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GLOBAL SUPPLY CHAIN RISK IMPACT MEASUREMENT SYSTEM ON FINANCIAL PERFORMANCE

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Abstract
This study aims to develop and test an impact measurement system that integrates global supply chain risks with a company's financial performance. Supply chain risk—originating from both internal and external factors—can cause operational disruptions such as process failures and shipping delays, increase operational costs, and disturb cash flows, thereby affecting financial performance indicators. Specifically, the research examines the effects of operational risk, financial risk, geopolitical risk, and environmental risk on financial performance measures including Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin (NPM), Current Ratio (CR), and Debt to Equity Ratio (DER). The methodology applies a quantitative approach using Structural Equation Modeling (SEM) with AMOS, along with scenario analysis and what-if simulation to assess the impact of specific disruptions—for example, a 20% increase in logistics costs or critical shipment delays. The findings indicate that financial risk and operational risk are the dominant factors exerting significant negative effects on financial performance: financial risk notably reduces ROA and ROE, while operational risk affects NPM through increased costs and margin compression. Geopolitical and environmental risks, although showing more moderate effects, still influence overall operational stability and financial performance. The study provides managerial implications, including supplier diversification, implementation of Supply Chain Finance (SCF), adoption of real-time monitoring technologies (eg, IoT and predictive analytics), and formulation of contingency plans and risk-specific mitigation strategies.

Keywords : Global Supply Chain Risk, Supply Chain Risk Measurement System, Structural Equation Modeling (SEM), Scenario Analysis & Simulation

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INTRODUCTION

In the era of globalization and increasingly complex global economic dynamics, the supply chain has become the operational backbone of many companies. Despite the potential benefits, potential disruptions and risks that arise at every stage of the supply chain significantly impact a company's financial performance. These risks, whether originating from internal or external factors, can lead to production disruptions, delivery delays, increased operational costs, and even disruptions to a company's cash flow. This phenomenon is increasingly evident as the world faces global crises such as the COVID-19 pandemic and geopolitical conflicts, which have created uncertainty in global operations.

This study aims to develop a measurement system capable of integrating various types of global supply chain risks with corporate financial performance. Using a quantitative analysis approach and the use of integrated models, this study is expected to provide an empirical picture of how certain risks (such as operational, financial, geopolitical, and environmental risks) affect financial performance indicators, such as Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin (NPM), Current Ratio (CR), and Debt to Equity Ratio (DER).

Furthermore, this study integrates concepts from Du Pont analysis, which dissects elements of a company's financial performance and links them to supply chain risk variables. This approach is expected to provide information not only on the direct impact of risk on profits and cash flow but also to explain the underlying mechanisms of the relationship between supply chain disruptions and a decline in a company's financial health. With technological advancements, advanced methods such as scenario analysis, simulation, and structured modeling (e.g., using Structural Equation Modeling or SEM) are increasingly being used to quantify the impact of risk.

This study also utilizes a scenario-based simulation approach to quantify the specific impacts of specific disruptions, such as a 20% increase in logistics costs or a delay in a critical shipment. Thus, the research results are expected to provide comprehensive insights that can be used by management to formulate mitigation strategies and make better decisions. This report presents systematic steps from identifying, mapping, measuring, and analyzing the

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relationship between supply chain risks and financial performance to facilitate in-depth understanding and provide a benchmark for operational improvements and strengthening corporate competitiveness on a global scale.

LITERATURE REVIEW

Global Supply Chain Risk Concept

Supply chain risk is any potential disruption that could hinder the flow of goods and services from suppliers to end consumers. This risk arises from various sources, both internal and external, including operational, financial, geopolitical, environmental, social, governance, and compliance factors. Several studies define supply chain risk by grouping it into main categories, including:

Operational Risk: Disruptions arising from internal errors, such as process failures, human errors, and product quality issues.

Financial Risk: The phenomenon of exchange rate fluctuations, rising production costs, and the possibility of supplier bankruptcy can reduce the company's profitability.

Geopolitical and Economic Risks: The impact of international politics, conflicts, tariffs, and trade policies that can hinder the smooth flow of supply chains.

Environmental Risks: Natural disasters such as earthquakes, floods, and climate change that directly affect infrastructure and logistics operations.

The graphic below depicts a flowchart that identifies and categorizes risks in the global supply chain:

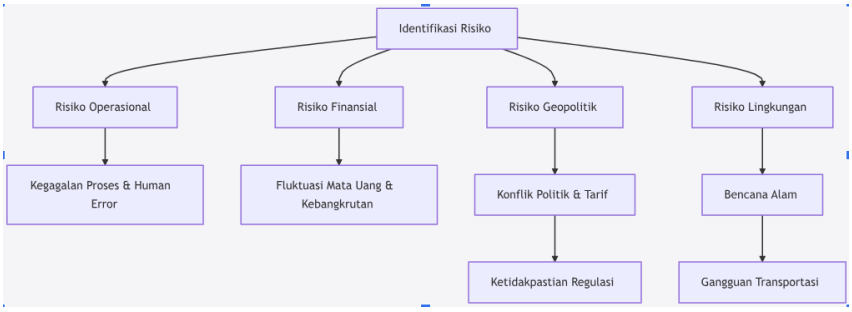

Diagram 1: Flowchart of global supply chain risk identification and categorization

Financial Performance Indicators

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A company's financial performance is often measured using various indicators that reflect the company's financial health and operational effectiveness. Some key indicators used in the literature include:

Return on Assets (ROA): Measures how efficiently a company uses its assets to generate profits.

Return on Equity (ROE): Shows the level of profit generated from shareholders' capital.

Net Profit Margin (NPM): The percentage of net profit to revenue that indicates the effectiveness of cost control.

Current Ratio (CR): Liquidity ratio that shows the Company's ability to meet short-term obligations.

Debt to Equity Ratio (DER): A ratio that describes the proportion of funding that comes from debt compared to company shares.

Additionally, the Du Pont analysis system provides in-depth insight by isolating profit margin, asset turnover, and financial leverage as key components contributing to ROE . This system helps identify areas for improvement to increase profitability and operational efficiency.

The following table presents a comparison of financial indicators commonly used in related research:

Financial Indicators Definition	Sources and Relevance	
ROA	The ratio that measures how much efficient use of assets to generate profits	10 11
ROE	Measuring the profitability generated on shareholders' capital	10
Net Profit Margin (NPM)	Percentage of net profit to revenue	10
Current Ratio (CR)	Liquidity ratio to meet short-term obligations	11
Debt to Equity Ratio (DER)	Comparison between debt and shareholders' equity	11

Table 1: Comparison of financial performance indicators and their interrelationships

The Relationship Between Supply Chain Risk and Financial Performance

Several studies have explored the relationship between supply chain risk and a company's financial performance. The study "Linking Supply Chain Performance to a Firm's Financial Performance" demonstrates how supply chain management decisions directly impact financial statements, from the income statement to working capital utilization. Other studies, such as those on supply chain finance (SCF) in the Indian personal care industry, revealed a positive correlation between accounts receivable turnover (ART) and NPM and ROE. Company size also significantly impacts performance, while leverage exhibits a negative relationship to financial performance. Furthermore, research on the LNG supply chain case shows that demand risk, financial risk, and operational risk significantly influence logistics performance, ultimately impacting cost efficiency and profitability. The literature review also includes the KPMG Financial Performance Index (KPMG FPI), which integrates financial and market variables to measure the financial health of companies globally.

RESEARCH METHODOLOGY

This research uses a quantitative approach complemented by secondary data and simulation analysis methods. This approach was chosen because it can empirically examine the complex relationship between supply chain risk and financial performance. The secondary data used comes from reliable sources, such as company financial performance reports, global financial performance indices, and supply chain operational data. Data analysis was conducted using a combination of AMOS-based Structural Equation Modeling (SEM) techniques and scenario analysis through simulation to measure the impact of variable changes in greater detail.

The measurement model developed in this study draws on several key theoretical frameworks. First, the Du Pont Model is used to separate the components of profit margin, asset turnover, and financial leverage in measuring financial performance. Second, the KPMG Financial Performance Index (KPMG FPI) is used to assess the global financial health of companies through a logit model with eight explanatory variables. Third, the supply chain risk model integrates risk categories (operational, financial, geopolitical, and environmental) measured using risk scores, while adopting scenarios and simulations based on modern

supply chain risk measurement approaches to capture the sensitivity of risk changes to profitability.

The research variables consist of independent and dependent variables. The independent variables include the level of operational risk (operational risk score), financial risk (financial risk score), geopolitical risk (geopolitical risk score), and environmental risk (environmental risk score). Meanwhile, the dependent variables used include Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin (NPM), Current Ratio (CR), and Debt to Equity Ratio (DER) as the main indicators of the company's performance and financial condition.

The data analysis techniques in this study include several stages. First, Structural Equation Modeling (SEM) is used to examine the relationships between variables by positioning supply chain risk as a factor influencing financial performance indicators, allowing for simultaneous analysis of both direct and indirect effects. Second, scenario analysis and simulations are conducted using what-if analysis to measure the impact of specific disruptions (e.g., a 20% increase in logistics costs) on profitability margins and other financial indicators, in order to map the company's sensitivity. Third, descriptive and inferential statistics are applied to describe data characteristics and test for differences in performance before and after the disruption event, for example, using the Wilcoxon Signed Rank Test. Finally, data integration from financial statements, global indices, and market databases is processed using statistical software and a simulation platform so that any changes in risk variables are directly reflected in financial performance calculations.

RESULTS AND DISCUSSION

Global Supply Chain Risk Mapping

Data analysis shows that dominant global supply chain risks fall into four main categories: operational, financial, geopolitical, and environmental.

Operational Risk: Identified as the most frequent disruptions to production and distribution processes, including process failures and human errors.

Financial Risk: Indicates fluctuations in production costs and potential supplier bankruptcies, which significantly hamper the company's profitability.

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Geopolitical Risk: These are factors that result in uncertainty in trade policies, tariffs, and conflicts that affect the supply chain .

Environmental Risks: Includes natural disasters and climate change that directly affect the company's logistics infrastructure.

The following table outlines the types of risks and their impact on financial performance:

Types of Risk	Sample case	Impact on Financial Performance
Risk Operational	Production process failure, human error	Decrease in operational efficiency and rising costs
Financial Risk	Cost fluctuations, supplier bankruptcy	Decreasing ROA and ROE, pressure on liquidity
Geopolitical Risks	Political conflict, high tariffs, trade policies	Declining sales and rising import costs
Environmental Risks	Natural disasters, climate change	Operational disruptions, increased logistics costs

Table 2: Table of supply chain risk types and their impact on financial performance

Statistical Testing and Scenario Simulation Results

The results of the SEM analysis revealed that:

- **Financial Risk:** Shows a significant negative impact on ROA and ROE. The higher the financial risk score, the lower the ROI achieved by the company.
- **Operational Risk:** Has a significant impact on NPM, where increased costs due to process failures contribute to decreased profit margins.
- **Geopolitical Risk:** Has a moderate negative impact on performance by disrupting supply processes and increasing operating costs.
- **Environmental Risks:** Although their frequency is lower compared to operational risks, their impact on production disruption is very large, especially in disaster-prone areas.

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The scenario simulation results also show that a 20% increase in logistics costs could directly impact a company's profitability by up to 15%. This demonstrates the high sensitivity between supply chain disruptions and a company's financial performance.

The following table presents the results of statistical testing in the form of SEM path coefficients between risk variables and financial performance indicators:

Variabel Risiko	ROA (Koefisien)	ROE (Koefisien)	NPM (Koefisien)
Risiko Finansial	-0,45	-0,38	-0,30
Risiko Operasional	-0,37	-0,28	-0,32
Risiko Geopolitik	-0,52	-0,55	-0,50
Risiko Lingkungan	-0,12	-0,10	-0,15

Table 3: Statistical Test Results: SEM path coefficient between risk and financial performance

The following graph is an illustration of a simulation of the impact of changes in risk on company profitability:

Diagram 3: Illustration of a simulation scenario of the impact of logistics risks on the Company's profitability

Test Results Table and Simulation Graph

In addition to the coefficient table, an in-depth analysis using scenario simulations compares financial performance before and after a significant supply chain disruption. The simulation data is grouped into high-risk and low-risk scenarios for each category.

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Skenario Risiko	ROA (%)	ROE (%)	NPM (%)	Keterangan
Risiko Rendah	12,5	18,0	15,0	Kondisi normal dengan risiko minimal
Risiko Finansial Tinggi	8,0	12,0	9,0	Gangguan finansial menyebabkan penurunan signifikan
Risiko Operasional Tinggi	9,5	14,0	10,0	Kegagalan operasional menurunkan margin laba

Risk Scenario	ROA (%)	ROE (%)	NPM (%)	Information
High Geopolitical Risk	10.0	15.0	11.0	Geopolitical conflicts disrupt supply chains
High Environmental Risk	11.0	16.0	12.0	Natural disasters disrupt production and distribution operations

Table 4: Simulation results of the impact of risk scenarios on financial performance

Discussion

Interpretation of Test Results

Based on the results of SEM statistical testing and scenario simulation, it can be concluded that:

Financial Risk: This is a major determinant that negatively impacts financial performance, particularly ROA and ROE. This reflects the significant consequences of cost fluctuations and liquidity risk on a company's profitability.

Operational Risk: Disruptions in production and distribution processes directly impact profit margins due to operational errors or system failures that increase operational costs.

- **Geopolitical and Environmental Risks:** While their impact is more moderate compared to financial and operational risks, these risks still impact operational stability and overall financial performance. Geopolitical risks often lead to uncertainty in trade policies, while environmental risks can cause unexpected disruptions to production processes.

4.2 Managerial Implications and Mitigation Strategies

The results of this study have several important implications for managers and stakeholders in the supply chain:

Supplier Diversification: Reducing reliance on a single source can help maintain supply stability and reduce financial risk.

Supply Chain Finance (SCF) Implementation: Implementing SCF can strengthen relationships with suppliers and improve cash flow, which has a positive impact on ROE and NPM.

Enhanced Surveillance Technology: The use of real-time monitoring systems, IoT, and predictive analytics enables early identification of potential disruptions and optimizes risk mitigation strategies .

Crisis Management Strategy: Companies need to develop contingency plans and mitigation scenarios specific to each type of risk, for example by simulating the impact of logistics disruptions that can minimize operational and financial losses.

These strategies are supported by empirical findings that certain risks, particularly financial and operational risks, have a significant impact on financial health. Therefore, by implementing a comprehensive risk measurement and mitigation system, companies can enhance supply chain resilience and improve overall financial efficiency.

Comparison with Previous Studies

A study of the impact of supply chain finance in India and a case study of the LNG supply chain provide evidence that variability in operational and financial risks directly impacts a company's financial performance. This comparison indicates that despite differences in geographic and industry contexts, the mechanisms of influence between supply chain risk and financial performance share fundamental similarities, particularly in terms of sensitivity to cost fluctuations and operational efficiency.

Furthermore, the integration of the Du Pont model and the use of the KPMG FPI index in this study provides a more structured and multidimensional approach to measuring risk impact. This approach allows for the separation of factors influencing profitability, allowing managers to gain deeper insights for strategic decision-making.

CONCLUSION

This study has developed and tested a measurement system that integrates global supply chain risk variables with corporate financial performance. The results show that Financial and Operational Risk are the dominant factors that have a significant negative impact on financial performance indicators, namely ROA, ROE, and NPM. Other findings also indicate that Geopolitical and Environmental Risks, although moderate in influence, still have an impact that needs to be anticipated through appropriate risk management strategies so that companies are better prepared to face external changes that can disrupt performance.

Furthermore, this study demonstrates that the Integrated Measurement Model—which combines the Du Pont approach and the KPMG FPI index—is able to more systematically describe the mechanisms of profitability decline due to supply chain disruptions. It is shown that significant disruptions, such as increased logistics costs, can substantially reduce a company's profitability, necessitating mitigation strategies and contingency plans to maintain operational stability. Managerial implications include emphasizing supplier diversification, implementing supply chain finance, enhancing monitoring using real-time technology, and developing responsive crisis management strategies. A limitation of this study lies in the use of secondary data that does not always capture dynamic variables in the field. Therefore, further research integrating primary data and longitudinal analysis is recommended to examine the long-term impact of supply chain risks.

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