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The impact of crude oil prices, interest rates, and the Rupiah exchange rate on the transportation and logistics sector stock index (IDX-TRANS), 2021–2025

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ABSTRACT

This study examines the impact of crude oil prices, interest rates, and the Rupiah exchange rate on the Transportation and Logistics Sector Stock Index (IDX-TRANS) on the Indonesia Stock Exchange for the period 2021–2025. Unlike prior sectoral studies that model a narrower set of macroeconomic drivers of IDX-TRANS, this study extends the specification by incorporating the BI Rate as an additional systematic risk factor and by explicitly controlling for the structural break associated with the COVID-19 mobility-restriction (PPKM) period. Grounded in Arbitrage Pricing Theory (APT) and the Efficient Market Hypothesis (EMH), this research employs a quantitative causal design using 59 monthly time-series observations (reduced from a nominal 60 months due to first-differencing). Variables are transformed into growth rates and first differences to satisfy stationarity requirements, confirmed using the Augmented Dickey-Fuller (ADF) test. Multiple linear regression analysis is conducted with inflation and a PPKM policy dummy as control variables, and classical assumption tests (normality, multicollinearity, autocorrelation, and heteroscedasticity) confirm that the model satisfies Best Linear Unbiased Estimator (BLUE) criteria. The simultaneous test (F-test) confirms that all variables jointly and significantly affect IDX-TRANS movements (Prob > F = 0.0062). Partially, interest rates (BI Rate) exert a significant negative effect (coefficient = −13.3604; p = 0.021), and the Rupiah exchange rate also has a significant negative effect (coefficient = −1.7850; p = 0.027), while crude oil prices show no significant effect (p = 0.547), attributed to the pass-through effect mechanism. The model explains 18.79% of IDX-TRANS variation (Adjusted R^2 = 0.1879). These findings suggest that monetary policy tightening and currency depreciation pose the greatest systemic risks to capital-intensive transportation firms in Indonesia.

Keywords: stock market index; macroeconomic factors; monetary policy; exchange rate; crude oil price
JEL Classification: G12; E44

1. Introduction

Capital markets serve a fundamental function within a nation's economic structure. Beyond their role as long-term fund-raising mechanisms for firms, stock markets act as indicators representing macro-level economic conditions. Throughout the 2021–2025 observation period, the global economic order was repeatedly disrupted by post-pandemic supply chain shocks, sharp inflation fluctuations, and geopolitical tensions. These events triggered cascading effects that undermined financial system stability across many countries.

Within the Indonesian Stock Exchange (IDX) context, macroeconomic dynamics consistently influence corporate cash flow expectations and ultimately elevate investors' risk perception (Dinata & Yusbardini, 2025). Three macroeconomic variables exhibit direct exposure to domestic industrial operating costs: the Rupiah exchange rate, the Bank Indonesia reference interest rate (BI Rate), and energy price volatility in global commodity markets (Sari & Purnamawati, 2024).

Although prior studies have examined macroeconomic effects on the Jakarta Composite Index (JCI/IHSG), using an aggregate index limits the ability to capture sector-specific impacts. When oil prices surge, for instance, the energy sector's large market capitalization may buoy the aggregate index even while the same price shock imposes heavy operational burdens on fuel-dependent sectors such as transportation and logistics. Gaswira et al. (2025) note that research directly targeting the IDX-TRANS index remains scarce.

The Transportation and Logistics Sector Index (IDX-TRANS) hold a particularly critical position. Launched officially in January 2021 (BEI, 2021), this index covers land, sea, and air transport firms as well as integrated logistics providers. Its capital-intensive, cost-sensitive operational structure renders it highly vulnerable to macroeconomic fluctuations. Table 1 illustrates the significant volatility recorded in IDX-TRANS over the observation period.

Table 1. IDX-TRANS fluctuations (2021–2025)

Year	Index Points	Annual Growth (YoY)
2021	1,599.38	+88.16%
2022	1,661.94	+3.91%
2023	1,601.51	−3.64%
2024	1,300.72	−18.78%
2025	1,966.08	+51.15%

Source: Investing.com (2026).

The substantial fluctuations—including a sharp contraction of −18.78% in 2024 coinciding with Bank Indonesia maintaining its rate at 6.00% and a depreciating Rupiah—underscore the sector's sensitivity to monetary conditions. A recovery of +51.15% in 2025 followed the beginning of monetary easing.

Although Gaswira et al. (2025) is, to date, the closest precedent in directly modeling IDX-TRANS, their specification is limited to the exchange rate, inflation, and world oil price and does not incorporate interest rate risk or control for the structural break associated with pandemic-era mobility restrictions—both of which are highly relevant given that the BI Rate held steady at 6.00% through the index's sharpest contraction (2024) and that the index's launch (January 2021) coincided closely with the onset of Indonesia's first PPKM measures. The present study extends this precedent in three specific ways: (1) by adding the BI Rate as a third systematic macroeconomic risk factor under APT, given the transportation sector's heavy reliance on debt-financed fleet acquisition; (2) by explicitly modeling the 2021–2022 mobility-restriction period as a regime dummy rather than omitting it, thereby

isolating the macro-financial relationships of interest from pandemic-specific distortions; and (3) by applying growth-rate and first-difference transformations with formal stationarity testing, a methodological step not detailed in the cited precedent. Against this empirical and methodological backdrop, and considering the broader inconsistent findings in the literature regarding oil price, interest rate, and exchange rate effects on sectoral indices (Gaswira et al., 2025; Bawangung et al., 2025; Listari et al., 2025), this study addresses the identified gap by jointly examining these three macroeconomic factors' effects on IDX-TRANS over the 2021–2025 period with a comprehensive specification that includes the relevant control variables.

2. Literature review

Theoretical Foundations

This study draws on two complementary theories. The Efficient Market Hypothesis (EMH), as articulated by Fama (1970) and described by Azis et al. (2024), posits that in an efficient market, asset prices fully reflect all available information. Under the semi-strong form of EMH—relevant here since all examined variables (oil prices, interest rates, exchange rates) are publicly available—new macroeconomic data releases are immediately processed by market participants, causing contemporaneous price adjustments in sectoral equity indices.

Arbitrage Pricing Theory (APT), developed by Ross (1976), extends this framework by asserting that expected asset returns are determined by multiple systematic macroeconomic risk factors. Unlike single-factor models, APT explicitly accommodates the multi-dimensional risk environment characterizing the transportation sector: energy price volatility, monetary policy changes, and currency fluctuations all operate as undiversifiable systematic risk factors that simultaneously impact firm valuations (Sangkoy et al., 2026, Azis et al., 2024).

Within this study's framework, APT primarily underpins the simultaneous-effect hypothesis (H1), which treats oil price, interest rate, and exchange rate jointly as undiversifiable systematic risk factors that collectively determine expected returns, while the semi-strong form of EMH motivates the individual partial-effect hypotheses (H2–H4), each predicting a contemporaneous, individually detectable price adjustment to a specific, publicly available macroeconomic signal. Taken together, the two theories imply that IDX-TRANS should respond both to the joint combination of macroeconomic risk factors and to each factor individually:

H1: Crude oil price, interest rate, and Rupiah exchange rate simultaneously affect IDX-TRANS during the 2021–2025 period.

Crude oil price and stock market performance

The transportation and logistics sector is among the largest fuel consumers in the Indonesian economy. This study uses Brent crude oil as the benchmark price given its global dominance (approximately 80% of global crude trading volume) and its legal anchoring in Indonesian domestic crude oil price (ICP) formulation per Ministerial Decree ESDM No. 416.K/MG.03/MEM.M/2025 (Intercontinental Exchange, 2024). Within APT, oil price volatility constitutes a systematic risk factor that directly exposes transportation firm valuations through operational cost channels.

However, empirical evidence remains mixed. Gaswira et al. (2025) found positive effects on IDX-TRANS, arguing that pass-through pricing capabilities allow firms to transfer fuel cost increases to consumers. Baroleh et al. (2024) confirmed significant negative effects on

transportation-related indices, while Listari et al. (2025) and Arifin et al. (2025) found no significant effect. This divergence suggests industry-specific mechanisms moderate the oil price–equity relationship.
H2: Crude oil price has a partial effect on IDX-TRANS during the 2021–2025 period.

Interest rate and stock market performance

The BI Rate functions as Indonesia's primary monetary policy instrument. For capital-intensive transportation firms heavily reliant on bank credit for fleet acquisition, interest rate fluctuations create significant valuation risks through two main channels: direct increases in the cost of funds (debt service burden), and increases in the discount rate applied to future cash flow valuations, which depress equity valuations (Azis et al., 2024). Empirically, Sari & Purnamawati (2024), Dinata & Yusbardini (2025), Mojambo et al., 2020, and Purnamasari et al. (2024) and Meidiaswati & Kusumawati (2023) confirmed negative effects, while Wahyudi (2025) found no significant effect for logistics-specific stocks.
H3: Interest rate (BI Rate) has a partial effect on IDX-TRANS during the 2021–2025 period.

Exchange rate and stock market performance

Exchange rate fluctuations impose structural cost pressures on transportation firms due to currency mismatch: revenue streams are primarily denominated in Rupiah, while essential cost components—international fleet leasing, insurance, and spare-part imports—are denominated in US dollars. Persistent Rupiah depreciation, from Rp14,105/USD in 2020 to Rp16,773/USD at end-2025, exacerbates this imbalance. Gaswira et al. (2025) confirmed significant negative effects on transportation-related indices, while Listari et al. (2025) found positive.
H4: The Rupiah exchange rate has a partial effect on IDX-TRANS during the 2021–2025 period.

3. Research method

Research design, population, and data

This study employs a quantitative causal design. The population comprises the complete monthly time-series history of IDX-TRANS, Brent crude oil prices, the BI Rate, the Rupiah/USD (JISDOR) exchange rate, inflation, and the PPKM policy indicator, from the index's official launch (25 January 2021) through December 2025. Because the population of monthly observations available since the index's launch is relatively limited, this study applies sampling jenuh (a census/total-population approach) rather than a drawn subsample: all 60 nominal monthly observations spanning January 2021–December 2025 are used. The one-month reduction from the nominal 60-month period to an effective N = 59 results from the first-differencing and growth-rate transformations applied to achieve stationarity, which consume the first observation (January 2021) as the base period. This census design implies that the modest sample size is an inherent feature of the index's relatively young age rather than a sampling choice, a point revisited in the Limitations subsection.

Data were collected from the following sources: IDX-TRANS closing prices from Investing.com, Brent crude prices from the World Bank Commodity Price database, and BI Rate, JISDOR exchange rate, and inflation data from Bank Indonesia's official statistics portal. Investing.com was used for the dependent variable because, at the time of data collection, it provided the most complete, continuously available monthly historical series for IDX-TRANS spanning the full observation window; the Indonesia Stock Exchange (IDX/BEI) does not currently publish an equivalent, freely accessible monthly series covering this period. Researchers with institutional

access to BEI's internal historical database are encouraged to cross-validate this series in future replications.

Variable definition and model specification

Variables are defined as follows. The dependent variable (Y) is the monthly growth rate of IDX-TRANS: $Y_t = [(\text{IDX-TRANS}_t - \text{IDX-TRANS}_{t-1}) / \text{IDX-TRANS}_{t-1}] \times 100\%$. The independent variables are: X1 (crude oil price growth rate, Brent benchmark), X2 (BI Rate first difference: $\Delta\text{BI Rate}_t = \text{BI Rate}_t - \text{BI Rate}_{t-1}$), and X3 (Rupiah/USD exchange rate growth rate via JISDOR). Control variables include X4 (inflation first difference) and X5 (PPKM policy dummy: 1 = Jan 2021–Dec 2022 restriction period; 0 = Jan 2023–Dec 2025 normalization period). The regression model is specified as:

$$Y = \alpha + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \varepsilon$$

Conceptual framework

Figure 1 summarizes the hypothesized relationships tested in this study. The three primary independent variables (oil price, interest rate, exchange rate) are hypothesized to jointly and individually affect IDX-TRANS, with inflation and the PPKM regime serving as statistical controls.

Figure 1. Conceptual framework

Path	Variable	Hypothesized Sign	Hypothesis
Joint / simultaneous	X1 + X2 + X3 → Y	—	H1
Partial	X1 (Oil price growth) → Y	Ambiguous (mixed evidence)	H2
Partial	X2 (BI Rate Δ) → Y	Negative	H3
Partial	X3 (Exchange rate growth) → Y	Negative	H4
Control	X4 (Inflation Δ) → Y	Negative (expected)	—
Control	X5 (PPKM dummy) → Y	Ambiguous (regime control)	—

Note: Arrows denote hypothesized directional paths from each predictor to IDX-TRANS monthly growth (Y); X4 and X5 are included as statistical controls rather than substantive hypotheses.
Source: Authors' own elaboration (2026)

Estimation procedure

Prior to transformation, preliminary Augmented Dickey-Fuller (ADF) tests on the untransformed level series indicated the presence of unit roots in the primary variables, consistent with the well-documented non-stationarity of macro-financial level series (Sihombing & Arsani, 2025). Growth-rate and first-difference transformations were therefore applied to each series prior to estimation, and the resulting transformed series were re-tested for stationarity to prevent spurious regression (Table 3).

Classical assumption tests were then conducted: normality (Shapiro-Wilk), multicollinearity (Variance Inflation Factor, VIF), autocorrelation (Breusch-Godfrey LM test), and heteroscedasticity (Breusch-Pagan test). Autocorrelation was assessed using the Breusch-Godfrey LM test rather than the Durbin-Watson statistic because the former accommodates higher-order autocorrelation structures and remains valid even when regressors are not strictly exogenous, both relevant given the lagged macro-financial structure of this

model. All analyses were performed using Stata 17.

4. Result and discussion

Descriptive statistics

Table 2 presents the descriptive statistics for all variables. IDX-TRANS recorded an average monthly growth of 1.69% with a standard deviation of 7.44%, reflecting substantial sectoral volatility spanning from −15.10% to +23.30% over the observation period. Brent crude oil growth averaged 0.42% per month (std. dev. = 7.54%), confirming high energy market volatility. BI Rate changes averaged near zero (0.015%), representing Bank Indonesia's gradual monetary adjustment posture. The Rupiah depreciated on average 0.30% per month with fluctuations between −5.00% (appreciation) and +3.70% (depreciation). The PPKM dummy's mean of 0.39 indicates approximately 39% of the observation period fell within the mobility restriction phase.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
IDX-TRANS Growth	59	0.01696	0.074	-0.151	0.233
Brent Growth	59	0.00420	0.075	-0.164	0.183
Bi Diff	59	0.00015	0.002	-0.003	0.005
Kurs Growth	59	0.00306	0.016	-0.05	0.037
Inflasi Diff	59	0.00001	0.023	-0.052	0.058
Dumy PPKM	59	0.38983	0.492	0	1

Source: Processed with Stata 17 (2026).

Stationarity Test (ADF)

Table 3 confirms that all continuous variables are stationary at the level after transformation, with ADF p-values below 0.05. The PPKM dummy is excluded from the unit root test as it is a regime indicator variable, not a continuous time-series variable.

Table 3. ADF Stationarity Test Results (Post-Transformation)

Variable	Z(t) Statistic	P-Value	Decision
IDX-TRANS Growth	−6.813	0.0000	Stationary
Brent Oil Growth	−7.738	0.0000	Stationary
BI Rate Difference	−4.037	0.0012	Stationary
Exchange Rate Growth	−7.194	0.0000	Stationary
Inflation Difference	−11.160	0.0000	Stationary

Source: Processed with Stata 17 (2026).

Classical Assumption Tests

All classical assumption tests were satisfied, confirming that the model meets the Best Linear Unbiased Estimator (BLUE) criteria. The Shapiro-Wilk test yields W = 0.9678 with p = 0.1209 (>0.05), indicating normally distributed residuals. Multicollinearity assessment shows all VIF values below 2.11 (Mean VIF = 1.55), well below the threshold of 10. The Breusch-Godfrey LM test yields Chi-square = 0.982 with p = 0.322 (>0.05), confirming the absence of autocorrelation. The Breusch-Pagan test yields Chi-square = 0.39 with p = 0.534 (>0.05), confirming homoscedasticity. These results indicate that the reported coefficients are reliable under standard OLS assumptions, though, as discussed in Section 5.4, formal tests of parameter stability across the PPKM and

post-PPKM regimes were not conducted and are recommended for future research.

Multiple Linear Regression results

Table 4 presents the regression output, yielding the following structural equation:

$$Y = 0.0073 + 0.0760X1 - 13.3604X2 - 1.7850X3 + 0.7716X4 + 0.0431X5$$

Table 4. Multiple Linear Regression Results

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf.	Interval]	Sig
Brent_growth	0.076	0.125	0.61	0.547	-0.176	0.328	
BI_Diff	-13.36	5.608	-2.38	0.021	-24.61	-2.111	**
Kurs_Growth	-1.785	0.785	-2.27	0.027	-3.36	-0.21	**
Inflasi_Diff	0.772	0.557	1.39	0.172	-0.345	1.888	
Dumy_PPKM	0.043	0.019	2.22	0.031	0.004	0.082	**
Constant	0.007	0.012	0.64	0.526	-0.016	0.03	

R-squared = 0.258 | Adjusted R-squared = 0.1879 | F-test = 3.684 | Prob > F = 0.0062 | Number of obs = 59

*** p<.05; * p<.1. Source: Processed with Stata 17 (2026).*

Hypothesis testing

H1 – Simultaneous Effect. The F-test yields Prob > F = 0.0062, which falls below the 0.05 significance threshold, confirming that all five variables jointly exert a significant effect on IDX-TRANS movements. H1 is therefore accepted. The Adjusted R^2 of 0.1879 indicates that the model explains 18.79% of the variation in IDX-TRANS, with the remaining 81.21% attributable to factors outside the model specification, including firm-level fundamentals such as profitability, operational efficiency, and sector-specific regulations. This magnitude of explanatory power is broadly consistent with the typically modest explanatory power reported in comparable sectoral macro-finance regressions in the Indonesian context (e.g., Gaswira et al., 2025; Bawangung et al., 2025), where firm-specific and idiosyncratic factors generally account for the majority of variation in monthly equity returns.

H2 – Crude Oil Price. Brent crude oil growth shows a coefficient of 0.0760 with p = 0.547, exceeding the 0.05 threshold. H2 is rejected; crude oil prices do not significantly affect IDX-TRANS. This finding is consistent with, and may be explained by, the pass-through effect mechanism: transportation and logistics firms may possess sufficient market power to offset rising fuel costs by adjusting service tariffs and applying fuel surcharges. Because the cost burden may ultimately be transferred to end consumers or upstream supply chain participants, issuers' net profit margins could remain comparatively protected, which would help explain why investors do not respond to short-term oil price fluctuations with significant sell-offs. This interpretation is consistent with Listari et al. (2025) and Arifin et al. (2025), and with the government's domestic fuel-price intervention policy, which may absorb global energy shocks before they directly affect issuer margins; firm-level margin data would be needed to confirm this mechanism directly.

H3 – Interest Rate. The BI Rate shows a highly significant negative effect (coefficient = −13.3604; p = 0.021). H3 is accepted. The large magnitude of this coefficient reflects the extraordinary sensitivity of capital-intensive transportation firms to monetary policy: a

one percentage-point increase in the BI Rate is associated with a 13.36 percentage-point decrease in IDX-TRANS growth, holding other variables constant. This operates through three plausible transmission channels: (1) increased cost of funds for fleet acquisition loans, (2) higher discount rates that depress the present value of future cash flows, and (3) portfolio reallocation as investors shift from equities to higher-yielding fixed-income instruments (deposits, government bonds). These findings align with Sari & Purnamawati (2024) and Dinata & Yusbardini (2025).

H4 – Exchange Rate. Rupiah depreciation exerts a significant negative effect on IDX-TRANS (coefficient = −1.7850; p = 0.027). H4 is accepted. Each 1% depreciation in the Rupiah is associated with approximately 1.79 percentage-point contraction in IDX-TRANS growth. This is consistent with the structural currency mismatch hypothesis: while transportation firms collect Rupiah-denominated revenues, critical operational expenditures including international fleet leasing, global logistics insurance, and spare-part imports are USD-denominated. Persistent Rupiah depreciation likely erodes net profit margins, which may trigger negative investor sentiment. These findings corroborate Gaswira et al. (2025), and are consistent with APT's characterization of exchange rate fluctuations as undiversifiable systematic risk.

Discussion

Control variables perform broadly as expected. Inflation (X4) yields p = 0.172, indicating insignificance as a standalone predictor—not implying irrelevance, but rather that its residual variation appears to be absorbed by the dominant effects of interest rates and exchange rates within the model. The PPKM dummy (X5) yields a positive and significant effect (coefficient = 0.0431; p = 0.031). This counterintuitive positive sign may reflect two non-mutually-exclusive mechanisms: the market's positive reception of decisive government crisis mitigation (reducing uncertainty), and a possible surge in e-commerce and parcel delivery volumes during physical mobility restrictions, which may have boosted logistics subsector profitability within the IDX-TRANS composition. This second mechanism is plausible given widely reported e-commerce growth in Indonesia during 2021–2022, but it is not directly tested with firm-level or industry volume data in this study and should therefore be regarded as a plausible interpretation rather than a confirmed mechanism.

Including the PPKM dummy as a regime control is intended to help separate the coefficients on interest rates and exchange rates from pandemic-era misspecification bias. This study does not, however, formally test whether the slope coefficients themselves (rather than only the intercept) differ between the PPKM and post-PPKM regimes—for example, via a Chow breakpoint test or dummy-interaction terms. Given the pronounced year-to-year swings in IDX-TRANS shown in Table 1, this is acknowledged as a limitation and a direction for future research (Section 5.4).

5. Conclusion

This study examined the effects of crude oil prices, the BI Rate, and the Rupiah/USD exchange rate on IDX-TRANS over 2021–2025 using OLS regression with inflation and PPKM controls. All predictors jointly exert a significant effect on the index (Prob > F = 0.0062; Adjusted R^2 = 0.1879), supporting APT's multi-factor premise that systematic risk in capital-intensive sectors is inherently multi-dimensional. Partially, the BI Rate (β = −13.3604; p = 0.021) and Rupiah depreciation (β = −1.7850; p = 0.027) each impose significant negative effects, while crude oil prices show no

significant effect (p = 0.547), consistent with a pass-through pricing mechanism and in line with the semi-strong form of EMH—whereby sector-specific cost structures can offset an otherwise expected price response. Monetary policy tightening and currency depreciation therefore constitute the primary systemic risks for Indonesia's transportation and logistics sector, with practical implications for investors (prioritizing BI Rate and exchange rate signals over oil price movements), firm management (hedging USD-denominated obligations and pursuing fixed-rate financing), and policymakers (accounting for the disproportionate sensitivity of capital-intensive sectors when calibrating interest rate adjustments).

Several limitations should be noted. The analysis is constrained by the 59-month history of the IDX-TRANS index, which limits statistical power and sub-period analysis; future research using a longer series would enable more robust inference. The dependent variable was sourced from Investing.com rather than BEI's internal database, and cross-validation is encouraged. The PPKM period is modeled as an intercept shift only—formal slope-stability tests remain a direction for future work—and the pass-through and e-commerce-surge interpretations, while theoretically grounded, are not directly tested with firm-level data. Extending this framework to other IDX sectoral indices and incorporating firm-level fundamentals would help establish the generalizability of these findings and likely improve explanatory power.

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