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Effects of Working Capital Management, Asset Efficiency, Financial Leverage and Operating Risk on The Financial Resilience of ASEAN Healthcare Firms (2021–2025)

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Abstract. This study examines the relationship between working capital management, asset efficiency, financial leverage, operating risk, and financial resilience among healthcare firms in six ASEAN countries during 2021–2025. Using a balanced panel of 182 listed firms (910 firm-year observations), financial resilience is measured by the emerging-market Altman Z-score for non-manufacturing firms. The study applies a fixed-effects model. The results show that working capital turnover (WCTO) and debt-to-equity ratio (DER) are positively and significantly associated with financial resilience, while short-term debt to total assets (SDTA) is positive at the 10% significance level. Cash conversion cycle (CCC), total asset turnover (TATO), and degree of operating leverage (DOL) are insignificant. The model is jointly significant, with a within R^2 of 48.66%. These findings highlight the importance of working capital productivity and provide cross-country evidence that the relationship between financial leverage and resilience may differ from conventional expectations.

Keywords Altman Z-score; ASEAN; Financial resilience; Healthcare sector; Working capital management

1 Introduction

From 2021 to 2025, ASEAN healthcare firms faced post-pandemic demand normalization, inflation, and supply-chain pressures, affecting liquidity, asset utilization, and debt-servicing capacity. Păun et al. [1] found that healthcare profitability declined in 2022 amid inflation and higher energy costs, while the sector's capital-intensive nature limits cost adjustments without affecting service capacity [2, 3]. These pressures were also reflected in

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Top Glove's declining profits in FY2022 and the financial losses reported by Indonesia's Kimia Farma and Indofarma during 2021–2023 [5, 6].

Previous studies have examined working capital management [2, 7, 8], asset efficiency [9, 10], and healthcare cost responses during crises [1, 3]. However, they primarily focus on profitability or operating performance rather than financial resilience, with these financial dimensions generally examined separately. Evidence on their individual and combined relationships with financial resilience remains limited, particularly across ASEAN healthcare markets. This study addresses this gap by examining the individual and joint relationships of working capital management, asset efficiency, financial leverage, and operating risk with financial resilience among listed healthcare firms in six ASEAN countries during 2021–2025. Its novelty lies in extending the analysis beyond profitability to financial resilience, examining four interconnected financial dimensions simultaneously, and providing cross-country evidence using the emerging-market Altman Z-score for non-manufacturing firms. This approach offers a broader perspective on the financial factors associated with healthcare firms' ability to withstand financial shocks.

2 Literature review and hypotheses

2.1 Theoretical framework

Trade-off Theory explains that firms balance the benefits and costs of financial decisions to achieve an optimal position [11]. In healthcare firms, working capital decisions involve balancing cash availability with sufficient inventory and liquidity buffers. Similarly, debt may support business operations and investment but also increases financial obligations and refinancing risks. Operating leverage reflects the trade-off between the benefits of fixed-cost capacity and the risk of losses when revenue declines. Thus, financial resilience depends on maintaining an appropriate balance between financial resources, obligations, and operating costs.

Signaling Theory, developed by Spence [12], explains how financial information communicates a firm's condition to investors and creditors under information asymmetry. Indicators such as CCC, WCTO, DER, SDTA, and DOL may signal liquidity efficiency, debt burden, and operating risk. For example, a prolonged CCC may indicate cash flow constraints, while high short-term debt may signal refinancing pressure. These indicators help external stakeholders assess financial conditions, although their actual relationships with financial resilience require empirical testing.

2.2 Hypothesis development

Trade-off Theory explains that firms must balance the benefits and costs of managing working capital. A longer Cash Conversion Cycle (CCC) indicates that funds remain tied up in inventory and receivables for a longer period, potentially increasing liquidity pressure and dependence on external financing. This condition may weaken a firm's ability to meet obligations and withstand financial shocks [2, 7, 8]. Therefore, a longer CCC is expected to reduce financial resilience. In contrast, Working Capital Turnover (WCTO) reflects how efficiently working capital generates revenue. Higher turnover indicates more productive use of working capital, which can support daily operations and reduce additional financing needs. This efficiency may strengthen a firm's financial

capacity and resilience [7, 8, 10]. Accordingly, the following hypotheses are proposed:

H1a: CCC has a negative effect on financial resilience. **H1b:** WCTO has a positive effect on financial resilience.

TATO measures a firm's ability to generate revenue from its assets. Efficient asset utilization can improve revenue generation and help firms cover operating expenses, whereas underutilized assets may create costs without sufficient returns. From the perspective of Trade-off Theory, firms need to balance the benefits of asset investment with the costs of maintaining those assets. Greater asset efficiency is therefore expected to support financial stability and resilience [9].

H2: TATO has a positive effect on financial resilience.

Trade-off Theory suggests that debt financing provides investment opportunities but also creates interest and repayment obligations. A high Debt-to-Equity Ratio (DER) may increase financial pressure and the risk of financial distress, particularly when operating cash flows are insufficient to meet obligations [2, 13]. Similarly, a higher Short-Term Debt to Total Assets Ratio (SDTA) indicates greater reliance on short-term financing, which may increase refinancing and liquidity risks. These conditions can limit a firm's ability to withstand financial shocks.

H3a: DER has a negative effect on financial resilience. **H3b:** SDTA has a negative effect on financial resilience.

According to Trade-off Theory, firms must balance the benefits of maintaining operational capacity against the risks associated with fixed operating costs. A high DOL indicates that operating profit is more sensitive to changes in sales. Although fixed costs can support operational capacity and profitability when demand increases, they may increase financial vulnerability when revenue declines because these costs remain payable. This trade-off is particularly relevant to healthcare firms, which need to maintain staffing, medical equipment, and service facilities despite fluctuations in demand [1, 3]. Therefore, higher operating leverage is expected to weaken a firm's ability to withstand financial shocks and maintain financial resilience.

H4: DOL has a negative effect on financial resilience.

Financial resilience reflects the combined influence of liquidity management, asset utilization, financing structure, and operating risk. These dimensions are interconnected: efficient working capital and asset utilization may strengthen financial capacity, while debt obligations and fixed operating costs may increase financial vulnerability. Trade-off Theory explains the balance between these financial benefits and risks, while Signaling Theory suggests that financial indicators provide information about a firm's financial condition to external stakeholders [12]. Examining these dimensions simultaneously therefore provides a broader understanding of the financial factors associated with firms' ability to withstand financial shocks [1, 3, 7, 9, 10].

H5: Working capital management (CCC and WCTO), asset efficiency (TATO), financial leverage (DER and SDTA), and operating risk (DOL) jointly affect financial resilience.

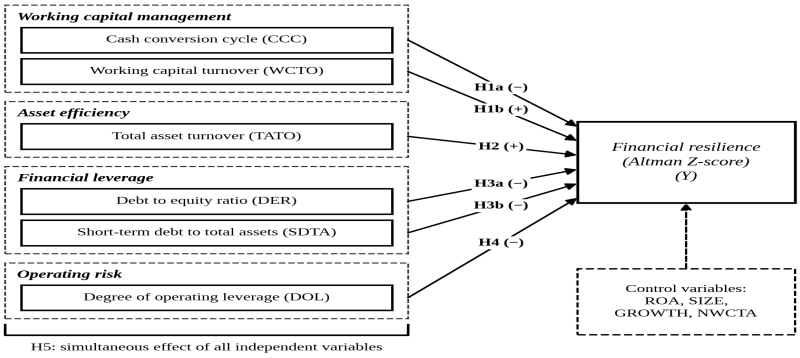


Fig. 1. Research model.

3 Methods

3.1 Data and sample

This study uses secondary financial data from OSIRIS, annual reports, and audited financial statements of healthcare firms listed in Indonesia, Singapore, Malaysia, Thailand, the Philippines, and Vietnam during 2021–2025. Purposive sampling was based on three criteria: (1) firms classified in the healthcare sector on their domestic stock exchanges; (2) firms remaining listed with financial reports available throughout 2021–2025; and (3) firms disclosing sufficient information to calculate all research variables. Firms not meeting these criteria were excluded, resulting in 182 firms and 910 firm-year observations in a balanced panel. The sample covers the six countries' respective stock exchanges, including the Indonesia Stock Exchange, Singapore Exchange, Bursa Malaysia, Stock Exchange of Thailand, Philippine Stock Exchange, and Ho Chi Minh Stock Exchange/Hanoi Stock Exchange. Consistent variable definitions were applied across countries, while monetary figures remained in each firm's reporting currency. All variables were winsorized at the 5th and 95th percentiles. The firm fixed-effects model accounts for unobserved, time-invariant firm characteristics, although country-specific institutional differences and time-varying macroeconomic conditions are not separately controlled for.

3.2 Variables and estimation

Financial resilience is measured using the emerging-market Altman Z-score for non-manufacturing firms [14]. A higher score indicates lower financial distress risk and stronger resilience. The model excludes the sales-to-total-assets ratio to avoid direct overlap with TATO. The control variables are return on assets (ROA), firm size (SIZE), sales growth (GROWTH), and net working capital to total assets (NWCTA). Variable definitions and formulas are presented in Table 1, while Equation (1) specifies the panel regression model estimated using Stata.

Table 1. Variable definitions.

Variable	Proxy (symbol)	Formula
Financial resilience (dependent)	Altman Z-score, emerging market, non-manufacturing (Z)	$Z = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$ X_1 = NWC / total assets; X_2 = retained earnings / total assets; X_3 = EBIT / total assets; X_4 = book value of equity / total liabilities
Working capital management	Cash conversion cycle (CCC)	$Days\ inventory + days\ sales - days\ pay$
	Working capital turnover (WCTO)	$Operating\ revenue\ /\ net\ working\ capital\ (N$
Asset efficiency	Total asset turnover (TATO)	$Sales\ /\ total\ assets$
Financial leverage	Debt to equity ratio (DER)	$Total\ liabilities\ /\ total\ equity$
	Short-term debt to total assets (SDTA)	$Current\ liabilities\ /\ total\ assets$
Operating risk	Degree of operating leverage (DOL)	$\%\Delta EBIT\ /\ \%\Delta Sales$
Controls	Return on assets (ROA)	$Net\ income\ /\ total\ assets$
	Firm size (SIZE)	$ln(total\ assets)$
	Sales growth (GROWTH)	$(sales_t - sales_{t-1})/sales_{t-1}$
	Net working capital to total assets (NWCTA)	$NWC\ /\ total\ assets$

$$Z_{it} = \alpha + \beta_1 CCC_{it} + \beta_2 WCTO_{it} + \beta_3 TATO_{it} + \beta_4 DER_{it} + \beta_5 SDTA_{it} + \beta_6 DOL_{it} + \beta_7 ROA_{it} + \beta_8 SIZE_{it} + \beta_9 GROWTH_i$$

where i indexes firms, t indexes years, α is the constant, $\beta_1 - \beta_{10}$ are regression coefficients and ε is the error term.

Model selection was conducted using the Chow, Hausman, and Breusch–Pagan Lagrange Multiplier tests. Partial coefficient tests evaluated H1a–H4, while the F-test assessed H5. Multicollinearity and heteroskedasticity were examined using the variance inflation factor (VIF) and Breusch–Pagan/Cook–Weisberg test, respectively.

4 Results

4.1 Descriptive statistics and correlations

Table 2 reports the statistics for 910 firm-year observations. The Z-score averages 0.426 with a standard deviation of 1.616, almost four times the mean, so financial condition varies widely across firms. TATO has the widest spread (standard deviation 7.688; range −41.878 to 148.434), average ROA is negative (−2.144), and NWCTA reaches −0.683, so some firms run negative net working capital.

Table 2. Descriptive statistics

Variable	N	Mean	Std. dev.	Minimum	Maximum
Z-score	910	0.426	1.616	−7.563	6.781
CCC	910	4.540	2.127	−4.517	13.238
WCTO	910	1.909	1.768	−4.226	8.988
TATO	910	0.231	7.688	−41.878	148.434
DER	910	−0.647	1.528	−7.529	4.282
SDTA	910	0.000	1.357	−6.972	3.797
DOL	910	−0.010	1.915	−7.669	7.971

Variable	N	Mean	Std. dev.	Minimum	Maximum
ROA	910	−2.144	1.508	−11.412	2.317
SIZE	910	0.000	2.275	−11.002	5.467
GROWTH	910	1.042	17.655	−1.000	461.300
NWCTA	910	0.152	0.167	−0.683	0.818

DER and SDTA correlate most strongly (0.8815), followed by SDTA and ROA (0.6808) and DER and ROA (0.5560); TATO, SIZE and GROWTH correlate weakly with the other variables (below 0.25 in absolute value). No pair exceeds the 0.90 threshold that Hair et al. [15] associate with serious multicollinearity, although DER and SDTA come close.

4.2 Model selection and regression results

The Chow test (F = 3.92; d.f. 181, 718; p = 0.000) prefers FEM over CEM, the Breusch-Pagan LM test (X^2 = 206.80; p = 0.000) prefers REM over CEM, and the Hausman test ((X^2 = 44.71; d.f. 10; p = 0.000), which settles the choice between the remaining two, prefers FEM over REM. FEM is therefore the estimation model. VIF values run from 1.02 (TATO) to 6.41 (SDTA) with a mean of 3.37, all below 10, so multicollinearity is not serious. The Breusch-Pagan/Cook-Weisberg test (X^2 (1) = 0.53; p = 0.467) does not reject constant variance, so heteroskedasticity is not a concern.

Table 3 presents the FEM estimates. The model is jointly significant (F(10, 718) = 68.06; p < 0.001), so H5 is supported, although the F-test also includes the controls; within R^2 of 0.4866 means the model explains 48.66% of the within-firm variation in the Z-score. WCTO and DER have positive effects significant at 1%, which supports H1b but contradicts H3a, because the DER sign is opposite to the hypothesis. SDTA is positive and significant only at 10%, so H3b also fails, and CCC, TATO and DOL are insignificant. ROA is the only significant control.

Table 3. Fixed effect panel regression and hypothesis decisions.

Variable	Coef.	Std. err.	t	p-value	Hypothesis decision
CCC	0.0571	0.0362	1.58	0.115	H1a not supported
WCTO	0.1375***	0.0494	2.78	0.006	H1b supported
TATO	−0.0033	0.0049	−0.67	0.502	H2 not supported
DER	0.2698***	0.0892	3.03	0.003	H3a not supported
SDTA	0.1935*	0.1129	1.71	0.087	H3b not supported
DOL	0.0208	0.0274	0.76	0.447	H4 not supported
ROA	0.1827***	0.0538	3.39	0.001	Control
SIZE	0.0389	0.0405	0.96	0.337	Control
GROWTH	−0.0022	0.0023	−0.94	0.346	Control
NWCTA	−0.5716	0.5977	−0.96	0.339	Control
Constant	0.5613**	0.2699	2.08	0.038	

Note: ***, ** and * denote significance at 1%, 5% and 10% (two-tailed). R^2 within = 0.4866, between = 0.1245, overall = 0.3270; F(10, 718) = 68.06.

5 Discussion

The results show that only WCTO has a positive and significant relationship with financial resilience as hypothesized. DER is positive and significant but contradicts H3a, while SDTA is positive only at the 10% level. Meanwhile, CCC, TATO, and DOL are insignificant.

CCC is insignificant ($\beta = 0.0571$; $p = 0.115$), differing from Roy et al. [7] and Phan and Dang [8], whose studies focus on crisis survival and profitability rather than Altman Z-score. Although a longer CCC may restrict cash availability, sufficient inventory and trade credit can also support healthcare operations and sales. These opposing effects may explain the insignificant relationship. In contrast, WCTO is positive and significant ($\beta = 0.1375$; $p = 0.006$), indicating that more productive use of net working capital is associated with stronger resilience. This supports the findings of Kumar et al. [10] and Çınaroğlu and Pirgaip [9]. However, unusually high WCTO values when net working capital approaches zero may influence the estimate. Overall, working capital productivity appears more relevant than the length of the cash cycle.

TATO has no significant relationship with resilience ($\beta = -0.0033$; $p = 0.502$). Its negative coefficient should not be interpreted as evidence of a negative effect because the 95% confidence interval includes zero. The extreme TATO values (maximum 148.434) may also reduce estimate stability. This suggests that asset turnover alone may not adequately capture the contribution of healthcare assets to financial resilience.

DER shows a positive and significant relationship ($\beta = 0.2698$; $p = 0.003$), contrary to H3a and the negative leverage–performance relationship reported by Le and Phan [13]. Under Trade-off Theory, debt may support investment and operations when its benefits exceed financing costs, provided that firms remain within an appropriate debt level [11]. Thus, debt may accompany stronger resilience when it finances productive activities. However, reverse causality is also possible: financially stronger firms may have greater access to external financing. Since FEM does not establish causal direction, the positive coefficient should be interpreted as an association rather than proof that higher debt improves resilience. DER and SDTA are also highly correlated (0.8815), requiring caution when interpreting their individual effects. SDTA is positive but only significant at the 10% level ($\beta = 0.1935$; $p = 0.087$), so H3b is not supported at the 5% level. These findings suggest that debt does not necessarily weaken resilience across all sampled firms, while the Indonesian cases discussed earlier [6] may represent more extreme conditions.

DOL is insignificant ($\beta = 0.0208$; $p = 0.447$). One possible explanation is that fixed operating cost structures may change relatively slowly within the five-year observation period, limiting within-firm variation. Moreover, specific cost pressures identified by Ekici et al. [3] and Păun et al. [1] may not be fully captured by an aggregate operating leverage measure.

Among the control variables, only ROA is positive and significant ($\beta = 0.1827$; $p = 0.001$). However, this result requires caution because EBIT to total assets is a component of the Altman Z-score. Similarly, NWCTA directly corresponds to the working-capital-to-total-assets component of the Z-score, creating potential mechanical overlap between the dependent variable and control variables. The FEM also relies on within-firm variation; therefore, relatively stable variables such

as CCC, DOL, and SIZE may have limited explanatory power over the five-year period. The between R^2 of 0.1245 further indicates that differences in resilience across firms remain largely unexplained.

Overall, the findings support the importance of working capital productivity in explaining financial resilience but do not support the assumption that leverage always weakens resilience among ASEAN healthcare firms. The results should nevertheless be interpreted cautiously because of potential reverse causality, the high correlation between leverage proxies, and the overlap between certain control variables and the Altman Z-score components.

6 Conclusion

This study provides cross-country evidence on the financial resilience of 182 listed healthcare firms across six ASEAN markets during 2021–2025. The results show that WCTO and DER are positively and significantly associated with the Altman Z-score, while SDTA is positive at the 10% significance level. CCC, TATO, and DOL show no significant within-firm associations. The model is jointly significant and explains 48.66% of within-firm variation. These findings highlight that working-capital productivity is more relevant to financial resilience than cash-cycle duration and challenge the assumption that higher leverage always weakens resilience. For healthcare managers, the results emphasize improving working-capital productivity while maintaining adequate liquidity and inventory buffers. Investors and creditors should also consider the purpose and repayment capacity of debt rather than treating high leverage as an automatic indicator of financial fragility.

This study has several limitations. Financial resilience is measured using only the Altman Z-score, which may not capture operational or service-continuity resilience. The sample is also limited to listed firms with complete five-year data, while country-specific institutional differences and time-varying macroeconomic conditions are not separately controlled for. Furthermore, the fixed-effects model identifies associations rather than causal relationships, and the high correlation between DER and SDTA requires cautious interpretation. Future research could employ alternative resilience measures, incorporate country- and year-level controls, estimate leverage proxies in separate specifications, and apply dynamic panel or instrumental-variable methods to address potential endogeneity. Country and healthcare subsector analyses may also provide further insight into differences across ASEAN markets.

References

1. D. Păun, G. S. Cordos, T. Oprisor, E. Savan, F. Duma, Financial resilience in a dual crisis: performance of Romanian healthcare SMEs amid the COVID-19 pandemic and geopolitical shock. East. Eur. Econ. (2026) https://doi.org/10.1080/00128775.2026.2650823
2. I. Dalci, H. Ozyapici, Working capital management policy in health care: the effect of leverage. Health Policy **122**, 1266–1272 (2018) https://doi.org/10.1016/j.healthpol.2018.09.012

3. E. Ekici, J. Zhang, J. Han, The impact of cost resilience on management decision to respond to the COVID-19 crisis in healthcare companies. Int. J. Healthc. Manag. **18**, 478–486 (2025) https://doi.org/10.1080/20479700.2024.2318512
4. S. Karakolias, Rethinking financial distress in public healthcare: evidence from Greek hospitals' governance attributes. Front. Public Health **13**, 1690901 (2025) https://doi.org/10.3389/fpubh.2025.1690901
5. Top Glove, Sharp drop in Top Glove profits as COVID-19 threat abates. Press release (20 September 2022) https://www.topglove.com/single-news-en?id=1769&title=sharp-drop-in-top-glove-profits-as-covid-19-threat-abates
6. R. Binekasri, BUMN Farmasi terjerat masalah keuangan, ini daftar penyakitnya. CNBC Indonesia (17 July 2024) https://www.cnbcindonesia.com/market/20240717131341-17-555395/bumn-farmasi-terjerat-masalah-keuangan-ini-daftar-penyakitnya
7. P. Roy, M. Rossi, C. Salloum, H. Jarrar, B. Ghose, Working capital management efficiency in large firms during crisis: implications for community-based enterprises. J. Enterp. Communities People Places Glob. Econ. (2024) https://doi.org/10.1108/JEC-10-2024-0201
8. T. D. Phan, T. H. Dang, Working capital management and firm profitability in ASEAN: a cross-country panel analysis. Int. J. Sustain. Dev. Plan. **21**, 2533–2545 (2026) https://doi.org/10.18280/ijsdp.210612
9. S. Çınaroğlu, B. Pirgaip, Financial efficiency of healthcare companies in an emerging market. Manag. Decis. Econ. **45**, 3283–3296 (2024) https://doi.org/10.1002/mde.4196
10. Kumar, K. S. Sawarni, S. Narayanasamy, Does efficiency in working capital management impact the overall performance of firms? Evidence from India. Glob. Bus. Rev. (2024) https://doi.org/10.1177/09721509231213524
11. A. Kraus, R. H. Litzenberger, A state-preference model of optimal financial leverage. J. Finance **28**, 911–922 (1973)
12. M. Spence, Job market signaling. Q. J. Econ. **87**, 355–374 (1973)
13. T. P. V. Le, T. B. N. Phan, Capital structure and firm performance: empirical evidence from a small transition country. Res. Int. Bus. Financ. **42**, 710–726 (2017) https://doi.org/10.1016/j.ribaf.2017.07.012
14. E. Altman, M. Iwanicz-Drozdowska, E. Laitinen, A. Suvas, Financial distress prediction in an international context: a review and empirical analysis of Altman's Z-score model. J. Int. Financ. Manag. Account. **28**, 131–171 (2016) https://doi.org/10.1111/jifm.12053
15. J. F. Hair, W. C. Black, B. J. Babin, R. E. Anderson, *Multivariate Data Analysis*, 8th edn. (Cengage Learning, 2019)