Original Research

Unlocking the Secrets of Profitability: Investigating the Role of Research and Development

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Abstract

Objective: The manufacturing sector is crucial for the development of emerging economies. This study aims to examine how research and development influence the firm's financial performance of manufacturing firms.
Design/Methods/Approach: This study employs publicly listed Indonesian firms' panel data from 2017 to 2021. The data are analyzed using the panel data approach.
Findings: The results indicate that research and development positively affect firm financial performance.
Originality: Research and development investment has been commonly carried out in developed countries but is still very limited in developing countries. This study focuses on the role of investment in research and development in determining the financial performance of companies in an emerging country.
Practical/Policy implication: Companies should prioritize cash and risk management to enable business expansion and innovation. Government support can be provided through tax incentives, R&D assistance, financing access, and public recognition of companies with high profitability. These incentives are aimed at enhancing economic growth and corporate competitiveness.

Keywords: Research & development, Liquidity, Profitability, Leverage, Financial performance.

JEL Classification: G20, G32, C58

1. Introduction

In the business sector, if a company innovates, it may stay caught up with its competitors; the company may be doing well because they have decided to update their business model. Innovation in the process can boost productivity by enhancing efficiency and effectiveness, while product innovation can positively impact product sales (Prihadyanti & Laksani, 2015). As a result, innovation is a critical strategy for minimizing the risk of commercial failure.

Research and development, sometimes abbreviated as R&D, is a process of discovering and developing new methods and ideas (Alhammadi et al., 2016; Barge-Gil & López, 2014). In a broad sense, the phrase refers to introducing novel ideas into established systems, such as those found in business, government, the public sector, or private industry (Gault, 2018; Ranerup et al., 2016). Companies are able to improve their skills, bring about more efficient output, and attain higher levels of performance when they engage in research and development operations (Arundel et al., 2019; Hund et al., 2021). The research and development process plays a crucial role in guiding choices related to the creation of products, advertising strategies, and marketing campaigns. Historically, the manufacturing sector has been an essential driver of economic growth in countries still in industrialization (Halkos et al., 2021; Sheridan, 2014). The expansion of manufacturing typically hastens the technological advancement of the economy as a whole, in part due to the fact that it can utilize idle labor (Friesenbichler & Kügler, 2022).

Research and development efforts can impact an organization's financial performance. This is due to the fact that the company's financial performance can serve as a benchmark for determining whether the company's finances can be considered to be in good condition or vice versa (Monteiroa et al., 2022; Oliveira et al., 2018). A firm's financial performance can be summed up as an analysis of how well it complies with all of the applicable financial requirements and how effectively it manages its business. Research and development efforts will have some bearing on the level of financial performance achieved by the company. Several studies have demonstrated that investments in research and development positively impact a company's overall performance.

Companies that allocate a budget for research and development achieve higher sales compared to those that do not. Nandy (2020) conducts research on the influence of activities related to research and development on the financial performance of pharmaceutical businesses listed on the Indian Stock Exchange. Chen & Wu (2020), Chen et al. (2019), and Shen et al. (2017) investigated the impact that the level of investment in research and development had on the financial performance of businesses in Taiwan.

According to Si et al. (2020), there is a correlation between research and development investment and sustainable financial success. Additionally, the researchers found that executive incentives had a moderating effect on the relationship. Kiraci et al. (2016) studied the impact of research and development on the profitability of companies in Turkey. Xu & Jin (2016) conducted a study to determine how much money invested in research, and development impacted the financial performance of 30 businesses already established in the Internet of Things (IoT) industry.

This study's objective is to evaluate the impact of research and development on the financial performance of corporations. This study is related to previous studies. However, there are notable distinctions. This research has several significant contributions. First, this research takes a holistic approach detailing the various elements of R&D, from investment to innovation strategy, providing a thorough understanding of how R&D contributes to the financial performance of manufacturing firms. Secondly, this study considers industry and regional context variations, illustrating the different dynamics of the relationship between R&D and financial performance across different business environments. Third, this study uses a panel regression analysis approach that can improve the accuracy of the analysis results and increase the reliability of the research findings. Finally, this study provides relevant and valuable information for developing manufacturing businesses in emerging markets. The organization of the article is as follows: the theoretical foundation is presented first, followed by the research hypotheses, research method, data analysis results, a thorough discussion, and finally, the conclusions.

2. Literature Review and Hypotheses Development

Resourced-based Theory

The core concept of the resource-based theory (RBV) is utilized in this investigation. According to the resourced-based hypothesis, a durable competitive advantage depends on organizational resources that are extremely valuable, rare, difficult to copy, and difficult to replace (Barney, 1996). Resource heterogeneity and immobility are the two aspects of the resource-based theory that set it apart from other strategic management theories. These concepts distinguish the resource-based theory from other strategic management theories (Lee & Yoo, 2021).

The resourced-based approach that Barney (1996) proposed has seen extensive use in various fields, including research and commercial creation. According to Andersén (2021), the resource-based theory posits that the key to practical innovation is maintaining a high level of resource control, which, in turn, will lead to an increase in the organization's overall performance. As a result, the resourced-based theory might be practical in an approach to strategic management that focuses on competitive advantage. Only if the company continues to make continual or constant improvements would it be possible to achieve competitiveness in terms of innovation.

Hypotheses Development

The relationship between research and development (R&D) activities and Return on Assets (ROA) shows how investment in innovation and product or service development can affect a company's financial performance. Through investment in R & D, companies can produce innovations that bring significant added value, increasing revenue and net profit and improving ROA (O'Connell et al., 2022; Si et al., 2020). In addition, companies that successfully implement their R&D results in unique products or more efficient operational processes can achieve a competitive advantage, strengthen market share, and positively impact ROA (Galli-Debicella, 2021; B. Guo et al., 2018; Handoyo et al., 2023). Nonetheless, the impact of R&D on ROA needs to be viewed in a longer-term framework, as investments in innovation may take time to produce visible results in a company's financial performance (Chen & Wu, 2020; Oliveira et al., 2018; Tsegaye, 2023). Therefore, companies should carefully manage the risk and time associated with R&D investments while understanding that the results may vary depending on several factors, including the company's ability to respond to market changes and commercialize the results of their innovations.

H1: Research and development (R&D) affects Return on Assets (ROA)

The relationship between liquidity and Return on Assets (ROA) reflects the dynamics between the availability of cash and the efficient use of assets in measuring a company's financial performance. A good level of liquidity, which indicates the availability of sufficient cash or liquid assets, can provide security and flexibility in the face of market changes or investment opportunities. However, remember that this relationship is complex, as too much liquidity can result in less productive assets and a negative impact on ROA (Leow & Lau, 2020; Trad et al., 2017). Appropriate risk-taking in allocating liquid assets can influence the balance between liquidity and ROA. In addition, business strategy and industry dynamics also play a role in this relationship (Alvi et al., 2020; Farida & Setiawan, 2022). Companies with growth and innovation strategies may take more significant risks using liquid assets to achieve higher ROA in the long run (Ghenimi et al., 2017; Killins, 2020). In contrast, companies with higher industry stability can maintain high liquidity without harming ROA. In analyzing financial health, companies must understand and wisely manage the balance between adequate liquidity and efficient asset use to achieve optimal financial performance.

H2: Liquidity Affects Return on Assets (ROA)

The relationship between Firm age and Return on Assets (ROA) reflects the complex interaction between time, experience, and financial performance. Older firms often have advantages in developing industry experience, better operations, and stability (Driss et al., 2021; Salehi et al., 2019). This can help them generate higher returns on assets (ROA) due to efficiency in asset management and business risk mitigation (Bungatang & Jumady, 2021; Diaz & Pandey, 2019). In addition, more established companies tend to have a more substantial reputation and a solid network of partners, which can positively impact ROA. However, young companies with solid innovation also have the potential to achieve high ROA through rapid growth and new market opportunities (Latifi et al., 2021; Mulyadi et al., 2021; Park et al., 2019). However, the relationship between firm age and ROA could be more consistent, as factors such as adaptation to the market, technological changes, and industry dynamics also play an essential role.

H3: Firm age affects Return on Assets (ROA)

Debt to Asset Ratio (DAR) and Return on Assets (ROA) are essential indicators in analyzing a company's financial health. DER describes how much a company relies on debt to fund its assets, measured by dividing total debt by total assets. Meanwhile, ROA measures a company's efficiency in generating profits from its assets, calculated by dividing net income by total assets. There is a complex relationship between these two metrics. While an increase in DAR may help fund the company's growth, it is worth noting that too much debt can introduce high financial risk and affect potential earnings (Absanto & Nnko, 2013; Lusardi & Mitchell, 2014; Ślusarczyk & Grondys, 2019). If the company can generate returns higher than the cost of debt, a high ROA can help balance the impact of a high DAR (Sukmawardini & Ardiansari, 2018; Wahyuni & Gani, 2022). However, if more than returns are needed to cover the cost of debt, ROA may be positively affected. Therefore, a company's management needs to make wise decisions in managing its capital and asset structure, to achieve an optimal balance between risk and return.

H4: Debt to Asset Ratio (DAR) affects Return on Asset (ROA)

The relationship between capital expenditure (CapEx) and Return on Assets (ROA) reflects the impact of investment in fixed assets on a company's financial performance. Capex involves spending to purchase, develop, or maintain fixed assets, which can increase revenue potential and operational efficiency (Lee & Lin, 2019; Meliawati et al., 2022). However, this relationship is only sometimes immediately apparent in the financial statements as Capex investments may take time to produce the results seen in ROA. Management should conduct a thorough strategic analysis in making Capex investment decisions, considering the potential returns and associated risks (Chari et al., 2019; Liao et al., 2016; Lu et al., 2016). Intelligent decisions can help companies achieve higher ROA with efficient use of assets. In managing Capex investments, companies should consider the industry context, business strategy, and long-term goals

to achieve an optimal balance between investment and return on assets (Choiriyah et al., 2021; Grozdic et al., 2020; Nukala & Rao, 2021).
H5: Capital Expenditure (CapEx) Affects Return on Assets (ROA)

Total Asset Turnover (TAT) and Return on Assets (ROA) have a close relationship and influence each other in measuring a company's financial performance. TAT, which measures the extent to which assets are utilized to generate revenue, significantly influences ROA (Diaz & Pandey, 2019; Utami, 2017). The higher the TAT, the more efficiently the company generates revenue from each dollar of assets used, which can increase ROA (Limajatini et al., 2022; Melan et al., 2023; Setyaningsih & Yuliana, 2020). This concept underscores that management that can manage assets to create revenue optimally tends to achieve a more favorable ROA.
H6: Total Asset Turnover (TAT) affects Return on Assets (ROA)

3. Method

This study uses a purposive sampling method to determine the sample of manufacturing companies that meet specific criteria. The criteria, namely companies whose shares were listed on the Indonesia Stock Exchange (IDX) in 2017, have research and development costs and report complete financial reports during the study period for five years. Ten companies were selected that met the criteria, and their financial reports were collected in the form of quarterly reports for five years. The total number of observations obtained is 200.

The dependent variable used is ROA, which reflects the company's financial performance in terms of profitability. Several previous studies have also used ROA as a proxy for financial performance, such as Kim et al. (2021), Xu & Jin (2016), Amanu & Rajendran (2021), Nandy (2020), Setiawan & Harmasanto (2019), Chen et al. (2019), and Shen et al. (2017).

The independent variables used in this study include research and development (RDI), company age (AGP), leverage (LVR), liquidity (LIQ), capital expenditure (CPX), and total asset turnover (TAT). RDI measures a firm's investment in research and development, and previous research shows that investment in RDI can improve a firm's financial performance. Firm age (AGP) measures the length of the establishment of the firm, and previous research shows that firm age can have a positive or negative influence on firm financial performance, depending on the context and characteristics of the firm.

Leverage (LVR) measures a firm's debt-to-equity ratio, and previous research suggests that leverage can have a positive or negative influence on a firm's financial performance, depending on the level of debt a firm uses. Liquidity (LIQ) measures a firm's ability to meet its financial obligations in the short term, and previous research shows that liquidity can positively influence a firm's financial performance.

Capital expenditure (CPX) measures the amount of investment a company makes to expand its business, and previous research shows that capital expenditure can positively influence a company's financial performance. Total asset turnover (TAT) measures the efficiency of using the company's assets to generate revenue, and previous research shows that total asset turnover can positively influence the company's financial performance. In this study, these independent variables are expected to help explain variations in corporate financial performance as measured by ROA.

$$ROA_{it} = \alpha + \beta_1 RDI_{it} + \beta_2 LIQ_{it} + \beta_3 AGP_{it} + \beta_4 LVR_{it} + \beta_5 CPX_{it} + \beta_6 TAT_{it} + \varepsilon_{i,t} \dots\dots\dots\dots\dots (1)$$

Table 1. Variables measurement information

Variable Name	Operational definition of the variables	Sources
ROA	Net income divided by total assets	(Choiriyah et al., 2021; Hakim & Apriliani, 2020; Leow & Lau, 2020; Trad et al., 2017)
LIQ	The company's ability to meet its financial obligations in the short term.	(Alvi et al., 2020; Ghenimi et al., 2017; Killins, 2020)
AGP	Length of establishment of the company	(Bungatang & Jumady, 2021; Diaz & Pandey, 2019; Latifi et al., 2021; Mulyadi et al., 2021)
RDI	Company investment in research and development	(Chen & Wu, 2020; Kiraci et al., 2016; Si et al., 2020; Xu & Jin, 2016)
LVR	The proportion of the company's debt compared to its equity	(Lusardi & Mitchell, 2014; Sukmawardini & Ardiansari, 2018; Wahyuni & Gani, 2022)
CPX	The amount of investment the company makes to expand its business	(Chari et al., 2019; Choiriyah et al., 2021; Grozdic et al., 2020; Nukala & Rao, 2021)
TAT	The efficient use of the company's assets in generating revenue	(Limajatini et al., 2022; Melan et al., 2023; Setyaningsih & Yuliana, 2020)

4. Result and Discussion

Table 1 shows that the ROA data is widely dispersed, with an average of 0.0421, a standard deviation of 0.0468, and a range of -0.0421 to 0.0421. Statistically, LIQ has a great deal of dispersion, with a mean of 3.5912 and a standard deviation of 2.0464. With a mean of 42.700 and a standard deviation of 9.6058, AGP's age is relatively consistent and does not fluctuate considerably. There are a few outliers in the RDI data, with a mean of 0.0035 and a standard deviation of 0.0053.

The average LVR is 0.3223, and the standard deviation is 0.1954; therefore, leverage information is clustered around the middle. The standard deviation of CPX is 0.0399, which indicates a great deal of dispersion around the mean. Finally, TAT averages 0.6868 and a standard deviation of 0.3794, indicating that the data is significantly dispersed around the mean. From this data, the characteristics of the observed sample companies can be interpreted. Large standard deviations on several variables indicate large data variations and diversity in the sample of companies. This shows that the companies in the sample have different performances and characteristics.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
ROA	200	0.0428	0.0469	-0.0435	0.2311
LIQ	200	3.5914	2.0459	0.8137	13.402
AGP	200	42.7	9.6058	20	58
RDI	200	0.0037	0.0053	0.0001	0.0228
LVR	200	0.3238	0.1955	0.0429	0.7674
CPX	200	0.0438	0.0399	0.0004	0.2449
TAT	200	0.6874	0.3796	0.0972	1.9011

In deciding between the Common Effect Model (CEM) and the Fixed Effect Model, the Chow test is used as a first step (FEM). The optimal model is FEM if the p-value from the Chow test is less than the significance level of the test (5%). In addition, the Fixed Effect Model (FEM) and the Random Effect Model (REM) were compared using the Hausman test (REM). The p-value from the Hausman test is less than the significance level (5%) we set for the test; thus, we used the Fixed Effect Model for our regression analysis (FEM). In light of this, the Fixed Effect Model (FEM) was chosen for this investigation. Independent and dependent variables in FEM differ between units but not with time. When the dependent and independent variables are held constant or do not change over time, and the study focuses on the variance between units, FEM is the suitable method to utilize.

Table 2. Best Model

Test	Summary	Probability
Chow	Cross-section Chi-square	0.0000
Hausman	Cross-section random	0.0000

Liquidity is one of the critical financial ratios for companies, especially manufacturing companies. The liquidity ratio measures a company's ability to meet its short-term financial obligations. This study found that the liquidity ratio negatively affects the ROA of manufacturing companies because it has a high ratio. Suppose the company has a very high liquidity ratio. In that case, it means that the manufacturing company allocates too much funds in the form of cash or short-term investments that are highly liquid. This can cause manufacturing companies to miss more profitable investment opportunities and limit the company's ability to generate profits. The effect of liquidity on the ROA of Indonesian manufacturing companies is relative depending on the level of liquidity owned by the company. Good liquidity can improve the company's ROA, but too high a liquidity ratio can negatively influence ROA. Therefore, it is necessary to have the right arrangement in managing liquidity ratios to not harm manufacturing companies' ROA.

The results found that company age affects the ROA of manufacturing companies. Company age can contribute positively to ROA in several ways. Companies operating for a long time can have a good reputation in the market, which can increase consumer and investor confidence (Araújo et al., 2023; Luchs et al., 2009). This can increase sales and the company's ability to obtain cheaper funding. In addition, long-established companies may also have more experience and specialized expertise in a particular industry, which can improve the efficiency and productivity of the company (Rajapathirana & Hui, 2018; Verhoef et al., 2021). The effect of company age on the ROA of Indonesian manufacturing companies is complex. It depends on factors such as company reputation, industry expertise, efficiency, productivity, and the ability to innovate and adapt to market changes (Farida & Setiawan, 2022; Gupta et al., 2016; Onufrey & Bergek, 2021). Therefore, companies need to manage the company's age well and create business strategies following the characteristics of the industry and the market at hand to achieve optimal ROA.

Research and development (R&D) do not affect Indonesian manufacturing companies' ROA (Return on Assets). Because the R & D undertaken is not following market needs and demands, the results will not significantly contribute

to increasing the company's ROA. In addition, R&D requires considerable costs, especially in the short term, so companies may need help to finance adequate R&D activities. Companies need sufficient funds for R & D to produce products or technologies that are sufficiently innovative and different from competitors and hence cannot increase the company's ROA (Aprisma & Sudaryati, 2020; Guo et al., 2021; Latifi et al., 2021; Piao & Choi, 2022).

Table 3. Regression Results

Variable	CEM	FEM	REM
C	(-0.0035)	(-0.6389)	(-0.1306)
	0.9301	0.0000*	0.1013
RDI	(0.8819)	(0.5822)	(0.4595)
	0.0276*	0.1519	0.2305
LIQ	(-0.005)	(-0.0085)	(-0.0069)
	0.0013*	0.0000*	0.0000*
AGP	(0.0191)	(0.4373)	(0.1130)
	0.4128	0.0000*	0.0183*
LVR	(-0.0986)	(-0.1499)	(-0.1158)
	0.0000*	0.0000*	0.0000*
CPX	(0.2919)	(0.0587)	(0.0914)
	0.0000*	0.1976	0.0421
TAT	(0.0720)	(0.0702)	(0.0676)
	0.0000*	0.0000*	0.0000*
R-squared	0.6505	0.6505	0.6614
Adjusted R-squared	0.6397	0.6397	0.6509
Prob(F-statistic)	0.0000	0.0000	0.0000

*Significant at 5%

Another thing that may not have an effect is that the R&D carried out could be more effective in improving the efficiency and productivity of the company because the results of R&D are challenging to measure directly in the short term (Liu et al., 2013; Salimi & Rezaei, 2018). If R&D does not result in significant improvements in the production process or savings in operating costs, it will not significantly increase the company's ROA (Cuandra & Setiawan, 2020; Linawati & Halim, 2017; Meiryanil et al., 2023). R&D also requires a sizable market to generate significant profits. If the market for the new product or technology that R&D generates is too tiny, the company may need to achieve economies of scale large enough to earn significant profits (Arte & Larimo, 2022; Castellani et al., 2017; Gherghina et al., 2020; Marshall & Parra, 2019).

Leverage, or the level of corporate debt, is the ratio between total debt and total assets owned by the company. The results found that leverage negatively affects manufacturing companies' ROA (Return on Assets). This is because manufacturing companies are too much in debt and cannot manage their debts properly, causing high-interest expenses that reduce the net profit generated by the company (Agustia et al., 2020; Çolak, 2021; Silva, 2019). In addition, too much debt can affect the company's operational performance, such as worsening the company's liquidity and solvency.

Capital Expenditure (CPX) is spending on long-term investments that aim to increase the production capacity or performance of the company. Although CPX has a close relationship with Return on Assets (ROA), the results of this study, CPX affects the ROA of manufacturing companies. First, CPX is an expenditure recognized in the company's financial statements as fixed assets, such as buildings, machinery, and equipment (Pena-Miguel & Pena, 2018; Yeo, 2018). These fixed assets are capitalized and depreciated over the next few years, so they do not directly affect the company's profit or ROA in the initial period after the investment is made.

Second, the effect of CPX on ROA depends on how effective the investment is in improving the company's operational performance and profit (Setiawan & Gestanti, 2018; Sunaryo, 2020). ROA may increase if CPX is used for appropriate and effective investments, such as increasing production capacity or improving production processes. However, ROA can be negatively affected if CPX is not used appropriately, such as too large investments or not following the company's needs. Third, the effect of CPX on ROA may be negligible if the company has a high level of competition in the same industry (Liao et al., 2016; Lu et al., 2016). In a highly competitive environment, CPX can be necessary to stay competitive (Meliawati et al., 2022; Yeo, 2018). ROA is only sometimes a good performance measure in this case, as external factors such as competition heavily influence a company's investment strategy.

5. Conclusion

This study aims to investigate the role of research and development on the profitability of manufacturing firms in an emerging country. Empirical analysis based on the quarterly data of manufacturing firms, the results indicate a

significant effect of research and development on return on asset. The results of this study have a significant impact, both for companies and the government, on improving Indonesia's manufacturing sector's financial performance. The findings provide valuable guidance for firms in improving their financial performance by considering the factors influencing profitability. In addition, the government can use the results of this study as a basis for providing support and incentives to companies that achieve high levels of profitability as part of efforts to encourage further investment in the manufacturing sector and support national economic growth.

Despite its significant contribution, this study also has some limitations that should be noted. Firstly, this study relies on panel data from quarterly financial statements of manufacturing companies, which may introduce data quality and consistency limitations. In addition, other variables potentially impacting firm profitability may not be included in this analysis. Another area for improvement is causality, where the relationship between the factors studied and profitability may only be identified but cannot ensure a definite cause-and-effect relationship. External factors such as economic conditions and policy changes that may affect the results must also be fully considered. In addition, the results of this study may have limitations in generalizability to the entire manufacturing sector in Indonesia. In interpreting and applying the results of this study, it should be recognized that it has certain limitations that need to be considered in making practical decisions and recommendations.

Author Contribution
Author 1 & 2: conceptualization, writing original draft, data curation, formal analysis, investigation, methodology.
Authors 3 & 4: review, supervision, validation.

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Conflict of Interest
The authors declare that no financial or commercial relationships could have caused a conflict of interest in the research.

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