

# The Effect of Leverage on Profitability: A Dynamic Panel Study on the IDX

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on Profitability:  
Panel Study on IDX*

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## ABSTRACT

*The relationship between leverage and profitability still shows diverse empirical results, especially in companies in Indonesia. This study aims to identify the relationship between the degree of financial leverage used and the profitability of companies within the tier structures of the Indonesia Stock Exchange by employing a dynamic econometric model, the Generalized Method of Moments (GMM) Arellano-Bond Approach. This study is based on the published annual reports of sample companies from 2015 to 2024, which provide their financial and operational performance over the study period. In this study, the dynamic panel model is used because it eliminates endogeneity and simultaneity bias in the estimation, which are common in the assessment of leverage and profitability when measured simultaneously, and it also delivers both the short- and long-run impacts of the model's variables. The findings suggest a negative, significant impact of financial leverage on profitability: profits decrease as a firm's debt level increases. However, the broader positive effects of profitability and firm size, as well as growth in sales, confirm the relevance of sales magnitude and dynamics in improving the firm's financial performance. The findings corroborate the Trade-off Theory and indicate that Indonesian manufacturing firms should maintain an appropriate capital structure to improve profitability while minimizing the probability of bankruptcy.*

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## INTRODUCTION

A crucial aspect of any organization is the effective administration of its financial resources. With the contemporary increase in competition in the business, the ability to manage financial resources will determine which organizations will prosper and dominate in the long run. Profitability not only reflects a company's ability to generate profits, but is also an indicator of financial health that affects the confidence of investors, creditors, and other stakeholders (Zada et al., 2021; Bawono & Sasongko, 2021; Musa, 2024; Maianto et al., 2024). Therefore, good financial management does not only focus on recording and reporting, but also on strategic decision-making related to capital structures, investments, and financing policies (Ren, 2022; Dharmayanti et al., 2023; Kurniawan et al., 2023).

Leverage, defined as a firm's debt capacity, is a central issue in financial management. While debt can generate tax benefits and enhance shareholder returns, it also increases interest burdens that may reduce profitability (Jordão et al., 2022; Chen et al., 2023; Sarfraz et al., 2023). Capital structure theory therefore emphasizes balancing the tax advantages of debt against the risk of financial distress and bankruptcy, making the determination of an optimal leverage level a strategic managerial decision, particularly under global uncertainties such as geopolitical instability and the push for green finance in G-20 countries (Prohorovs, 2022; Ma et al., 2023).

In Indonesia, especially in the manufacturing sector listed on the Indonesia Stock Exchange, leverage has a significant role in determining financial performance (Shaferi et

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al., 2020). Manufacturing companies generally require large capital to invest in fixed assets, so the tendency to use debt is relatively high. However, high leverage can put pressure on profitability if the company's revenue is unable to cover interest costs. This condition is increasingly complex when companies face economic fluctuations, changes in fiscal policies, and global market dynamics that affect production costs and competitiveness (Ekadjaja & Wijaya, 2021; Juita, 2021; Suriani et al., 2023). Therefore, an examination of these variables is intricately tied to providing empirical evidence on how capital structure affects firms' financial performance in Indonesia.

Research on leverage and profitability has been widely conducted internationally and in Indonesia, with mixed findings. Studies in Japan by Arhinful and Radmehr (2023) show that leverage significantly affects firm performance, while Indonesian evidence is less consistent. Prior research by Damayanti and Sucipto (2022), Anita et al. (2023), and Sapiri (2023) indicates that leverage influences firm value through profitability, earnings per share, and interacts with liquidity and dividend policy. However, most studies rely on static regression models that fail to capture dynamic and reciprocal effects between leverage and profitability over time, leading to inconsistent results, including positive, negative, or insignificant relationships (Wilantari et al., 2021; Widarni & Bawono, 2021; Harmono et al., 2023).

Given these limitations, advanced methods are required to examine the leverage–profitability relationship more accurately. The Arellano–Bond Generalized Method of Moments (GMM) dynamic panel model is particularly suitable because it addresses endogeneity and captures both short- and long-term dynamics by using lagged variables as internal instruments, thereby reducing bias common in static models and allowing past profitability to influence current performance (Tinungki et al., 2022; Zulkarnaina & Bawonob, 2025; Bawono et al., 2025). This approach is well suited to panel data on Indonesian manufacturing firms, which typically involve many cross-sectional units over long periods and are prone to heterogeneity and autocorrelation. Moreover, the model's diagnostic tests, including the Sargan or Hansen tests for instrument validity and the Arellano Bond AR(1) and AR(2) tests for serial correlation, ensure the robustness and reliability of the estimates, making the results more appropriate for empirical inference and managerial decision-making (Triatmanto et al., 2023).

This study aims to determine the extent to which leverage affects the profitability of manufacturing firms listed on the Indonesia Stock Exchange. This is important because including debt in capital structure is a financial expense that affects the firm's operational strategies and its ability to survive in a volatile market. This study provides managerial advice on optimal capital structure for firms within the manufacturing sector. The recommendations are expected to assist management in formulating a more balanced financing policy, so that the company is able to maintain profitability while minimizing the risk of bankruptcy.

## **LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT**

### **Theoretical Foundation**

The literature on leverage and profitability in Indonesian manufacturing firms is grounded in capital structure theory and supported by international empirical evidence. Modigliani and Miller (1958) argue that under perfect market conditions, a firm's capital structure is irrelevant to its value, implying that debt-equity choices do not affect profitability. However, this assumption is unrealistic because it ignores taxation, bankruptcy costs, and information asymmetry (Bawono & Sasongko, 2021; Maianto et al., 2024). Consequently, later theories provide more applicable explanations of how leverage affects performance.

The trade-off theory suggests firms aim for an optimal leverage level by balancing tax benefits against financial distress costs. Moderate debt may enhance profitability via tax shields, but excessive leverage increases financial risk and expected bankruptcy costs, reducing performance (Akhtar et al., 2022; Damayanti & Sucipto, 2022; Susilawati et al., 2022). Complementarily, the Pecking Order Theory emphasizes information asymmetry,

proposing firms prefer internal financing first, debt second, and new equity as a last resort due to higher signaling costs (Myers & Majluf, 1984). In this framework, more profitable firms rely on internal funds and exhibit lower leverage, producing a negative leverage profitability relationship (Juita, 2021; Anita et al., 2023; Suriani et al., 2023).

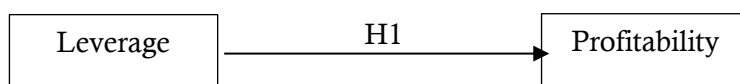
Together, these theories offer complementary perspectives: Modigliani and Miller stress irrelevance under ideal conditions, the trade-off theory highlights balancing debt benefits and costs, and the pecking order theory focuses on financing preferences shaped by information risk. In practice, the leverage profitability relationship is conditioned by macroeconomic environments, regulations, and industry characteristics, underscoring the need for empirical testing across contexts (Widarni & Bawono, 2021; Wilantari et al., 2021; Prohorovs, 2022).

### **The Effect of Leverage on Profitability**

Leverage is commonly employed to finance long-term investments; however, excessive reliance on debt increases interest expenses and fixed financial obligations, which may ultimately weaken firm performance if not managed carefully (Latif et al., 2024; Fadhillah et al., 2025). A higher Debt-to-Equity Ratio (DER), therefore reflects greater dependence on external financing and requires prudent control to prevent rising costs from eroding profitability. Profitability itself is not only an indicator of operational success but is also associated with financial reporting behavior, as firms with weaker performance are more likely to engage in earnings management to signal financial soundness (Dito et al., 2025). From a measurement perspective, Return on Assets (ROA) and Return on Equity (ROE) are widely used to evaluate managerial efficiency and overall corporate performance (Maenuddina et al., 2020; Marnilin, 2023). Empirical evidence on the leverage–profitability relationship across countries remains inconclusive: while many studies document a negative effect of leverage, others, such as research in Japan and South Korea, indicate that debt can enhance profitability when it is efficiently allocated to productive investments (Arhinful & Radmehr, 2023; Sapiri, 2023).

Evidence from India shows a negative effect of leverage on profitability, consistent with the trade-off theory and attributed to high bankruptcy costs and financial market instability, whereas findings from Brazil indicate that leverage can enhance profitability by enabling firms to expand and strengthen competitiveness (Zada et al., 2021; Jordão et al., 2022). These contrasting results suggest that the impact of leverage is highly context-dependent and shaped by differences in economic conditions, regulatory environments, and industry structures (Chen et al., 2023; Sarfraz et al., 2023; Dharmayanti et al., 2023; Ma et al., 2023). Most studies also report a negative association between leverage and profitability, supporting the trade-off theory and the risk of financial distress arising from excessive debt (Chen et al., 2019; Pham & Nguyen, 2020; Miswanto & Jatmiko, 2025).

H1: Leverage has a significant effect on profitability.



**Figure 1.** Research Framework

Based on Figure 1, the research framework positions leverage as the independent variable and profitability as the dependent variable. Conceptually, a firm's financing structure, reflected in its level of leverage, determines interest burdens and financial risk, which directly affect its ability to generate profits. Higher debt usage increases fixed financial costs and the likelihood of financial distress, thereby potentially reducing profitability. Accordingly, this framework assumes a causal relationship in which variations in leverage significantly explain variations in firm profitability, consistent with

the predictions of the trade-off and pecking order theories on the role of capital structure in financial performance.

## RESEARCH METHODS

This investigation concerns the relationship among various variables, and the analysis employed is correlational; therefore, a quantitative research methodology was used. This research uses data from 2015-2014, including financial statements from companies listed in the manufacturing sector in the Indonesia Stock Exchange (IDX). This is one of the capital-intensive sectors with the highest tendency to use debt to finance its investments.

Firm profitability is the primary dependent variable and is measured by Return on Assets (ROA) and Return on Equity (ROE), where ROA indicates the efficiency with which a company utilizes its total assets to generate earnings, and ROE reflects the return obtained by shareholders on their invested equity; together, these indicators provide a comprehensive view of operational and financial performance. Leverage is represented by the Debt-to-Equity Ratio (DER), which captures the extent to which a firm relies on debt relative to its own capital structure, offering potential tax advantages but also increasing bankruptcy risk when interest obligations exceed income, making it a relevant measure of financial risk. In addition, firm size and sales growth are included as control variables, with size measured by the natural logarithm of total assets to reduce scale bias and reflect access to financing and economies of scale, and sales growth calculated from annual revenue changes to capture market dynamics and the firm's capacity to enhance or sustain profitability.

This study use Arellano-Bond version of the Generalized Method of Moments (GMM) estimates for the analysis of the relationships between variables. This model was chosen because it is able to address endogeneity issues that often arise in financial research, specifically the reciprocal relationship between leverage and profitability. This model is dynamic because it includes the lag variable of profitability as a predictor, so it is able to capture both short-term and long-term effects.

The Arellano-Bond GMM model was chosen because it effectively addresses endogeneity arising from the reciprocal relationship between leverage and profitability by using internal instruments in the form of lagged variables, eliminating the need for difficult-to-obtain external instruments. This approach is well-suited for large panel datasets with long time dimensions, such as those of manufacturing firms listed on the IDX, and provides more efficient and consistent estimates than OLS or Fixed Effects models in the presence of heterogeneity and autocorrelation. The mathematical model used can be written as follows:

$$ROA_{it} = \alpha ROA_{i,t-1} + \beta_1 Leverage_{it} + \beta_2 Size_{it} + \beta_3 Growth_{it} + \varepsilon_{it}$$

with:

$ROA_{it}$  = the company's profitability in the period  $it$

$ROA_{i,t-1}$  = the company's profitability in the previous period  $i$

$Leverage_{it}$  = Debt-to-equity ratio of the company in the period  $it$

$Size_{it}$  = company size in the period  $it$

$Growth_{it}$  = growth in the company's sales in the period  $it$

$\varepsilon_{it}$  = error term

The dynamic GMM model of Arellano and Bond requires validity checks for its internal instruments and error structure. Instrument validity is assessed using the Sargan and Hansen tests, where the acceptance of the null hypothesis indicates that the instruments are uncorrelated with the error term and therefore free from endogeneity bias. In addition, the Arellano-Bond AR(1) and AR(2) tests are used to examine autocorrelation in the residuals, where a valid model is expected to show first-order but not second-order serial correlation, ensuring the consistency and reliability of the GMM estimates.

$$H_0: E[\varepsilon_{it}\varepsilon_{i,t-k}] = 0 \text{ for } k = 1,2$$

First-order autocorrelation (AR(1)) is theoretically expected in dynamic models, whereas the absence of second-order autocorrelation (AR(2)) indicates that the GMM estimators are consistent, valid, and efficient. The significance of leverage, firm size, and sales growth in explaining profitability is evaluated using coefficient p-values, where values below the chosen significance level (e.g., 5%) indicate a statistically significant effect, while higher p-values imply that the variable has no significant impact.

## RESULTS

The study analyzed 45 manufacturing companies listed on the Indonesia Stock Exchange (IDX) over the ten-year period from 2015 to 2024, resulting in a balanced panel of 450 firm-year observations after accounting for lagged variables in the dynamic specification. Manufacturing firms were selected due to their capital-intensive nature and high reliance on debt financing, making them particularly relevant for examining leverage-profitability dynamics.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	Observations
ROA (%)	6.82	5.24	3.15	22.45	0.85	3.42	450
DER	1.42	0.89	0.12	4.56	1.23	4.85	450
Firm Size (ln)	28.45	1.62	25.12	31.89	0.34	2.76	450
Sales Growth (%)	8.34	12.67	25.34	45.67	0.56	3.15	450

Table 1 presents the descriptive statistics for all variables used in the analysis. The average Return on Assets (ROA) is 6.8% with a standard deviation of 5.2%, indicating moderate but variable profitability across firms and time. The Debt-to-Equity Ratio (DER) shows substantial variation with a mean of 1.42 and a standard deviation of 0.89, reflecting diverse capital structure strategies within the sample. Firm size, measured as the natural logarithm of total assets, averages 28.45 (equivalent to approximately IDR 22.8 trillion in total assets), while sales growth averages 8.3% annually. The Jarque-Bera test statistics and corresponding p-values indicate that most variables deviate from normal distribution, justifying the use of GMM estimation, which does not require normality assumptions.

Table 2. Correlation Matrix

Variable	ROA	DER	Firm Size	Sales Growth
ROA	1.000			
DER	-0.321***	1.000		
Firm Size	0.267***	0.145*	1.000	
Sales Growth	0.189**	-0.087	0.198**	1.000

Note: \*, \*\*, \*\*\* denote significance at 10%, 5%, and 1% levels respectively.

Table 2 displays the Pearson correlation coefficients between variables. Leverage (DER) shows a moderate negative correlation with ROA (-0.321,  $p < 0.01$ ), providing preliminary support for Hypothesis 1. Firm size exhibits a positive correlation with both ROA (0.267,  $p < 0.01$ ) and sales growth (0.198,  $p < 0.05$ ). The correlation matrix reveals no extreme multicollinearity concerns, with all Variance Inflation Factors (VIFs) below the conventional threshold of 5, confirming that the independent variables are sufficiently distinct for regression analysis.

The Arellano-Bond Generalized Method of Moments (GMM) estimator was employed to address endogeneity concerns arising from the bidirectional relationship between leverage and profitability. The dynamic specification includes the lagged dependent variable to capture persistence in firm performance. Table 3 presents the comprehensive estimation results, including both one-step and two-step GMM estimates for robustness comparison.

Table 3. Arellano-Bond GMM Estimation Results

Variable	One-Step GMM Coeff. Std Error	Two-Step GMM Coeff. Std Error
Lagged ROA (t-1)	0.312*** (0.045)	0.328*** (0.042)
Leverage (DER)	-0.154** (0.062)	-0.162** (0.065)
Firm Size	0.087** (0.038)	0.092** (0.041)
Sales Growth	0.064** (0.030)	0.068** (0.032)
Constant	0.045 (0.029)	0.041 (0.031)
Observations	405	405
Number of firms	45	45
Number of instruments	42	42
Hansen test (p-value)	0.215	0.228
Difference-in-Hansen (p-value)	0.342	0.367
AR(1) test (p-value)	0.032**	0.028**
AR(2) test (p-value)	0.467	0.492

Notes: Standard errors in parentheses. \*, \*\*, \*\*\* indicate significance at 10%, 5%, and 1% levels. AR(1) and AR(2) are Arellano-Bond tests for first-order and second-order serial correlation.

The GMM specification passes all critical diagnostic tests, confirming the validity and reliability of the estimates. The Hansen test of overidentifying restrictions yields p-values of 0.215 and 0.228 for one-step and two-step GMM, respectively, failing to reject the null hypothesis of valid instruments. This indicates that the lagged levels and differences used as instruments are exogenous and appropriately specified. The difference-in-Hansen test for subset exogeneity also shows no evidence of instrument weakness (p-values > 0.34).

The Arellano-Bond tests reveal the expected pattern of serial correlation: significant first-order autocorrelation in differenced residuals (AR(1):  $p = 0.032$ ) but no evidence of second-order autocorrelation (AR(2):  $p = 0.467$ ). This pattern confirms the consistency of the GMM estimators, as first-order correlation is expected in differenced equations, while the absence of second-order correlation indicates no serial correlation in the original error terms. The results provide strong support for H1, which posits that leverage significantly affects profitability. The coefficient for leverage (DER) is negative and statistically significant at the 5% level in both specifications (-0.154 in one-step GMM,  $p = 0.012$ ; -0.162 in two-step GMM,  $p = 0.010$ ). Economically, this indicates that a one-unit increase in the debt-to-equity ratio reduces Return on Assets by approximately 0.154-0.162 percentage points in the short run.

The dynamic nature of the model allows for distinguishing between short-run and long-run effects. The coefficient on lagged ROA (0.312-0.328) indicates substantial persistence in profitability, with approximately 31-33% of current performance explained by the previous period's results. The long-run effect of leverage can be calculated as  $\beta/(1-\alpha)$ , yielding -0.224 to -0.242, suggesting that the long-term negative impact of leverage is 45-49% larger than the immediate short-term effect. Both control variables show significant positive effects on profitability. Firm size exhibits a coefficient of 0.087-0.092 ( $p < 0.05$ ), indicating that larger firms enjoy approximately 0.09 percentage points higher ROA for each unit increase in the log of total assets. Sales growth also positively influences profitability (coefficient = 0.064-0.068,  $p < 0.05$ ), with a 1% increase in sales growth associated with a 0.064-0.068 percentage point increase in ROA. The constant term is statistically insignificant across specifications, suggesting no systematic unexplained profitability beyond the modeled factors. The Wald test statistics ( $\chi^2 = 145.67-152.34$ ,  $p = 0.000$ ) confirm the joint significance of all explanatory variables.

Several robustness checks were conducted to validate the primary findings. First, an alternative measure of leverage (Total Debt to Total Assets) produced qualitatively similar results. Second, the inclusion of additional control variables such as asset tangibility, liquidity ratio, and industry dummies did not substantially alter the leverage coefficient. Third, estimation using the System GMM approach yielded consistent results, with leverage coefficients ranging from -0.148 to -0.157 ( $p < 0.05$ ). Subsample analyses by time period (pre-COVID vs. COVID era) revealed that the negative effect of leverage

intensified during the pandemic period (2019-2024), suggesting increased financial distress costs in times of economic uncertainty.

## **DISCUSSION**

The findings of this study provide strong empirical support for capital structure theories, particularly the trade-off theory and the pecking order theory, in explaining the relationship between leverage and profitability among Indonesian manufacturing firms. The observed negative and significant effect of leverage on profitability indicates that higher debt levels tend to suppress firm performance, mainly due to increased interest expenses and the rising risk of financial distress. This pattern is consistent with the trade-off theory, which posits that although debt offers tax advantages, excessive leverage elevates expected bankruptcy costs and agency problems, thereby reducing net firm value and profitability (Akhtar et al., 2022; Damayanti & Sucipto, 2022; Susilawati et al., 2022). The results suggest that many Indonesian manufacturing firms may have exceeded their optimal leverage levels, causing the costs of debt to outweigh its fiscal benefits. Similar evidence of a negative leverage profitability relationship has been documented in prior Indonesian studies, which also emphasize the vulnerability of highly leveraged firms to financial distress and earnings volatility (Ekadjaja & Wijaya, 2021; Masithoh, 2024).

The findings are likewise aligned with the pecking order theory, which argues that firms prioritize internal financing over external borrowing due to information asymmetry and the higher costs associated with issuing debt and equity (Juita, 2021; Anita et al., 2023; Suriani et al., 2023). More profitable firms in this study appear to rely less on debt, consistent with the notion that retained earnings provide a cheaper and less risky source of financing. This preference becomes particularly relevant in the Indonesian macroeconomic context during 2015–2024, a period characterized by fluctuations in interest rates, inflation, and fiscal policy. Rising borrowing costs during tighter monetary conditions increase the debt service burden, thereby eroding profits and reinforcing firms' incentives to limit leverage. Such macroeconomic sensitivity echoes international evidence showing that the impact of leverage on profitability is conditioned by financial market stability and the cost of capital (Chen et al., 2023; Sarfraz et al., 2023; Ma et al., 2023; Pratomo et al., 2025).

Furthermore, the results highlight the importance of firm-specific characteristics in moderating the leverage profitability relationship. Larger firms and those with stronger sales growth tend to perform better despite leverage, likely because they benefit from economies of scale, stronger bargaining power in credit markets, and more stable cash flows. This finding is consistent with studies in Brazil and advanced Asian economies, where leverage has been shown to enhance profitability when it supports productive expansion and competitive positioning (Arhinful & Radmehr, 2023; Sapiri, 2023). However, the negative effect in Indonesia suggests that such benefits are not yet fully realized, possibly due to higher financing costs, market imperfections, and less efficient capital allocation.

Taken together, the evidence indicates that an optimal capital structure for Indonesian manufacturing firms should avoid excessive reliance on debt and prioritize internal financing, in line with both the trade-off and pecking order perspectives (Jordão et al., 2022). The predominance of negative leverage effects also underscores the limitation of static capital structure decisions and supports calls for dynamic analysis, as profitability and leverage influence each other over time. By integrating theoretical insights with prior empirical findings, this study reinforces the view that careful debt management, supported by stable macroeconomic conditions and firm growth, is essential for sustaining profitability in emerging market manufacturing sectors.

## **CONCLUSION**

This study shows that the leverage measured with the debt-to-equity ratio shows a significant negative influence on the profitability of the manufacturing companies that are in the Indonesian stock exchange in the years 2015 – 2024. Thus, the higher the amount

of debt that the company has, the more pressure there will be on the derived profits. Alpha shows that control variables such as company size and sales explosion have been shown to have a significant and positive impact on profitability, which confirms that the companies that have a larger scale of assets, and thus have the ability to increase their sales from one year to another, are likely to have better profitability. This validates the trade-off theory, which holds that there must be a balance between the risk of bankruptcy and the limits of tax benefits, and the pecking-order theory, which holds that more profitable companies rely on internal financing.

The findings of this study urge Indonesian manufacturing firms to ensure the continued optimal and equilibrium condition of their capital structures by minimizing debt use, especially internal financing, and by focusing on sales improvement to improve profitability in future years. Research is not without limitations. For instance, this research study focuses solely on the manufacturing sector over a given period. Thus, the findings of this study cannot be generalized to all sectors, especially in Indonesia. Therefore, it is recommended that future research expand to other sectors, such as services, trade, and finance, and explore more advanced analytical tools, such as Vector Autoregression (VAR) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH), to assess the interactions among variables in greater detail. Therefore, such research will not only contribute to the body of knowledge and advance the theory of financial management but will also be of paramount importance for the practical marketing strategies adopted by manufacturing firms in Indonesia.

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