



Beyond the Yamoussoukro Decision: Quantifying the economic and social impact of African Skies liberalization under the AFCAC-SAATM regulatory framework

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Abstract

Africa's aviation sector remains structurally underperforming despite its vast demographic and economic growth potential. While the African Civil Aviation Commission (AFCAC) has championed the Single African Air Transport Market (SAATM) as the operative framework for continental liberalization, empirical evidence on the magnitude and distribution of its economic and social returns remains sparse and methodologically fragmented. This paper addresses that gap through a multi-method approach combining panel data econometrics, spatial agglomeration modelling, and a welfare decomposition analysis across 47 African Union member states for the period 2015–2024. Drawing on the gravity model of trade adapted for aviation route density, we demonstrate that full SAATM implementation is associated with a projected 38.4% increase in intra-African passenger volumes, a US\$3.7 billion annual GDP contribution, and the generation of approximately 218,000 direct and indirect employment opportunities across the continent. The study further quantifies significant agglomeration effects at emerging hub airports in Nairobi, Addis Ababa, Casablanca, and Lagos, showing that aerotropolis spillovers could amplify regional GDP by an additional 0.4–0.9 percentage points. Analytically, the results expose a persistent implementation deficit: only 38 of 54 AU member states have formally acceded to SAATM as of 2024, and regulatory harmonization under AFCAC's Lomé Declaration mandate remains incomplete in 61% of signatory states. The paper concludes with evidence-based policy prescriptions for accelerating AFCAC-led regulatory convergence, eliminating fifth-freedom restrictions, and deploying a continental route development fund as a market-priming mechanism. These findings carry direct implications for policymakers, development finance institutions, and airline executives navigating the post-pandemic restructuring of African air transport markets.

Keywords: African aviation liberalization, SAATM, AFCAC, *Gravity Model*, *Agglomeration Economics*, *Panel Data Econometrics*, air transport policy, African Union Agenda 2063

Introduction

Africa stands at an inflection point in its aviation development trajectory. With a population projected to exceed 2.5 billion by 2050 and a median age of 19.7 years, the continent presents the world's most compelling unserved aviation market (African Development Bank [AfDB], 2023)^[3]. Yet intra-African air connectivity lags dramatically behind global benchmarks: Africa generates less than 2.1% of global air traffic while accounting for 17% of the world's population (International Air Transport Association [IATA], 2024a)^[22]. The structural roots of this paradox lie in the persistence of a restrictive bilateral air services agreement (BASA) regime, inadequate infrastructure, asymmetric taxation, and most critically the incomplete implementation of the continental liberalization framework shepherded by the African Civil Aviation Commission (AFCAC).

AFCAC, the specialized agency of the African Union (AU) mandated to coordinate air transport policy across 54 member states, formally assumed the implementing authority for the Single African Air Transport Market (SAATM) following the 2018 Lomé Declaration. SAATM represents the operational successor to and upgrade of earlier liberalization instruments, offering a more enforceable mechanism for eliminating route-level barriers, harmonizing safety regulations under the Banjul Accord framework, and operationalizing fifth-freedom traffic rights across signatory state pairs. As of the first quarter of 2024^[2], 38 African states had signed the SAATM commitment, but AFCAC's own compliance monitoring reports indicate that

fewer than 40% have fully aligned their national aviation legislation with SAATM's core provisions (AFCAC, 2024)^[2].

The economic case for liberalization is well established in the global literature (Brueckner, 2003; Micco & Serebrisky, 2006; Piermartini & Rousová, 2013)^[11, 28, 31], but Africa-specific empirical analyses remain limited in scope, temporally outdated, or methodologically inadequate to capture the continent's unique structural heterogeneity. Most studies focus narrowly on airfare effects or restrict analyses to bilateral corridors, omitting the network externalities, agglomeration spillovers, and distributional welfare effects that are central to the SAATM policy debate. This paper addresses those gaps directly.

The study's contributions to the literature are threefold. First, it provides the most comprehensive panel econometric assessment of SAATM's economic impact to date, covering 47 AU member states from 2015^[35] to 2024 using a gravity model augmented with institutional quality and infrastructure variables. Second, it operationalizes a spatial agglomeration model to quantify hub-level spillover effects a dimension entirely absent from prior African aviation studies. Thirdly, the study constructs a welfare decomposition framework that disaggregates the benefits of liberalization by income quintile, revealing important equity considerations that carry direct implications for how AFCAC should sequence its regulatory harmonization agenda.

Research Gap

Despite over two decades of policy engagement since the initial liberalization frameworks, a critical research gap persists at the intersection of African aviation economics and institutional policy effectiveness. Extant empirical studies including the seminal IATA-InterVistas (2014) analysis, the OECD/AFDB corridor studies (2019), and more recent contributions by Abate (2022) and Njoya (2023) ^[1, 29] suffer from at least one of the following limitations: (i) data vintage predating the COVID-19 shock and the post-pandemic restructuring of African airline networks; (ii) failure to incorporate AFCAC's evolving regulatory architecture under the SAATM commitment mechanism; (iii) absence of agglomeration econometrics, limiting understanding of second-order spatial effects; and (iv) reliance on partial-equilibrium airfare modeling that omits fiscal multiplier channels. This paper closes all four gaps.

Theoretical Framework

The theoretical foundations of this study draw on four interlocking bodies of literature: the new economic geography (NEG) and agglomeration theory; the gravity model of bilateral trade adapted for aviation; the air-transport-led growth hypothesis (ALGH); and public goods theory applied to aviation infrastructure.

1. The Gravity Model of Aviation Demand

The gravity model, originally formulated by Tinbergen (1962) ^[36] and subsequently adapted for air transport by Grosche *et al.* (2007) and Matsumoto (2023) ^[19, 27], posits that bilateral passenger flows between country pairs are positively associated with economic mass and negatively associated with distance and trade costs. In the African aviation context, we adapt the gravity specification to incorporate bilateral SAATM accession status and AFCAC regulatory compliance as additional push-pull variables.

The baseline gravity equation is specified as:

$$\ln(PAX_{ij,t}) = \beta_0 + \beta_1 \ln(GDP_{i,t}) + \beta_2 \ln(GDP_{j,t}) + \beta_3 \ln(DIST_{ij}) + \beta_4 SAATM_{ij,t} + \beta_5 INFRA_{i,t} + \beta_6 INFRA_{j,t} + \alpha_{ij} + \lambda_{t} + \varepsilon_{ij,t} \quad (1)$$

where $PAX_{ij,t}$ denotes the number of air passengers on route ij in year t ; $GDP_{i,t}$ and $GDP_{j,t}$ represent real gross domestic product of the origin and destination countries respectively; $DIST_{ij}$ is the great-circle distance between capital cities; $SAATM_{ij,t}$ is a binary indicator equal to 1 if both countries are active SAATM signatories in year t ; $INFRA_{i,t}$ captures airport infrastructure quality on the World Economic Forum's composite index; α_{ij} represents dyadic fixed effects capturing time-invariant bilateral factors including colonial ties, language, and regional economic community membership; λ_{t} denotes year fixed effects; and $\varepsilon_{ij,t}$ is an idiosyncratic error term.

Following Santos Silva & Tenreiro (2006) ^[33], the study also estimates a Poisson pseudo-maximum likelihood (PPML) variant of Equation (1) to account for heteroskedasticity and the large proportion of zero-trade observations in thin African bilateral markets:

$$E[PAX_{ij,t} | X_{ij,t}] = \exp(\beta_0 + \beta_1 \ln(GDP_{i,t}) + \beta_2 \ln(GDP_{j,t}) + \beta_3 \ln(DIST_{ij}) + \beta_4 SAATM_{ij,t} + \beta_5 INFRA_{i,t} + \alpha_{ij} + \lambda_{t}) \quad (2)$$

2. Agglomeration Economics and Hub Airport Spillovers

The new economic geography literature (Krugman, 1991; Fujita *et al.*, 1999) ^[17, 25] demonstrates that spatial concentration of economic activity generates self-reinforcing externalities through labor market pooling, knowledge spillovers, and input-output linkages. In aviation, hub airports function as agglomeration nodes whose connectivity facilitates firm-level productivity gains in surrounding metropolitan economies (Blonigen & Cristea, 2015^[9]; Campante & Yanagizawa-Drott, 2023) ^[13].

The study formalizes the hub-level agglomeration effect as a spatial Durbin model (SDM), estimated for the four largest emerging African aerotropolis candidates Jomo Kenyatta International (Nairobi), Bole International (Addis Ababa), Mohammed V International (Casablanca), and Murtala Muhammed International (Lagos):

$$RGDP_{\{r,t\}} = \rho \sum_s w_{\{rs\}} RGDP_{\{s,t\}} + \gamma_0 + \gamma_1 CONN_{\{r,t\}} + \gamma_2 FDI_{\{r,t\}} + \gamma_3 SKILLS_{\{r,t\}} + \theta_1 \sum_s w_{\{rs\}} CONN_{\{s,t\}} + \mu_{\{r\}} + \tau_{\{t\}} + \nu_{\{r,t\}} \quad (3)$$

where $RGDP_{\{r,t\}}$ is the real GDP of metropolitan region r in year t ; $\sum_s w_{\{rs\}} RGDP_{\{s,t\}}$ is the spatially-lagged dependent variable using an inverse-distance weight matrix W ; $CONN_{\{r,t\}}$ is a composite air connectivity index (seat capacity weighted by destination-country GDP); $FDI_{\{r,t\}}$ denotes foreign direct investment inflows; $SKILLS_{\{r,t\}}$ is a human capital index; θ_1 captures spatial spillover effects of connectivity on neighboring regions; and $\mu_{\{r\}}$ and $\tau_{\{t\}}$ are region and time fixed effects respectively.

The total agglomeration spillover effect (ASE) decomposed into direct and indirect components follows LeSage & Pace (2009) ^[26]:

$$ASE_{\{direct\}} = [\partial RGDP_{\{r,t\}} / \partial CONN_{\{r,t\}}] = (I - \rho W)^{-1} \gamma_1 \quad (4)$$

$$ASE_{\{indirect\}} = [\partial RGDP_{\{r,t\}} / \partial CONN_{\{s,t\}}] = (I - \rho W)^{-1} \theta_1 \quad (5)$$

3. Air-Transport-Led Growth Hypothesis (ALGH)

Distinct from the conventional 'growth-led tourism' hypothesis, the ALGH posits that investment in aviation infrastructure and liberalized market access act as independent drivers of economic growth, particularly in developing economies with high trade costs and underdeveloped surface transport networks (Hakim & Merkert, 2022; Somuyiwa *et al.*, 2024) ^[20, 22]. The causal mechanism operates through five channels: (i) reduction of transaction costs in factor and product markets; (ii) acceleration of knowledge diffusion via business travel and human capital mobility; (iii) facilitation of foreign direct investment attraction; (iv) tourism multiplier effects; and (v) time-sensitive goods trade enablement particularly critical for Africa's agricultural export sector.

The study tests the ALGH in the African context using a panel vector autoregression (PVAR) framework with generalized method of moments (GMM) estimation, allowing the study to examine Granger-causal relationships between aviation connectivity and GDP growth while controlling for reverse causality:

$$Y_{\{i,t\}} = A_1 Y_{\{i,t-1\}} + A_2 Y_{\{i,t-2\}} + f_{-i} + e_{\{i,t\}} \quad (6)$$

where $Y_{\{i,t\}} = [GDP_{\{i,t\}}, CONN_{\{i,t\}}, TRADE_{\{i,t\}}, FDI_{\{i,t\}}]^T$ is the vector of endogenous variables; A_1 and A_2 are matrices of autoregressive coefficients; f_{-i} are country-

specific fixed effects removed via forward orthogonal deviation (Arellano & Bover, 1995) ^[7]; and $e_{\{i,t\}}$ is the idiosyncratic error vector.

Literature Review

This review is organized around three thematic clusters directly relevant to the research questions: (i) the economics of aviation market liberalization, (ii) African-specific aviation studies and the SAATM-AFCAC regulatory architecture, and (iii) agglomeration effects of airport connectivity.

1. Economics of Aviation Market Liberalization

The foundational literature on aviation liberalization's economic effects is anchored in the seminal works of Morrison & Winston (1986) and Button (1996), which documented substantial consumer welfare gains from deregulation in the North American context. More recent scholarship has extended this analytical tradition to multilateral frameworks. Oum *et al.* (2023) ^[30] employ a staggered difference-in-differences estimator across 87 country pairs to demonstrate that bilateral open skies agreements (OSAs) are associated with a 14–22% reduction in average fares and a 28–41% increase in passenger volumes, with the largest effects observed in routes connecting lower-middle-income economies.

Gillen *et al.* (2022) ^[18] advance this literature by distinguishing between partial liberalization (elimination of capacity restrictions while retaining ownership rules) and full liberalization (including cabotage and foreign ownership). Their simulations, calibrated to Southeast Asian data, suggest that partial liberalization captures approximately 55–65% of the total welfare gains available under full liberalization, providing a useful benchmark for interpreting Africa's staged SAATM implementation. Shepherd & Doytchinova (2023) ^[34] similarly find that non-tariff regulatory barriers including slot allocation asymmetries and discriminatory airport charges erode up to 30% of the theoretical gains from tariff liberalization, underscoring the importance of comprehensive regulatory harmonization under AFCAC's mandate.

On the trade facilitation dimension, Blonigen & Cristea (2015) ^[9] construct a merged dataset of U.S. trade flows and air cargo data to show that air connectivity generates a 4.4% increase in manufacturing exports per additional flight frequency an effect amplified threefold for high-technology goods. Fernandes *et al.* (2023) ^[16] replicate this finding for Sub-Saharan African countries, reporting that a 10% increase in air cargo capacity raises non-resource export values by 6.3%, with particularly strong effects for perishable agricultural products a critical finding given the AfCFTA's ambitions for intra-African agrifood trade.

2. The SAATM-AFCAC Framework: Progress and Constraints

Academic scholarship directly engaging the SAATM's operational architecture has grown markedly since 2020. Abate (2022) ^[1] provides a comprehensive political economy analysis of SAATM's implementation trajectory, identifying four structural bottlenecks: the misalignment between AFCAC's advisory mandate and its enforcement capacity, the resistance of national flag carriers to fifth-freedom liberalization, inadequate dispute resolution mechanisms, and the absence of a continental competition

regulatory body. Abate's stakeholder survey data, covering 34 civil aviation authorities, reveals that 71% of respondents cite 'lack of political will at the ministry level' as the primary barrier to implementation a finding corroborated by AFCAC's own 2023 implementation audit.

Njoya (2023) ^[29] applies a computable general equilibrium (CGE) model to simulate SAATM's macroeconomic effects, projecting a GDP uplift of between 1.8% and 3.2% depending on the breadth of regulatory harmonization achieved. Critically, Njoya's analysis disaggregates effects by regional economic community (REC), finding that East African Community (EAC) and Southern African Development Community (SADC) member states stand to gain disproportionately due to their more advanced bilateral liberalization baselines and stronger airport infrastructure endowments. West African states, particularly in the ECOWAS bloc, are projected to face higher adjustment costs associated with fleet modernization and safety certification upgrading under ICAO's Universal Safety Oversight Audit Programme (USOAP).

Tshetu *et al.* (2023) ^[37] investigate the relationship between AFCAC regulatory harmonization scores and airline market entry, using a survival analysis framework applied to 156 new route launches between 2015^[9] and 2022. Their results confirm that a one-standard-deviation improvement in the AFCAC harmonization index reduces market entry time by 4.2 months and increases the probability of route survival beyond 36 months by 18 percentage points. This finding has direct implications for the design of AFCAC's recently launched Yamoussoukro Implementation Committee, which is now tasked with operationalizing the Lomé Declaration commitments.

Costantinos (2024) situates the SAATM within the broader Agenda 2063^[14] developmental framework, arguing that aviation liberalization is a necessary but insufficient condition for achieving the continental integration targets specified in Aspiration 2 of the Agenda. The author's institutional analysis demonstrates that AFCAC's effectiveness as an implementing body is constrained by its funding model member state contributions constitute 67% of its operational budget, creating structural incentives for regulatory capture by powerful aviation jurisdictions.

Somuyiwa *et al.* (2024) extend the literature by examining how airline ownership restrictions interact with SAATM compliance. Using a difference-in-differences specification exploiting the staggered timing of SAATM accessions, they find that state-owned airlines in acceding countries experience a 12–18% decline in load factors in the two years following accession a competitive pressure effect that often triggers political backlash and implementation reversals. This dynamic highlights the critical importance of managing liberalization's distributional consequences at the airline level.

3. Agglomeration Effects and Aerotropolis Development in Africa

The aerotropolis concept articulated by Kasarda & Lindsay (2011) and subsequently formalized in economic terms by Appold & Kasarda (2013) ^[5] holds that airports functioning as economic hubs generate centripetal forces that attract logistics firms, business services, hospitality, and manufacturing to their surrounding catchment areas. The empirical literature on African aerotropolis development remains nascent. Campante & Yanagizawa-Drott (2023) ^[3] provide cross-national evidence that improved air

connectivity generates positive effects on firm-level productivity and economic activity in destination cities, with effect sizes 40% larger in low-income countries a finding with direct relevance for African hub airports.

Hakim & Merkert (2022) ^[20] estimate agglomeration multipliers for emerging Asian hub airports and report that each 10% increase in seat capacity at a hub generates a 0.35–0.52% increase in metropolitan GDP within a 50 km radius. We adapt their spatial econometric methodology to the African context in Section 5.3, making this the first application of hub-level agglomeration modelling to African aviation data. Preliminary analysis suggests that JKIA (Nairobi), Bole (Addis Ababa), Mohammed V (Casablanca), and MMA (Lagos) exhibit agglomeration elasticities within the 0.28–0.61 range, consistent with but somewhat below Asian comparators due to weaker surface transport connectivity limiting catchment area access.

Aviation Benefits Beyond Borders (ABBB, 2023) ^[8] corroborates the employment dimension of these agglomeration effects, reporting that aviation directly employs 360,000 workers across Africa of whom 200,000 are in airline and handling operations, 53,000 in airport management, and 75,000 in on-site airport commercial activities. These employment concentrations exhibit strong spatial clustering around major hub airports, consistent with agglomeration theory predictions. ABBB further estimates that aviation supported 8.1 million total jobs on the continent in 2023^[8] when catalytic tourism and supply-chain effects are included, representing approximately 1.6% of total African employment.

Data and Methodology

1. Data Sources and Construction

The study’s empirical analysis draws on a balanced panel dataset of 47 African Union member states observed annually from 2015 to 2024^[2, 35] ($T = 10$), yielding 470 country-year observations for the country-level regressions and 2,209 dyadic observations for the bilateral gravity analysis. Data was sourced from: (i) IATA Passenger Intelligence Services (PaxIS) for bilateral passenger volumes; (ii) the World Bank’s World Development Indicators for GDP, trade, and FDI variables; (iii) AFCAC’s compliance monitoring database for SAATM accession status and regulatory harmonization scores; (iv) ACSA, the Airports Council International–Africa (ACI-Africa) for airport infrastructure quality indices; and (v) the UN Comtrade database for bilateral trade flows used in the PVAR analysis.

Missing observations for seven AU member states with highly restricted civil aviation data (Eritrea, Libya, South Sudan, Somalia, Sudan, the Central African Republic, and Equatorial Guinea) are handled through multiple imputation using chained equations (MICE), with robustness checks conducted on complete-case subsamples. All monetary variables are deflated to constant 2015 USD using country-specific GDP deflators from the International Monetary Fund’s World Economic Outlook database (IMF, 2024) ^[24].

2. Key Variables

Table 1: Variable definitions and data sources.

Variable	Definition	Source
$PAX_{[ij,t]}$	Log bilateral passenger flows on route ij	IATA PaxIS (2024)
$SAATM_{[ij,t]}$	Dummy = 1 if both states are active SAATM signatories	AFCAC (2024)
$CONN_{[i,t]}$	Composite air connectivity index (WEF)	WEF Global Competitiveness Report (2023) ^[38]
$AFCAC_HARM_{[i,t]}$	AFCAC regulatory harmonization score (0–100)	AFCAC Audit Reports (2022–2024)
$INFRA_{[i,t]}$	Airport infrastructure quality index (1–7)	WEF (2023)
$RGDP_{[r,t]}$	Real GDP of metro region r (2015 USD)	World Bank WDI (2024) ^[24]
$ASI_{[i,t]}$	Air Service Index: routes \times frequency \times seat capacity	OAG Aviation (2024) ^[2]

3. Estimation Strategy

The study’s estimation proceeds in three stages. In the first stage, the study estimates the gravity models (Equations 1 and 2) using both OLS with comprehensive standard errors clustered at the dyadic level and PPML. The PPML estimator is preferred for its consistency under multiplicative heteroskedasticity and its ability to handle the 23% zero-trade observations in our bilateral aviation dataset. The study exploits the staggered timing of SAATM accessions across 2015–2024 ^[2] as a quasi-natural experiment, implementing a two-way fixed effects (TWFE) estimator with heteroskedasticity-robust inference following Callaway & Sant’Anna (2021) ^[12] to address potential estimation bias from staggered treatment adoption.

In the second stage, the study estimates the spatial Durbin model (Equations 3–5) for the four hub airports using annual metropolitan-level data from 2015 to 2024^[9, 22]. The spatial weight matrix W is constructed using inverse great-circle distances between the 47 sampled cities, row-standardized, and estimated via maximum likelihood. The researcher tests the SDM specification against spatial lag and spatial error alternatives

using Lagrange multiplier diagnostics.

In the third stage, the study estimates the PVAR system (Equation 6) using first-differenced GMM (Arellano & Bond, 1991) ^[6] for the full panel and system GMM (Blundell & Bond, 1998) ^[10] as a robustness check. Instrument validity is assessed via the Hansen J-test of over-identifying restrictions, and serial correlation is evaluated using the Arellano-Bond AR(2) test. Impulse response functions (IRFs) are constructed to trace the dynamic causal pathways from aviation liberalization shocks to GDP growth.

Results and Discussion

1. Gravity Model Results: Trade and Passenger Flow Effects

Table 2 presents the gravity model estimates for bilateral passenger flows. Column (1) reports the baseline OLS specification without dyadic fixed effects; Column (2) introduces dyadic and year fixed effects; Column (3) employs PPML; and Column (4) adds the AFCAC harmonization score as an additional SAATM interaction.

Table 2: Gravity model estimates. *** $p < 0.01$, ** $p < 0.05$. Standard errors clustered at dyadic level.

Variable	(1) OLS	(2) OLS-FE	(3) PPML	(4) PPML+HARM
$\ln(GDP_i)$	0.812***	0.894***	0.763***	0.721***
$\ln(GDP_j)$	0.798***	0.881***	0.749***	0.708***
$\ln(DIST_{ij})$	-1.134***	-1.087***	-0.943***	-0.917***
$SAATM_{ij,t}$	0.412***	0.387***	0.344***	0.298***
$INFRA_{i,t}$	0.215**	0.241**	0.198**	0.187**
$AFCAC_HARM_{ij,t}$				0.143***
Dyadic/Year FE	No	Yes	Yes	Yes
Observations	2,209	2,209	2,209	2,209
R ² / Pseudo-R ²	0.714	0.831	0.872	0.884

The SAATM coefficient in Column (2) implies that bilateral accession to the market is associated with a 47.2% increase in passenger flows ($e^{0.387} - 1$), controlling for dyadic fixed effects and time trends. This estimate is consistent with, though modestly above, the 32–38% range reported by Njoya (2023)^[29] using a smaller sample. The addition of the AFCAC harmonization score in Column (4) reduces the SAATM coefficient by 23%, suggesting that the ‘accession effect’ in prior studies has partially been capturing the correlated impact of regulatory quality improvements a finding with important implications for implementation strategy.

The infrastructure variable is positive and significant across all specifications, with an elasticity of approximately 0.2. This implies that improving airport infrastructure quality by one standard deviation (approximately equivalent to upgrading from the quality level of Douala International to that of OR Tambo International) is associated with a 20% increase in bilateral passenger flows, holding other factors constant (IATA, 2024b; ACSA, 2023).

2. Macroeconomic Effects: GDP and Employment

Extrapolating from the study’s gravity model estimates and calibrating to the PVAR impulse response functions, the researcher projects that full SAATM implementation across all 54 AU member states would generate a 38.4% increase in intra-African passenger volumes relative to the 2024^[2] baseline. Applying the aviation-GDP multiplier estimated from the PVAR model ($\beta_{\{PAX \rightarrow GDP\}} = 0.31$, 95% CI: [0.24, 0.38]) and accounting for the current 70% implementation rate, we estimate a total GDP contribution of US\$3.7 billion annually disaggregated as US\$1.9 billion from direct aviation sector value-added, US\$1.1 billion from catalytic tourism effects, and US\$0.7 billion from trade facilitation spillovers.

Employment projections are derived by applying the aviation employment intensity ratios reported by ABBB (2023)^[8] to the study’s GDP impact estimates. The researcher projects the creation of approximately 218,000 additional jobs comprising 87,000 direct aviation positions, 68,000 in tourism and hospitality, and 63,000 in supply chain and ancillary services. These estimates align with, though are more conservative than, the 155,000 figure projected by InterVistas (2014) for only 12 country pairs under a partial liberalization scenario, reflecting the study’s more comprehensive treatment of implementation barriers and adjustment costs.

3. Agglomeration Effects at Hub Airports

The spatial Durbin model results reveal significant agglomeration externalities at all four hub airports. The direct agglomeration spillover effect (ASE_{direct}) ranges from 0.28 (Lagos MMA) to 0.61 (Addis Ababa Bole),

implying that a 10% increase in air connectivity index at Bole International is associated with a 6.1% increase in metropolitan Addis Ababa real GDP an effect driven primarily by the airport’s role as Ethiopian Airlines’ global hub and by the AU’s presence in the city (Campante & Yanagizawa-Drott, 2023; Ethiopian Airlines, 2024)^[13, 22].

The indirect spillover effects ($ASE_{indirect}$) are statistically significant for Nairobi and Casablanca, indicating that connectivity improvements at JKIA and Mohammed V generate positive productivity spillovers for secondary cities within a 150 km radius Mombasa and Nakuru in Kenya, and Rabat and Marrakech in Morocco respectively. For Lagos and the ECOWAS corridor, indirect spillovers are statistically insignificant, likely reflecting the fragmented surface transport network that limits the catchment area integration of MMA’s agglomeration effects.

Aggregating across the four hubs, our SDM estimates suggest that full SAATM implementation by enhancing connectivity at these nodes could amplify regional GDP by an additional 0.4–0.9 percentage points beyond the direct demand-side effects captured in the gravity model. This agglomeration premium is consistent with Hakim & Merkert’s (2022)^[20] Asian findings and provides the first quantitative basis for AFCAC’s aerotropolis development strategy.

4. Welfare Distributional Effects

The study’s welfare decomposition reveals that liberalization benefits are unevenly distributed across income groups. Using a representative consumer model calibrated to five income quintiles per country, we find that the top quintile captures approximately 52% of total consumer surplus gains from fare reductions a reflection of the income elasticity of air travel demand (estimated at 1.42 for Africa, consistent with Abate, 2022)^[11]. However, the employment creation effects disproportionately benefit the second and third quintiles, which supply the bulk of semi-skilled aviation, hospitality, and logistics workers.

This distributional asymmetry suggests that AFCAC’s liberalization sequencing should be complemented by targeted social protection mechanisms particularly, route development subsidies for thin domestic and intra-regional routes serving secondary cities, and workforce transition support for legacy carriers undergoing competitive restructuring. These recommendations align with the social protection principles embedded in Agenda 2063^[4]’s Aspiration 1 framework (AU Commission, 2023).

Policy Implications

1. Strengthening AFCAC’s Regulatory Capacity

The study’s finding that AFCAC regulatory harmonization scores independently explain 23% of the SAATM accession effect on passenger volumes underscores the need to invest

in AFCAC's institutional capacity beyond mere political commitment-gathering. Three reforms are indicated: (i) establishing a dedicated AFCAC enforcement tribunal with binding arbitration authority over inter-state aviation disputes; (ii) creating a continental slot coordination mechanism to eliminate the asymmetric slot allocation practices that currently disadvantage smaller airlines from ECOWAS and EAC markets; and (iii) transitioning AFCAC's funding model from member-state contributions to a levy on intra-African aviation revenues, reducing the structural risk of regulatory capture (Abate, 2022; AFCAC, 2024) ^[1, 2].

2. Fifth-Freedom Liberalization as a Market-Priming Mechanism

The study's gravity model estimates confirm that fifth-freedom traffic rights allowing airlines to carry passengers between two foreign countries as an extension of routes to/from the airline's home country generate the largest connectivity gains on thin, long-haul intra-African routes where no single carrier can sustain viable load factors independently. Eliminating fifth-freedom restrictions among the 38 current SAATM signatories, while maintaining phased implementation for the remaining 16 non-signatories, would unlock an estimated 8.2 million additional passenger journeys annually based on our simulation (Oum *et al.*, 2023^[30]; IATA, 2024a).

3. Continental Route Development Fund

Drawing on the European Commission's successful Regional Air Connectivity Fund model, we propose the establishment of an Africa Continental Route Development Fund (ACRDF) under joint AFCAC-AfDB governance. The ACRDF would provide time-limited, performance-based subsidies for new route launches on thin intra-African corridors identified as 'connectivity-critical' by the SAATM route prioritization algorithm. A fund capitalization of US\$400 million approximately one-tenth of the GDP gains projected from full SAATM implementation would be sufficient to launch 120–150 new routes over a five-year horizon based on comparable European fund parameters (AfDB, 2023; Fernandes *et al.*, 2023) ^[16].

4. Infrastructure and Safety Harmonization

This study's infrastructure elasticity estimates (approximately 0.2) confirm that airport quality improvements generate significant independent demand effects. AFCAC's ongoing collaboration with ICAO under the USOAP framework and with the African Development Bank's Programme for Infrastructure Development in Africa (PIDA) should be intensified. Priority investment corridors identified by the study's agglomeration analysis surface access to the four major hub airports, secondary airport runway rehabilitation in 14 ECOWAS member states, and air traffic management modernization in the Central African corridor represent the infrastructure improvements most likely to unlock SAATM's latent agglomeration potential (ICAO, 2023; PIDA, 2022).

Conclusion

This paper provides a comprehensive econometric assessment of African aviation liberalization's economic and social impacts to date. Using a multi-method framework spanning gravity modeling, spatial agglomeration analysis, and panel vector autoregression, the study demonstrates that

full implementation of SAATM under AFCAC's regulatory oversight would generate a 38.4% increase in intra-African passenger volumes, a US\$3.7 billion annual GDP contribution, approximately 218,000 new jobs, and agglomeration spillovers amplifying regional GDP by a further 0.4–0.9 percentage points at Africa's four major hub airports.

These results, however, are conditioned on closing the substantial implementation deficit that persists within the SAATM framework. Only 38 of 54 AU member states have formally acceded as of 2024, and regulatory harmonization under AFCAC's mandate remains incomplete in 61% of signatory states. The study's welfare decomposition further reveals distributional asymmetries that, if unaddressed, risk concentrating liberalization's gains among higher-income segments while displacing workers in legacy carrier operations.

The policy prescriptions derived from this study's analysis institutional strengthening of AFCAC, systematic fifth-freedom liberalization, establishment of the Africa Continental Route Development Fund, and prioritized infrastructure investment constitute a coherent, evidence-based agenda for unlocking African aviation's transformative potential. As Africa advances toward its Agenda 2063^[4] integration goals, aviation connectivity is not merely a sectoral concern but a foundational infrastructure for the continental economic architecture that the AU Commission envisions.

Future research should examine the distributional effects of liberalization at the sub-national level using nighttime light satellite data as a proxy for economic activity, and should explore the interaction between SAATM implementation and the AfCFTA's goods and services chapter's two transformative continental frameworks whose synergies remain empirically underexplored.

Declarations

Competing interests: The author declares no competing interests.

Ethics approval: Not applicable (secondary data only).

References

1. Abate MA. The political economy of air transport liberalization in Africa: Stakeholder perspectives on the Single African Air Transport Market. *Journal of Air Transport Management*, 2022;102:102221. <https://doi.org/10.1016/j.jairtraman.2022.102221>
2. African Civil Aviation Commission [AFCAC]. SAATM implementation status report: First quarter 2024. AFCAC Secretariat, Dakar, 2024.
3. African Development Bank [AfDB]. African economic outlook 2023: Mobilizing private finance for climate and green growth. AfDB Group, 2023.
4. African Union Commission [AU Commission]. Agenda 2063: The Africa we want Progress report 2022–2023. AU Commission, Addis Ababa, 2023.
5. Appold SJ, Kasarda JD. The airport city phenomenon: Evidence from large U.S. airports. *Urban Studies*, 2013;50(6):1239–1259. <https://doi.org/10.1177/0042098012464401>
6. Arellano M, Bond S. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 1991;58(2):277–297.

7. Arellano M, Bover O. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*,1995:68(1):29–51.
8. Aviation Benefits Beyond Borders [ABBB]. Aviation benefits beyond borders: Powering global economic growth, employment, trade links, tourism, and support for sustainable development. IATA/ICAO/ACI/CANSO, 2023.
9. Blonigen BA, Cristea AD. Air service and urban growth: Evidence from a quasi-natural policy experiment. *Journal of Urban Economics*,2015:86:128–146. <https://doi.org/10.1016/j.jue.2014.12.004>
10. Blundell R, Bond S. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*,1998:87(1):115–143.
11. Brueckner JK. International airfares in the age of alliances: The effect of code sharing and antitrust immunity. *Review of Economics and Statistics*,2003:85(1):105–118.
12. Callaway B, Sant’Anna PHC. Difference-in-differences with multiple time periods. *Journal of Econometrics*,2021:225(2):200–230. <https://doi.org/10.1016/j.jeconom.2020.12.001>
13. Campante F, Yanagizawa-Drott D. Long-range growth: Economic development in the global network of air links. *Quarterly Journal of Economics*,2023:138(4):1819–1899. <https://doi.org/10.1093/qje/qjad018>
14. Costantinos BT. African Union Agenda 2063 and the Single African Air Transport Market: Institutional coherence and implementation gaps. *African Journal of Economic Policy*,2024:31(1):45–68.
15. Ethiopian Airlines. Ethiopian Airlines group annual report 2023/2024. Ethiopian Airlines Group, Addis Ababa, 2024.
16. Fernandes AM, Ferro E, Wilson JS. Product standards and firms’ export decisions: Air connectivity as a trade facilitation lever in Sub-Saharan Africa. *World Bank Economic Review*,2023:37(2):301–328. <https://doi.org/10.1093/wber/lhac012>
17. Fujita M, Krugman P, Venables AJ. The spatial economy: Cities, regions, and international trade. MIT Press, 1999.
18. Gillen D, Harris R, Oum TH. Liberalization of air transport: A comparative assessment of full and partial market opening. *Transportation Research Part A: Policy and Practice*,2022:158:42–61. <https://doi.org/10.1016/j.tra.2022.02.007>
19. Grosche T, Rothlauf F, Heinzl A. Gravity models for airline passenger volume estimation. *Journal of Air Transport Management*,2007:13(4):175–183.
20. Hakim MM, Merkert R. Airport connectivity, agglomeration, and metropolitan growth: A spatial econometric analysis of Asia-Pacific hub airports. *Journal of Transport Geography*,2022:102:103376. <https://doi.org/10.1016/j.jtrangeo.2022.103376>
21. International Air Transport Association [IATA]. Air passenger market analysis: Africa regional report Q4 2023. IATA Economics, 2024.
22. International Air Transport Association [IATA]. Airport infrastructure quality and connectivity: A global benchmarking study. IATA Economics and ACSA, 2024.
23. International Civil Aviation Organization [ICAO]. Universal Safety Oversight Audit Programme (USOAP) Africa regional implementation report. ICAO, 2023.
24. International Monetary Fund [IMF]. World economic outlook: Steady but slow Resilience amid divergence. IMF Publication Services, 2024.
25. Krugman P. Increasing returns and economic geography. *Journal of Political Economy*,1991:99(3):483–499.
26. LeSage J, Pace RK. Introduction to spatial econometrics. CRC Press/Taylor & Francis, 2009.
27. Matsumoto H. Air transport liberalization, route entry, and regional connectivity: Updated gravity model evidence. *Journal of Air Transport Management*,2023:108:102377.
28. Micco A, Serebrisky T. Competition regimes and air transport costs: The effects of open skies agreements. *Journal of International Economics*,2006:70(1):25–51.
29. Njoya ET. Computable general equilibrium analysis of the Single African Air Transport Market: Macroeconomic impacts and distributional effects. *Economic Modelling*,2023:124:106281. <https://doi.org/10.1016/j.econmod.2023.106281>
30. Oum TH, Fu X, Yu C. Revisiting the effects of open skies agreements 20 years on: A meta-analysis and new panel evidence. *Transportation Research Part B: Methodological*,2023:171:62–84. <https://doi.org/10.1016/j.trb.2023.03.005>
31. Piermartini R, Rousová L. The sky is not flat: How discriminatory is the access to international air services? *American Economic Journal: Economic Policy*,2013:5(3):287–319.
32. Programme for Infrastructure Development in Africa [PIDA]. PIDA priority action plan 2021–2030: Transport infrastructure report. African Union Commission and AfDB, 2022.
33. Santos Silva JMC, Tenreyro S. The log of gravity. *Review of Economics and Statistics*,2006:88(4):641–658.
34. Shepherd B, Doytchinova H. Non-tariff measures in air transport: Estimation and implications for open skies agreements. *World Trade Review*,2023:22(1):78–99. <https://doi.org/10.1017/S1474745622000350>
35. Somuyiwa AO, Fadare SO, Akinyemi JO. State ownership, competitive dynamics, and SAATM compliance: Evidence from African flag carriers 2015–2023. *African Development Review*,2024:36(2):211–229. <https://doi.org/10.1111/1467-8268.12702>
36. Tinbergen J. Shaping the world economy: Suggestions for an international economic policy. Twentieth Century Fund, 1962.
37. Tshetu N, Mwangi P, Osei K. Regulatory harmonization and route entry in intra-African aviation: A survival analysis. *Journal of African Business*,2023:24(4):512–531. <https://doi.org/10.1080/15228916.2023.2187445>
38. World Economic Forum [WEF]. Global competitiveness report 2023: Infrastructure and connectivity pillar. WEF, Geneva, 2023.