

Risk Management in Facing Macroeconomic Uncertainty on Pertamina's Profitability

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Keywords	ABSTRACT
macroeconomic stress testing, monte carlo simulation, sensitivity analysis, Pertamina	This study examines the effect of macroeconomic variables on the financial performance of PT Pertamina (Persero), a strategic Indonesian state-owned energy company (Badan Usaha Milik Negara/BUMN). Using time series data from 2005 to 2023, the research applies an econometric model examine relationship of macroeconomic variables between exchange rate, inflation, Bank Indonesia interest rate (BI Rate), and international crude oil prices (ICP) with corporate financial performance (Return on Equity/ROE and Return on Assets/ROA). Quantitative analysis is enhanced Montecarlo Simulation to model financial uncertainty and macroeconomic stress testing (moderate, pessimistic, optimistic scenarios). This study also integrates the risk management framework to construct a proses of risk management, and formulate data-driven risk mitigation strategies. The research is expected to contribute to the development of risk-informed financial management strategies based on econometric analysis and to serve as a reference for other BUMN in managing macroeconomic uncertainty.

INTRODUCTION

Global crude oil price trends, including the Indonesian Crude Price (ICP), have fluctuated significantly from 2005 to 2024, directly affecting the Indonesian economy. PT Pertamina (Persero), as the main state-owned energy company in Indonesia, can be affected by fluctuations in macroeconomic factors such as ICP, exchange rates, GDP, interest rates, and inflation. In the study by Edy et al. (2024), it is stated that fluctuations in world oil prices have become one of the main factors affecting the Indonesian economy in recent decades. Several oil and gas industry-related companies in Indonesia are significantly affected by global oil price fluctuations, which have wide impacts on various sectors of the domestic economy such as Indonesia's trade balance, inflation, economic growth, and fiscal policy. The need for risk mitigation through a based *risk management* approach is very important to maintain the company's profitability.

PT Pertamina (Persero) uses the US dollar exchange rate as a reference for selling crude oil in its upstream sector (Subholding Upstream) and for purchasing crude oil to be processed into finished products in its downstream sector (Subholding Refining & Petrochemical). This causes the exchange rate to be a critical parameter to consider in projecting the company's financial figures. Another important parameter is interest rate risk (BI Rate). An increase in the BI rate will attract investors, thereby affecting the variability of investment returns (Gatot, 2019). Other commonly used macroeconomic parameters are inflation and GDP (Gross Domestic Product) (Agu et al., 2022; Akgül et al., 2022; Fernando, 2022; Konchitchki & Patatoukas, 2014; Okonkwo et al., 2018). A country's inflation rate reflects the change in the general price level of goods and services continuously over a certain period (Bank Indonesia, 2024). Meanwhile, the GDP parameter reflects the total units produced in a country. The GDP growth rate represents public consumption, investment, and government expenditure capacity in that country. Oil and gas companies' strategies for minimizing risks from these

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macroeconomic conditions absolutely require an essential role within *risk management* policy frameworks that can mitigate macroeconomic volatility and anticipate the company's future financial performance.

The Net Income trend shows fluctuating figures, indicating that the company faces parameters correlated with decreases and increases in net profit—a major challenge for management in projecting the company's sustainability. According to Wibowo (2016), fluctuations in world crude oil prices influence the financial performance of major oil companies in ASEAN countries, such as Petronas Malaysia, Pertamina Indonesia, and Thai Oil Thailand, based on a comparative study from 2010–2014.

Pertamina's ROE and ROA patterns are erratic and do not align consistently with the volatility of other macroeconomic variables (ICP, exchange rate, inflation, interest rates, and GDP). These fluctuation patterns merit further research in relation to Pertamina's financial performance.

By predicting these trends, Pertamina's management and stakeholders (such as the Government) are expected to anticipate risks effectively. The enactment of SOE Regulation Number PER-3/MBU/03/2023, concerning Guidelines for Governance and Significant Corporate Activities of SOEs, mandates Pertamina, as a state-owned company, to manage *risk management* aspects in its operations and base its *risk management* framework on the national risk management standard. In *risk management planning* when facing uncertain macroeconomic variables, macro stress testing tools are frequently used. Macro stress testing focuses mainly on the sensitivity of economic variables to assess their impact on financial risk. The aim is to quantify the potential impact of changes in macroeconomic variables (Ministry of Finance of the Republic of Indonesia, Macro Stress Test of SOE Fiscal Risk, 2010).

This study will examine the correlations and influences among ICP, exchange rate, inflation, interest rates, and GDP on Pertamina's ROE and ROA performance, followed by a macro stress test on these variables and managerial recommendations for PT Pertamina (Persero), Indonesia's largest oil and gas state-owned company. This study aims to analyze the relationships between macroeconomic variables and PT Pertamina's ROE (Return on Equity) and ROA (Return on Assets) in detail, framed comprehensively within the corridor of the *risk management* framework.

Edy et al. (2024) show that macroeconomic factors such as oil prices, exchange rates, and inflation significantly impact the Indonesian economy. However, their study does not deeply explore how energy companies like PT Pertamina can manage risks from these macroeconomic factors concerning financial performance, nor does it discuss the application of a based *risk management* framework.

Similarly, Wibowo's (2016) research identifies a relationship between oil price fluctuations and financial performance for major ASEAN oil companies, including PT Pertamina, but focuses more on comparative analysis rather than how these companies apply international *risk management* standards to address macroeconomic volatility. Additionally, it does not introduce macroeconomic stress testing for projecting future financial performance amid uncertainty.

The objective of this study is to examine the influence of global oil price fluctuations, exchange rates, inflation, interest rates, and GDP on PT Pertamina's financial performance using ROE and ROA indicators, while also applying macroeconomic stress testing within the *risk management* framework. The study aims to provide strategic *risk management* recommendations for PT Pertamina and other Indonesian energy companies to maintain stable financial performance amid macroeconomic volatility. The benefits include assisting energy companies in long-term strategic planning considering macroeconomic variables and offering guidance to policymakers and stakeholders in managing risks and projecting financial outcomes.

METHOD

This research was conducted using secondary data starting from the end of the year 2005-2023 at PT Pertamina (Persero). The selection of the research period was chosen based on the limitations of data published by PT Pertamina (Persero).

The data of this study uses secondary data with the following details:

- 1) ROE and ROA data in *time series* were obtained from financial statement data through the company website PT Pertamina (Persero).
- 2) The data on *the variable Indonesia Crude Price* (ICP) in *time series* is collected from the data of the Ministry of Energy and Mineral Resources. Variable data on interest rates, inflation and GDP in *time series* was obtained from the website of the Indonesian Central Statistics Agency (BPS).

The following is a summary matrix of the data analysis processing techniques in this study, including the following:

Table 1. Matrix of research data processing and analysis techniques

No	Analysis Method	Purpose	Tools	Information
1	Correlation Analysis and Multiple Linear Regression Analysis	This study uses correlation analysis and multiple linear regression to determine the relationship and influence between macro variables and ROE and ROA	Pearson Correlation Analysis and Multiple Linear Regression Analysis with test: Classic Assumptions Partial Regression Equation Coofisien Determination	Using <i>Minitab</i> Software
2	Risk Management Process-based Planning Analysis	Determination of <i>Scope</i> , Context and Criteria <i>Risk Assessment</i> : Identify Risks Risk Analysis Risk Evaluation <i>Risk Treatment</i>	Macroeconomic Analysis <i>Stress Testing</i> to look for variables that have an impact (<i>severity</i>) -Monte Carlo <i>Simulation</i> (MCS) analysis to generate <i>probability (likelihood)</i> <i>Sensitivity Analysis</i>	Stress Test Analysis Using <i>Minitab</i> Software MCS analysis using <i>Crystall Ball</i> Software

RESULTS AND DISCUSSION

Statistical Descriptive

This research consists of dependent variables, namely the profitability of PT Pertamina (Persero) which is proxied by the ratio of ROA and ROE, as well as independent variables consisting of ICP, exchange rate, inflation, interest rate and GDP. The research data period started from 2005 – 2023, so that 19 observations were obtained.

PT Pertamina's ROE has an average of 12.09% with a standard deviation of 4.88, indicating that there is a significant difference in performance between years. The minimum ROE was 2.63% in 2020, while the maximum of 22.40% occurred in 2006, with a median (Q2) of 11.27%, which indicates a middle value that is quite close to the average. Meanwhile, PT Pertamina (Persero)'s ROA has an average of 5.133% with a standard deviation of 2.039, showing a relatively smaller variation than ROE. The range of ROA values ranges from 1.188%

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(in 2020) to 10.456% (in 2006), with a median of 5.235%, indicating a distribution that tends to be symmetrical. For macroeconomic variables, GDP has an average of Rp 10,708.60 trillion and a fairly high standard deviation of Rp 5,574.38 trillion, reflecting a significant increase from year to year. The minimum GDP value was recorded at Rp 2,774.28 trillion, while the maximum value reached Rp 20,892.35 trillion, indicating strong national economic growth in the last almost two decades. Inflation has an average value of 5.444% with a standard deviation of 3.817, indicating price fluctuations that are quite varied between years. The range of inflation is very wide, from a minimum value of 1,680% to a maximum of 17,110%, reflecting several periods of high price pressure. The rupiah exchange rate against the US dollar also shows volatility, with an average of Rp 12,077/US\$ and a standard deviation of Rp 2,399, as well as a minimum value of Rp 8,975 and a maximum of Rp 15,592. The mid-exchange rate (Q2) of Rp 12,440 shows a tendency to depreciate the exchange rate during the observation period. The variable interest rate averaged 6.632% with a standard deviation of 2.260, reflecting fluctuations in monetary policy in response to domestic and global macroeconomic conditions. The interest rate value ranges from 3,500% to 12,750%. The world oil price (ICP) showed an average value of US\$ 74.16 per barrel with a standard deviation of 23.36, indicating the volatility of international oil prices that is quite high. The price range of ICP is very wide, from US\$ 40.16 to US\$ 112.73, which can have a direct or indirect impact on the performance of business sectors, including those reflected in profitability. Pearson's correlation analysis shows the strength of the linear relationship between two variables. The results of Pearson's correlation analysis and its plot can be seen in the following figure. ROE and ROA have a very strong and positive correlation ($r = 0.966$; CI: 0.911–0.987), which indicates that an increase in ROA is likely to be followed by an increase in ROE.

This is natural because both are indicators of the company's profitability that are interrelated. ROE and log GDP show a moderate negative correlation ($r = -0.591$; CI: -0.824 to -0.188), as well as ROA with log GDP ($r = -0.590$; CI: -0.824 to -0.186). This indicates that the increase in GDP is precisely correlated with a decrease in profitability, which may be due to cyclical factors or increased cost structures in the phase of economic expansion. ROE and inflation have a weak positive correlation ($r = 0.283$; CI: -0.197 to 0.653), while ROA also showed a weak positive correlation with inflation ($r = 0.230$; CI: -0.251 to 0.619). However, the confidence *interval range* that includes zero suggests that this relationship is not statistically significant. ROE and rate show a strong negative correlation ($r = -0.706$; CI: -0.879 to -0.371), while ROA also has a strong negative correlation with the exchange rate ($r = -0.652$; CI: -0.853 to -0.281). This means that exchange rate depreciation (an increase in the exchange rate of Rp/US\$) tends to reduce the company's profitability, indicated by increased import costs or foreign exchange debt. Interest rates are positively correlated with weak ROE ($r = 0.404$; CI: -0.062 to 0.725) and ROA ($r = 0.403$; CI: -0.062 to 0.725). Although the correlation is positive, the test results are insignificant because the confidence interval includes zero. ICP (oil price) shows a moderate positive correlation to ROE ($r = 0.527$; CI: 0.095 to 0.792) and ROA ($r = 0.364$; CI: -0.108 to 0.702). Rising oil prices are likely to benefit sectors directly related to energy or commodity exports. Some relationships between independent variables are also quite strong and need to be considered for the potential for multicollinearity. These relationships include a strong correlation between inflation and interest rates ($r = 0.876$; CI: 0.701 to 0.952), as well as between log GDP and log exchange rate ($r = 0.885$; CI: 0.721 to 0.955), and a strong negative correlation between log GDP and interest rates ($r = -0.807$; CI: -0.923 to -0.557).

Multiple Linear Regression Analysis

Before the interpretation of the multiple linear regression coefficient, the OLS assumption test was first carried out which underlies the validity of the multiple linear regression parameter estimation.

Of the OLS assumption test for two models, each with dependent variables ROA and ROE. The residual normality assumption was tested using *the Kolmogorov-Smirnov* method. The test results showed that *the p-values* for both models were above the significance threshold ($0.15 > 0.05$), indicating that the residual distribution followed the normal distribution. Thus, the residual normality assumption has been met. The non-autocorrelation assumption is tested through *Durbin-Watson* statistics. The Durbin-Watson values of 2.19866 (ROA model) and 2.10696 (ROE model) are around ideal values of 2. This shows that there is no autocorrelation in residuals, either positive or negative. Therefore, the residual independence assumption in the model can be declared fulfilled. To test the existence of heteroscedasticity, the *Glejser* method is used by modeling the residual absolute value as a dependent variable. The results showed that all independent variables in both models had *insignificant* *p-values* (*total p-values* > 0.05), indicating the absence of a systematic relationship between independent variables and residual absolute values. Thus, the assumption of homogeneity or similarity of residual variance is met. However, the test results on the assumption of the absence of multicollinearity show that there is a fairly high linear dependence between independent variables. This can be seen from the VIF value on several independent variables that exceeded the tolerance threshold of 10. The GDP log variable shows a VIF value of 31.85, and a log exchange rate (*ln_kurs*) of 16.98, which significantly exceeds the recommended upper limit ($VIF > 10$). This indicates a high correlation between independent variables that can disrupt the stability of the regression coefficient estimation. To anticipate this, the next step can be to exclude GDP logs in the regression model.

The results of the OLS classical assumption test after excluding the GDP log variable showed a significant improvement in model stability. First, the residual normality assumption remains met for both regression models (with dependent ROA and ROE), as indicated by the values *p-value Kolmogorov-Smirnov* which is above 0.15. This indicates that the residual distribution still follows the normal distribution. Second, the autocorrelation test using *Durbin-Watson* statistics yielded a value of 2.17291 for the ROA model and 2.13297 for the ROE model. Both are close to the ideal value of 2, indicating no significant autocorrelation in residuals. Third, the results of the heteroscedasticity test with *the Glejser* method showed that all independent variables had a *p-value* above 0.05, both for the ROA and ROE models. This indicates that there is no heteroscedasticity, so the assumption of homoscedasticity is acceptable. Finally, the multicollinearity test showed substantial improvement after the GDP logs were removed from the model. All VIF values are well below the general threshold of 10, with the highest value being only 5.31 (Interest Rate), indicating that there is no serious multicollinearity in the current model. The results of the model estimation assuming Full OLS are fulfilled as follows.

The multiple linear regression model has fulfilled all the basic assumptions of OLS, so that the interpretation of the coefficient can be accepted as valid. This model estimates the influence of macroeconomic variables, namely inflation, exchange rates (exchange rate logs), interest rates, and world oil prices (ICP) on profitability which is proxied through two indicators: ROA and ROE. For models with ROA-dependent, the constant is valued at 47.5 with a *p-value* of 0.051. Of all the independent variables, only *ln_kurs* showed statistical significance at the level of 5% (*p-value* = 0.045), with a coefficient of -4.92 . This shows that exchange rate depreciation (increase in exchange rate) has a significant negative effect on ROA, meaning that weakening of the exchange rate tends to reduce the rate of return on assets. Other variables such as inflation, interest rates, and ICP have a statistically insignificant coefficient (*p-value* > 0.05), although the direction of the coefficient is consistent with economic theory: inflation and exchange rates have a negative effect, while interest rates and ICP have a positive effect on ROA. The R-squared value of 54.07% and the Adjusted R-squared of 40.95% indicate that the model can explain about 41% of the variation in ROA. In a model with dependent ROE,

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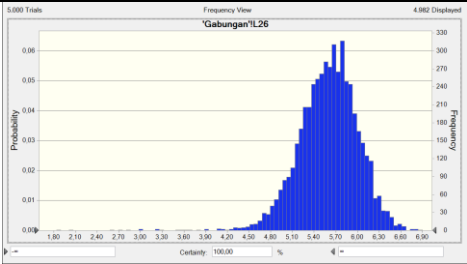
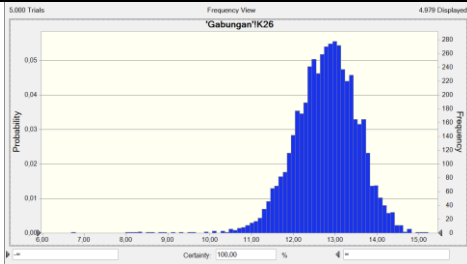
the results showed that the constant (123.1) was significant at the level of 5% (p-value = 0.018). Two independent variables showed significant influence, namely $\ln_kurs$ (coefficient = -12.88; p-value = 0.014) and ICP (coefficient = 0.0877; p-value = 0.025). This shows that exchange rate depreciation significantly lowers ROE, while the increase in world oil prices actually has a positive and significant impact on ROE. Inflation and interest rate variables showed a not significant influence, although the direction of the influence remained consistent. The *R-squared* value of 65.98% and the *Adjusted R-squared* of 56.26% indicate that the model has a stronger explanatory ability than the ROA model.

Overall, the estimated results show that the exchange rate (exchange rate) is a significant and consistent determinant that affects the profitability of PT Pertamina (Persero), both through ROA and ROE. Meanwhile, the price of crude oil (ICP) has special significance for ROE, which can be indicated economically, Indonesia is a commodity importing country. Although not all independent variables are significant, the model shows a fairly good power of explanation, especially in explaining ROE variations. These findings imply that exchange rate stability and global oil price dynamics need to be strategically considered in corporate financial planning at the macro and micro levels.

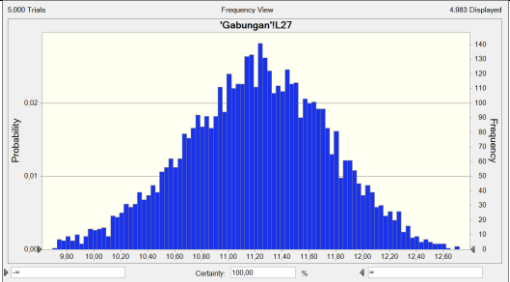
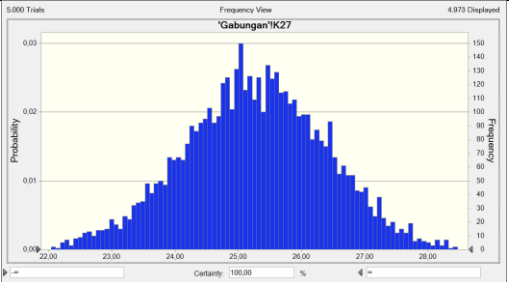
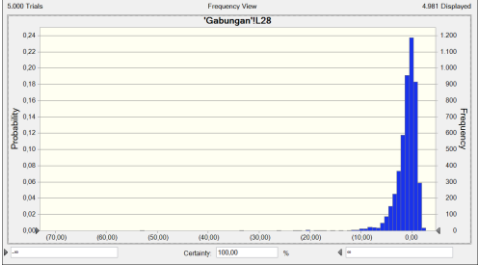
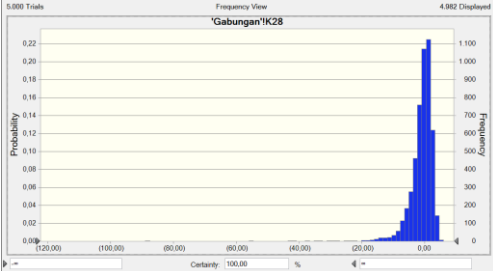
Monte Carlo Simulation (MCS)

Monte Carlo Simulation (MCS) is carried out with 3 (three) scenarios, namely moderate economic conditions, optimistic economic conditions, and pessimistic economic conditions. Moderate economic conditions are calculated based on the average input of the values of each macroeconomic variable. Optimistic economic conditions are calculated based on the input of the minimum value for inflation and exchange rate variables and the maximum for interest rates and ICP. Meanwhile, economic conditions are pessimistic, maximum value inputs for inflation and exchange rate variables and minimum for interest rates and ICP. Distribution assumptions for the variables Inflation is distributed lognormal, rate distributed Beta, interest rate distributed Beta, and ICP is distributed Normal. The MCS results of each scenario can be seen in Table 2.

Table 2. MCS Results (*probability*)

Scenario	ROA	ROE
Moderate	 Red = 5.54 min = -57.17 Max = 6.9 Std. Dev = 1.36	 Red = 12.69 Min = -93.08 Max = 15.22 Std. Dev = 2.32

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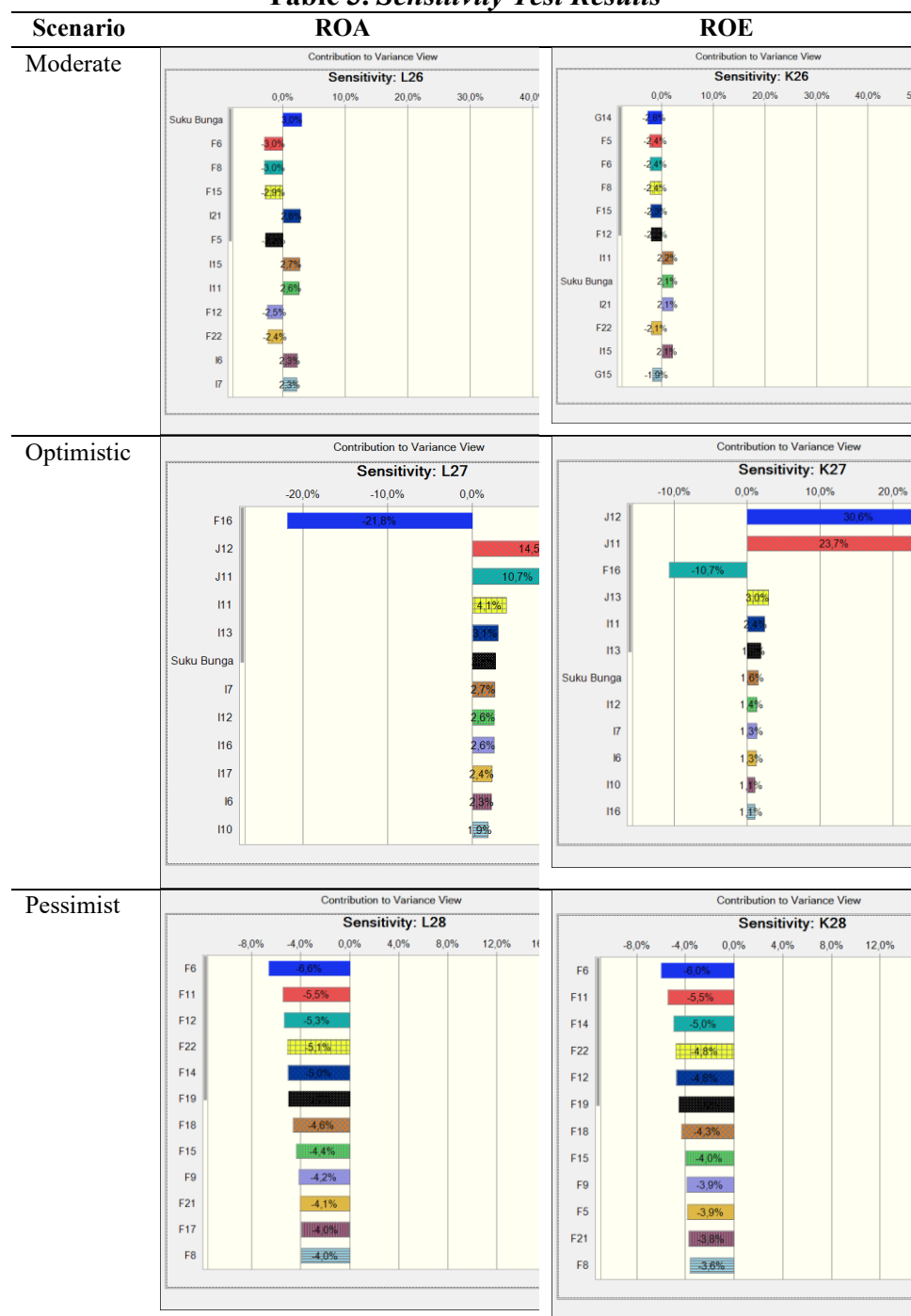
Scenario	ROA	ROE
Optimistic	 Red = 11.20 min = 9.08 Max = 12.76 Std. Dev = 0.54	 Red = 25.25 Min = 21.11 Max = 29.05 Std. Dev = 1.15
Pessimist	 Red = -2.21 min = -1184.63 Max = 2.72 Dev Std. = 24.63	 Red = -2.94 Min = -1996.84 Max = 6.01 Std. Dev = 41.53

Source: Output Crystall ball

The table above shows that in a moderate scenario the average distribution of ROA is around 5.54%, with a minimum outlay value of -57.17% and a maximum of 6.9%. In the optimistic scenario, the average distribution of ROA is around 11.20%, with a minimum value of 9.08% and a maximum of 12.76%. In the pessimistic scenario, the average distribution of ROA is around -2.21%, with a minimum outlier value of -1,184.63% and a maximum of 2.72%. In a moderate distribution scenario, the average ROE is around 12.69%, with a minimum outlier value of -93.08% and a maximum of 15.22%. In the optimistic scenario, the average distribution of ROE is around 25.25%, with a minimum value of 21.11% and a maximum value of 29.05%. In a pessimistic scenario, the average ROE distribution is around -2.94%, with a minimum outlier value of -1,996.84% and a maximum of 6.01%. Which variables are most sensitive to affecting changes in ROA and ROE can be seen in the following table.

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Table 3. Sensitivity Test Results



Source: *Output Crystall ball*

In a moderate scenario, interest rates and inflation are most sensitive to ROA, while ROE is most sensitive to interest rates and inflation. In the optimistic scenario, inflation and ICP are most sensitive to affect ROA and ROE. Meanwhile, in the pessimistic scenario, inflation is very sensitive to affect ROA and ROE.

Macroeconomic Stress Test

The results of the macroeconomic stress test can be seen in the following table:

Table 4. Macrotest test results

Scenario	Variable	Value	Percentage Change (%)	
			ROE	ROA
Moderate	Inflation	5,44	-2.09	-3.20
	Exchange rate	12.076,74	-97.71	-96.43
	Interest	6,63	4.70	7.31
	ICP	74,16	5.80	4.23
Optimistic	Inflation	1,68	-0.32	-0.49
	Exchange rate	8.975,00	-94.26	-93.02
	Interest	12,75	9.81	15.25
	ICP	112,73	8.85	6.47
Pessimist	Inflation	17,11	-7.58	-11.62
	Exchange rate	15.592,00	-100.69	-99.37
	Interest	3,50	2.09	3.24
	ICP	40,16	3.10	2.27

Source: Excel processing results

Based on Table 4, the results *Macro Stress Testing* shows how extreme and realistic changes in key macroeconomic variables, namely inflation, exchange rate (exchange rate), interest rate, and oil price (ICP) affect the profitability of the company proxied through *Return on Equity* (ROE) and *Return on Assets* (LENGTH). Three scenarios are used: moderate, optimistic, and pessimistic, with each assuming a different level of economic pressure. In the moderate scenario, inflation is maintained at an average level of 5.44%, which has a negative impact on profitability, namely a decrease in ROE of 2.09% and ROA of 3.20%. The depreciation of the exchange rate to Rp 12,076.74/US\$ resulted in a very large impact, namely a decrease in ROE of 97.71% and ROA of 96.43%, indicating a very high sensitivity of profitability to exchange rate movements. On the other hand, the increase in interest rates and ICP each produced a positive impact, with interest rates increasing ROE by 4.70% and ROA by 7.31%, and ICP increasing ROE by 5.80% and ROA by 4.23%. In the optimistic scenario, inflation is suppressed to a low level of 1.68%, only having a marginal negative impact on ROE (-0.32%) and ROA (-0.49%). The appreciation of the exchange rate to Rp 8,975/US\$ still led to a decline in profitability, with ROE down 94.26% and ROA down 93.02%, which seems to reflect a non-linear effect or very strong dependence on exchange rates in the estimation model. The increase in interest rates to 12.75% makes the highest positive contribution in this scenario to ROE (+9.81%) and ROA (+15.25%).

Likewise, ICP increased to US\$ 112.73 per barrel, resulting in an increase in ROE of 8.85% and ROA of 6.47%. In contrast, in the pessimistic scenario, very high inflationary pressures (17.11%) led to a decline in ROE and ROA of 7.58% and 11.62%, respectively, indicating that price pressures are directly depressing profitability. The sharp depreciation of the exchange rate up to Rp 15,592/US\$ had the most drastic impact, with a decrease in ROE of 100.69% and ROA of 99.37%, which theoretically even exceeded the actual level of profitability and indicated potential losses. The interest rate decreasing to a low level of 3.50% resulted in a small positive impact on profitability (ROE +2.09%, ROA +3.24%), as well as the ICP which decreased to US\$ 40.16, but still had a positive impact on ROE (+3.10%) and ROA (+2.27%), which may reflect a lighter energy cost structure under these extreme conditions. Overall, the results *Stress Testing* This underlines that the exchange rate (exchange rate) is the most sensitive and critical variable for profitability, followed by inflation. Meanwhile, ICP and interest rates tend to have a positive impact in various scenarios, albeit with varying intensities. The managerial implications of these results emphasize the importance of a hedging strategy against exchange rate risk, as well as close monitoring of macroeconomic conditions to maintain the stability of the company's profitability in the face of external uncertainties.

Statistical Analysis and Risk Management

The results of Pearson's correlation can provide an initial overview of the strength and direction of the relationship between macroeconomic variables (ICP, exchange rate, inflation, interest rates, and GDP) and PT Pertamina (Persero)'s profitability indicators, namely ROA and ROE. In particular, there was a very strong and positive correlation between ROA and ROE ($r = 0.966$), suggesting that increased asset effectiveness in generating profits was directly related to increased returns to shareholders. This very high correlation reflects the consistency between the two profitability indicators in reflecting the company's financial performance. Meanwhile, the exchange rate showed a strong negative correlation between the two profitability indicators, namely ROA and ROE. This shows that exchange rate depreciation (exchange rate increase) tends to reduce profitability. These results are consistent with the characteristics of energy commodity-based companies, where most of the input and debt transactions are denominated in foreign exchange, especially US\$, so that exchange rate fluctuations have a direct impact on the cost structure and financial expenses. These findings are in line with a study by Kharisma & Kusumastuti (2021) which also highlights the exchange rate as the most significant factor on the financial performance of energy SOEs. ICP has a moderately positive correlation to ROE, and weaker to ROA. Although not very strong, the direction of this relationship is economically relevant, as the increase in crude oil prices generally increases oil and gas companies' revenues, which ultimately has an impact on profitability. These results reinforce the findings of previous research by Alawadhi & Longe (2024) and Edy et al. (2024), which showed that oil prices are an important factor influencing macroeconomic variables and energy sector performance. For inflation and interest rate variables, the results show a relatively weak and insignificant correlation to profitability. Although the direction of the correlation corresponds to the expectations of economic theory (inflation has a negative impact, interest rates have a positive impact), the strength of the relationship is still low.

This finding is consistent with the research of Kharisma & Kusumastuti (2021), where inflation and interest rates do not have a significant impact on the financial performance of Pertamina and other energy SOEs. In addition, GDP even shows a negative correlation to ROA and ROE, which may reflect cyclical conditions or financing and operational structures that are not directly correlated positively with national economic growth. Thus, the results of this correlation show that of the five macroeconomic variables studied, the exchange rate (exchange rate) and crude oil price (ICP) are the most statistically and economically relevant variables to PT Pertamina's profitability. The regression results show that of the five macroeconomic variables analyzed, only the exchange rate (exchange rate) and crude oil price (ICP) have a statistically significant effect on *Return on Equity* (ROE) and, in the case of exchange rates, also on *Return on Assets* (ROA). Meanwhile, inflation, interest rates, and GDP did not show a significant influence, either in the regression model or in the stress testing results. These findings are in line with the results of the research of Kharisma & Kusumastuti (2021) which also concluded that of the five macroeconomic variables, only crude oil prices and exchange rates significantly affect the financial performance of state-owned enterprises in the energy sector, especially Pertamina. These results reinforce the argument that these two variables are key factors to consider in financial planning and risk mitigation strategies, given the characteristics of the energy business that are highly sensitive to global dynamics, in particular commodity price volatility and exchange rate fluctuations. Furthermore, the results of *macroeconomic stress testing* in this study show that exchange rate change scenarios have the most drastic impact on the decline in ROA and ROE in all three scenarios (moderate, optimistic, and pessimistic), with a decrease of more than 90% in pessimistic scenarios. This shows a high structural dependence on the stability of the US\$/IDR exchange rate, which is also reinforced

by the Kharisma & Kusumastuti study (2021) and is in line with the findings of Alawadhi & Longe (2024), which emphasizes the importance of risk mitigation policies such as *hedging* in the face of commodity price shocks and external variables. In terms of the influence of crude oil prices (ICP), the results of this study show a significant positive relationship with ROE, although not significantly with ROA. This is in line with the research of Edy et al. (2024) and Fernady & Darmansyah (2024) which emphasized that oil price fluctuations have a real influence on national macroeconomic indicators and stock prices of energy companies. However, not all positive effects of ICP in *stress testing* scenarios are linear or consistent across all scenarios, indicating other influences that may be mediative, such as operational efficiency or changing cost components. Theoretically, the results of this study strengthen the empirical evidence that external variables such as the exchange rate and ICP are the main determinants of the profitability of energy companies. Practically, this finding has strategic implications in corporate risk management, especially for PT Pertamina (Persero). Knowing that exchange rates and crude oil prices greatly affect profitability, companies can strengthen their financial risk management policies, for example through the implementation of *currency hedging*, futures contracts or *hedging* for commodities, or diversification of other sources of funding and energy supply.

Determination of Scope, Context and Criteria

The scope of this research focuses on the PT Pertamina (Persero) group in a consolidated manner from *upstream* to *downstream* business, with a focus on macroeconomic variables that can affect the profitability of PT Pertamina (Persero). The external context in this study focuses more on the Company's challenges on macroeconomic variables such as exchange rate fluctuations, ICP price volatility, inflation, and BI interest rates. Meanwhile, the internal context is the company's policies in policies related to production capacity and cost structure for both the *upstream-downstream* sector, policies on *imported crude*, foreign exchange debt, *non-subsidized* product selling price strategies, corporate policies on *derivative tools* such as, *hedging commodities*, *swaps*, *hedging* exchange rate and others. The risk criteria for this study are that Pertamina can manage macroeconomic uncertainty risks in a structured manner, maintain financial sustainability and long-term investment strategies, and align risk tolerance with business objectives. This study assesses the likelihood and impact of each risk, then determines the risk *level* as shown in the table below.

Table 5. Probability, impact and risk level criteria

Likelihood Criteria

Index	Likelihood Criteria	% Likelihood
5	Almost Certain	Occurs almost every 1–2 years
4	Very Likely	Occurs every 3–4 years
3	Possible	Occurs every economic cycle
2	Rare	Occurs 1–2 times in 10 years
1	Almost Impossible	Occurs once in more than 10 years

Impact Criteria

Index	Impact Criteria	% Impact
5	Very Large	ROE/ROA decrease > 75%, significant loss
4	Large	ROE/ROA decrease 40–75%
3	Moderate	ROE/ROA decrease 20–40%
2	Small	ROE/ROA decrease 5–20%
1	Very Small	Decrease < 5%

Risk Management in Facing Macroeconomic Uncertainty on Pertamina's Profitability

Risk Level

Index Range	Risk Level
15–30	High Risk
10–15	Moderate to High Risk
5–9	Moderate Risk
4	Low to Moderate Risk
1–3	Low Risk

Based on the regression analysis and simulation of the scenario as well as the historical financial performance above, the Risk Tolerance Limit (BTR) to evaluate the level of risk acceptable to PT Pertamina (Persero) is a minimum ROE of 5% and a minimum ROA of 2%. Risks that cause values below this threshold are categorized as *intolerable risks* and must be mitigated according to the Risk Management framework.

Table 6. BTR for evaluation of acceptable risk levels

Risk	Parameters	Minimum Tolerance	Actions/policies if the Minimum BTR is exceeded
Exchange Rate (Rp/US\$)	ROE	5%	Mandatory Hedging, Restructuring of Export-Import Costs
ICP	ROE	7%	Diversification of other <i>crude</i> sources, long-term contracts
Inflation	ROA	2%	Cost savings, efficiency for <i>Operational Expenditure</i>
BI Rate	ROA	3%	Debt control or debt restructuring

Risk Identification, Risk Analysis and Risk Evaluation

Identification of Risks from the results of *macro stress tests* and *Monte Carlo Simulation*, the main *Risk Events* identified are (i) decreased profitability (ROA/ROE) due to exchange rate depreciation, (ii) decreased profitability (ROA/ROE) due to high inflation, (iii) ROE/ROA instability due to low ICP, (iv) increased interest expense due to high interest rates. *Risk Analysis* is carried out by mapping the risks identified in the risk map by considering the probability of occurrence and the impact of these risks. Risk analysis involves a detailed consideration of the uncertainties, sources of risk, impacts, possibilities, events, scenarios, controls and effectiveness of those controls. The next step is presented with the risk map as follows:

Table 7. Risk Register based on the results of Stress Test on Three Scenarios

No	Risk Event	Worst-Case Scenario	Impact (ROE/ROA %)	Inherent Impact	Probability	Score	Risk Level
1	Exchange rate depreciation (Rp/US\$)	Pessimistic (Rp 15,592)	ROE ↓ -100%, ROA ↓ -99%	5	5	25	High Risk
2	Inflation surge	Pessimistic (17.1%)	ROE ↓ -7.58%, ROA ↓ -11.6%	4	5	20	High Risk
3	ICP decline	Pessimistic (US\$ 40.16)	ROE ↓ -3.10%, ROA ↓ -2.27%	3	3	9	Moderate Risk
4	Sharp increase in BI Rate	Optimistic (12.75%)	ROE ↑ +9.8%, ROA ↑ +15.2%	3	2	6	Moderate Risk

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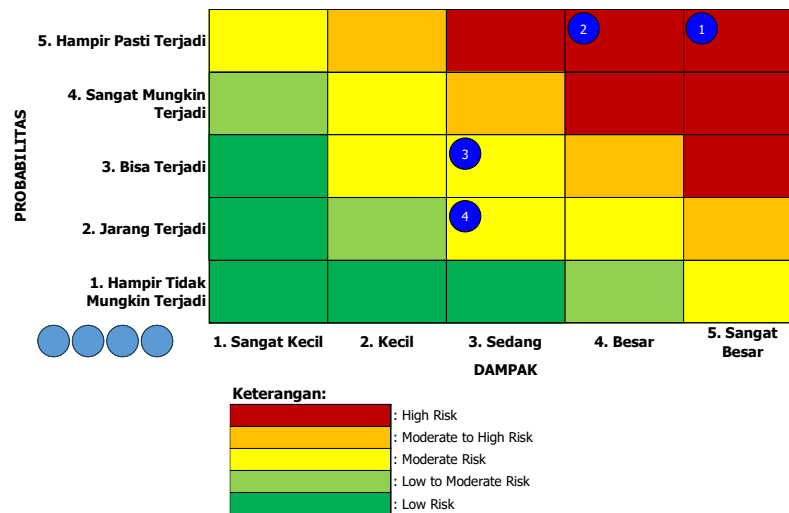


Figure 1. Risk Mapping - Inherent Risk

Risk Evaluation

Risk evaluation compares the calculated risk level with the company's *risk appetite* criteria to determine the next course of action. The risk of exchange rate changes is the most crucial risk and requires an immediate response by the company. And the second risk is that a high rate of inflation surge requires active mitigation. Other risks can be managed with passive strategies, such as monitoring or diversification.

Risk Treatment

Risk Treatment is the process of selecting and implementing measures to overcome risks.

Table 8. Residual Risk Score

No	Risk Event	Worst-Case Scenario	Impact (ROE/ROA %)	Inherent Impact	Probability	Score	Inherent Risk Level	Mitigation Strategy	Residual Impact	Probability	Score	Residual Risk Level
1	Exchange rate depreciation (Rp/US\$)	Pessimistic (Rp 15,592)	ROE ↓ -100%, ROA ↓ -99%	5	5	25	High Risk	Hedging Forward Contract	3	3	9	Moderate Risk
2	Inflation surge	Pessimistic (17.1%)	ROE ↓ -7.58%, ROA ↓ -11.6%	4	5	20	High Risk	Cost efficiency & expenditure-related policy	3	3	9	Moderate Risk
3	ICP decline	Pessimistic (US\$ 40.16)	ROE ↓ -3.10%, ROA ↓ -2.27%	3	3	9	Moderate Risk	Revenue diversification or commodity hedging	2	2	4	Low to Moderate Risk
4	Sharp increase in BI Rate	Optimistic (12.75%)	ROE ↑ +9.8%, ROA ↑ +15.2%	3	2	6	Moderate Risk	Funding restructuring or debt restructuring	2	1	2	Low Risk

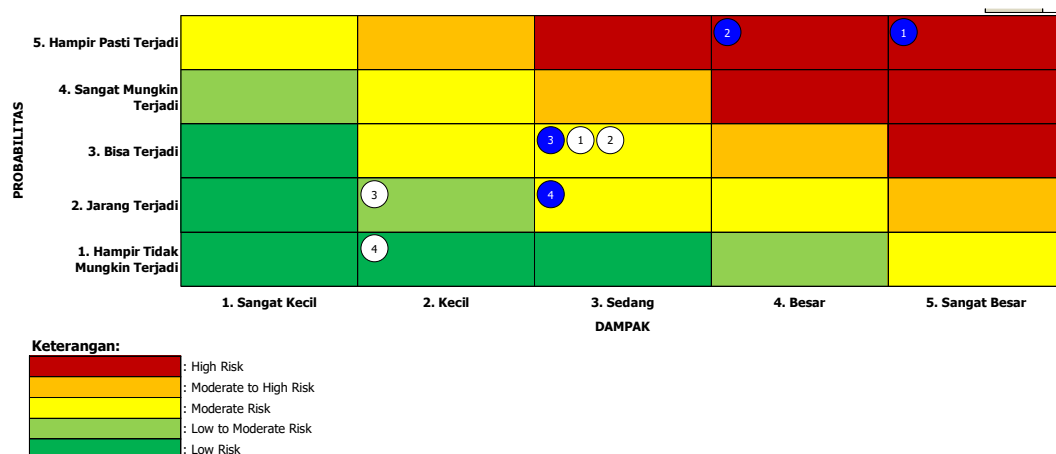


Figure 2. Risk Mapping - Inherent Risk & Residual Risk

Managerial Implications

Based on the results of the *residual risk evaluation*, there are two risks (exchange rate and inflation) that have decreased the risk level, but still exceed the tolerance limit. So that advanced *risk treatment strategies* can be carried out through:

1. The implementation of a *hedging strategy* on the exposure of the US\$/IDR exchange rate and *commodities* needs to be strengthened to reduce the impact of rupiah depreciation on the burden of operating costs and foreign exchange liabilities as well as the procurement of *crude imports*. Increase *derivative* transactions by *hedging foreign exchange* (*forward/swap/option contracts*). Although there are challenges of political discourse, namely *hedging transactions* are detrimental to the Company when *the exchange rate/commodity hedging* cost is higher than the realization of the costs that occur. Another strategy that can be done is *a cash buffer* in USD, to reduce the sudden surge in exchange rates.
2. Cost control & operational efficiency when inflation rises, can be done by implementing cost efficiency strategies, renegotiation of vendor contracts, umbrella contracts, long-term contract strategies with fixed prices, and vendor supply procurement strategies by Pertamina Group (the needs of holding groups and subsidiaries are met by the group itself).
3. Meanwhile, the figure of *the residual risk* from the decline in the ICP price is still acceptable and periodic monitoring is needed. Management to reduce dependence on *crude lifting revenue*, namely diversifying the revenue portfolio through entering renewable energy businesses such as *sustainable geothermal energy*, *sustainable Aviation Fuel (SAF)*, *green refinery*, *sustainable petrochemicals*. Another strategy is *Strategic stock & inventory buffer* so that you can buy when the ICP price is low and get a high inventory price when selling products.
4. Increasing the *BI Rate* in value can be carried out through long-term debt restructuring management strategies (refinancing if interest rates fall again), investment in non-cyclical sectors such as investment in the gas, geothermal, LNG and other renewable energy sectors. Another strategy is to optimize *cash flow* and cash flow so that you can pay interest without reducing capital expenditure.

CONCLUSION

The analysis of macroeconomic variables and PT Pertamina (Persero)'s profitability reveals that the exchange rate has a strong and significant negative correlation with both ROA and ROE, while the Indonesian Crude Price (ICP) shows a moderate positive correlation with ROE. Other variables such as inflation, interest rates, and GDP demonstrate weak or insignificant correlations with profitability. Regression and Monte Carlo simulations confirm exchange rate fluctuations and ICP as the most influential factors driving changes in profitability, with exchange rate risk causing substantial declines in ROA and ROE under pessimistic conditions, and inflation also impacting financial performance notably in stress test scenarios despite its weaker direct correlation. Given the dominant role of exchange rate risk, PT Pertamina (Persero) should prioritize foreign exchange management and develop adaptive, scenario-based *risk management planning* strategies aligned with the risk management framework to sustain profitability amid global economic uncertainties. Future research could explore the integration of additional macroeconomic and industry-specific variables, such as geopolitical risks or energy transition policies, and assess dynamic risk mitigation approaches using real-time data to enhance PT Pertamina's resilience against evolving economic challenges.

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