

Original Article

Determinants of International Tourist Arrivals to Indonesia and the Impact of the COVID-19 Pandemic: An Augmented Gravity Model Approach

¹Sarah Bahiyah, ²Banatul Hayati

^{1,2}Faculty of Economics and Business, Diponegoro University, Semarang, Indonesia.

Received Date: 28 August 2026

Revised Date: 18 September 2026

Accepted Date: 23 September 2026

Published Date: 25 September 2026

Abstract: International tourist arrivals to Indonesia declined sharply during the COVID-19 pandemic, underscoring the need to understand the factors shaping international tourism flows. This study examines the determinants of international tourist arrivals to Indonesia using an augmented gravity model, drawing on panel data from ten major origin countries (Malaysia, Singapore, China, Japan, South Korea, India, Australia, the United Kingdom, France, and the United States) over 2015–2024. The conventional gravity framework is extended with population, exchange rate, institutional quality, direct-flight availability, and a COVID-19 pandemic dummy. Estimation uses Poisson Pseudo-Maximum Likelihood (PPML) to address heteroskedasticity and zero-valued observations, with pooled ordinary least squares (OLS) as a robustness check. Results show that geographic distance and the pandemic have significant negative effects on tourist arrivals, while exchange rate and direct-flight availability have significant positive effects. Institutional quality also has a significant negative effect, consistent with a substitution effect between domestic and outbound tourism in origin countries. Origin-country GDP per capita, Indonesia's GDP per capita, and population are statistically insignificant, likely reflecting limited variation among the ten high-volume origin markets. These findings indicate that connectivity and real travel costs matter more than economic size in shaping tourism flows to Indonesia, suggesting that policy should prioritize expanding direct flight access and monitoring exchange rate competitiveness.

Keywords: COVID-19 Pandemic, Direct Flights, Indonesia, Institutional Quality, Poisson Pseudo-Maximum Likelihood, Tourism Demand.

I. INTRODUCTION

Tourism is one of the sectors on which Indonesia relies to develop its economy, primarily through its contribution to foreign exchange earnings. Indonesia's natural endowments and the distinct local cultures of each region are the attractions that draw international visitors every year, and receipts from tourism peaked at USD 16.9 billion in 2019, collapsed during the COVID-19 pandemic, and then recovered to USD 6.78 billion in 2022, USD 14.0 billion in 2023 and USD 16.7 billion in 2024. The recovery of earnings has tracked the recovery of arrivals closely, which is why the sector has been positioned by the government as a prospective leading contributor to national foreign exchange and to inclusive growth.

The arrivals series itself follows the same arc. According to Statistics Indonesia (BPS) [1], international arrivals rose by 58 percent between 2015 and 2019, from 10.23 million to 16.11 million. The year 2015 is a natural starting point because it coincides with the introduction of the Visa-Free Visit policy under Presidential Regulation No. 69 of 2015, which removed the visa requirement for nationals of a large group of countries. The upward trend was interrupted when COVID-19 escalated into a global pandemic: arrivals fell to 4.05 million in 2020, only a quarter of the 2019 level, and then to 1.56 million in 2021, the lowest figure in two decades, in a year in which the visa-free facility was itself suspended. Arrivals then recovered to 5.89 million in 2022, 11.68 million in 2023 and 13.09 million in 2024.

These aggregate movements conceal substantial cross-country heterogeneity. Ten origin countries – Malaysia, Singapore, China, Japan, South Korea, India, Australia, the United Kingdom, France and the United States – consistently account for between 65 and 72 percent of total arrivals, but the volumes they generate differ by an order of magnitude. The standard gravity framework, introduced by Tinbergen [2] for bilateral trade and adapted to tourism by Morley, Rosselló and Santana-Gallego [3], predicts that flows rise with the economic size of the two countries and fall with the distance between them. Indonesia's arrivals pattern is only partly consistent with that prediction.

The first inconsistency concerns distance. China, South Korea, Australia and Japan all lie within a narrow band of roughly 5,200 to 5,800 kilometres from Jakarta, yet China and Australia are consistently among the largest contributors while South Korea and Japan send far fewer visitors. Physical distance between capitals is therefore a poor proxy for the travel cost and travel



friction actually faced by tourists. One candidate explanation is the availability of non-stop air service, which determines journey time and transit cost independently of the physical separation between two countries [4]. Two markets equidistant from Indonesia can face very different effective barriers if one has a direct route and the other does not.

The second inconsistency concerns income. Malaysia and China have consistently lower per capita income than the United Kingdom or France, yet generate far larger arrival volumes. Per capita income is an average and does not, on its own, capture the size of the travelling market: China's population of more than 1.4 billion means that its upper-middle-income segment can exceed the entire population of several European source markets. Population, however, is not a complete answer either, since Singapore, with roughly six million residents, remains one of Indonesia's largest source markets throughout the period.

Research applying an augmented gravity framework to Indonesia as a destination remains limited, and the existing studies leave the specific question addressed here open. Goswami, Sarwar and Rahman [5] estimate pandemic effects on tourism inflows across the Asia-Pacific but do not include Indonesia among the destinations analysed. Ghali, Fidrmuc, Samargandi and Sohag [6] incorporate institutional quality into a global gravity model covering 134 origins and 31 destinations, but their sample ends in 2014 and therefore predates the pandemic entirely. Singagerda, Desfiandi and Marantika [7] do focus on Indonesia and do include a COVID-19 dummy, but their dependent variables are tourism trade and investment flows rather than arrivals.

This study addresses that gap by estimating an augmented gravity model of arrivals to Indonesia from its ten largest source markets over 2015–2024, a window that spans the pre-pandemic expansion, the pandemic collapse and the post-pandemic recovery. The specification combines conventional gravity terms with origin-country institutional quality, the bilateral exchange rate, a direct-flight indicator and a pandemic dummy, and is estimated by Poisson Pseudo-Maximum Likelihood (PPML) following Santos Silva and Tenreiro [8]. The contribution is threefold: it brings direct-flight connectivity into a gravity model of Indonesian inbound tourism, where, to the authors' knowledge, it has rarely been used; it tests whether origin-country governance operates as a complement to or a substitute for outbound travel in this particular set of markets; and it quantifies the pandemic effect for Indonesia while holding the structural determinants constant.

II. LITERATURE REVIEW

A) *Tourism Demand and the Gravity Framework*

The theoretical foundation of the model is the constrained utility maximisation of an individual traveller. Morley et al. [3] express the utility of a resident of origin i visiting destination j in period t as a function of the number of trips taken, consumption of all other goods, a vector of origin characteristics that push residents to travel and a vector of destination characteristics that pull them in. The traveller maximises this utility subject to a budget constraint in which total trip cost multiplied by the number of trips, plus the price of other goods multiplied by their quantity, cannot exceed income. Solving the associated Lagrangian yields an individual demand function for visits :

$$N^{*ijt} = F(\pi_{ijt}, p_{it}, M_{it}, ZO^{sit}, ZD^{ijt}) \quad (1)$$

where π is the total cost of the trip, p is the price of other goods in the origin, M is individual income, and ZO and ZD are the push and pull vectors, respectively. Lim [9] clarifies that the relevant price in tourism demand is the full cost of travelling, comprising a transport component that is conventionally proxied by distance and an in-destination component governed by the exchange rate between the origin and destination currencies. Standard demand theory adds that the number of potential buyers shifts the demand curve, which motivates the inclusion of origin population as a measure of market scale [10], [11].

The empirical counterpart of this demand function is the gravity model. Tinbergen [2] formalised bilateral trade as proportional to the economic mass of the two countries and inversely proportional to the distance between them, by analogy with Newton's law of gravitation. Anderson and Van Wincoop [12] showed that the bare specification suffers from omitted variable bias because it captures only size and distance. Since Indonesia is the sole destination in this study, the variation to be explained is entirely cross-origin and over time, and the augmented specification therefore takes the multiplicative form.

$$N^{*ijt} = A \cdot \prod (ZO^{sit})^{\alpha_s} \cdot \prod (ZD^{ijt})^{\beta_p} \cdot \prod (ZOD^{ijt})^{\gamma_r} \quad (2)$$

In which the origin vector contains per capita income, population and institutional quality; the destination vector contains Indonesian per capita income as a proxy for destination quality; and the bilateral vector contains distance, the exchange rate and direct-flight availability. An external shock term for the pandemic is added to this structure.

B) *Empirical Evidence and Hypotheses*

The empirical gravity literature on tourism is consistent on some coefficients and divided on others. Distance is the most robust finding: Khadaroo and Seetanah [13], estimating a dynamic panel by GMM across 28 countries and 756 country pairs for 1990–2000, find a significant negative distance effect alongside positive effects of origin per capita income and population, and identify transport infrastructure as a determinant of destination attractiveness. Keum [14], using pooled OLS, fixed and random

effects on 28 of South Korea's major trading partners for 1990–2002, reports distance as the variable with the largest elasticity in the model.

Evidence on the role of air service is more recent. Galli, Fraga and de Sequeira Santos [15] model foreign air arrivals to thirteen Brazilian international airports and find that air connectivity is central to destination development. Alderighi and Gaggero [4] estimate a zero-inflated negative binomial model on semi-annual data covering twenty Italian regions and twenty-four European countries for 1999–2010 and find that flight frequency raises both arrivals and length of stay, with low-cost carriers exerting a considerably larger effect than full-service carriers; in their model, destination GDP, distance and the exchange rate all enter negatively. Yerdelen Tatoglu and Gul [16], using a multi-dimensional panel gravity model on 30 origins and 14 of the world's most-visited destinations for 2008–2016, likewise include a direct-flight indicator, and report positive origin GDP but negative destination GDP and distance effects.

The institutional dimension is the most contested. Ghalia et al. [6] find that institutional quality and the absence of conflict significantly raise tourist flows, interpreting good institutions as a proxy for efficient bureaucracy that eases the administrative burden of travelling abroad, and for the prosperity that finances it – a complementarity mechanism. Ullah, Leurcharusmee and Yamaka [17], by contrast, estimate symmetric and asymmetric panel ARDL models on 54 countries for 1996–2023 and find that improvements in governance quality reduce outbound tourism expenditure in the long run, because greater confidence in domestic services and lower domestic transaction uncertainty shift consumption toward domestic tourism – a substitution mechanism. The sign of origin-country institutional quality is therefore an empirical question rather than a settled theoretical prediction.

On the pandemic, Goswami et al. [5] estimate a PPML gravity model on 48 origins and 8 Asia-Pacific destinations using monthly data from January 2019 to October 2021 and find that the pandemic period reduced arrivals by 49.8 percent relative to non-pandemic months, with distance entering negatively and population positively. Singagerda et al. [7] find a significant negative COVID-19 effect on Indonesian tourism trade and investment. Ghosh [18], applying the Common Correlated Effects estimator to Australian inbound demand from 15 Asian markets over 1991–2018, finds positive origin and destination income effects and negative distance, exchange rate and price effects.

These findings, together with the theoretical framework above, yield the following hypotheses. H1: higher origin per capita income increases arrivals to Indonesia. H2: Higher Indonesian per capita income, as a proxy for destination quality, increases arrivals. H3: Greater geographical distance reduces arrivals. H4: A larger origin population increases arrivals. H5: depreciation of the rupiah against the origin currency increases arrivals. H6: Higher origin institutional quality affects arrivals, with the sign left open because the complementarity and substitution mechanisms predict opposite directions. H7: The availability of a direct flight increases arrivals. H8: the COVID-19 pandemic reduces arrivals.

C) Data and Variables

The study uses a balanced annual panel of ten origin countries; Malaysia, Singapore, China, Japan, South Korea, India, Australia, the United Kingdom, France and the United States over 2015–2024, giving 100 observations. These countries were selected because they consistently account for the largest share of arrivals to Indonesia throughout the period. All data are secondary and were collected from documentation from official statistical sources. Table 1 sets out the measurement and source of each variable.

Table 1: Variable Definitions, Measurement and Data Sources

Variable	Definition and Measurement	Expected Sign	Source
TOUR	Annual number of international tourist arrivals to Indonesia from origin <i>i</i> (persons)	Dependent	Statistics Indonesia (BPS)
GDPPC _{<i>i</i>}	Real GDP per capita of origin <i>i</i> , constant 2015 US\$	+	World Bank
GDPPC _{<i>j</i>}	Real GDP per capita of Indonesia, constant 2015 US\$	+	World Bank
DIST	Great-circle distance between the capital of origin <i>i</i> and Jakarta (km); time-invariant	–	CEPII GeoDist
POP	Total population of origin <i>i</i> (persons)	+	World Bank
EXR	Rupiah per unit of origin currency (IDR/LCU), derived from IDR/USD divided by LCU/USD	+	IMF
INST	Government Effectiveness percentile rank of origin <i>i</i> (0–100)	+/–	World Bank, WGI
DFLIGHT	Dummy = 1 if a non-stop commercial route from origin <i>i</i> to Indonesia operated in year <i>t</i> , 0	+	Airline press releases, RoutesOnline, ANTARA

	otherwise		News, Travel Weekly Australia
COVID	Dummy = 1 for 2020 and 2021, 0 otherwise	–	Author's construction

Source: Compiled by the authors.

Two measurement choices deserve comment. First, the exchange rate is expressed as rupiah per unit of origin currency, so an increase denotes depreciation of the rupiah and therefore a fall in the relative price of an Indonesian holiday for the foreign visitor; the expected sign is accordingly positive. Second, institutional quality is measured on the origin side rather than the destination side. Because Indonesia is the only destination in the panel, a destination-side governance index would be identical across all origins within a given year and would be absorbed into the year variation of Indonesian per capita income. Government Effectiveness is chosen among the six Worldwide Governance Indicators [19] because it captures the quality of public services and bureaucratic administration, which is the dimension most plausibly linked to the ease of obtaining passports and travel documents.

D) Estimation Strategy

Gravity models are conventionally log-linearised and estimated by OLS. The baseline log-linear specification is

$$\ln TOUR_{it} = \beta_0 + \beta_1 \ln GDPPC_{it} + \beta_2 \ln GDPPC_{jt} + \beta_3 \ln DIST_{it} + \beta_4 \ln POP_{it} + \beta_5 \ln EXR_{it} + \beta_6 INST_{it} + \beta_7 DFLIGHT_{it} + \beta_8 COVID_{it} + \varepsilon_{it} \quad (3)$$

Santos Silva and Tenreyro [8] identify two problems with estimating (3) by OLS. First, by Jensen's inequality, the expectation of a logarithm is not the logarithm of the expectation, so when the error variance depends on the regressors, that is, under heteroskedasticity, the log-linear OLS estimates are biased and inconsistent. Second, the logarithm is undefined at zero, so any zero-valued flow must be dropped, which risks sample selection bias. Both problems are relevant here: the Breusch–Pagan test reported below rejects homoskedasticity decisively, and arrivals from several origins collapse to near-zero levels in 2021.

PPML avoids both problems by estimating the multiplicative form of the model directly, specifying the conditional mean as an exponential function rather than log-linearising the dependent variable. The estimated specification is therefore;

$$E(TOUR_{it} | X_{it}) = \exp(\beta_0 + \beta_1 \ln GDPPC_{it} + \beta_2 \ln GDPPC_{jt} + \beta_3 \ln DIST_{it} + \beta_4 \ln POP_{it} + \beta_5 \ln EXR_{it} + \beta_6 INST_{it} + \beta_7 DFLIGHT_{it} + \beta_8 COVID_{it}) \quad (4)$$

The exponential form guarantees non-negative fitted values, which is consistent with a count-type dependent variable. PPML is consistent provided the conditional mean is correctly specified and does not require the dependent variable to be Poisson-distributed, which is why it is described as a pseudo-maximum-likelihood estimator. It also implicitly down-weights observations with larger variance, making it robust to heteroskedasticity. Coefficients on logged regressors are interpreted as elasticities and those on unlogged regressors as semi-elasticities, converted to percentage effects by $(e^{\beta} - 1) \times 100$.

The model is estimated without fixed effects. Country fixed effects would absorb the time-invariant distance variable and prevent its identification, while year fixed effects would be perfectly collinear with the COVID-19 dummy and with Indonesian per capita income, both of which vary only over time. To accommodate within-country correlation over time, standard errors are clustered at the origin-country level, following the approach used by Ghalia et al. [6]. Estimation was carried out in Stata. Diagnostic testing covers multicollinearity (variance inflation factors), heteroskedasticity (Breusch–Pagan), serial correlation (Wooldridge test for panel data [20]) and functional form (the RESET test adapted to PPML by Santos Silva and Tenreyro [8]). Joint significance is assessed by the Wald test and individual significance by z-tests, following Cameron and Trivedi [21], with goodness of fit reported as the pseudo R-squared, which measures the correlation between fitted and actual values rather than the share of variance explained.

III. RESULTS AND DISCUSSION

A) Descriptive Statistics

Table 2: Descriptive Statistics of the Research Variables

Variables	Obs	Mean	Std. Dev.	Min	Max	Unit
TOUR	100	699,599	679,227	3,196	2,980,753	Persons
GDPPCi	100	36,003	21,272	1,584	68,219	US\$
GDPPCj	100	3,799	320.2	3,288	4,367	US\$
DIST	100	6,844	4,673	886	16,371	Km
POP	100	350	534	5.4	1,450	Million persons
EXR	100	7,579	6,944	11	20,456	IDR/LCU
INST	100	77.35	10.75	56.01	95.67	Index
DFLIGHT	100	0.51	0.50	0	1	Dummy
COVID	100	0.20	0.40	0	1	Dummy

Source: Stata output, processed by the authors.

Arrivals average 699,599 per origin-year but range from 3,196 to 2,980,753, a spread that reflects both cross-country heterogeneity and the collapse during 2020–2021. Origin per capita income spans a factor of forty, from USD 1,584 to USD 68,219, while Indonesian per capita income varies within a much narrower band because it varies only over time. Distance ranges from 886 km (Singapore) to 16,371 km (the United States). The direct-flight dummy has a mean of 0.51, indicating that slightly more than half of the origin-year observations had non-stop service, and the COVID-19 dummy has a mean of 0.20, consistent with two pandemic years out of ten.

B) Diagnostic Tests

Table 3: Variance Inflation Factors

Variables	VIF	1/VIF
lnGDPPCi	9.71	0.103
INST	7.26	0.138
lnPOP	5.51	0.181
lnDIST	4.95	0.202
DFLIGHT	2.61	0.383
lnEXR	2.46	0.406
COVID	1.68	0.595
lnGDPPCj	1.04	0.957
Mean VIF	4.40	

Source: Stata output, processed by the authors.

All variance inflation factors lie below the conventional threshold of 10, and the mean VIF is 4.40, so severe multicollinearity is not present. The highest value, 9.71 for origin per capita income, together with 7.26 for institutional quality, nonetheless indicates a strong association between the two: countries with high per capita income tend also to score highly on government effectiveness. This should be borne in mind when interpreting the individual coefficients on these two variables, since correlated regressors inflate standard errors and make it harder to identify their separate effects.

The Breusch–Pagan test on the log-linear specification yields $\chi^2(1) = 55.27$ with $p = 0.0000$, rejecting homoskedasticity at any conventional level. This is the central justification for using PPML rather than log-linear OLS, since it is precisely under heteroskedasticity that Jensen’s inequality renders the log-linear estimates biased. The Wooldridge test for first-order serial correlation in panel data returns $F(1,9) = 4.948$ with $p = 0.0532$, so the null of no first-order autocorrelation is not rejected at the 5 percent level, although the margin is narrow; clustering the standard errors by country provides additional protection against any residual within-country dependence.

The RESET test adapted to PPML gives $\chi^2(1) = 3.89$ with $p = 0.0486$, marginally rejecting the null of correct functional form at the 5 percent level. This result is reported transparently rather than suppressed. The exponential conditional mean is retained because it is a structural feature of the gravity model and is the condition under which logged coefficients can be read as elasticities; abandoning it would make the estimates non-comparable with the literature. The marginal rejection is more plausibly a symptom of omitted bilateral determinants – cultural proximity, visa arrangements, promotional expenditure – than of an incorrect link function, and it is acknowledged below as a limitation.

C) Estimation Results

Table 4: Poisson Pseudo-Maximum Likelihood Estimates

Variables	Coefficient	Robust Std. Err.	z	P> z
lnGDPPCi	0.125	0.124	1.01	0.313
lnGDPPCj	−0.358	0.413	−0.87	0.385
lnDIST	−0.487**	0.192	−2.53	0.011
lnPOP	0.101	0.072	1.42	0.157
lnEXR	0.169***	0.032	5.32	0.000
INST	−0.025***	0.004	−5.44	0.000
DFLIGHT	0.988***	0.280	3.53	0.000
COVID	−1.015**	0.402	−2.52	0.012
Constant	17.336***	3.502	4.95	0.000
Wald $\chi^2(8)$	13,925.5	Prob > χ^2	0.0000	
Pseudo R ²	0.8284	Observations	100	

*Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Standard errors clustered at the origin-country level. Source: Stata output, processed by the authors.*

The Wald statistic of 13,925.5 with $p = 0.0000$ rejects the null that all slope coefficients are jointly zero, so the regressors are jointly significant. The pseudo R-squared of 0.8284 indicates a close correspondence between fitted and observed arrivals. Four of the eight regressors are individually significant: the exchange rate, institutional quality and direct-flight availability at the 1 percent level, and distance and the pandemic dummy at the 5 percent level. Origin per capita income, Indonesian per capita income and origin population are not statistically significant.

D) Discussion

Origin per capita income carries the theoretically expected positive sign but is not significant ($\beta = 0.125$, $p = 0.313$), so H1 is not supported. This departs from Ghalia et al. [6] and Yerdelen Tatoglu and Gul [16], both of which find a positive and significant income elasticity. The most likely explanation is the composition of the sample. Those studies pool a large and heterogeneous set of origins, whereas the ten markets here were selected precisely because they send the most visitors, which compresses the effective variation between income and travel propensity. The pattern in the raw data illustrates the point: Malaysia and China, with per capita incomes well below those of the United States, the United Kingdom and France, dominate arrivals to Indonesia. Within this group, proximity and affordability appear to matter more than income level. The high correlation between origin income and government effectiveness noted above may also be absorbing part of the income effect.

Indonesian per capita income is negative and insignificant ($\beta = -0.358$, $p = 0.385$), so H2 is not supported. The negative sign is nevertheless consistent with Yerdelen Tatoglu and Gul [16] and Alderighi and Gaggero [4], who interpret a negative destination-income coefficient as evidence that more prosperous destinations are also more expensive and therefore less attractive at the margin, in contrast to Ghosh [18], who finds a positive effect. The insignificance here is largely mechanical: because Indonesia is the only destination, this variable has no cross-sectional variation at all and moves only over time, within a narrow range of USD 3,288 to USD 4,367 across the decade. Ten annual observations spanning a 33 percent increase are unlikely to identify a destination-quality effect precisely.

Distance is negative and significant at the 5 percent level ($\beta = -0.487$, $p = 0.011$), supporting H3: a one percent greater distance is associated with 0.487 percent fewer arrivals, other things equal. This is consistent with Khadaroo and Seetanah [13], Ghosh [18] and Keum [14], and with the standard interpretation of distance as a proxy for transport cost and travel time. The elasticity is inelastic but is the largest in absolute value among the logged regressors, which matches the observed dominance of Malaysia and Singapore and the modest contribution of the United Kingdom and France. That it remains below unity is itself informative: distance does not fully explain the pattern, since Australia and China, at comparable distances to Japan, South Korea and India, generate substantially more arrivals.

Origin population is positive but insignificant ($\beta = 0.101$, $p = 0.157$), so H4 is not supported, in contrast to Khadaroo and Seetanah [13], Yerdelen Tatoglu and Gul [16] and, for tourism trade and investment flows, Singagerda et al. [7]. Again, the composition of the sample is the likely explanation. Singapore, with roughly six million residents, is among the largest source markets, while India, with more than a billion, contributes under eight percent of arrivals. Within this particular set of origins, market size is simply not the operative constraint; distance and air connectivity are.

The exchange rate is positive and significant at the 1 percent level ($\beta = 0.169$, $p = 0.000$), supporting H5. Since the variable is defined as rupiah per unit of origin currency, a one percent depreciation of the rupiah is associated with 0.169 percent more arrivals: a weaker rupiah lowers the relative price of an Indonesian holiday. This is the same mechanism identified by Ghosh [18], whose negative coefficient reflects the inverse currency convention, and is consistent with Singagerda et al. [7], albeit for a different dependent variable (tourism trade and investment flows). The elasticity is the smallest among the significant logged regressors, indicating that arrivals are less price-sensitive than distance-sensitive over this period – unsurprising given that bilateral rates were relatively stable, with the largest cumulative movement being a 21.8 percent appreciation of the Singapore dollar.

Origin institutional quality is negative and significant at the 1 percent level ($\beta = -0.025$, $p = 0.000$). Converted to a percentage effect, a one-point increase in the Government Effectiveness percentile is associated with 2.47 percent fewer arrivals to Indonesia. H6, which left the sign open, is therefore supported in its substitution form. The result aligns with Ullah et al. [17]: as domestic governance improves, confidence in domestic services rises and uncertainty in domestic consumption falls, making domestic tourism a more attractive substitute for foreign travel. It runs against the complementarity mechanism of Ghalia et al. [6]. The sample composition again matters: most of these origins – Singapore, Japan, South Korea, Australia and the European markets – already score between 75 and 95 on the index, a range in which further administrative improvement is unlikely to relax any remaining constraint on outbound travel but may well strengthen the domestic alternative.

The high variance inflation factors of this variable and origin per capita income (7.26 and 9.71 respectively) mean this coefficient should be read with some caution. Moreover, because Government Effectiveness varies little over time, the coefficient largely reflects cross-country differences and may partly proxy for unobserved origin characteristics correlated with income,

distance and route availability, so the substitution interpretation is offered as a plausible explanation rather than a tested mechanism.

Direct-flight availability is positive and significant at the 1 percent level ($\beta = 0.988$, $p = 0.000$). In percentage terms, origins with a non-stop connection to Indonesia record arrivals approximately 168.6 percent higher than origins without one, the largest effect in the model. This supports H7 and is consistent with Alderighi and Gaggero [4] and Galli et al. [15]. A direct route removes transit time, transit cost and the inconvenience of connecting, all of which enter the traveller's total trip cost. The descriptive pattern is unambiguous: Malaysia, Singapore, China, Japan, South Korea and Australia maintained non-stop service throughout most of the period and dominate arrivals, whereas France and the United States had no direct service at any point and contribute far less. The United Kingdom, which had direct service only in 2017–2018, and India, which gained it in 2023, provide within-country variation that helps identify the effect. That said, route entry is not random – carriers open routes where they expect demand – so this coefficient should be read as an association rather than a clean causal estimate.

The pandemic dummy is negative and significant at the 5 percent level ($\beta = -1.015$, $p = 0.012$), equivalent to a 63.7 percent reduction in arrivals during 2020–2021 relative to non-pandemic years, holding the structural determinants constant. H8 is supported. The magnitude exceeds the 49.8 percent reported by Goswami et al. [5] for the Asia-Pacific region, which is plausible given that their monthly window begins in 2019 and ends in October 2021 and that Indonesia combined border closure, international flight restrictions and suspension of the Visa-Free Visit facility. The raw data are consistent: arrivals from the ten origins fell from 11 million in 2019 to 610,000 in 2021. The pandemic differs in kind from the other regressors, operating as an abrupt administrative closure of the market rather than a gradual shift in relative prices or incomes.

E) Robustness Check

The model was re-estimated as a log-linear pooled OLS specification to check the stability of the results. This is not an alternative preferred estimator; the heteroskedasticity documented above is precisely the condition under which log-linear OLS is biased, but it is a check on whether the signs and significance patterns survive a change in functional form and estimator.

Table 5: Comparison of PPML and Pooled OLS Estimates

Variables	PPML	Pooled OLS (log-linear)
lnGDPPCi	0.125	0.370
lnGDPPCj	-0.358	-1.320
lnDIST	-0.487**	-0.817***
lnPOP	0.101	0.172
lnEXR	0.169***	0.126***
INST	-0.025***	-0.039**
DFLIGHT	0.988***	0.639**
COVID	-1.015**	-2.208***
Constant	17.336***	25.938***
R ²	0.8284 (pseudo)	0.7480
Observations	100	100

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Source: Stata output, processed by the authors.

The sign of every coefficient is preserved across the two estimators, and the set of variables that reach significance is identical. The magnitudes differ, as expected: the pooled OLS estimates are uniformly larger in absolute value for distance, the pandemic dummy and institutional quality and smaller for direct flights. Such divergence in magnitude is what the log-of-gravity critique would lead one to expect when the log transformation is applied under heteroskedasticity and low-arrival observations receive disproportionate weight, although the comparison alone cannot establish which set of magnitudes is correct. The consistency of the qualitative results across specifications supports the robustness of the main findings.

IV. CONCLUSION

This study estimated an augmented gravity model of international tourist arrivals to Indonesia from its ten largest source markets over 2015–2024, using Poisson Pseudo-Maximum Likelihood with origin-clustered standard errors. The eight determinants are jointly significant, and four of them are individually significant.

Geographical distance reduces arrivals, with an elasticity of -0.487 , confirming the core gravity prediction that transport cost and travel time deter travel. Depreciation of the rupiah against the origin currency raises arrivals with an elasticity of 0.169 , confirming that relative price competitiveness matters even if arrivals are not highly price-elastic. Origin-country institutional quality reduces arrivals: a one-point increase in Government Effectiveness is associated with 2.47 percent fewer visitors, consistent with a substitution of domestic for foreign tourism as domestic governance improves. The availability of a direct flight is associated with 168.6 percent more arrivals, the largest effect in the model. The pandemic period is associated with 63.7 percent

fewer arrivals. Origin per capita income, Indonesian per capita income and origin population are not significant, which is best explained by the deliberately narrow composition of the sample – ten high-volume origins in which proximity and connectivity dominate – and, for the destination income variable, by its lack of cross-sectional variation.

Two implications for practice follow from these associations, subject to the caveats set out below. First, because air connectivity carries the largest coefficient in the model, restoring and expanding non-stop routes is a plausible priority for tourism promotion, potentially more productive than marketing expenditure directed at high-income markets that remain poorly connected; the contrast between Australia and China on one side and France and the United States on the other is instructive. Second, because market size and income do not explain the observed pattern within this group of origins, the targeting of promotional strategy may be better organised around effective travel friction than around population or income rankings. These are implications drawn from association rather than from an identified causal design, and should be read accordingly.

The study has several limitations. The data are annual and therefore cannot capture seasonality or the month-to-month variation in pandemic restrictions during 2020–2021. Distance is measured as a fixed capital-to-capital great-circle distance and does not track changes in actual travel cost over time. The model is estimated without fixed effects because country effects would absorb distance, and year effects would be collinear with the pandemic dummy, so it does not control for unobserved heterogeneity such as cultural proximity and shared language; the marginal rejection in the RESET test is consistent with such omissions. Endogeneity is also not formally addressed: route entry responds to expected demand, and the Government Effectiveness index is a broad perception-based aggregate rather than a measure of travel-specific administrative capacity. In addition, the ten origins were selected because they are Indonesia's largest source markets, that is, on the basis of the dependent variable, which likely attenuates the estimated effects of market-size variables and limits generalisation to smaller markets; and with only ten clusters, cluster-robust standard errors may be downward biased, so coefficients with p-values close to conventional thresholds (distance, $p = 0.011$; COVID-19, $p = 0.012$) should be interpreted cautiously. Future research should use monthly or quarterly data, adopt a time-varying proxy for travel cost such as airfares or flight frequency, and consider instrumental-variable or high-dimensional fixed-effects approaches that can accommodate time-invariant bilateral regressors.

Interest Conflicts

The authors declare that there is no conflict of interest concerning the publishing of this paper.

V. REFERENCES

- [1] Badan Pusat Statistik, Statistik Kunjungan Wisatawan Mancanegara, Jakarta, Indonesia (2021–2024).
- [2] Tinbergen, J., *Shaping the world economy: Suggestions for an international economic policy*, Twentieth Century Fund, New York, USA (1962).
- [3] Morley, C., Rosselló, J., & Santana-Gallego, M., Gravity models for tourism demand: Theory and use, *Annals of Tourism Research*, 48 (2014) 1–10.
- [4] Alderighi, M., & Gaggero, A. A., Flight availability and international tourism flows, *Annals of Tourism Research*, 79 (2019) 102642.
- [5] Goswami, G. G., Sarwar, M. R., & Rahman, M. M., COVID-19 impact on tourism inflow in selected Asia-Pacific countries: A gravity model framework, *International Journal of Emerging Markets*, 19(12) (2024) 4459–4480.
- [6] Ghalia, T., Fidrmuc, J., Samargandi, N., & Sohag, K., Institutional quality, political risk and tourism, *Tourism Management Perspectives*, 32 (2019) 100576.
- [7] Singagerda, F. S., Desfiandi, A., & Marantika, E. R., The gravity model of Indonesian tourism trade and investment, *ETIKONOMI*, 22(1) (2023) 143–154.
- [8] Santos Silva, J. M. C., & Tenreiro, S., The log of gravity, *The Review of Economics and Statistics*, 88(4) (2006) 641–658.
- [9] Lim, C., Review of international tourism demand models, *Annals of Tourism Research*, 24(4) (1997) 835–849.
- [10] Mankiw, N. G., *Principles of microeconomics*, 7th ed., Salemba Empat, Jakarta, Indonesia (2018).
- [11] Pindyck, R. S., & Rubinfeld, D. L., *Microeconomics*, 8th ed., Erlangga, Jakarta, Indonesia (2012).
- [12] Anderson, J. E., & Van Wincoop, E., Gravity with gravitas: A solution to the border puzzle, *The American Economic Review*, 93(1) (2003) 170–192.
- [13] Khadaroo, J., & Seetanah, B., The role of transport infrastructure in international tourism development: A gravity model approach, *Tourism Management*, 29(5) (2008) 831–840.
- [14] Keum, K., Tourism flows and trade theory: A panel data analysis with the gravity model, *Annals of Regional Science*, 44(3) (2010) 541–557.
- [15] Gallia, P., Fraga, C., & de Sequeira Santos, M. P., Gravitational force exerted by Brazilian tourist destinations on foreign air travelers, *Journal of Air Transport Management*, 55 (2016) 76–83.
- [16] Yerdelen Tatoglu, F., & Gul, H., Analysis of tourism demand using a multi-dimensional panel gravity model, *Tourism Review*, 75(2) (2020) 433–447.
- [17] Ullah, A., Leurcharusmee, S., & Yamaka, W., Governance quality and outbound tourism expenditure: Evidence from symmetric and asymmetric panel ARDL models, *Economics*, 14(5) (2026) 177.
- [18] Ghosh, S., Inbound Australian tourism demand from Asia: A panel gravity model, *Journal of Economic Studies*, 48(7) (2020) 1388–1400.
- [19] World Bank, *Worldwide Governance Indicators*, Washington DC, USA (2025).
- [20] Wooldridge, J. M., *Introductory econometrics: A modern approach*, 6th ed., Cengage Learning, Boston, USA (2016).
- [21] Cameron, A. C., & Trivedi, P. K., *Microeconometrics: Methods and applications*, Cambridge University Press, New York, USA (2005).