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RESEARCH ARTICLE

Macroeconomic Dynamics Toward International Aviation Demand in Indonesia

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Abstract

The international aviation sector plays a strategic role in supporting global mobility and Indonesia's economic recovery, particularly in the post-COVID-19 pandemic period. This study aims to analyze the influence of macroeconomic variables on international aviation demand in Indonesia from 2010 to 2024. The variables examined include economic growth, exchange rates, airfares, visa fees, and world oil prices, with the number of international passengers serving as the primary indicator of aviation demand. The research findings indicate a long-term relationship between macroeconomic variables and international aviation demand. Exchange rates and the number of international passengers have a positive and significant impact on demand, while economic growth and visa fees show a significant negative influence. In the short term, the dynamics of international aviation demand are influenced by passenger movement patterns from the previous period, with a rapid and stable adjustment process toward equilibrium.

Keyword: JPI, PDB, KURS, AIRP, ARDL

Introduction

The international aviation sector serves as a vital indicator of global connectivity and socio-economic dynamics. In Indonesia, aviation demand is influenced by economic policies, market conditions, and consumer preferences, making it highly relevant for both the industry and policy formulation (Utami & Wijayanto, 2023). This industry plays a strategic role in regional connectivity and supporting the national economy, although its contribution to GDP has fluctuated and experienced a sharp contraction due to the COVID-19 pandemic (Irwansyah et al., 2022; Wibowo & Lestari, 2022). Global travel restrictions led to a drastic decline in international passenger numbers; however, a recovery is becoming evident through increased mobility and the restoration of international routes (Malahayati et al., 2021). Prior to the pandemic, demand growth was driven by the rising middle class, improved digital access, and tourism promotion. Generally, aviation demand is influenced by economic growth, exchange rates, airfares, and travel costs (Purnomo & Hadi, 2020; Zachariah et al., 2023).

Economic uncertainty and macroeconomic fluctuations have a significant impact on international aviation demand through changes in purchasing power, operational costs, and public confidence. Economic shocks have an asymmetrical impact, with contractions being sharper than recovery phases, thereby increasing the vulnerability of the aviation industry (Sakuntala et al., 2024). Inflation, interest rates, and the volatility of the Rupiah exchange rate also pressure airline performance and travel demand, even though a weakening Rupiah may attract foreign tourists (He et al., 2024; Efendi et al., 2023). Surges in airfares have been proven to reduce passenger numbers (Irwansyah et al., 2022), while economic conditions in tourists' countries of origin and the global economic slowdown also affect tourist flows to Indonesia (Hadi & Wijoyo, 2023). Although international passenger numbers have begun to recover post-pandemic (BPS, 2023), the recovery remains gradual due to shifts in travel behavior and the increasing use of virtual meetings (Wijaya & Lestari, 2023). With Indonesia projected to become one of the world's largest aviation markets (IATA, 2025), analyzing the relationship between economic growth and international aviation demand is essential to support recovery strategies and sustainable growth (Kurniawan & Dewi, 2023).

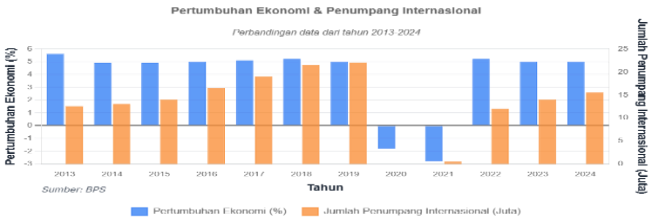

Figure 1: Economic Growth and International Passenger Volume in Indonesia

BPS data for the 2010–2024 period shows that prior to the COVID-19 pandemic, the Indonesian economy grew steadily within the range of 5–6%, accompanied by an increase in international passenger numbers to over 20 million by 2018–2019. The 2020 pandemic caused an economic contraction and nearly halted air mobility. Although economic growth has returned to above 5% since 2021, the recovery of international aviation through 2024 has been slower compared to the national economic recovery. This condition is influenced by Rupiah exchange rate fluctuations, airfares with dynamic pricing mechanisms, and travel policies such as Visa on Arrival fees and visa-free schemes.

On the supply side, world oil prices significantly affect airline operational costs, as fuel accounts for approximately 20–30% of total costs; thus, its fluctuation impacts both ticket prices and aviation demand (Putra & Hidayat, 2022). Price elasticity theory explains the negative relationship between airfares and passenger volume; however, modern demand approaches emphasize the role of non-price factors and external shocks. Research on aviation demand in Indonesia remains limited in incorporating macroeconomic variables and post-pandemic data (Wibisono & Lestari, 2021). Studies by Gupta (2022) and Wang & Lee (2023) highlight the limitations of conventional models, while IATA (2021) asserts that aviation demand dynamics are heavily influenced by global shocks. Therefore, this study analyzes the influence of macroeconomic variables on the number of international passengers in Indonesia to support policies in the aviation and tourism sectors.

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Method

This study employs a quantitative approach to analyze the causal relationship between macroeconomic variables and international aviation demand in Indonesia through secondary data processing using statistical and econometric techniques for both short-term and long-term analysis (Creswell & Creswell, 2023). This approach is highly relevant for economic research due to its ability to test theories, identify patterns, and generate robust empirical evidence, particularly in time-series analysis within the aviation sector (Babbie, 2021). The research focuses on Indonesia's primary international airports, which accounted for over 80% of international passenger traffic pre-pandemic and are considered representative of national aviation demand dynamics (BPS, 2023). Secondary data were obtained from official sources such as BPS, Bank Indonesia, the Ministry of Transportation, and the IEA, compiled as panel data for the 2010–2024 period to efficiently and reliably capture structural changes during the pre-pandemic, crisis, and post-pandemic recovery phases (Hsiao, 2014; Baltagi, 2021; Saunders et al., 2023).

The analytical model used in this study is the Autoregressive Distributed Lag (ARDL) model, reintroduced by Pesaran & Shin (1997) and further developed through the bounds testing procedure by Pesaran et al. (2001). This model allows for the analysis of long-term relationships between variables with mixed integration orders, $I(0)$ and $I(1)$, without the prerequisite of initial cointegration tests. The primary advantage of ARDL lies in its ability to produce consistent long-term estimates, its effectiveness with small sample sizes, and its capacity to capture short-term dynamics through the Error Correction Model (ECM) framework.

The ARDL model was specifically selected for its capability to analyze both short- and long-term relationships between international passenger volume and macroeconomic factors—such as real GDP, exchange rates, airfares, visa fees, and oil prices without requiring variables to have the same level of integration. This model is flexible with mixed data, effective for the limited sample period of 2010–2024, and capable of capturing cointegration and the impact of external shocks, including the COVID-19 pandemic, resulting in more robust estimates (Pesaran et al., 2021; Pratama & Dewi, 2023; Utami & Wijayanto, 2023). Rusiadi (2019) emphasizes that this flexibility makes ARDL superior in analyzing economic fundamental responses and the simultaneous interconnections of macroeconomic variables, such as economic growth, exchange rates, and ticket prices, within a single integrated level equation framework. The level function equation serving as the starting point is:

$$\ln JPIt=\beta0+\beta1\ln PDBt+\beta2\ln EXRt+\beta3\ln AIRPt+\beta4\ln VCt+\beta5\ln OILt+\epsilon t$$

Definition of Variables:

- $\ln JPI$ = Natural logarithm of the total number of International Passengers at period t.
- *ln PDBt* = Natural logarithm of Economic Growth (Real GDP) at period*t.*
- *ln EXRt* = Natural logarithm of the Exchange Rate at period*t*
- *ln AIRPt* = Natural logarithm of Airfares at period *t.*
- *ln VCt* = Natural logarithm of Visa Costs at period*t.*
- *ln OILt* = Natural logarithm of World Oil Prices at period *t.*
- *β0,…,β5* = ong-run regression coefficients to be estimated.
- *ϵt* = Error term.

The specification of the ARDL model in this research is defined as:

$$\Delta lnJPIt=\beta01+\sum_{i=1}^{n1}\beta11i\Delta lnJPIt-i+\sum_{i=0}^{n2}\beta12i\Delta lnPDBt-i+\sum_{i=0}^{n3}\beta13i\Delta EXRt-i+\sum_{i=0}^{n4}\beta14i\Delta lnAIRPt-i+\sum_{i=0}^{n5}\beta15i\Delta lnVCt-i+\sum_{i=0}^{n6}\beta16i\Delta lnOILt-i$$
$$+\phi11lnJPIt-1+\phi12lnPDBt-1+\phi13EXRt-1+\phi14lnAIRPt-1+\phi15lnVCt-1+\phi16lnOILt-1+\epsilon t1$$

This model will be estimated using the Pooled Mean Group (PMG) or Mean Group (MG) approach, determined through the Hausman test to evaluate the homogeneity of long-term parameters across the panels (Chudik & Pesaran, 2023). PMG assumes uniform long-term coefficients across all panels, whereas MG allows for variation between panels, making it more effective in capturing the distinct characteristic differences of each airport

Results and Discussion

Stationarity tests

Stationarity tests are employed to ensure that time-series data possess stable statistical characteristics, preventing the occurrence of spurious regression and ensuring that econometric estimates can be validly interpreted, particularly before conducting long-term relationship testing and dynamic modeling (Enders, 2008).

Tablel 1 Stationarity Test Result

Variabel	ADF Statistic	Critical Value	Prob.	Unit Root	Notes
JPI	-4.117270	-2.816740	0.0009	First Difference	Stationary
PDB	-5.005326	-2.754993	0.0001	First Difference	Stationary
KURS	-2.198779	-2.754993	0.0318	First Difference	Stationary
AIRP	-5.137929	-2.771926	0.0001	First Difference	Stationary
VC	-7.071068	-2.816740	0.0000	First Difference	Stationary
OIL	-3.946803	-2.771926	0.0009	First Difference	Stationary

Source: Processed by the author, 2026

Based on the stationarity test results in the table, it can be concluded that all research variables namely JPI, PDB, EXR, AIRP, VC, and OIL have achieved stationarity at the first difference level. This is evidenced by the ADF Statistic values being lower than the critical values and probabilities falling below the 0.05 threshold. These results indicate that no unit root problems were found in the data after the first differentiation, thus satisfying the stationarity assumption. Consequently, the data characteristics support the use of the ARDL method to accurately analyze short-term and long-term relationships, allowing the study to proceed to the next stage of analysis.

Cointegration Bound-Testing Result

Table 2 Cointegration Bound-Testing Result

Definition	Value
Statistic Test (F-statistic)	2,246341
Number of Independent Variable (k)	5

Critical Value Bounds Test (Asymptotic, n = 1000)

Significancy	I(0) Lower Bound	I(1) Upper Bound
10%	2,08	3,00
5%	2,39	3,38
2,5%	2,70	3,73
1%	3,06	4,15

Source: Processed by the author, 2026

Based on the output in Table 4.2, the results of the cointegration test through the bounds test show an F-Statistic value of 2.246341, which is greater than the critical value of 3.38. This indicates that the cointegration assumption has been satisfied, leading to the conclusion that a long-term relationship exists among the variables, which can be utilized for further analysis and forecasting."

Lag Optimum Determination

Table 3 Lag Optimum Test Result

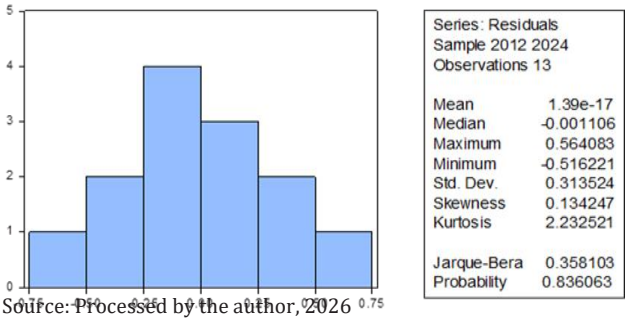
Model ARDL	Log Likelihood	AIC	BIC	HQ	Adjusted R^2
ARDL(1,0,0,0,0,0)	-3,326536	1,877552	2,130758	1,717941	-0,313504
ARDL(2,0,0,0,0,0)	-2,784143	1,960753	2,250132	1,778341	-0,586870
ARDL(3,0,0,0	-	2,0995	2,4250	1,8942	-

,0,0)	2,547277	05	56	91	1,279969

Source: Processed by the author, 2026

Based on the ARDL model selection results in the table above, the ARDL (1,0,0,0,0,0) model is identified as the optimal lag structure due to its lowest Akaike Information Criterion (AIC) value of 1.877552, compared to the ARDL (2,0,0,0,0,0) and ARDL (3,0,0,0,0,0) models. Furthermore, this model also exhibits relatively lower Bayesian Information Criterion (BIC) (2.130758) and Hannan-Quinn (HQ) (1.717941) values, rendering it the most efficient in explaining the research data structure. Specifically, this model indicates that the dependent variable is influenced by one previous period, while all independent variables only impact the current period without additional lags. Given these characteristics, the ARDL (1,0,0,0,0,0) model is deemed the most appropriate and robust for subsequent analysis of both short-term and long-term relationships.

Classical Assumption Tests



Source: Processed by the author, 2026

The output indicates the results of the normality test, with a probability value of 0.836063, which is greater than 0.05 (0.836063 > 0.05). Consequently, it can be concluded that the data used are normally distributed.

Table 4 Hetoroskedasticity Test (hasil Breusch-Pagan-Godfrey test)

F-statistic	2.927628	Prob. F(6,6)	0.1084
Obs*R-squared	9.690114	Prob. Chi-Square(6)	0.1383
Scaled explained SS	1.272064	Prob. Chi-Square(6)	0.9732

Source: Processed by the author, 2026

The output above presents the results of the heteroskedasticity test. The obtained probability value of 0.1383 is greater than 0.05 ($0.1383 > 0.05$), leading to the conclusion that the data used passes the heteroskedasticity test.

Table 5 Serial Correlation LM Test

F-statistic	3.088396	Prob. F (2,4)	0.1545
Obs*R-squared	7.890334	Prob. Chi-Square (2)	0.1372

Source: Processed by the author, 2026

The output above explains the results of the Autocorrelation test. The obtained p-value of 0.1372 is greater than 0.05 ($0.1372 > 0.05$), leading to the conclusion that the data used passes the Autocorrelation test.

Long Term Test

Table 6 Long Term Test

Variable	coefficients	Std. Error	t-Statistic	Probability
KURS	5,317019	0,463777	11,4646	0,0001
OIL	0,041434	0,040313	1,0278	0,0435
PDB	-0,114296	0,231029	-0,4947	0,0428
AIRP	0,8421	0,251233	45.2341	0,0025
VC	-0,172359	0,018965	-9,0884	0,0003
JPI	3,478656	0,898481	3,8717	0,0117
Constanta (C)	-19,18406	10,22881	-1,8755	0,0166

Source: Processed by the author, 2026

Based on the long-term Bounds Testing results under the assumption of a restricted constant without a trend, the exchange rate (KURS) and the number of international passengers (JPI) have a positive and significant effect. This indicates that a strengthening exchange rate and increased international mobility drive aviation demand in the long run, aligning with the findings of Wijayanti and Hadi (2022) as well as Suryaningsih and Kusuma (2021). In contrast, Gross Domestic Product (PDB) and visa costs (VC) exhibit a negative and significant influence, suggesting that structural economic adjustments and administrative travel barriers suppress international aviation demand, as noted by Kurniawan & Dewi (2023) and García-Sánchez et al. (2013).

ECT dan Short Term Test

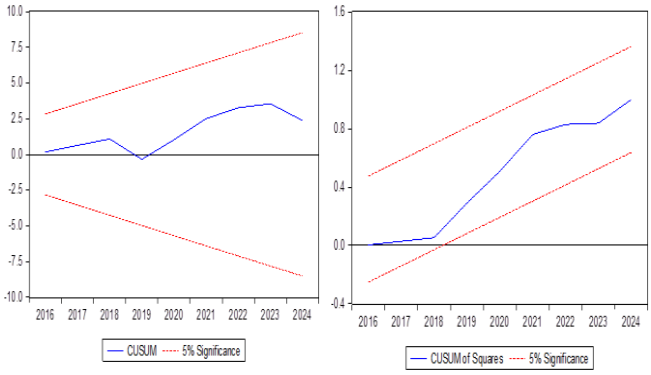
Table 7 ECT dan Short Term Test

Independent Variable	Model Notation	coefficients	Std. Error	t-Statistic	Probability	Definition
Change of JPI Short Term (Lag 1)	Δ^2JPIt-1	1,946277	0,270478	7,09	0,0193	Significant
Change of JPI Short Term (Lag 2)	Δ^2JPIt-2	1,747351	0,250920	6,84	0,0207	Significant
Error Correction Term	ECTt-1	-0,914537	0,134581	-6,15	0,0037	Significant

Source: Processed by the author, 2026

The Error Correction Term coefficient (ECT_{t-1}) is 0.914537 and is significant at the 5% level (Prob. 0.0037), indicating a very strong short-term adjustment mechanism toward long-term equilibrium. This coefficient value suggests that nearly all imbalances from the previous period can be corrected within a relatively short timeframe, ensuring a rapid adjustment process and a stable model. In the short run, changes in the number of international passengers ($\Delta^2 JPI$) at lags one and two show positive and significant coefficients of 1.946277 and 1.747351, respectively. This signifies that an increase in JPI from previous periods still provides a tangible boost to the dependent variable. This reinforces that short-term dynamics are driven not only by the correction mechanism toward long-term equilibrium but also by the sustained influence of JPI fluctuations from several preceding periods, aligning with the findings of Narayan et al. (2021).

Stability Model Test



Source: Processed by the author, 2026

Figure 2: Stability Test CUSUM, dan Stability Test ARDL (CUSUMQ)

Based on the model stability test results using the CUSUM and CUSUM of Squares approaches, it can be stated that the research model demonstrates stability and consistency throughout the 2016–2024 observation period. This is reflected by the movement of the test statistics, which consistently remain within the critical bounds at the 5% significance level, without crossing or intersecting the boundary lines. The absence of significant indications of structural changes confirms the high level of reliability of the model, making it suitable and robust for further analysis.

Disscussion

The research findings indicate a long-term relationship between macroeconomic variables and international aviation demand. The exchange rate has a positive and significant effect, while economic growth and visa costs show a significant negative influence. In the short term, aviation demand is influenced by passenger movement patterns from the previous period, with a rapid and stable adjustment process toward equilibrium

Limitation Of The Study

This study analyzes international aviation demand in Indonesia, utilizing passenger data from major airports including CGK, DPS, KNO, and SUB for the 2010–2024 period. The analysis encompasses the pre-pandemic, mid-pandemic, and post-COVID-19 phases to examine long-term trends and their impacts. The variables examined include economic growth (real PDB), Rupiah exchange rate fluctuations, international airfares, visa costs, and world oil prices. By employing the Autoregressive Distributed Lag (ARDL) model with panel data from various airports, this research explores the long-term relationships between these variables and international aviation demand

Conclusions and Recommendations

The variable of Gross Domestic Product (PDB), exchange rates (KURS), airfares (AIRP), visa costs (VC), and oil prices (OIL) exert a significant influence on international aviation demand (JPI) in the long run. Although GDP (PDB) partially exhibits a negative effect (a pandemic-related anomaly), as a collective unit, these macroeconomic variables remain the primary determinants shaping passenger volume trends in Indonesia throughout the 2010–2024 period as noted by Kurniawan & Dewi (2023). The model results yield a negative and significant Error Correction Term (ECT), indicating that in the event of major shocks—such as the 2020 pandemic the model possesses the capacity to correct such imbalances. Furthermore, the stability confirmed by the CUSUM and CUSUM of Squares tests demonstrates that the relationships between these macroeconomic variables remain consistent. This proves that the structure of international aviation demand in Indonesia maintains a robust fundamental foundation tied to macroeconomic variables.

Future research is encouraged to incorporate non-economic variables, such as travel restriction policies, consumer confidence indices, or global health factors, to capture demand dynamics more comprehensively. Furthermore, utilizing higher-frequency data or a spatial approach across airports could provide more detailed insights into the differing demand responses in each region. Testing alternative models is also essential to strengthen the validity of these findings and enrich the literature in the field of air transport economics

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