial pressure. A similar situation occurred with the quick ratio, which fell from 1.85 in 2018 to 0.49 in 2024, indicating insufficient cash and near-cash resources to cover liabilities without selling inventory.

### 3.1.2 Profitability Ratios

**Table 4.** Profitability Ratios

**Billion DZD**

| | **Item** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|---|---|---|
| **Profitability Ratios** | Net Income | -0.10 | 0.02 | 0.01 | -0.25 | 0.03 | -0.58 | -1.10 | -0.49 |
| | Total Assets | 7.17 | 6.90 | 7.02 | 6.44 | 7.02 | 6.18 | 6.40 | 6.99 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sales | 1.53 | 1.34 | 1.46 | 1.28 | 1.65 | 1.22 | 0.58 | 0.84 |
| | Equity | 2.96 | 3.07 | 3.07 | 2.74 | 2.86 | 2.15 | 2.56 | 2.37 |
| **Net Profit Margin (NPM)** | | **-0.07** | **0.01** | **0.01** | **-0.20** | **0.02** | **-0.48** | **-1.90** | **-0.58** |
| **Return on Assets (ROA)** | | **-0.01** | **0.00** | **0.00** | **-0.04** | **0.00** | **-0.09** | **-0.17** | **-0.07** |
| **Return on Equity (ROE)** | | **-0.03** | **0.01** | **0.00** | **-0.09** | **0.01** | **-0.27** | **-0.43** | **-0.21** |

**Source:** Calculated based on EMIVAR Financial Reports (2017-2024)

**Fig.2.** Profitability Ratios




**Source:** Excel output; based on Table 4

EMIVAR exhibited weak profitability performance, with the net profit margin remaining close to zero until 2021, before deteriorating to -0.48 in 2022 and reaching its lowest level of -1.90 in 2023. It then improved to -0.58 in 2024, although it remained negative. ROA and ROE followed a similar pattern, reaching -0.17 and -0.43, respectively, in 2023 before improving to -0.07 and -0.21 in 2024. This suggests that the company's business structure is struggling to convert its assets and shareholders' funds into sustainable profits. Operating expense pressures and inefficient asset utilization affected EMIVAR's ability to generate income and reverse a persistent decline in profitability.

### 3.1.3 Activity Ratios

**Table 5.** Activity Ratios

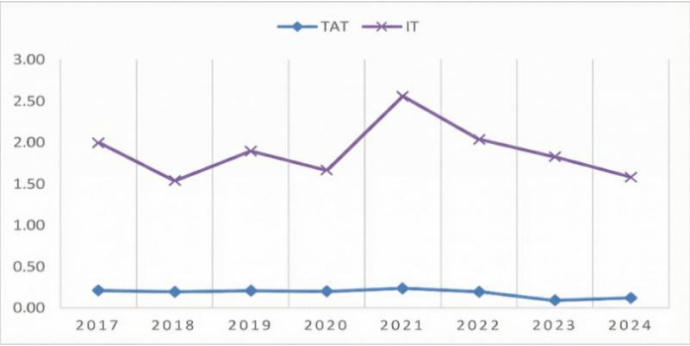
**Billion DZD**

| | **Item** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** |
|---|---|---|---|---|---|---|---|---|---|
| **Activity Ratios** | Current Assets | 3.07 | 2.90 | 3.15 | 2.78 | 2.61 | 2.60 | 1.44 | 1.61 |
| | Current Liabilities | 1.83 | 1.43 | 1.62 | 1.34 | 1.38 | 1.91 | 1.97 | 2.78 |
| | Total Assets | 7.17 | 6.90 | 7.02 | 6.44 | 7.02 | 6.18 | 6.40 | 6.99 |
| | Sales | 1.53 | 1.34 | 1.46 | 1.28 | 1.65 | 1.22 | 0.58 | 0.84 |
| | COGS | 0.56 | 0.40 | 0.53 | 0.50 | 0.69 | 0.55 | 0.42 | 0.38 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Inventory | 0.28 | 0.26 | 0.28 | 0.30 | 0.27 | 0.27 | 0.23 | 0.24 |
| **Total Assets Turnover (TAT)** | **0.21** | **0.19** | **0.21** | **0.20** | **0.24** | **0.20** | **0.09** | **0.12** |
| **Inventory Turnover (IT)** | **2.00** | **1.54** | **1.89** | **1.67** | **2.56** | **2.04** | **1.83** | **1.58** |

**Source:** Calculated based on EMIVAR Financial Reports (2017-2024)

**Fig.3.** Activity Ratios




**Source:** Excel output; based on Table 5

Over the review period, EMIVAR's operational efficiency weakened. Total asset turnover fell from 0.24 in 2021 to 0.12 in 2024, showing that each unit of the company's assets generated progressively lower levels of revenue over time.

### 3.1.4 Cash Conversion Cycle (CCC)

**Table 6.** Cash Conversion Cycle (CCC)

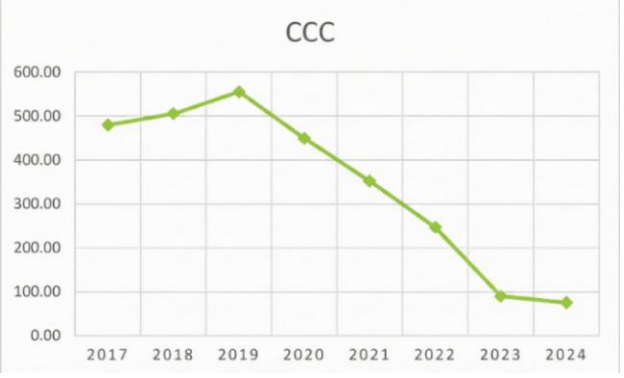
**Billion DZD**

| | Item | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Cash Conversion Cycle (CCC)** | Accounts Receivable | 2.75 | 2.63 | 2.85 | 2.21 | 2.49 | 2.31 | 1.13 | 1.31 |
| | Accounts Payable | 0.55 | 0.49 | 0.51 | 0.55 | 0.65 | 0.95 | 0.95 | 0.76 |
| | Sales | 1.53 | 1.34 | 1.46 | 1.28 | 1.65 | 1.22 | 0.58 | 0.84 |
| | COGS | 0.56 | 0.40 | 0.53 | 0.50 | 0.69 | 0.55 | 0.42 | 0.38 |
| | Inventory | 0.28 | 0.26 | 0.28 | 0.30 | 0.27 | 0.27 | 0.23 | 0.24 |
| **Days Inventory Outstanding (DIO)** | | **185.46** | **240.30** | **192.49** | **217.44** | **141.11** | **179.70** | **199.93** | **288.84** |
| **Days Sales Outstanding (DSO)** | | **654.50** | **716.60** | **714.76** | **631.45** | **552.68** | **692.78** | **708.54** | **566.37** |
| **Days Payables Outstanding (DPO)** | | **360.32** | **451.86** | **352.33** | **399.82** | **342.14** | **626.01** | **819.37** | **720.01** |
| **Cash Conversion Cycle (CCC)** | | **479.63** | **505.04** | **554.92** | **449.07** | **351.65** | **246.47** | **89.10** | **75.20** |

**Source:** Calculated based on EMIVAR Financial Reports (2017-2024)

EMIVAR's Cash Conversion Cycle (CCC) remains exceptionally high during most of the study period, as reported in Table (6) and illustrated in Figure (4). Significant working capital inefficiencies are reflected in the rising CCC from 479.63 days in 2017 to 505.04 days in 2018 and reaching a maximum of 554.92 days in 2019. The elevated CCC values reflect liquidity stress and delayed cash recovery. In 2021, the CCC decreased to 351.65 days reflecting lower sales and inventory levels, before declining to 89.10 days in 2023 and 75.20 days in 2024.

**Fig.4.** Cash Conversion Cycle (CCC)




**Source:** Excel output; based on Table 6

The unusually high DSO and DPO values should also be interpreted in light of EMIVAR's operating context. As a public company operating in public works and long-term projects, EMIVAR is engaged in project-based activities that may involve relatively long billing, collection, and settlement cycles. This operating structure may partly explain the prolonged receivables and payables periods observed during the study period.

### 3.1.5 Leverage Ratios

**Table 7.** Leverage Ratios

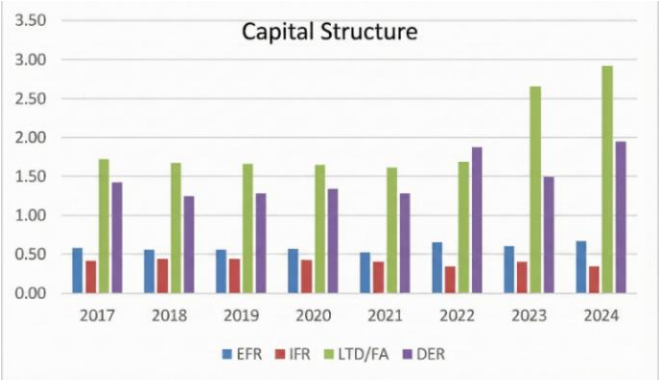
**Billion DZD**

| | Item | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Leverage Ratios** | NonCurrent Liabilities | 2.38 | 2.39 | 2.32 | 2.32 | 2.30 | 2.13 | 1.87 | 1.84 |
| | Current Liabilities | 1.83 | 1.43 | 1.62 | 1.34 | 1.38 | 1.91 | 1.97 | 2.78 |
| | NonCurrent Assets | 4.10 | 3.99 | 3.86 | 3.83 | 3.72 | 3.58 | 4.96 | 5.37 |
| | Total Assets | 7.17 | 6.90 | 7.02 | 6.44 | 7.02 | 6.18 | 6.40 | 6.99 |
| | Sales | 1.53 | 1.34 | 1.46 | 1.28 | 1.65 | 1.22 | 0.58 | 0.84 |
| | Equity | 2.96 | 3.07 | 3.07 | 2.74 | 2.86 | 2.15 | 2.56 | 2.37 |
| | EBIT | -0.12 | 0.04 | 0.02 | -0.03 | 0.08 | -0.51 | -1.02 | -0.57 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Interest Expense | 0.01 | 0.02 | 0.01 | 0.02 | 0.03 | 0.07 | 0.07 | 0.08 |
| External Financing Ratio (EFR) | **0.59** | **0.55** | **0.56** | **0.57** | **0.52** | **0.65** | **0.60** | **0.66** |
| Internal Financing Ratio (IFR) | **0.41** | **0.44** | **0.44** | **0.43** | **0.41** | **0.35** | **0.40** | **0.34** |
| Long-term Debt to Fixed Assets Ratio | **1.72** | **1.67** | **1.66** | **1.65** | **1.62** | **1.68** | **2.65** | **2.92** |
| Debt to Equity Ratio (DER) | **1.42** | **1.24** | **1.28** | **1.34** | **1.29** | **1.88** | **1.50** | **1.95** |
| Times Interest Earned (TIE) | **-12** | **2** | **2** | **-1.5** | **2.67** | **-7.29** | **-14.57** | **-7.13** |

**Source:** Calculated based on EMIVAR Financial Reports (2017-2024)

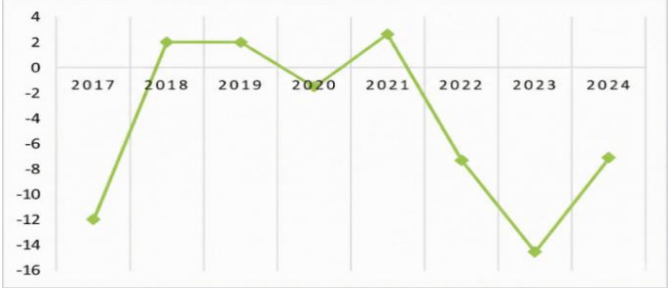
**Fig.5.** Leverage Ratios




**Source:** Excel output; based on Table 7

Table (7) shows a declining internal financing ratio from 0.41 to 0.34, and increasing external financing ratio from 0.59 in 2017 to 0.66 in 2024. The debt-to-equity ratio rises from 1.42 in 2017 to 1.95 in 2024 and the long-term debt to fixed assets ratio escalates from 1.72 to 2.92, suggesting an increasingly fragile capital structure and elevated financial risk as long-term liabilities increasingly exceeded the productive capacity of fixed assets.

**Fig.6.** Times Interest Earned




**Source:** Excel output; based on Table 7

In 2018 and 2019, the Times Interest Earned ratio recorded a modest

value of (2). The ratio turned negative reaching -7.29 in 2022, -14.57 in 2023, and -7.13 in 2024, indicating that operating earnings were insufficient to cover interest expenses.

## 3.2 Distress Prediction Model

### 3.2.1 Altman Z-score

$$Z = 6.56\ X_1 + 3.26\ X_2 + 6.72\ X_3 + 1.05\ X_4$$

**Where:**

*$X_1$: Working Capital / Total Assets*
*$X_2$: Retained Earnings / Total Assets*
*$X_3$: Earnings before Interest and Taxes (EBIT) / Total Assets*
*$X_4$: Equity / Total Liabilities*

For the Z-score model applied to firms, a score below 1.10 indicates financial distress, a score between 1.10 and 2.60 falls within the grey zone, while a score above 2.60 indicates a financially safe position (Altman & Hotchkiss, 2006).

**Table** 8. Z-Score Ratio

| | Item | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Altman Z-score** | $X_1$ | 0.26 | 0.21 | 0.22 | 0.22 | 0.18 | 0.11 | -0.08 | -0.17 |
| | $X_2$ | -0.02 | 0.003 | -0.01 | -0.04 | -0.04 | -0.06 | -0.09 | -0.24 |
| | $X_3$ | -0.02 | 0.01 | 0.003 | -0.005 | 0.01 | -0.08 | -0.16 | -0.08 |
| | $X_4$ | 0.41 | 0.44 | 0.44 | 0.43 | 0.41 | 0.35 | 0.40 | 0.34 |
| Z = | | **1.94** | **1.92** | **1.89** | **1.73** | **1.55** | **0.36** | **-1.47** | **-2.08** |

**Source:** Calculated based on **Altman and Hotchkiss** (2006)

The results signal a high probability of financial failure as the company moved from the gray zone into the distress zone. The Altman Z-score decreased from 1.94 in 2017 to 1.55 in 2021, before dropping sharply to 0.36 in 2022 and turning negative in 2023 (-1.47) and (-2.08) in 2024 indicating a sustained deterioration in EMIVAR's financial health.

### 3.2.2 Springate S-score

$$S = 1.03A + 3.07B + 0.66C + 0.4D$$

**Where:**

***A:*** *Working Capital / Total Assets*
***B:*** *Earnings Before Interest and Taxes (EBIT) / Total Assets*
***C:*** *Earnings Before Taxes (EBT) / Current Liabilities*
***D:*** *Sales / Total Assets*

According to Springate model, an S-score below 0.862 indicates financial

distress, whereas a score equal to or above 0.862 indicates a financially healthy position (Springate, 1978).

**Table** 9. S-Score Ratio

| | Item | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Springate S-score** | *A* | 0.26 | 0.21 | 0.22 | 0.22 | 0.18 | 0.11 | -0.08 | -0.17 |
| | *B* | -0.02 | 0.005 | 0.002 | -0.004 | 0.01 | -0.08 | -0.16 | -0.08 |
| | C | -0.07 | 0.03 | 0.01 | -0.02 | 0.06 | -0.27 | -0.52 | -0.21 |
| | *D* | 0.21 | 0.19 | 0.21 | 0.20 | 0.24 | 0.20 | 0.09 | 0.12 |
| S = | | **0.24** | **0.33** | **0.32** | **0.28** | **0.35** | **-0.23** | **-0.88** | **-0.51** |

**Source:** Calculated based on **Springate (1978)**

The Springate S-score remained below the 0.862 cut-off throughout the study period, indicating financial distress in all the years. The score increased slightly from 0.24 in 2017 to 0.35 in 2021, before deteriorating sharply to -0.23 in 2022, -0.88 in 2023, and -0.51 in 2024. These results indicate that financial vulnerability was already present during earlier years and became substantially more severe after 2021.

### 3.2.3 Zmijewski X-Score

$$X = -4.3 - 4.5\,X_1 + 5.7\,X_2 + 0.004\,X_3$$

**Where:**

$X_1$: *Return on Assets (ROA)*

$X_2$: *Total Liabilities / Total Assets*

$X_3$: *Current Assets / Current Liabilities (Current Ratio)*

According to the Zmijewski model, an X-score greater than zero indicates financial distress, whereas a negative score corresponds to a non-distress side (Zmijewski, 1984).

**Table** 10. X-Score Ratio

| | Item | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|
| **Zmijewski X-score** | $X_1$ | -0.01 | 0.003 | 0.001 | -0.04 | 0.004 | -0.09 | -0.17 | -0.07 |
| | $X_2$ | 0.59 | 0.55 | 0.56 | 0.57 | 0.52 | 0.65 | 0.60 | 0.66 |
| | $X_3$ | 0.68 | 2.03 | 1.94 | 2.07 | 1.89 | 1.36 | 0.73 | 0.58 |
| X = | | **-0.93** | **-1.20** | **-1.15** | **-0.92** | **-1.37** | **-0.19** | **-0.15** | **-0.26** |

**Source:** Calculated based on **Zmijewski (1984)**

Zmijewski X-scores remained negative throughout the study period, indicating that the model does not classify EMIVAR in the distress zone. However, the values moved closer to the zero threshold after 2021, indicating a deterioration in its financial position, without reaching the point

of default according to the model.

The three models differ in their classification of EMIVAR's financial condition. While Altman and Springate indicate financial distress, Zmijewski scores remain below the distress threshold, although their movement closer to zero after 2021 reflects a deterioration in the enterprise financial position.

**Table 11.** Correlation Matrix

| Item | | CR | NPM | ROA | DER | Atman Z-S | Springate S-S | Zmijewski X-S |
|---|---|---|---|---|---|---|---|---|
| **CR** | **r** | 1 | .771 | .789 | -.774 | .974 | .944 | -.866 |
| | **Sig** | | .025 | .020 | .024 | .000 | .000 | .005 |
| **NPM** | **r** | .771 | 1 | .961 | -.361 | .772 | .924 | -.771 |
| | **Sig** | .025 | | .000 | .380 | .025 | .001 | .025 |
| **ROA** | **r** | .789 | .961 | 1 | -.540 | .797 | .941 | -.889 |
| | **Sig** | .020 | .000 | | .167 | .018 | .000 | .003 |
| **DER** | **r** | -.774 | -.361 | -.540 | 1 | -.755 | -.669 | .841 |
| | **Sig** | .024 | .380 | .167 | | .030 | .070 | .009 |
| **Atman Z-S** | **r** | .974 | .772 | .797 | -.755 | 1 | .939 | -.845 |
| | **Sig** | .000 | .025 | .018 | .030 | | .001 | .008 |
| **Springate S-S** | **r** | .944 | .924 | .941 | -.669 | .939 | 1 | -.913 |
| | **Sig** | .000 | .001 | .000 | .070 | .001 | | .002 |
| **Zmijewski X-S** | **r** | -.866 | -.771 | -.889 | .841 | -.845 | -.913 | 1 |
| | **Sig** | .005 | .025 | .003 | .009 | .008 | .002 | |

**Source: SPSS 23 output.**

The correlation matrix shows strong associations between selected financial ratios and distress prediction model scores over the study period. The current ratio is positively associated with the Altman Z-score (r=0.974) and Springate S-score (r=0.944) and negatively associated with Zmijewski X-score (r=-0.866). Similarly, ROA is positively associated with the Z-score (r=0.797) and the Springate S-score (r=0.941) and negatively correlated with Zmijewski X-score (r=-0.889). DER is positively correlated with Zmijewski X-score (r=0.841). Given the limited number of annual observations, these coefficients are interpreted descriptively rather than a strong inferential evidence.

## 4. DISCUSSION

The results indicate that the financial deterioration observed in EMIVAR during the study period was not explained solely by ratio

analysis, but rather from accumulative financial weaknesses over time. In this context, the ongoing liquidity constraints played a crucial role in transmitting financial pressure across different levels in the firm.

This fragility was exacerbated by the persistent weaknesses in liquidity, profitability, and operational efficiency where the recorded losses were not just accounting results, but a clear indication of a fundamental imbalance between the asset base and the revenue-generated activities. This suggests that the distress was driven by internal operational constraints, not only by external market conditions. In addition, the financial structure contributed to deepening this fragility, so the accumulation of debt combined with a limited ability to generate profits transformed leverage from a supporting tool into a source of instability. Overall, the consistency between the analysis of financial ratios and distress prediction models' scores emphasizes that the quantitative signs of default are deeply rooted in the firm's financial structure.

These findings are consistent with expectations derived from the literature. The finding that declining profitability, weakening liquidity, and poor asset use predict financial trouble tracks with what Altman et al. (2017) argued, and the case for combining multiple diagnostic tools rather than relying on any single model was already made by Almamy et al. (2016). What the EMIVAR analysis adds is a practical illustration of the value of combining multiple diagnostic tools, as the models capture financial deterioration but differ in their classification of distress.

The more interesting implication, though, is about timing. EMIVAR did not experience sudden deterioration, it weakened progressively, with liquidity, profitability, and financial pressure all deteriorating over several years. The warning signals were there well before any actual default. This observation deserves particular attention: financial distress is often readable in advance, which means the real question is whether decision-makers are adequately monitoring these warning signals.

These results should also be viewed in light of the broader institutional and economic environment in which EMIVAR operates. As a

public enterprise operating in the public works sector, its financial performance may be affected by factors such as public spending, project execution, and payment cycles, and general economic conditions. Although these factors were not directly examined, they provide an important context for interpreting the observed financial pressures.

The case of EMIVAR therefore highlights the importance of regularly monitoring financial indicators and distress prediction models for public enterprises, as financial deterioration may develop progressively before reaching more severe levels.

## 5. CONCLUSION

### 5.1. Main results

The findings of this study on EMIVAR during (2017-2024) reveal a gradual but deepening financial imbalance, where:

- Serious short-term solvency pressure is emerged after 2021, where the current ratio falling below acceptable levels in 2024;
- The inability to generate sufficient returns from assets reflected in persistently weak and deteriorating values of profitability indicators, mainly ROA;
- Increasing asset underutilization was reflected in the decline of total asset turnover in 2024, indicating weakening operational efficiency;
- A continuous weakening of EMIVAR's financial position was reflected in the increasing reliance on external financing, the rise in the debt-to-equity ratio, and the negative interest coverage ratios observed during the final years of the study period;
- The distress prediction models provide different assessments of EMIVAR's financial condition. The Altman Z-score declined sharply from 1.55 in 2021 to -2.08 in 2024, while Springate S-score remained below its distress threshold throughout the study period. In contrast, the Zmijewski X-score remained below the distress threshold, although it moved closer to zero after 2021, indicating a deterioration in the enterprise financial position;
- The correlation analysis further indicated co-movement between selected financial ratios and distress-model scores.

### 5.2. Recommendations

From a managerial perspective, the findings suggest that:

- Liquidity management should be treated as a strategic priority rather than a short-term operational concern;
- The enterprise should establish measurable recovery targets, particularly for liquidity and leverage, with periodic monitoring of progress toward restoring the current ratio above 1 and reducing the debt-to-equity ratio from its 2024 level of 1.95.
- The persistence of negative profitability suggests the need for structural corrective actions rather than temporary cost adjustments;
- The firm's reliance on debt, combined with insufficient operating earnings to cover interest expenses, calls for a reassessment of the financing structure;
- EMIVAR should establish a dedicated financial analysis and early-warning function responsible for regularly monitoring key financial ratios and distress prediction scores and reporting emerging financial risks to management.

### 5.3. Policy Implications

At the public policy level, the EMIVAR case highlights the importance of strengthening financial monitoring and adopting early-warning mechanisms within Algerian public enterprises. Regular financial assessment can help identify signs of deterioration at an early stage and support timely corrective action. However, broader policy implications require further evidence from other Algerian public enterprises.

### 5.4. Research Perspectives

This study presents a detailed longitudinal evaluation limited to a single firm. Future research could focus on:

- A wider sample of firms within the same sector or across different industries could extend this approach in future research;
- The examination of the relative timing of distress signals across models, investigating which indicators or models tend to issue

warnings earlier in the distress process;

- The incorporation of cash flow-based measures or benchmarking firms against sectorial averages could also enhance the robustness of future analyses.

## 5. Bibliography List:


**1. Books:**

- Altman, E. I., & Hotchkiss, E. (2006). Corporate Financial Distress and Bankruptcy: Predict and Avoid Bankruptcy, Analyze and Invest in Distressed Debt (3 ed.). John Wiley & Sons. doi:10.1002/9781118267806
- Brigham, E. F., & Ehrhardt, M. C. (2017). Financial Management: Theory & Practice (15 ed.). Boston: Cengage Learning.
- Higgins, R. C. (2012), Analysis for Financial Management (10th ed.), McGraw-Hill, New York, USA.
- Ross, S. A., Westerfield, R., Jaffe, J. F., & Jordan, B. D. (2019). Corporate Finance. McGraw-Hill Education.

**2. Theses:**

- Springate, G. L. (1978), *Predicting the Possibility of Failure in a Canadian Firm: A Discriminant Analysis*, Simon Fraser University, Canada.

**3. Journal article :**

- Agarwal, V., & Taffler, R. (2008). Comparing the performance of market-based and accounting-based bankruptcy prediction models. *Journal of Banking & Finance, 32*(8), 1541-1551. doi:https://doi.org/10.1016/j.jbankfin.2007.07.014
- Almamy, J., Aston, J., & Ngwa, L. N. (2016). An evaluation of Altman's Z-score using cash flow ratio to predict corporate failure amid the recent financial crisis: Evidence from the UK. *Journal of Corporate Finance, 36*, 278-285. doi:https://doi.org/10.1016/j.jcorpfin.2015.12.009
- Altman, E. I. (1968). FINANCIAL RATIOS, DISCRIMINANT ANALYSIS AND THE PREDICTION OF CORPORATE

BANKRUPTCY. *The Journal of FINANCE, 23*(4), 589-609. doi:https://doi.org/10.1111/j.1540-6261.1968.tb00843.x

- Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2017). Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's Z-Score Model. *Journal of International Financial Management & Accounting, 28*(2). doi:https://doi.org/10.1111/jifm.12053
- Beaver, W. H. (1966). Financial Ratios As Predictors of Failure. *Journal of Accounting Research, 4*, 71-111. doi:https://doi.org/10.2307/2490171
- Bourmel, Z., & Ben Rahmoun, S. (2024). The Contribution of Financial Failure Prediction Models to Assessing the Viability of Economic Institutions: An Analysis of the Financial Statements of Ruiba Company from 2013 to 2018. *AL-Manhel Economique, 7*(1), 887-896. Retrieved from https://asjp.cerist.dz/en/article/247691
- Casey, C., & Bartczak, N. (1985). Using Operating Cash Flow Data to Predict Financial Distress: Some Extensions. *Journal of Accounting Research, 23*(1), 384-401. doi:https://doi.org/10.2307/2490926
- ElBannan, M. A. (2021). On the prediction of financial distress in emerging markets: What matters more? Empirical evidence from Arab spring countries. *Emerging Markets Review, 47*. doi:https://doi.org/10.1016/j.ememar.2021.100806
- Kalladi, N., & Taleb, M. (2021). A Typical Application of the Altman and Springate Model in Predicting Financial Default Among Industrial Companies Listed on the Algiers Stock Exchange. *Journal of Financial, Accounting And Managerial studies, 8*(3), 281-297. Retrieved from https://asjp.cerist.dz/en/article/178705
- Meguelati , A., & Boursas, W. (2023). The Extent to Which the Results of Quantitative Models for Predicting Financial Distress Are Consistent with the Financial Position of the Biofarm Group for the Period (2017–2021). *Journal Of Research in Finance and Accounting, 8*(1), 57-78. Retrieved from https://asjp.cerist.dz/en/article/230551
- Mohamad, A., Azad, M., & Sifat, I. (2021). Predicting financial distress in an emerging market : corporate actions, accounting ratios,

or both? *American Journal of Finance and Accounting, 6*(3-4), 314-331. doi:10.1504/AJFA.2021.117217

- Mulyati, S., & Ilyasa, S. (2020). The Comparative Analysis of Altman Z-Score, Springate, Zmijewski, And Internal Growth Rate Model in Predicting the Financial Distress (Empirical Study on Mining Companies Listed on Indonesia Stock Exchange 2014-2017). *KINERJA , 24*(1). doi:https://doi.org/10.24002/kinerja.v24i1.3231
- Ohlson, J. A. (1980). Financial Ratios and the Probabilistic Prediction of Bankruptcy. *Journal of Accounting Research, 18*(1), 109-131 . doi:https://doi.org/10.2307/2490395
- Platt, H. D., & Platt, M. B. (2002). Predicting corporate financial distress: Reflections on choice-based sample bias. *Journal of Economics and Finance, 26*, 184–199. doi:https://doi.org/10.1007/BF02755985
- Powell, R. J., Dinh, D. V., Vu, N. T., & Vo, D. H. (2024). Accounting-based variables as an early warning indicator of financial distress in crisis and non-crisis periods. *International Journal of Finance & Economics, 29*(4), 4105-4124. doi:https://doi.org/10.1002/ijfe.2864
- Tapa, A., & Ahmad Razif, N. L. (2021). Financial Distress Prediction of Airlines Companies. *Indian-Pacific Journal of Accounting and Finance, 5*(2), 3-15. doi:10.52962/ipjaf.2021.5.2.129
- Whitaker, R. B. (1999). The early stages of financial distress. *Journal of Economics and Finance, 23*, 123–132. doi:https://doi.org/10.1007/BF02745946
- Zhao, J., Ouenniche, J., & De Smedt , J. (2024). Survey, classification and critical analysis of the literature on corporate bankruptcy and financial distress prediction. *Machine Learning with Applications, 15*(100527). doi:https://doi.org/10.1016/j.mlwa.2024.100527
- Zmijewski, M. E. (1984). Methodological Issues Related to the Estimation of Financial Distress Prediction Models. *Journal of Accounting Research, 22*, 59-82. doi:https://doi.org/10.2307/2490859

**4. Reports and Institutional Sources**

- CACI. (n.d). EMIVAR Sétif / Entreprise de Mise en Valeur & d'Aménagement Rural. Chambre Algérienne de Commerce et d'Industrie: El Mouchir – Annuaire des Entreprises Algériennes. Retrieved from https://www.elmouchir.caci.dz/entreprise/3868/emivar-setif-entreprise-de-mise-en-valeur-damenagement-rural
- Laeven, L., & Valencia, F. (2018). Systemic Banking Crises Revisited. *IMF Series*, *2018*(206). doi:https://doi.org/10.5089/9781484376379.001