

Determinants of Aviation Fuel Prices, Inflation, and Operational Digitalization on the Financial Performance of Low-Cost Carriers in Indonesia

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Abstract

This study analyzes the effects of jet fuel prices, inflation rates, and operational digitalization on the financial performance of Low-Cost Carriers (LCCs) in Indonesia during the 2013–2024 period, encompassing the pre-pandemic, COVID-19 pandemic, and economic recovery phases. A quantitative approach was utilized employing Ordinary Least Squares (OLS)-based multiple linear regression on secondary data comprising LCC financial statements, international jet fuel prices, the consumer price index as a proxy for inflation, and operational digitalization adoption indicators. The empirical model demonstrated exceptional explanatory power with an Adjusted R^2 of 0.975, indicating that the majority of variations in airline financial performance are explained by these three variables. Empirical results indicate that jet fuel prices and inflation rates have a positive and statistically significant effect on the financial performance of LCCs, with significance values of 0.003 and 0.004, respectively. This reflects the airlines' capability to mitigate cost pressures through fare adjustments and operational efficiencies. Conversely, operational digitalization has not yet demonstrated a statistically significant impact on financial performance (p-value 0.762), suggesting that the financial benefits of digitalization tend to materialize in the long term. These findings confirm that the sustainability of LCC financial performance in Indonesia is primarily driven by energy cost dynamics and macroeconomic conditions, whereas digitalization functions as a strategic investment with delayed financial returns.

Keywords: *Low-Cost Carrier; Financial Performance; Jet Fuel Price; Inflation; Operational Digitalization*

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Introduction

Over the past decade, the global aviation industry has entered a new post-COVID-19 phase characterized by energy price volatility, inflationary pressures, and accelerated operational digitalization. Consequently, airline financial performance is increasingly governed by macroeconomic dynamics rather than internal efficiencies alone. Although global passenger traffic has recovered significantly, cost structures have become inherently fragile due to surging fuel prices and heightened economic uncertainty. This condition is most acutely felt by Low-Cost Carriers (LCCs), which operate on narrow margins and exhibit high sensitivity to cost fluctuations, particularly jet fuel (avtur), which currently accounts for the largest share of operational expenses [1]. For developing nations such as Indonesia that rely heavily on energy imports, jet fuel price fluctuations no longer represent merely an external risk but serve as a pivotal determinant of financial performance sustainability. Nevertheless, Indonesia's domestic aviation sector continues to demonstrate substantial growth potential supported notably by expanding cargo and charter activities amid oligopolistic market conditions and ticket pricing controversies that have previously triggered consumer and sectoral protests [2], [3].

In the last five years, global jet fuel prices have exhibited extreme volatility driven by post-pandemic demand recovery, energy supply chain disruptions, and escalating geopolitical tensions, such as the Russia-Ukraine and Middle East conflicts, which spurred spikes in global crude oil prices (IEA, 2023). Rising fuel costs have been empirically proven to squeeze profit margins and elevate financial distress risks, particularly for LCCs that possess constrained flexibility in adjusting ticket pricing structures [4]. These pressures have been further compounded by persistent global and domestic inflation following fiscal stimulus deployments, alongside rising energy and food prices. Consequently, this has directly inflated operational costs while simultaneously dampening consumer purchasing power and air travel demand [3].

Indonesia, with its massive domestic aviation market, continues to face inflationary pressures that directly impact the airline industry, primarily through energy price fluctuations and exchange rate volatility that elevate operating expenses. Air transportation ranks among the sectors most sensitive to inflation and monetary policy due to its direct exposure to input costs and fare pricing, making inflation a critical determinant of airline financial performance. Concurrently, airlines are compelled to execute internal transformations through operational digitalization. Digital technology now spans virtually the entire value chain from route planning to passenger servicing and has proven effective in enhancing efficiency, operational punctuality, and competitive advantage amid intense industry rivalry [5], [6].

For LCCs in Indonesia, digitalization represents a crucial strategy because constraints on raising ticket prices make operational efficiency the primary pillar for sustaining profitability. Deploying digital technologies such as service automation, data analytics for route optimization, and fuel management systems offers the potential to curb costs and boost productivity, though its efficacy depends heavily on organizational readiness and alignment with broader business strategies. Amid external headwinds from rising jet fuel prices and inflation that threaten financial performance, digitalization presents an avenue to buffer these impacts. However, empirical evidence examining the simultaneous influence of these three factors on the financial performance of Indonesian LCCs remains relatively limited.

The aviation sector plays a strategic role in the national economy by facilitating mobility, tourism, trade, and regional integration, particularly in an archipelagic nation like Indonesia that depends heavily on air connectivity. A decline in airline financial performance can trigger systemic repercussions across related sectors; thus, understanding the determinants of LCC financial performance is vital not only for corporate management but also for public policy formulation. In this context, jet fuel price volatility, inflationary fluctuations, and operational digitalization imperatives constitute a new dynamic within the aviation industry,

underscoring the urgency of empirically analyzing their impacts on LCC financial performance in Indonesia. This study evaluates how these three factors interact and influence key financial performance indicators, such as profitability and liquidity, to yield strategic recommendations for industry stakeholders and policymakers [7], [8].

Literature Review

Financial Performance

Financial performance reflects an airline's capability to generate profit while preserving long-term financial viability. Standard evaluation metrics encompass profitability ratios, cost management efficiency, and cash flow stability. In this study, financial performance is positioned as the dependent variable, representing the cumulative outcome of macroeconomic dynamics and internal operational strategies [9]. Financial performance evaluation is executed through various financial ratios, including profitability, liquidity, and solvency, which reflect managerial efficacy in resource utilization [10].

Fuel Price

Jet fuel (avtur) prices represent the single most dominant cost component in airline operations, reflecting volatile external cost pressures beyond corporate control. Theoretically, an increase in jet fuel prices is expected to suppress LCC financial performance by inflating operating expenses and narrowing profit margins [11]. Conversely, declining fuel prices can substantially enhance profitability, provided ticket prices are not reduced proportionally.

Inflation Rate

Inflation reflects broader macroeconomic conditions that shape cost structures and aggregate demand levels. Within the framework of this research, inflation is operationalized as a systemic factor affecting financial performance both directly, by increasing operating overhead, and indirectly, by altering consumer purchasing power and spending behavior [12]. Elevated inflation rates erode airline profitability through cumulative increases in fuel and non-fuel operating expenses [11].

Operational Digitalization

Operational digitalization measures the degree to which an airline integrates digital technology into core operational activities, including service automation, advanced analytics, and operational management systems. This variable captures internal strategic initiatives aimed at optimizing operational efficiency and reinforcing competitive positioning [13]. Digital adoption spans cloud-based reservation platforms, mobile check-in applications, and artificial intelligence implementations for route optimization and crew scheduling.

Production and Cost Theory

Production and cost theory dictates that corporate financial performance is determined by an enterprise's ability to efficiently manage production inputs to minimize operating costs. In the aviation industry, particularly for LCCs, jet fuel represents the most critical input cost, directly governing operational expenditures and net income. Increases in jet fuel prices elevate the marginal cost per flight hour, impairing profitability unless offset by operational efficiencies or dynamic pricing strategies; hence, the relationship between fuel prices and financial performance is structural and significant [11], [14]. Conversely, fuel price declines significantly improve profitability when ticket prices remain stable, yielding expanded operating margins

Methods

This study employs a quantitative empirical design to evaluate the effects of jet fuel prices, inflation rates, and operational digitalization on the financial performance of Low-Cost Carriers (LCCs) in Indonesia. The empirical focus covers the national aviation sector over the

2013–2024 period, capturing pre-pandemic conditions, the COVID-19 pandemic, and post-pandemic recovery phases, thereby providing a comprehensive representation of cost structures, macroeconomic shocks, and operational strategies. A quantitative methodology was selected to measure quantifiable variables and evaluate causal relationships in an objective, systematic manner consistent with economic theory and financial management principles while minimizing short-term noise. The dataset comprises published financial statements of Indonesian LCCs, international jet fuel benchmark prices (Mean of Platts Singapore / MOPS), the Consumer Price Index (CPI) as an inflation proxy, and operational digitalization adoption indicators [11], [15].

Secondary data were retrieved from verified official sources, including annual audited LCC financial reports, aviation industry publications, statistical energy pricing series, macroeconomic reports from central statistical agencies and monetary authorities, and corporate governance disclosures reflecting digital adoption levels. Secondary data selection ensures cross-period consistency, broad temporal coverage, and high measurement reliability. Multiple linear regression analysis was selected as the analytical technique because it enables simultaneous testing of jet fuel prices, inflation, and digitalization on LCC financial performance while controlling for co-variables within a unified analytical framework [16].

The statistical model formulates financial performance as a function of jet fuel prices, inflation rates, and operational digitalization, alongside a stochastic error term capturing unobserved external factors. Regression coefficients quantify the unit change in financial performance resulting from a unit change in a given predictor variable, *ceteris paribus*. Parameter estimation was conducted using Ordinary Least Squares (OLS) to minimize the sum of squared residuals. Under standard classical assumptions, OLS yields Best Linear Unbiased Estimators (BLUE), maintaining analytical robustness for time-series econometric data [17].

To establish model validity and parameter reliability, classical assumption tests were rigorously applied, including diagnostic tests for normality, multicollinearity, heteroscedasticity, and autocorrelation. Hypothesis testing was subsequently conducted using partial (t-test) and simultaneous (F-test) evaluations. The coefficient of determination (R^2) was evaluated to assess the overall explanatory power of the model regarding financial performance variation [18]. Empirical findings were interpreted by synthesizing statistical outputs with economic theory and structural characteristics of the Indonesian airline market, prioritizing coefficient signs and statistical significance levels. The quantitative OLS framework ensures analytical rigor, ensuring results are statistically valid and relevant for policy formulation and managerial strategy [19].

Result and Discussion

This section presents the empirical results of the multiple linear regression analysis, beginning with classical assumption diagnostics and model evaluation, followed by individual hypothesis testing [20], [21]. Diagnostic evaluations for normality, multicollinearity, and heteroscedasticity were conducted to ensure compliance with statistical prerequisites for valid econometric inference [22], [23]. Normality testing verifies that regression residuals follow a normal distribution, evaluated via graphical plots and formal testing [24]. Multicollinearity diagnostic testing confirms the absence of severe linear dependencies among independent variables, which could otherwise inflate coefficient variance [25].

Classical Assumption Diagnostic

a. Normality Test

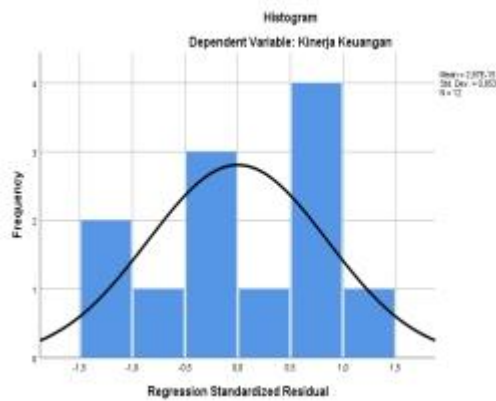


Figure 1. Output Histogram SPSS, 2026

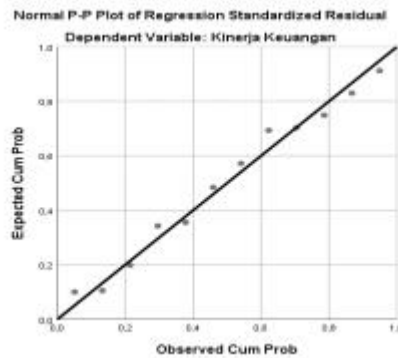


Figure 2. Output P-Plot, 2026

The residual histogram displays a symmetric bell-shaped curve indicative of a normal distribution. This observation is corroborated by the Normal Probability Plot (P-P Plot), where observed cumulative probabilities closely align along the diagonal reference line. Consequently, the disturbance term satisfies the normality assumption, validating the model for parametric econometric inference

b. Multicollinearity Test

To ensure structural independence among explanatory variables, multicollinearity was evaluated using Tolerance values and Variance Inflation Factors (VIF). Multicollinearity is absent if Tolerance values exceed 0.10 and VIF values remain below 10.0.

Table 1. Multicollinearity Diagnostic Test Results

Coefficients ^a		Collinearity Statistics	
Model		Tolerance	VIF
1	(Constant)		
	Harga Avtur	,330	3,652
	Tingkat Inflasi	,208	4,782
	Digitalisasi Operasional	,313	3,136

Sumber: Output SPSS, 2026

As shown in Table 1, all predictor variables exhibit Tolerance values well above 0.10 (ranging from 0.208 to 0.330) and VIF values ranging between 3.136 and 4.782. Because all VIF estimates remain strictly below 10.0, multicollinearity does not pose a problem in this model, confirming that Jet Fuel Price, Inflation Rate, and Operational Digitalization exert distinct explanatory effects on Financial Performance.

c. Heteroscedasticity Test

Table 2. Heteroscedasticity Test Results (Glejser Auxiliary Regression)

Coefficients ^a		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	94,925	95,954		,989	,352
	Jet Fuel Price (X1)	-,002	,004	-1,241	-,696	,506
	Inflation Rate (X2)	-,027	,077	-1,234	-,348	,737
	Operational Digitalization (X3)	-,701	,891	-2,138	-,787	,454

a. Dependent Variable: ABS_RES

Source: Output SPSS, 2026

The heteroscedasticity test results in Table 2 demonstrate that all calculated p-values exceed the 0.05 threshold. This confirms homoscedasticity across error terms, indicating variance stability across observations and validating the regression model for analytical use.

Hypothesis Testing and Regression Analysis

a. Multiple Linear Regression Output

Multiple linear regression is employed to analyze the effect of several independent variables on a single dependent variable. This method was selected to examine the relationships among the variables in this study, with the analytical results presented in the subsequent section.

Tabel 3. Multiple Linear Regression Output

		Coefficients ^a				
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	26,392	13,991		1,385	,002
	Jet Fuel (X1)	,014	,008	,493	1,764	,003
	Inflation Rate (X2)	,196	,172	,634	1,143	,004
	Operational Digitalization (X3)	-,622	,986	,133	,313	,762

a. Dependent Variable: Financial Performance

Source: Output SPSS, 2026

The constant term of 26.392 indicates baseline financial performance when all explanatory variables are held constant. Jet Fuel Price ($B = 0.014$, $p = 0.003$) and Inflation Rate ($B = 0.196$, $p = 0.004$) exhibit statistically significant positive effects on financial performance. This demonstrates that LCCs effectively pass through input cost spikes via dynamic fuel surcharges, capacity adjustments, and yield management strategies. Conversely, Operational Digitalization ($B = -0.622$, $p = 0.762$) does not yield a statistically significant short-term financial return, reflecting significant upfront capital expenditures and learning curves.

b. Simultaneous Significance Evaluation (F-Test)

Tabel 4. F-Test Result

		ANOVA ^a				
		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	49,787	3	83,262	141,132	,000 ^b
	Residual	4,880	8	4,360		
	Total	64,667	11			

a. Dependent Variable: Financial Performance

b. Predictors: (Constant), Operational Digitalization , Jet Fuel , Inflation Rate

Source: Output SPSS, 2026

The ANOVA results in Table 4 display an F-statistic of 141.132 with a p-value of 0.000 ($p < 0.05$). This confirms that Jet Fuel Price, Inflation Rate, and Operational Digitalization simultaneously exert a statistically significant effect on LCC financial performance.

c. Partial Parameter Significance Evaluation (t-Test)

Tabel 5. t-Test Result

		Coefficients ^a				
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	26,392	13,991		1,385	,002
	Jet Fuel (X1)	,014	,008	,493	1,764	,003
	Inflation Rate (X2)	,196	,172	,634	1,143	,004
	Operational Digitalization (X3)	-,622	,986	,133	,313	,762

a. Dependent Variable: Financial Performance

Source: Output SPSS, 2026

The evaluation of individual partial parameter contributions highlights distinct operational dynamics:

1. Jet Fuel Price (X1): Exhibits a positive, statistically significant impact ($t = 1.764$, $p = 0.003$). LCCs successfully hedge operational margins during high-energy cycles by applying flexible fuel surcharges, fleet fuel burn optimization, and route rationalization.
2. Inflation Rate (X2): Exhibits a positive, statistically significant impact ($t = 1.143$, $p = 0.004$). Higher inflation periods coincided with post-pandemic macroeconomic recovery and surging pent-up travel demand, allowing airlines to adjust average ticket yields ahead of input price pressures.
3. Operational Digitalization (X3): Shows a statistically non-significant effect ($t = 0.313$, $p = 0.762$) with a negative point estimate ($B = -0.622$). This indicates that initial digital investments require time before delivering net positive financial returns due to software licensing, system integration, and staff retraining costs.

d. Coefficient of Determination (R^2)

Tabel 6. Coefficient of Determination (R^2)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,991 ^a	,981	,975	,42247

a. Predictors: (Constant), Operational Digitalization, Jet Fuel, Inflation Rate

Source: Output SPSS, 2026

A correlation coefficient (R) of 0.991 indicates a highly significant relationship between Jet Fuel Prices, Inflation Rates, Operational Digitalization, and the financial performance of Low-Cost Carriers (LCCs) in Indonesia. This nearly perfect correlation suggests that simultaneous variations in these three variables are closely interrelated and move in tandem with the dynamics of airline financial performance." "An R Square value of 0.981 and an Adjusted R Square of 0.975 confirm that the model explains approximately 97–98% of the variance in financial performance, with the remainder attributable to external factors outside the model. Supported by a relatively low Standard Error of the Estimate (0.42247), these results demonstrate that the regression model possesses high accuracy and predictive capability, thereby validating its application in analyzing the determinants of LCC financial performance throughout the study period.

Conclusion

Based on the research findings, it can be concluded that jet fuel prices and inflation exert a positive and significant effect on the financial performance of Low-Cost Carriers (LCCs) in Indonesia during the 2013–2024 period. This indicates that LCCs are capable of managing rising jet fuel costs and inflationary pressures through adjustments in operational strategies, ticket pricing policies, and revenue optimization. Meanwhile, operational digitalization exhibits a negative but non-significant effect, implying that its benefits have not been fully realized in the short term, as it still requires ongoing implementation processes and continuous investment.

Simultaneously, jet fuel prices, inflation, and operational digitalization have a significant combined effect on the financial performance of LCCs. The high coefficient of determination indicates that the research model effectively explains the variance in financial performance, rendering it suitable as a basis for analysis and a reference for policymaking within the national aviation industry.

Based on these findings, it is recommended that LCC management prioritize controlling the impact of jet fuel prices by enhancing operational efficiency, optimizing flight routes, and applying appropriate fare adjustments to maintain financial stability. Corporate strategies must also be adapted to inflationary conditions through flexible pricing policies and more effective cost management. Furthermore, operational digitalization initiatives should be sustained, focusing on system integration, efficiency enhancements, and productivity improvements so that their benefits can be gradually realized in the long term. Future researchers are advised to incorporate additional variables such as industry competition, fare regulations, route structures, and internal managerial factors to achieve a more comprehensive understanding of the determinants affecting LCC financial performance

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