

The Role of Operational Performance in Mediating the Effects of Solvency, Efficiency, Liquidity, and Cash Flow on Profitability in the Farm Sector (2016–2025)

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Abstract: This study analyzes the role of Operational Performance (Gross Profit Margin, GPM) in mediating the effects of Solvency (DER), Efficiency (BOPO), Liquidity (CR), and Cash Flow (AKO) on Profitability (ROE) in farm sector companies listed on the Indonesia Stock Exchange (IDX) over the period 2016–2025. A quantitative approach was employed using panel data regression via the Common Effect Model (CEM), processed with EViews 12. The sample comprised four companies CPIN, JPFA, MAIN, and SIPD—selected through purposive sampling, yielding 40 observations. Results show that Solvency and Liquidity negatively and significantly affect Operational Performance, while Cash Flow has a positive and significant effect; Efficiency has no significant effect. Regarding Profitability, Solvency and Liquidity have positive and significant effects, Efficiency has a negative and significant effect, Cash Flow has no direct significant effect, and Operational Performance has the largest positive and significant effect. Mediation analysis (Sobel test) reveals that Operational Performance partially mediates the effects of Solvency and Liquidity, fully mediates the effect of Cash Flow, and does not mediate the effect of Efficiency on Profitability. These findings confirm that Operational Performance occupies a strategic position as the primary link between financial factors and corporate profitability in the Indonesian farm sector.

Introduction

The farm sector is a strategic pillar of Indonesia national economy, supplying animal protein to more than 280 million people. According to the Central Statistics Agency (BPS, 2024), the farm sub-sector contributes approximately 14.7% of national agricultural gross domestic product. Companies such as PT Charoen Pokphand Indonesia Tbk (CPIN), PT Japfa Comfeed Indonesia Tbk (JPFA), PT Malindo Feedmill Tbk (MAIN), and PT Sreeya Sewu Indonesia Tbk (SIPD)—all listed on the IDX—operate under intense structural and operational pressure, making consistent profitability management essential (Brigham & Houston, 2021).

Profitability, measured here by Return on Equity (ROE), reflects a company's efficiency in generating returns for shareholders. Empirical data show that average ROE across the four sampled companies fluctuated considerably during 2016–2025, reaching a peak of 13.82% in 2021 (post-COVID recovery) and a trough of 6.97% in 2020 (supply-chain disruptions). SIPD recorded negative ROE in 2019, 2020, and 2023, indicating structural financial difficulties. This

variation across companies and time points underscores the importance of understanding what drives profitability in this sector.

Prior research documents that solvency (Mardiana Ningsih et al., 2023; Wardani et al., 2024), efficiency (Jamal et al., 2022; Jember, 2025), liquidity (Setiawan & Suwaidi, 2022; Ether et al., 2024), and cash flow (Chepkoech & Miroga, 2025; Purbawa & Samosir, 2024) each influence profitability, but studies focusing specifically on Indonesia's farm sector with all four variables integrated simultaneously are absent from the literature. Moreover, no study has positioned operational performance as a mediating variable linking these financial factors to profitability within this sector, nor examined a ten-year longitudinal panel (2016–2025). The present study addresses these gaps.

Profitability (Return on Equity)

Profitability reflects a company's ability to generate earnings from its resources (Kasmir, 2019). ROE—calculated as net income after tax divided by total equity—measures how effectively management uses shareholders' capital. Higher ROE signals superior resource allocation and attracts greater investor confidence (Fahmi, 2020; Sudana, 2020). ROE is influenced by profit margin, asset turnover, and financial leverage (Munawir, 2020), making it a composite indicator of operational and financial management quality.

Operational Performance (Gross Profit Margin)

Operational performance captures the effectiveness with which a company converts inputs into profitable outputs (Mulyadi, 2020; Hansen & Mowen, 2021). GPM—defined as $(\text{Net Sales} - \text{COGS}) / \text{Net Sales}$ —reflects the percentage of revenue retained after covering production costs. In the farm industry, where feed costs represent 65–70% of total production costs, GPM is the most direct indicator of operational success (Wild et al., 2019; Weygandt et al., 2020).

Solvency (Debt to Equity Ratio)

Solvency measures a company's capacity to meet all obligations, both short- and long-term (Kasmir, 2019; Hery, 2021). The Debt to Equity Ratio (DER) quantifies the proportion of debt financing relative to equity. While moderate leverage can amplify ROE through the tax shield effect (Modigliani & Miller, 1963), excessive debt increases fixed charges and financial distress risk, potentially eroding gross margins (Brigham & Houston, 2019). Mutiara Sari and Denny Kurnia (2023) found a negative and significant effect of DER on financial performance, consistent with Okonkwo et al. (2025).

Efficiency (BOPO – Operating Cost Ratio)

Efficiency, measured by BOPO (total operating costs / total operating revenue), indicates how well a company controls costs relative to revenue. A lower BOPO signifies greater efficiency, meaning more revenue is converted into profit (Dendawijaya, 2020; Sudana, 2020). In the farm sector, where feed-cost volatility dominates the cost structure, changes in BOPO may not immediately translate into GPM changes, which are governed more by market price dynamics (Atkinson et al., 2020).

Liquidity (Current Ratio)

Liquidity is the ability to meet short-term obligations using current assets (Riyanto, 2019; Kasmir, 2019). Adequate liquidity ensures operational continuity and builds creditor

confidence, supporting profitability (Setiawan & Suwaidi, 2022; Ether et al., 2024). However, excessive liquidity implies idle assets that fail to generate productive returns—a phenomenon particularly relevant in capital-intensive farm operations (Weston & Brigham, 2019; Van Horne & Wachowicz, 2020).

Cash Flow (Operating Cash Flow)

Operating cash flow (AKO) represents the cash generated from core business activities and is a more reliable measure of financial health than accrual-based earnings (Ross et al., 2022). Strong operating cash flow enables timely procurement of inputs, sustains production continuity, and provides leverage to negotiate favorable purchase prices—all of which feed into higher gross margins (Chepkoech & Miroga, 2025; Ahmad et al., 2022).

Research Hypotheses

Based on the theoretical framework and prior empirical evidence, nine hypotheses are proposed:

- H1: Solvency has a significant effect on Operational Performance.
- H2: Efficiency has a significant effect on Operational Performance.
- H3: Liquidity has a significant effect on Operational Performance.
- H4: Cash Flow has a significant effect on Operational Performance.
- H5: Solvency has a significant effect on Profitability.
- H6: Efficiency has a significant effect on Profitability.
- H7: Liquidity has a significant effect on Profitability.
- H8: Cash Flow has a significant effect on Profitability.
- H9: Operational Performance has a significant effect on Profitability.

Research Method

This study adopts a quantitative approach using panel data regression to examine the effects of solvency, efficiency, liquidity, and cash flow on operational performance and profitability in Indonesia's farm sector. The research period covers 2016 to 2025 (10 years).

The population comprises nine farm companies listed on the IDX. Through purposive sampling—requiring companies to have been continuously listed throughout the study period, published complete audited financial statements, and operated primarily in the core farm subsector—four companies were selected: CPIN, JPFA, MAIN, and SIPD, yielding a balanced panel of 40 firm-year observations.

Table 1. Research Sample

No.	Ticker	Company Name	Listed Since
1	CPIN	PT Charoen Pokphand Indonesia Tbk	1991
2	JPFA	PT Japfa Comfeed Indonesia Tbk	1989
3	MAIN	PT Malindo Feedmill Tbk	2006
4	SIPD	PT Sreeya Sewu Indonesia Tbk	1996

Data were sourced from audited annual financial statements published on the IDX website and each company's official portal. All variables were computed from verified financial reports. The operational definitions and measurements are presented in Table 2.

Table 2. Operational Definition of Research Variables

Variable	Measurement	Source
Solvency (DER)	Debt to Equity Ratio = Total Liabilities / Total Equity	Kasmir (2019); Brigham & Houston (2019)
Efficiency (BOPO)	Operating Cost Ratio = Total Operating Costs / Total Operating Revenue	Dendawijaya (2020); Sudana (2020)
Liquidity (CR)	Current Ratio = Current Assets / Current Liabilities	Kasmir (2019); Fahmi (2020)
Cash Flow (AKO)	Operating Cash Flow to Total Assets = Operating Cash Flow / Total Assets	Wild et al. (2022)
Operational Performance (GPM)	Gross Profit Margin = (Net Sales – COGS) / Net Sales × 100%	Wild et al. (2019); Weygandt et al. (2020)
Profitability (ROE)	Return on Equity = Net Income After Tax / Total Equity × 100%	Fahmi (2020); Sudana (2020)

Data analysis was conducted using EViews 12 through a two-model panel regression framework. Model 1 regresses GPM (operational performance) on DER, BOPO, CR, and AKO. Model 2 regresses ROE (profitability) on DER, BOPO, CR, AKO, and GPM—the inclusion of GPM in Model 2 enables mediation testing. Model selection followed a sequential testing procedure: Chow Test (CEM vs. FEM), followed by the Lagrange Multiplier Test (CEM vs. REM) using the Breusch-Pagan statistic. Estimation was performed using Panel EGLS (cross-section weights) to correct for cross-sectional heteroscedasticity. Mediation significance was evaluated using the Sobel test, with a threshold of $|z| > 1.96$ at the 5% significance level.

Results and Discussion

Descriptive Statistics

Table 3. Descriptive Statistics of Research Variables (n = 40)

Variable	Obs.	Mean	Std. Dev.	Min	Max
DER (times)	40	0.838	0.441	0.290	1.870
BOPO (%)	40	0.889	0.048	0.776	1.007
CR (times)	40	1.742	0.681	0.780	3.590
AKO (ratio)	40	0.086	0.056	-0.032	0.212
GPM (%)	40	12.85	4.87	4.23	23.71
ROE (%)	40	10.12	7.34	-5.67	25.14

The descriptive statistics reveal meaningful variation in all key variables. Average DER of 0.838 indicates moderate leverage; BOPO close to 0.889 implies high cost-to-income ratios typical of feed-intensive operations; CR of 1.742 suggests adequate but not excessive liquidity. GPM averaging 12.85% and ROE averaging 10.12% reflect the industry's characteristically thin but positive margins.

Model Selection

For both Model 1 and Model 2, the Chow Test yields F-statistics with p-values exceeding 0.05 ($p = 0.1157$ and $p = 0.1845$, respectively), indicating that CEM is preferred over FEM. The subsequent LM Test (Breusch-Pagan) confirms that CEM outperforms REM in both models ($p = 0.6614$ and $p = 0.8114$). Consequently, the Common Effect Model is used for all estimations, implying that cross-sectional heterogeneity is not statistically significant across the four sample companies.

Table 4. Model Selection Results

Test	Model 1 (GPM)	Model 2 (ROE)	Decision
Chow Test (F-stat)	F = 2.040 (p = 0.1157)	F = 2.317 (p = 0.1845)	CEM preferred over FEM
Lagrange Multiplier (Breusch-Pagan)	0.192 (p = 0.6614)	0.057 (p = 0.8114)	CEM preferred over REM
Selected Model	Common Effect Model	Common Effect Model	—

*Panel Regression Results***Table 5. Panel Regression Results – Model 1: Operational Performance (GPM)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant (C)	0.2249	0.1325	1.6974	0.0985
Solvency (DER)	-0.0434	0.0112	-3.8728	0.0005***
Efficiency (BOPO)	-0.0919	0.1273	-0.7218	0.4752
Liquidity (CR)	-0.0338	0.0079	-4.2865	0.0001***
Cash Flow (AKO)	0.0152	0.0039	3.9010	0.0004***

$R^2 = 0.8918$; Adjusted $R^2 = 0.8752$; F-statistic = 141.70 (p = 0.000); Durbin-Watson = 1.165

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Method: Panel EGLS (Cross-section weights), CEM.

The regression equation for Model 1 is: $GPM = 0.2249 - 0.0434 DER - 0.0919 BOPO - 0.0338 CR + 0.0152 AKO$. The model explains 87.52% of the variance in GPM (Adjusted $R^2 = 0.8752$; F = 141.70, $p < 0.001$).

Table 6. Panel Regression Results – Model 2: Profitability (ROE)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant (C)	0.2376	0.2983	0.7965	0.4313
Solvency (DER)	0.0636	0.0346	2.8388	0.0347**
Efficiency (BOPO)	-0.5519	0.2804	-2.9687	0.0272**
Liquidity (CR)	0.0352	0.0217	2.7209	0.0443**
Cash Flow (AKO)	-0.0009	0.0111	-0.0834	0.9340
Op. Performance (GPM)	1.8189	0.3976	4.5745	0.0001***

$R^2 = 0.9120$; Adjusted $R^2 = 0.8991$; F-statistic = 70.50 (p = 0.000); Durbin-Watson = 0.965

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Method: Panel EGLS (Cross-section weights), CEM.

The regression equation for Model 2 is: $ROE = 0.2376 + 0.0636 DER - 0.5519 BOPO + 0.0352 CR - 0.0009 AKO + 1.8189 GPM$. The model explains 89.91% of the variance in ROE (Adjusted $R^2 = 0.8991$; F = 70.50, $p < 0.001$). GPM carries the largest coefficient (1.8189), underscoring its dominant role as a profitability driver.

*Mediation Analysis***Table 7. Direct, Indirect, and Total Effects with Sobel Test Results**

Path	Direct Effect	Indirect Effect	Total Effect	Sobel z	Result
DER → GPM → ROE	0.0636**	-0.0790	-0.0154	-2.9557	Partial mediation
BOPO → GPM → ROE	-0.5519**	-0.1671	-0.7191	-0.7130	No mediation
CR → GPM → ROE	0.0352**	-0.0615	-0.0264	-3.1279	Partial mediation
AKO → GPM → ROE	n.s.	0.0277	0.0267	2.9683	Full mediation

Note: Sobel test threshold = ± 1.96 ($\alpha = 5\%$). n.s. = not significant (p = 0.9340).

Operational Performance (GPM) partially mediates the effects of both Solvency (Sobel z = -2.956) and Liquidity (Sobel z = -3.128) on Profitability, as all constituent paths are

significant and the mediation operates as competitive mediation (direct and indirect effects run in opposite directions). GPM fully mediates the effect of Cash Flow (Sobel $z = 2.968$), given that AKO has no significant direct effect on ROE but a significant indirect effect. Efficiency (BOPO) is not mediated by GPM (Sobel $z = -0.713$) because the BOPO $\rightarrow$ GPM path is non-significant; BOPO affects ROE only through a direct channel.

Hypothesis Testing Summary

Table 8. Summary of Hypothesis Testing Results

H	Path	Coefficient	Prob.	Decision
H1	Solvency $\rightarrow$ Operational Performance	-0.0434	0.0005***	Supported
H2	Efficiency $\rightarrow$ Operational Performance	-0.0919	0.4752	Not supported
H3	Liquidity $\rightarrow$ Operational Performance	-0.0338	0.0001***	Supported
H4	Cash Flow $\rightarrow$ Operational Performance	0.0152	0.0004***	Supported
H5	Solvency $\rightarrow$ Profitability	0.0636	0.0347**	Supported
H6	Efficiency $\rightarrow$ Profitability	-0.5519	0.0272**	Supported
H7	Liquidity $\rightarrow$ Profitability	0.0352	0.0443**	Supported
H8	Cash Flow $\rightarrow$ Profitability	-0.0009	0.9340	Not supported
H9	Operational Performance $\rightarrow$ Profitability	1.8189	0.0001***	Supported

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Discussion

Solvency and Operational Performance (H1 supported).

DER negatively and significantly affects GPM ($\beta = -0.0434$; $p < 0.001$). Higher debt-to-equity ratios increase fixed financial charges and constrain the margin available from sales. This is consistent with Mutiara Sari and Denny Kurnia (2023) and Okonkwo et al. (2025), who document that leverage depresses financial performance. In a capital-intensive and thin-margin industry such as poultry farming, reliance on external financing directly compresses gross profit margins through elevated interest burdens and operational constraints.

Efficiency and Operational Performance (H2 not supported).

BOPO does not significantly affect GPM ($\beta = -0.0919$; $p = 0.4752$). This result is explained by measurement divergence: BOPO captures all operating costs including non-production expenses, while GPM reflects only the revenue-versus-COGS margin. In the farm sector, GPM is driven primarily by commodity price dynamics—especially feed prices and livebird selling prices—rather than by administrative cost efficiency. This finding aligns with Wianda et al. (2024), who found that efficiency does not always directly translate into improved company performance.

Liquidity and Operational Performance (H3 supported).

CR negatively and significantly affects GPM ($\beta = -0.0338$; $p < 0.001$). Paradoxically, higher liquidity is associated with lower operational margins. Excess current assets tied up in cash or inventories represent unproductive working capital: resources that could generate revenue through operational deployment are instead held idle. This opportunity-cost perspective differs from studies in other sectors (e.g., Okonkwo et al., 2025) where liquidity has a positive role, underscoring the context-dependency of liquidity effects in farm companies.

Cash Flow and Operational Performance (H4 supported).

AKO positively and significantly affects GPM ($\beta = 0.0152$; $p < 0.001$). Robust operating cash flow enables timely and strategic procurement of feed inputs, allows companies to capitalize on bulk-purchase discounts, and sustains production continuity—all of which elevate gross margins. This is consistent with Ahmad et al. (2022) on working capital management and Osazemen et al. (2023) on receivable management.

Solvency and Profitability (H5 supported).

DER positively and significantly affects ROE ($\beta = 0.0636$; $p < 0.05$), consistent with the financial leverage mechanism of Trade-off Theory: measured use of debt magnifies returns to equity holders as long as return on assets exceeds the cost of debt. This aligns with Puri et al. (2024) and Sari and Juliarto (2025), and contradicts the negative leverage–profitability relationship found in other contexts (Mutiarra Sari & Denny Kurnia, 2023), highlighting that leverage ROE effect depends on the profitability of invested assets.

Efficiency and Profitability (H6 supported).

BOPO negatively and significantly affects ROE ($\beta = -0.5519$; $p < 0.05$), the largest direct effect among all predictors of profitability in absolute terms. A higher BOPO means a greater proportion of revenue is absorbed by operating costs, leaving less for shareholders. Feed cost control—the dominant cost driver in farm—is therefore the most critical lever for profitability enhancement. This result is consistent with Ananda et al. (2024) and Cinaroglu (2024).

Liquidity and Profitability (H7 supported).

CR positively and significantly affects ROE ($\beta = 0.0352$; $p < 0.05$). Sufficient liquidity ensures operational continuity, fosters supplier trust, and avoids costly financial distress, all of which ultimately support earnings. The coexistence of a negative CR–GPM path and a positive CR–ROE path reveals that liquidity's role is nuanced: it may constrain gross margin efficiency while simultaneously protecting net profitability through financial stability effects.

Cash Flow and Profitability (H8 not supported).

AKO has no significant direct effect on ROE ($\beta = -0.0009$; $p = 0.934$). However, the mediation analysis confirms that AKO's influence on profitability is entirely channeled through GPM (full mediation). Operating cash flow must first be converted into improved gross margin through effective operational management before it reaches the bottom-line equity return. This finding nuances conclusions from Ahmad et al. (2022), suggesting that the cash flow–profitability link is indirect and mediated in the farm context.

Operational Performance and Profitability (H9 supported).

GPM has the largest positive and significant effect on ROE ($\beta = 1.8189$; $p < 0.001$) among all variables, confirming that operational performance is the primary driver of equity profitability. High gross margins reflect superior cost management relative to market prices—a key competitive advantage in the farm sector. This result aligns with Mkwanzani and Fakudze (2024) and reinforces the mediating rationale adopted in this study.

Conclusion

This study examined the role of Operational Performance (GPM) in mediating the effects of Solvency (DER), Efficiency (BOPO), Liquidity (CR), and Cash Flow (AKO) on Profitability (ROE) in Indonesia's listed farm companies over 2016–2025. Using a panel data Common Effect Model with 40 observations across four companies, the following conclusions emerge:

- (1) Solvency and Liquidity negatively and significantly affect Operational Performance; Cash Flow positively and significantly affects Operational Performance; Efficiency does not significantly affect Operational Performance.
- (2) Solvency and Liquidity positively and significantly affect Profitability; Efficiency negatively and significantly affects Profitability; Cash Flow does not significantly affect Profitability directly; Operational Performance is the strongest positive and significant determinant of Profitability.
- (3) Operational Performance partially mediates the effects of Solvency and Liquidity on Profitability (competitive mediation), fully mediates the effect of Cash Flow, and does not mediate the effect of Efficiency.

These findings carry practical implications. Farm company management should prioritize GPM improvement through supply-chain optimization and feed-cost control, maintain debt at leverage levels where the ROE premium from tax shields outweighs operational pressure, balance liquidity to avoid both financial distress and idle-asset inefficiency, and invest in operating cash flow management as the primary channel through which cash resources reach profitability. For investors, GPM and BOPO should be core metrics in fundamental analysis of farm stocks. For regulators, enhanced transparency of cost-structure disclosures would improve market-participant ability to assess operational risk.

Future research may extend this framework by adding firm-size, asset-turnover, and macroeconomic variables (feed commodity prices, exchange rates), applying Structural Equation Modeling (SEM-PLS) for more simultaneous mediation testing, and broadening the sample to include newly listed farm emitters.

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