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# Liquidity, Leverage, Firm Size, and Bankruptcy Risk

*Fidela Agatha[1]*, Krisdiana[2], Agustina[3]*

[1,2,3] *Fakultas Ekonomi dan Bisnis, Universitas Swadaya Gunung Jati, Indonesia*.

**General Background:** Bankruptcy risk assessment helps stakeholders identify financial vulnerabilities before operational failure occurs. **Specific Background:** Indonesian textile and garment companies face demand uncertainty, pressure on export values, cost volatility, and working capital constraints during the period 2020–2024. **Knowledge Gap:** Evidence on how firm size moderates the effects of liquidity and leverage on bankruptcy risk in this sector remains limited. **Objective:** This study investigates the impact of liquidity and leverage on bankruptcy risk and tests the moderating role of firm size. **Methods:** Data were collected from 13 textile and garment firms listed on the IDX, comprising 65 firm-year observations. Model selection and diagnostic tests were conducted, and panel regression with fixed effects and moderation was used for the analysis. **Results:** Liquidity was found to significantly increase the Altman Z-score and thus reduce bankruptcy risk. Leverage had no significant individual effect, but the combined effect of the two was significant. Firm size attenuated the effect of liquidity but did not significantly moderate the effect of leverage. **Novelty:** Firm size exerts a selective effect via the liquidity channel rather than through all financial determinants. **Implications:** Managers should pay particular attention to liquidity management.

**Keywords:** Liquidity, Leverage, Firm Size, Bankruptcy Risk, Altman Z-score.

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**Correspondence:*
*Fidela Agatha*
*fidela.122020014@ugj.ac.id*

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## INTRODUCTION

Bankruptcy risk is a central issue in corporate finance as it reflects the likelihood that a company will fail to sustain its operations and meet its obligations. Early detection of bankruptcy risk is vital for management to continue operations, for creditors to assess repayment capacity, for investors to evaluate potential losses, and for regulators to monitor sector stability. In the manufacturing sector, with its high working capital requirements, the ability to detect financial vulnerabilities is particularly critical, as cash flow constraints can rapidly disrupt production, payments to suppliers, and debt repayment. Indonesia's textile and garment sector plays a strategic role as it contributes to non-oil exports, absorbs labour, and is integrated into global value chains. The sector is also vulnerable to fluctuations in international demand, reliance on imported raw materials, transport costs, and fiscal pressures. These challenges have been exacerbated in the post-pandemic period due to uncertain demand recovery, rising input costs, and increasingly tight financial conditions, which have eroded companies' profitability and resilience (Aljughaiman *et al*., 2023; Arania *et al*., 2022).

This empirical phenomenon is clearly evident in the export patterns of Indonesian textiles and ready-made garments, as illustrated in Table 1 and Figure 1. Export volume rose from 274.5 thousand tonnes in 2023 to 299.9 thousand tonnes in 2024, whilst the value of exports saw moderate growth from USD 6,740.1 million to USD 7,081.4 million. This suggests that the rise in export volume was not accompanied by a commensurate increase in value, indicating pressure on average export value and on companies' ability to generate higher profits (Central Bureau of Statistics, 2024). Such a pattern reinforces the urgency of assessing the risk of bankruptcy, as higher volumes of activity do not necessarily imply stronger financial health.

[Table 1. Indonesia's Textile and Clothing Exports]

[Figure 1. Trends in Export Volume and Value]

The pressures facing the industry are also reflected in reports of contraction and operational pressures within the textile and ready-to-wear sectors during 2024, including weakening demand, competition from imports, and reports of redundancies or factory closures. For example, media reports citing the Ministry of Industry indicate that textile imports rose following the introduction of changes to import regulations, whilst major textile firms also carried out redundancies during the same period (Sari & Djumena, 2024). These conditions create a practical dilemma: companies may continue to operate and sell their products, yet remain financially vulnerable due to margin compression, short-term liabilities and debt obligations. It is therefore important to incorporate liquidity and leverage into bankruptcy risk forecasts for this industry, rather than considering only sales or export indicators. Previous studies have repeatedly shown that both liquidity and leverage are significant indicators of financial instability and the probability of bankruptcy. Liquidity is often viewed as short-term solvency and is expected to alleviate financial stress, whilst leverage represents a reliance on debt and has the potential to increase the cost of financial stress (Beaver, 1966; Billios *et al*., 2024; Magrini, 2025; Nguyen & Kien, 2022; Zhao *et al*., 2024). Recent research on bankruptcy prediction highlights that ratio-based models are indeed useful, but must be interpreted with caution regarding sector, sample length and model design (Almaskati *et al*., 2021; Charalambous *et al*., 2022; Zhao *et al*., 2024). However, the empirical evidence remains ambiguous. Several studies in Indonesia have found a significant effect of liquidity and leverage on financial distress, whilst other studies have found no significant effect or one that is context-dependent (Marginingsih *et al*., 2024; Stepani & Nugroho, 2023).

These discrepancies highlight an empirical gap. The impact of financial ratios may depend on business attributes, industry conditions, sample duration and model configuration. Recent studies on bankruptcy prediction suggest that model effectiveness is influenced by the selection of accounting ratios, estimation methodologies, data configuration, and the prediction time horizon (Almaskati *et al*., 2021; Charalambous *et al*., 2022; Iparraguirre-Villanueva & Cabanillas-Carbonell, 2024; Perboli & Arabnezhad, 2021; Radovanovic & Haas, 2023; Smith & Alvarez, 2022; Zhao *et al*., 2024). Company size is a significant contingency factor, as larger firms generally have better access to finance, superior reputational capital, a more substantial asset base, and diversified operations. These advantages may modify the effects of liquidity and leverage on bankruptcy risk. Recent studies also indicate that the role of firm size is not uniform across models and sectors (Handini & Susilo, 2025; Lestari *et al*., 2025; Marginingsih *et al*., 2024; Pratiwi & Yunita, 2025; Sabaruddin *et al*., 2024).

Furthermore, there remains a contextual gap. Studies examining the moderating effect of firm size on the relationship between liquidity, leverage and bankruptcy risk in Indonesian textile and garment firms remain limited, particularly for the period 2020–2024, when these firms faced post-pandemic adjustments, export value pressures, cost volatility and financial vulnerabilities. Furthermore, there is a methodological gap: many previous studies have used broader manufacturing samples or simple regression models, whereas sector-specific panel data with moderated regression can better capture firm-level heterogeneity over time and conditional effects (Iparraguirre-Villanueva & Cabanillas-Carbonell, 2024; Marginingsih *et al*., 2024; Pratiwi & Yunita, 2025).

Based on these gaps, this study analyses the impact of liquidity and leverage on bankruptcy risk and tests whether firm size moderates these relationships amongst textile and garment companies listed on the Indonesia Stock Exchange during the period 2020–2024. Theoretically, this study enriches the bankruptcy risk literature by adopting a contingency perspective, which suggests that firm size does not uniformly moderate all financial drivers. Empirically, this study contributes by presenting evidence from a vulnerable sector within an emerging economy during the post-pandemic era. These findings assist managers, creditors and investors in assessing whether liquidity and leverage indicators should be interpreted differently across companies of varying sizes.

This study draws on signalling theory, trade-off theory and agency theory. From the perspective of (Spence, 1973), signalling theory explains that information asymmetry can be reduced when the party possessing information sends credible signals to the party with less information. In this study,

liquidity is regarded as a financial signal because current assets divided by current liabilities reflects a company's ability to meet its short-term obligations and maintain its operations. High liquidity can serve as a signal to creditors and investors that the risk of bankruptcy is lower, consistent with the frequent use of accounting ratios as early warning indicators in bankruptcy prediction (Beaver, 1966; Beaver *et al*., 2005; Shumway, 2001).

The trade-off argument, as put forward by (Kraus & Litzenberger, 1973), states that a company will balance the benefits of debt, including tax benefits, against the anticipated costs arising from financial difficulties. In the textile and garment sector, leverage can increase the pressure to repay debt when profit margins are under pressure or cash flows fluctuate (Campbell *et al*., 2008; Tinoco & Wilson, 2013). Agency theory, proposed by (Jensen & Meckling, 1976), illustrates how conflicts between managers, shareholders and creditors can influence debt policy, asset utilisation and risk attitudes. Financial pressure can lead to sub-optimal debt decisions, thereby increasing agency costs and the likelihood of bankruptcy. These ideas are relevant because Indonesian textile and garment firms operate in a sector where working capital, access to finance, and debt management are closely intertwined with their survival.

**The Impact of Liquidity on Bankruptcy Risk**

Liquidity reflects a firm's ability to meet short-term obligations and maintain operational flexibility. Firms with higher current ratios are better able to pay suppliers, maintain their working capital cycle, and avoid short-term payment defaults. Liquidity remains an important early warning indicator in bankruptcy prediction, as current solvency typically deteriorates before overall financial health worsens (Beaver, 1966; Billios *et al*., 2024; Zhao *et al*., 2024). Liquidity has also been found to be associated with financial distress in studies conducted in Indonesia, although the strength and direction of this relationship may vary across samples (Dianova & Nahumury, 2019; Marginingsih *et al*., 2024; Stepani & Nugroho, 2023). In this study, as bankruptcy risk is proxied by the Altman Z-Score, a positive effect on the Z-Score implies a lower risk of bankruptcy.

From the perspective of signalling theory (Spence, 1973), a higher current ratio serves as a credible signal to external stakeholders—creditors, investors and suppliers—that the firm possesses adequate resources to meet its short-term commitments, thereby reducing perceived bankruptcy risk. The trade-off theory (Kraus & Litzenberger, 1973) reinforces this expectation: firms that maintain adequate liquid assets reduce the probability of incurring financial distress costs, both directly and indirectly, as short-term solvency acts as a buffer against cash flow shocks that trigger defaults. In the textile and garment sector, where production cycles depend on timely procurement and payments, this theoretical mechanism is highly relevant.

$H_1$ : Liquidity has a significant effect on the risk of bankruptcy.

**The Effect of Leverage on Bankruptcy Risk**

Leverage describes the extent to which a firm finances its assets through debt rather than equity. The trade-off theory (Kraus & Litzenberger, 1973) states that above the optimal debt level, the expected marginal costs arising from financial difficulties—such as legal costs, operational disruptions, and the loss of key stakeholders—exceed the tax-shield benefits of additional borrowing; thus, higher leverage is expected to increase the risk of bankruptcy. Agency theory (Jensen & Meckling, 1976) adds a complementary channel: as the debt-to-equity ratio increases, the conflict between shareholders and creditors intensifies because shareholders may pursue riskier projects to take advantage of limited liability protection, whilst creditors face a higher probability of loss. These agency costs can erode firm value and increase the likelihood of default. In the textile and garment sector, where profit margins are often thin and cash flows are sensitive to fluctuations in raw material prices and export demand cycles, the channels of financial distress costs and agency costs implied by these theories are highly relevant.

In studies of manufacturing and accounting in Indonesia, findings regarding leverage are also varied, highlighting the need for further sector-specific testing, as leverage may operate differently depending on the scale of the firm, the quality of reporting, and the capital structure (Abbas *et al*., 2021; Dianova & Nahumury, 2019; Marginingsih *et al*., 2024).

$H_2$ : Leverage has a significant effect on bankruptcy risk.

**The Combined Effect of Liquidity and Leverage on Bankruptcy Risk**

Multi-indicator bankruptcy models, such as the Altman-type model and subsequent default risk models, emphasise that indicators of solvency, profitability, leverage and activity collectively explain corporate failure (Altman, 1968; Altman, 2018; Barboza *et al*., 2017; Iparraguirre-Villanueva & Cabanillas-Carbonell, 2024; Jones *et al*., 2017; Ohlson, 1980; Radovanovic & Haas, 2023; Zmijewski, 1984). Consequently, the simultaneous test is regarded as a model-level evaluation of the ability of financial ratio configurations to explain bankruptcy risk in a meaningful way.

The theoretical basis for this combined test stems from the complementary mechanisms implied by signalling theory, trade-off theory and agency theory. Signalling theory suggests that liquidity conveys information regarding short-term solvency; trade-off theory indicates that leverage reflects a balance between the benefits of debt and the costs of financial distress; whilst agency theory highlights the governance and incentive dimensions in both financing and asset management decisions. As these theories identify distinct yet interrelated channels through which financial indicators influence the probability of default, testing using a single ratio alone may underestimate the explanatory power of the financial ratio framework; a simultaneous assessment captures the combined information content of these channels.

$H_3$ : Liquidity and leverage together have a significant effect on the risk of bankruptcy.

**The Moderating Role of Firm Size on the Effects of Liquidity and Leverage**

Company size may alter the effects of liquidity, as larger firms generally have stronger access to finance, broader reputational capital, greater bargaining power, and more diverse internal resources. Consequently, the protective effect of liquidity may be stronger for smaller firms that are more reliant on current assets to sustain day-to-day operations. This reasoning is consistent with contingency-based financial and accounting studies indicating that firm size can alter the relevance of liquidity, leverage, and other financial indicators (Handini & Susilo, 2025; Lestari *et al*., 2025; Marginingsih *et al*., 2024; Pratiwi & Yunita, 2025; Sabaruddin *et al*., 2024).

Signalling theory supports this rationale: smaller firms typically face greater information asymmetry with external stakeholders, so the signal conveyed by a strong current ratio carries relatively greater weight in mitigating perceived default risk. For larger firms with an established reputation and analyst coverage, information asymmetry is lower and the marginal signalling value of liquidity is reduced. Agency theory offers a parallel ‘ ’ argument: in smaller firms, monitoring mechanisms are generally weaker and the overlap between owners and managers is more common, so liquidity becomes a more critical observable indicator of whether the firm can sustain its operations without engaging in value-destructive behaviour under financial pressure.

$H_4$ : Firm size moderates the effect of liquidity on bankruptcy risk.

Company size may also influence the relationship between leverage and bankruptcy risk. Large firms are often able to alleviate debt pressures through refinancing options and creditor confidence, whilst small businesses tend to have fewer safeguards against debt repayment difficulties. However, research employing a moderation framework suggests that firm size does not always consistently strengthen or weaken the interaction of financial ratios across different contexts (Abbas *et al*., 2021; Mu’minah *et al*., 2023; Sabaruddin *et al*., 2024). Consequently, the moderating effect of firm size on leverage is an empirical question requiring testing, rather than an assumption.

Trade-off theory provides a basis for expecting moderation: larger firms may be able to tolerate higher levels of debt before reaching the point where expected distress costs dominate, as their asset diversification and revenue stability shift the optimal leverage threshold upwards. Agency theory suggests a similar possibility, as larger firms tend to have stronger governance structures and stricter creditor covenants that constrain risk-shifting behaviour. Nevertheless, the theoretical direction remains ambiguous, as post-pandemic conditions—such as uniform cost pressures and demand uncertainty across the textile and garment sectors—may neutralise the size-based advantages predicted by both theories.

$H_5$ : Firm size moderates the effect of leverage on bankruptcy risk.

The conceptual framework illustrating the hypothetical relationships among all research variables is presented in Figure 2.

[Figure 2. Conceptual Framework]

## METHODS

This study employs a quantitative explanatory design using secondary panel data. This design is appropriate as the study aims to test the causal relationship between financial ratios, bankruptcy risk and the moderating role of firm size. Panel data is suitable for this purpose as it captures both inter-firm variation (cross-sectional variation) and variation over time (time-series variation) during the observation period of 2020–2024. This allows the model to control for unobserved firm-specific characteristics. An interaction-based moderation approach is also relevant as it tests whether the effects of liquidity or leverage vary across different levels of firm size (Helm & Mark, 2012).

The research subjects are textile and garment companies listed on the Indonesia Stock Exchange (IDX) during the period 2020–2024. The research population consists of 23 companies. Purposive sampling was used to ensure that only companies meeting the analytical requirements were included. The final sample comprises 13 companies and 65 firm-year observations. This study utilised historical secondary data from publicly available financial statements; therefore, no respondent recruitment process was carried out.

The final sample comprised 13 companies: Polychem Indonesia (ADMG), Trisula Textile Indonesia (BELL), Eratex Djaja (ERTX), Indo Rama Synthetic (INDR), Asia Pacific Investama (MYTX), Pan Brothers (PBRX), Golden Flower (POLU), Asia Pacific Fibers (POLY), Ricky Putra Globalindo (RICY), Trisula International (TRIS), Uni-Charm Indonesia (UCID), Mega Perintis (ZONE), and Inocycle Technology Group (INOV).

The inclusion criteria required that companies be listed in the textiles and garments sector during the observation period, that audited annual financial statements for the years 2020–2024 be available, that the companies had not been permanently delisted or undergone a merger during the study period, and that all necessary variables—including the Current Ratio, Debt-to-Equity Ratio, company size, and Altman Z-Score—were available. Companies that did not meet one or more of these criteria were excluded from the final balanced panel.

Data were collected through documentation by accessing annual reports and audited financial statements from the IDX and the official websites of the sampled companies. Data were coded consistently by company and year, matched to published financial statements, and verified to ensure that each ratio was calculated using the same operational definition across all observations. The sampling stages and the annual distribution of company-year observations are presented in Table 2 and Table 3, respectively.

[Table 2. Sample Selection]

[Table 3. Sample Distribution]

Bankruptcy risk is proxied by the Altman Z-Score for publicly listed manufacturing companies.

The formula is: Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5 Where: X1 = working capital / total assets, X2 = retained earnings / total assets, X3 = earnings before interest and tax / total assets, X4 = market value of equity / book value of total liabilities, and X5 = sales / total assets. The higher the Z-score, the better the financial health and the lower the risk of bankruptcy; therefore, positive coefficients should be interpreted as a reduction in the risk of bankruptcy. The operational definitions and measurements of all variables are summarised in Table 4.

[Table 4. Measurement of Variables]

The data were analysed using EViews 12. The analysis began with descriptive statistics, followed by the selection of a panel model using the Chow test, the Hausman test, and the Lagrange Multiplier test where necessary. The final model was estimated using moderated panel regression. Hypotheses H1 and H2 were tested via the liquidity and leverage coefficients, H3 via the combined significance of the model, and H4–H5 via the interaction terms between firm size and liquidity or leverage.

The regression model is: $BRit = \beta0 + \beta1LIQit + \beta2LEVit + \beta3SIZEit + \beta4(LIQit \times SIZEit) + \beta5(LEVit \times SIZEit) + \varepsilon it$. The statistical significance of the interaction coefficients serves as the primary criterion for identifying the direction and strength of moderation. This model is tested for multicollinearity, heteroscedasticity and autocorrelation to assess model fit. Furthermore, this study includes numerical robustness analysis and sensitivity analysis using the available 65-company-year panel dataset. As the proposed dataset provides the Current Ratio, Debt-to-Equity Ratio, firm size, Altman Z-score, and two interaction terms, the robustness checks focus on alternative moderated regression specifications based on these interaction terms. Robustness tests requiring additional accounting components, such as Ohlson, Zmijewski, Springate, the Debt-to-Assets Ratio, or the Interest Coverage Ratio, are not reported as the necessary raw components are not included in the available proposed dataset.

## RESULTS AND DISCUSSION

The sample comprises 13 textile and garment firms observed over five years, yielding 65 firm-years of data. Descriptive statistics reveal significant heterogeneity in financial conditions, as presented in Table 5. The mean Altman Z-score is 0.645, whilst the median is 1.840. This indicates that the companies in the sample, on average, are approaching a zone of financial distress, although some firm-years remain relatively resilient. The minimum Z-score of –39.850 and the maximum of 13.570 indicate significant differences in financial health across firms and across years.

Liquidity has an average of 1.762, a minimum value of 0.040, and a maximum value of 16.280, indicating inconsistency in short-term solvency. The average leverage is 2.119, with a maximum value of 114.290 and a minimum value of -30.150. A negative leverage value reflects companies with a negative equity position, which are experiencing a critical financial downturn. This large dispersion is one of the reasons why resilience tests using winsorised leverage or alternative leverage proxies are recommended for the final empirical set.

[Table 5. Descriptive Statistics]

### Panel Model Selection and Diagnostic Tests

As shown in Table 6, the panel model selection confirms that the fixed-effects model is the most appropriate estimator. The Chow test rejects the mixed model and supports the fixed-effects model, whilst the Hausman test indicates that fixed effects are preferable to random effects. This implies that unobserved firm-specific characteristics do exist and are correlated with the explanatory variables. Consequently, the fixed-effects estimator is appropriate for controlling for differences that remain constant over time across firms.

[Table 6. Panel Model Selection]

The diagnostic results, summarised in Table 7, support the adequacy of the model. The highest correlation amongst the independent variables is 0.3999, which is below the conventional threshold for multicollinearity. The Glejser test reports a p-value above 0.05, indicating that no heteroscedasticity was detected. The Durbin-Watson statistic of 1.858 falls within the non-autocorrelated range. These tests reinforce confidence in the estimates of the main fixed effects, although a more robust re-estimation using raw panel data is still recommended due to the extreme DER values.

[Table 7. Diagnostic Summary]

### Fixed-Effects Regression Results and Hypothesis Testing

The fixed-effects regression results, presented in Table 8, show that liquidity has a positive and statistically significant coefficient. As the dependent variable is the Altman Z-Score, this implies that higher liquidity improves financial health and reduces the risk of bankruptcy. The coefficient for the leverage variable is positive but not significant, suggesting that the risk of bankruptcy does not depend on debt itself, after controlling for firm-specific fixed factors. Firm size is also not a significant direct predictor.

The interaction term between liquidity and firm size is negative and statistically significant. This implies that firm size reduces the positive impact of liquidity on the Altman Z-score. The protective function of liquidity is more significant for small firms and diminishes as firm size increases. The interaction between leverage and firm size is negative but not significant, meaning that firm size does not significantly alter the relationship between leverage and bankruptcy risk in the sample. The results of the hypothesis testing are summarised in Table 9, and the differential moderating effect of firm size on the relationship between liquidity and bankruptcy risk is visualised in Figure 3.

[Table 8. Fixed-Effects Regression Results]

[Table 9. Summary of Hypothesis Tests]

[Figure 3. Moderation Plot]

### Robustness and Sensitivity Tests

To verify the robustness of the main findings, numerical robustness and sensitivity analyses were conducted using alternative moderated regression specifications. These

robustness models focus on the liquidity × firm size and leverage × firm size interaction terms, given the presence of two moderator variables simultaneously in the model. This provides an additional layer of evidence regarding the consistency of the direction of the moderating effects. The results of the robustness and sensitivity tests are presented in Table 10.

[Table 10. Robustness and Sensitivity Tests]

The results of the robustness tests support the main moderation findings. The liquidity × firm size interaction remains negative and statistically significant, whilst the leverage × firm size interaction remains statistically insignificant. Therefore, the main contribution of this article—that firm size operates primarily through the liquidity channel rather than the leverage channel—is supported by the alternative specification focusing on interactions. Additional robustness tests using alternative bankruptcy proxies were not included as the available proposal dataset did not contain all the accounting components required to calculate the Ohlson, Zmijewski or Springate scores.

**Discussion**

The first hypothesis is supported. Liquidity has a significant positive effect on the Altman Z-Score, meaning that firms with stronger short-term solvency face a lower risk of bankruptcy. This result is theoretically consistent with signalling theory, as stronger liquidity sends a positive signal regarding a firm's ability to meet its short-term obligations. It is also practically relevant for textile and garment firms, as their operations depend on adequate working capital to purchase raw materials, pay suppliers, maintain stock levels, and continue production amidst uncertain demand.

These findings are also consistent with trade-off theory: by maintaining adequate current assets relative to current liabilities, firms reduce the expected costs arising from financial distress, including the risk of production stoppages, default on supplier payments, and forced asset liquidation, which in turn safeguards their overall financial health as reflected in the Z-Score. From an agency theory perspective, adequate liquidity reduces the incentive for managers to make sub-optimal short-term decisions, such as delaying critical payments or accepting unfavourable financing terms under cash flow pressure, thereby reducing agency costs that might otherwise accelerate financial deterioration.

These findings are consistent with various studies that identify liquidity as a key determinant of financial distress and default risk (Beaver, 1966; Billios *et al*., 2024; Shumway, 2001; Zhao *et al*., 2024). These findings also support evidence from Indonesia suggesting that liquidity is associated with financial distress, although the direction and strength of this relationship may vary across sectors and samples (Dianova & Nahumury, 2019; Marginingsih *et al*., 2024; Stepani & Nugroho, 2023). In the textile and garment sector, these findings suggest that liquidity serves not only as an accounting metric but also as a direct buffer against operational disruptions.

The second hypothesis was not supported, as leverage did not exert a significant individual influence on the Altman Z-Score. This finding contrasts with research identifying leverage as a key factor in financial distress (Campbell *et al*., 2008; Nguyen & Kien, 2022; Tinoco & Wilson, 2013), but is consistent with the notion that the predictive power of financial ratios depends on context (Agarwal & Taffler, 2008; Iparraguirre-Villanueva & Cabanillas-Carbonell, 2024; Radovanovic & Haas, 2023). This sample includes extreme values and negative equity positions in the debt-to-equity ratio (DER). These conditions may affect the interpretability of the ratio, as the same DER figure may represent different levels of debt, different restructuring situations, or different declines in equity across firms.

From the perspective of trade-off theory, the non-significant results may reflect the fact that the expected distress cost channel operates unevenly within this sample: the presence of extreme DER values, including negative equity positions, means that conventional trade-off calculations (balancing the benefits of the tax shield against increased distress costs) break down for the most financially distressed firms, thereby weakening the overall statistical relationship. Agency theory offers a further interpretation: when a firm is already in or approaching distress, the standard agency conflict between shareholders and creditors may be superseded by the dynamics of restructuring, regulatory intervention, or management behaviour geared towards survival, which reduces the explanatory power of the conventional debt-to-equity ratio as a standalone predictor of bankruptcy risk.

The third hypothesis is supported by the significance of the combined model. This suggests that the risk of bankruptcy is better assessed using a combination of financial indicators rather than relying on a single ratio. This finding is consistent with research on bankruptcy prediction, which shows that multi-indicator models offer a more comprehensive explanation of the risk of financial distress (Altman, 1968; Altman, 2018; Balcaen & Ooghe, 2006; Barboza *et al*., 2017; Kou *et al*., 2021; Ohlson, 1980; Tinoco & Wilson, 2013; Zmijewski, 1984). Textile and garment firms should assess short-term liquidity and capital structure alongside firm-specific attributes.

These results are theoretically consistent because the three underlying theories—signalling theory, trade-off theory and agency theory—each operate through different financial channels. Signalling theory explains why liquidity conveys information about short-term business continuity; the trade-off theory clarifies how debt burdens lead to financial distress costs; and agency theory captures governance-related frictions that influence both asset utilisation and financing decisions. The combined significance of these models confirms that these theoretical channels collectively contribute to explaining bankruptcy risk, even when individual predictors such as leverage are not statistically significant on their own.

The fourth hypothesis was confirmed. The significant negative interaction between liquidity and firm size indicates that firm size mitigates the positive effect of liquidity on the Altman Z-Score. This suggests that liquidity plays a more important role in reducing bankruptcy risk for small firms. Large firms may also have better access to external financing, greater reputational capital and a more diversified asset portfolio, whilst their financial stability may be less dependent on current cash holdings. Conversely, small firms are more vulnerable to

fluctuations in working capital, overdue receivables, supplier demands and short-term debt obligations. These findings are consistent with research indicating that firm size can influence the significance of financial indicators, although the nature of this moderating effect varies depending on the research context (Handini & Susilo, 2025; Lestari *et al*., 2025; Marginingsih *et al*., 2024; Pratiwi & Yunita, 2025).

This differential effect is consistent with signalling theory: smaller firms operate under greater information asymmetry, so a strong liquidity position serves as a stronger signal to stakeholders, whilst larger firms can rely on reputational capital and established creditor relationships that partially substitute for such liquidity signals. Agency theory reinforces this interpretation: in small firms, where formal governance mechanisms are generally less developed and external oversight is limited, liquidity serves as a more critical and observable safeguard against management decisions that might otherwise accelerate financial deterioration under cash flow pressures.

The fifth hypothesis is not supported, as firm size does not significantly moderate the effect of leverage. This suggests that, in the textile and ready-to-wear clothing industry, size does not always protect businesses from leverage pressures. Post-pandemic cost volatility and pressure on export values may make it difficult for both small and large firms to service their debt. Therefore, creditors and investors should not regard an increase in asset size as a mitigant of debt risk. Leverage should be evaluated in conjunction with loan tenures, cash flow capacity, interest coverage ratios, and restructuring conditions. This finding is consistent with moderation studies showing that firm size does not always function consistently in financial interactions (Abbas *et al*., 2021; Mu'minah *et al*., 2023; Sabaruddin *et al*., 2024).

From a trade-off theory perspective, the lack of significant moderation suggests that size-related advantages in absorbing crisis costs—such as asset diversification and refinancing capacity—are insufficient to significantly alter the ‘ ’ relationship between leverage and bankruptcy risk when the entire sector is exposed to the same macroeconomic shocks. Agency theory offers a consistent interpretation: although larger firms generally have stronger governance structures and creditor covenants, these mechanisms do not appear to provide them with distinct protection against the leverage-related risks that affected the textile and garment sector during periods of systemic financial stress. In other words, post-pandemic conditions may have levelled the playing field regarding agency costs across firm sizes, thereby rendering the moderating effect of firm size on leverage empirically negligible.

## CONCLUSION

This study concludes that liquidity significantly influences the risk of bankruptcy among textile and garment firms in Indonesia. Specifically, liquidity increases the Altman Z-score, implying that stronger short-term solvency reduces the risk of bankruptcy. Leverage does not show a significant individual effect, suggesting that debt dependence, as measured by the debt-to-equity ratio (DER), does not independently explain bankruptcy risk once firm-specific fixed effects have been controlled for.

The model is significant as a whole, confirming the need to consider bankruptcy risk within a multidimensional framework of financial ratios. The impact of firm size on the relationship between liquidity and bankruptcy risk was found to be significant, weakening the positive effect of liquidity on the Altman Z-score. However, firm size has a minor influence on the relationship between leverage and bankruptcy risk. The results indicate that firm size does not consistently moderate all financial factors, with its effect being more significant on the liquidity channel than on the leverage channel.

This study makes a theoretical contribution to the bankruptcy risk literature by proposing an integrated model combining signalling theory, trade-off theory and agency theory within a moderated panel data framework. The findings contribute to contingency-based bankruptcy prediction by demonstrating that firm-specific characteristics can be used to selectively modify the explanatory power of financial statistics. This study provides industry-specific insights from Indonesian textile and garment firms for the period 2020–2024, a time of post-pandemic adjustment and financial strain.

In practical terms, the findings suggest that managers should prioritise liquidity management, particularly in small firms where liquidity has a stronger influence on financial health. Creditors should interpret firm size with caution, as large scale does not necessarily eliminate risks associated with leverage. Investors should use liquidity and the Altman Z-Score as early warning indicators whilst also considering debt quality and sector-specific pressures.

This study is limited to a single sector, a specific national market, and accounting-based variables over the period 2020–2024. Future research should incorporate profitability, operating cash flow, interest coverage ratios, corporate governance, and alternative bankruptcy prediction models, such as the Ohlson, Zmijewski or Springate scores, depending on the availability of the necessary raw accounting data. Future studies could use alternative leverage proxies to investigate whether DER-based results remain consistent across different measures of debt burden.

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**Conflict of Interest Statement:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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***Table 1** / Indonesia's Textile and Clothing Exports*

| Indicator | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|
| Export volume (000 tonnes) | 284.6 | 318.3 | 327.8 | 274.5 | 299.9 |
| Export value (FOB, million USD) | 5,799.2 | 6,854.6 | 7,882.4 | 6,740.1 | 7,081.4 |

**Table 2** / Sample Selection

| Sampling stage | Description | Number of companies |
|---|---|---|
| Initial population | Textile and garment companies listed on the IDX as of 2024 | 23 |
| Exclusions | Companies that do not meet one or more inclusion criteria: incomplete full-period reports, discontinuous listing, delisting/merger, or missing variables | 10 |
| Final sample | Companies meeting all analytical criteria | 13 |
| Observation period | 2020–2024 | 5 years |
| Final observation results | Balanced panel: 13 companies × 5 years | 65 company-years of observation |

***Table 3** / Sample Distribution*

| Year | Number of firms | Company-years |
|---|---|---|
| 2020 | 13 | 13 |
| 2021 | 13 | 13 |
| 2022 | 13 | 13 |
| 2023 | 13 | 13 |
| 2024 | 13 | 13 |
| Total | 13 | 65 |

***Table 4** / Measurement of Variables*

| Variable | Symbol | Measurement | Operational definition |
|---|---|---|---|
| Bankruptcy risk | BR | Altman Z-score | $Z = 1.2 \times 1 + 1.4 \times 2 + 3.3 \times 3 + 0.6 \times 4 + 1.0 \times 5$ |
| Liquidity | LIQ | Current Ratio | Current assets / Current liabilities |
| Leverage | LEV | Debt-to-Equity Ratio | Total liabilities / total equity |
| Company size | SIZE | Natural logarithm of total assets | Ln(total assets) |
| Interaction 1 | LIQ×SIZE | Moderation term | Current ratio × Ln(total assets) |
| Interaction 2 | LEV×SIZE | Moderating term | Debt-to-Equity Ratio × Ln(total assets) |

***Table 5** / Descriptive Statistics*

| Variable | Mean | Median | Maximum Value | Minimum | Standard Deviation |
|---|---|---|---|---|---|
| Altman Z-score | 0.645 | 1.840 | 13.570 | -39.850 | 7.750 |
| Liquidity (CR) | 1,762 | 1,490 | 16,280 | 0.040 | 2.083 |
| Debt-to-Equity Ratio (DER) | 2.119 | 0.880 | 114,290 | -30,150 | 16,624 |
| Company Size (Ln Total Assets) | 28,272 | 28,140 | 30,250 | 25,970 | 1,170 |
| Liquidity × Company Size | 49,936 | 41,221 | 489,278 | 1,195 | 61,748 |
| Leverage Ratio x Company Size | 60,017 | 26,315 | 3,313.255 | -872,942 | 479,480 |

***Table 6** / Panel Model Selection*

| Test | Statistic | p-value | Decision |
|---|---|---|---|
| Chow test (cross-sectional F) | 7.7450 | 0.0000 | Fixed effects are preferred |
| Hausman test (chi-squared) | 18.9103 | 0.0020 | Fixed effects are preferred |
| Final model | - | - | Fixed Effects Model (FEM) |

***Table 7** / Diagnostic Summary*

| Diagnostic tests | Indicator | Result | Interpretation |
|---|---|---|---|
| Multicollinearity | Maximum correlation = 0.3999 | < 0.80 | No multicollinearity issues |
| Heteroscedasticity (Glejser) | p-values = 0.9839; 0.5926; 0.6295; 0.9630; 0.5975 | > 0.05 | No heteroscedasticity detected |
| Autocorrelation | Durbin-Watson = 1.8580 | 1.7673 < DW < 2.2317 | No autocorrelation detected |

***Table 8** / Fixed-Effects Regression Results*

| Variable | Coefficient | Standard Error | t-statistic | p-value |
|---|---|---|---|---|
| Constant | 1.397969 | 0.578738 | 2.415547 | 0.0197 |
| Liquidity (CR) | 8.052336 | 1.563273 | 5.150946 | 0.0000 |
| Debt Ratio (DER) | 0.308665 | 1.890054 | 0.163310 | 0.8710 |
| Company Size | 0.000619 | 0.001087 | 0.569702 | 0.5716 |
| Liquidity × Company Size | -0.042910 | 0.012300 | -3.488755 | 0.0011 |
| Leverage × Company Size | -0.011046 | 0.065494 | -0.168661 | 0.8668 |
| Model summary | Adjusted $R^2$ = 0.872919 | F = 26.85964 | DW = 1.858000 | Prob(F) = 0.000000 |

***Table 9** / Summary of Hypothesis Testing*

| Hypothesis | Statement | Empirical results | Decision |
|---|---|---|---|
| H1 | Liquidity affects the risk of bankruptcy | A significant positive effect on the Z-score; lower bankruptcy risk | Supported |
| H2 | Debt ratio influences the risk of bankruptcy | Not significant | Not supported |
| H3 | Liquidity and leverage jointly influence the risk of bankruptcy | The model is jointly significant | Supported |
| H4 | Company size moderates the effect of liquidity | Significant negative interaction | Supported |
| H5 | Company size moderates the effect of leverage | Non-significant interaction | Not supported |

***Table 10** / Robustness and Sensitivity Tests*

| Variable | Coefficient | Standard Error | t-statistic | p-value |
|---|---|---|---|---|
| Constant | 1.521349 | 0.529744 | 2.871855 | 0.0060 |
| Liquidity × Company Size | -0.044425 | 0.011810 | -3.761645 | 0.0005 |
| Leverage × Company Size | -0.000348 | 0.000723 | -0.481110 | 0.6326 |
| Interpretation | A significant decline in liquidity | Insignificant reduction in leverage | Core results remain stable | Supported |

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***Figure 1** / Trends in Export Volume and Value*

***Figure 2** / Conceptual Framework*

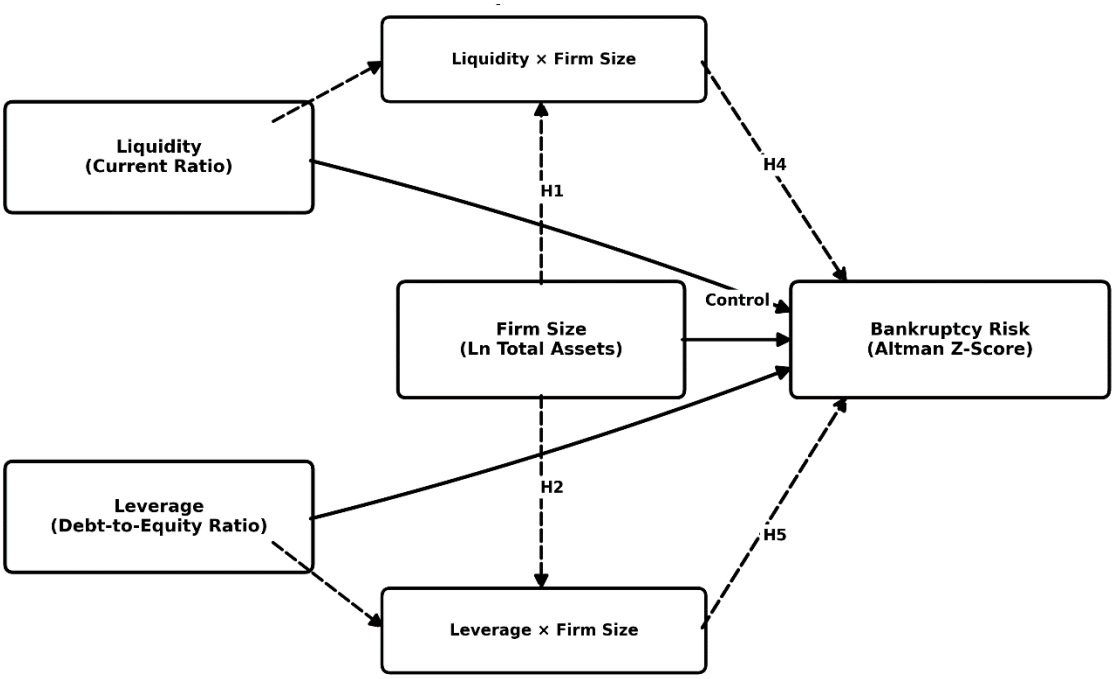

***Figure 3** / Moderation Plot*