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Research paper

# Assessing the economic impact of the single African air transport market: The case of Tanzania

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ABSTRACT

Tanzania is one of the 21 (out of 54) African countries that are yet to ratify the Single African Air Transport Market (SAATM) launched in 2018 as the first project of the African Union's agenda 2063. SAATM aims to create a single unified air transport market for Africa thereby opening skies across the whole continent and aiding the economic integration agenda. Using the two-stage least squares estimator that is robust to endogeneity bias, this study empirically assesses the economic effects of liberalization of air services between Tanzania and other African countries. The results show that removing restrictions on designation, flight frequency, and capacity for air transport between Tanzania and other parts of Africa would lead to a rise in the number of air passengers. Specifically, the results suggest that between 2010 and 2018, routes linking Tanzania and other African countries that were governed by liberal bilateral air services agreements (BASAs) enjoyed slightly lower fares compared to routes governed by restrictive BASAs. The results also suggest that air travel demand is not very sensitive to fare implying that the increase in the flow of passengers by an average of 16.9% between 2010 and 2018 can be attributed to the enhancement in service quality (as measured by flight frequency), and increased competition resulting from the entry of new players or intensified competition among existing ones. The policy implication of this study might be the need for Tanzania to embrace the SAATM initiative.

## 1. Introduction

The literature has extensively debated the economic regulation of air services since the 1990s, with a particular emphasis on the impact of open skies policies on air traffic growth, pricing, and consumer welfare (e.g., O'Reilly & Alec Stone, 1998; Gillen et al., 1999; Melville, 1998). The accumulating evidence suggests a positive relationship between air transport liberalization and air traffic growth in countries with more liberal air services agreements as opposed to those with restrictive aviation regimes (e.g., Forsyth, 2006; Njoya et al., 2018; Warnock-Smith & Morrell, 2008). Tanzania, like many African nations, adopted measures to liberalize its air transport services over two decades ago, influenced by the US and EU experiences with liberalization and the prevailing wisdom in academic and policy circles. The liberalization of air services in Tanzania entailed relaxing market entry restrictions on bilateral air services agreements in terms of designation,[1] flight frequency, capacity,[2] and the granting of fifth freedom rights.[3] Intra-Africa air services liberalization has been implemented under the Yamoussoukro Decision (YD) framework; a policy reform initiative launched in 1999 by African states seeking to open up African airspace.

The Tanzanian aviation sector was relatively underdeveloped when the country began to take steps towards liberalization of its economy in the 1980s. Air transport was at its infancy, with the first flag carrier established in 1977, and East African Airways, a carrier jointly owned by the governments of Tanzania, Kenya, and Uganda, providing domestic and international links to and from the three countries. However, political tensions between the three nations resulted in the collapse of the airline in the late 1970s (Tanzanian Ministry of Finance and Planning,

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[1] Designation means any airline which has been designated and authorised by a state party to exercise its traffic rights under the bilateral air services agreement.

[2] Capacity and frequency refer to the quantity of services that airlines can provide in terms of type of aircraft used, the payload available on a route or a section of a route, the frequency operated by such aircraft over a given period on a route or a section of a route.

[3] The fifth freedom allows a carrier the privilege to transfer passengers between two foreign countries on a flight either bound for or originating at the carrier's home base.

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2021). Over the past two decades, air traffic has grown rapidly in Tanzania, despite the relatively underdeveloped state of its aviation sector. According to World Bank estimates,[4] the number of licensed air services providers increased from 54 in 2011 to 111 in 2019, and air traffic rose from 0.19 million passengers in 2000 to 1.49 million passengers in 2019, representing an annual average growth rate of over 10%. This impressive growth in traffic is mainly due to Tanzania's "open skies" policy in accordance with the YD, which has led to an increase in flights by foreign airlines, along with other driving factors such as strong economic growth, political stability, and tourism.

According to the World Bank Development Indicators,[5] Tanzania's GDP grew on average by over 7% per annum between 2000 and 2019, while its inbound tourism via all modes of transport increased from just 501,000 to 1.3 million.[6] However, only 14% of Tanzania's Bilateral Air Services Agreements (BASAs) comply with the operational principles of YD (IATA Consulting & InterVISTAS, 2021).

The main objective of this study is to empirically assess the economic effects of the implementation of SAATM in Tanzania (i.e., the liberalization of air services between Tanzania and other African countries). In essence, we aim to examine the effect of Tanzania's air liberalization policy on intra-Africa air travel demand. We draw from the stream of literature in this area that international air transport liberalization has a considerable impact on fares, and like other liberalization policies, Tanzania's air transport policy has the potential to increase demand for air travel. Considering this, we argue that this policy's effect on air travel demand is indirect. In other words, air travel demand increases as a result of decreased fares, enhanced service quality, or both. To efficiently achieve our objective, therefore, we exploit the cross-sectional time series dimension of the Sabre data for a heterogeneous panel of African countries between 2010 and 2018 in which Tanzania has a bilateral air liberalization agreement. We specify various regression models which we empirically estimate using the Fixed Effect and noble two-stage least squares estimator that is robust to endogeneity bias.

To the best of our knowledge, this paper pioneers providing an empirical assessment of the effect of air transport liberalization on intra-African air travel using Tanzania as a case study. Another novelty of our paper is that we used the Categorical Principal Component Analysis (CATPCA) recently developed by Kolenikov and Angeles (2009) to construct a more comprehensive measure of liberalization policy which captures the various dimensions of Tanzania's air liberalization. Existing studies mostly rely on using one or two dimensions (indicators) of liberalization policy which, arguably, is too narrow. From the various analyses we conducted, however, our results suggest that Tanzania's air liberalization policy results in a 0.03% drop in fare prices[7] and this prompted an increase in the flow of passengers by an average of about 16.9% between 2010 and 2018. Our paper's main contribution is that it expands understanding of the role of air liberalization in promoting intra-African air travel.

The remaining parts of this paper are structured under four sections. Literature review and methodology sections come under sections two and three, respectively. While section four provides the empirical results of the methods we employed as well as discussions of these results, section five concludes the paper.

## 2. Literature review

The economic impact of air transport liberalization has been extensively examined, and its direct and indirect effects are well-established. Among the most extensively researched effects of aviation policy reform are its impacts on airfares and passenger flows. Available literature in this area suggests significant positive and negative interconnection between (various) liberalization policies, airfare, passenger flow, and to a larger extent, trade costs (see for example Abate, 2016; Abate & Christidis, 2020; Doove et al., 2001; Micco & Serebrisky, 2006; Njoya et al., 2018). In terms of airfare, for example, Doove et al. (2001) showed that international air passenger traffic restrictions lead to increased travel costs, with the degree of restrictions affecting the increase, which varies from 3 to 22 percent for discount fares. This means that economies with more restrictive aviation regimes, such as the Asia Pacific, have a higher price impact, ranging from 12 to 22 percent, while economies with more liberal air transport policies, such as the United States, tend to have lower price effects, ranging from 9 to 18 percent.

Similarly, Njoya et al. (2018) investigated the impact of air services liberalization in the EU-Africa aviation market and found that liberalized markets had 14 percent lower airfares and 28 percent higher departure frequencies than markets with restricted market access. Abate and Christidis (2020) showed that when there are air services agreements between the European Union (EU) and regional blocks that open markets, average base fares on routes are 6 percent to 23 percent lower, and passenger volumes are 27 percent higher than on routes governed by bilateral air services agreements. Additionally, the authors found that the EU's external aviation policy has led to higher levels of capacity utilization but has no effect on flight frequencies.

While most studies on the impact of air service liberalization on fares suggest an inverse relationship (InterVISTAS-ga, 2006; Njoya et al., 2018; Manuela, 2007), some studies have reported no correlation between air transport liberalization and airfares. For example, Abate (2016) found that, when studying the impact of air transport liberation in Ethiopia, routes governed by liberal policies within Africa had better service quality, but liberal policies had no impact on fares.

In terms of passenger traffic, existing studies consistently show a positive correlation between air services liberalization and increased passenger flows. One of the most comprehensive studies on this topic is the InterVISTAS study, which examined 1400 country-pairs worldwide and found that traffic increased by an average of 12–35 percent, and in some cases even exceeded 50 percent of the pre-liberalization rates (InterVISTAS-ga, 2006). Other studies have also documented the positive effects of air services liberalization on passenger traffic. For example, Piermartini and Rousova (2008) found that increasing the air liberalization index from the 25th percentile to the 75th percentile could result in a 30 percent increase in traffic volume. Ismaila et al. (2014) estimated that removing restrictions on international routes to and from Nigeria could lead to a traffic growth of 33–137 percent.

Studies conducted in specific countries and regions have also shown positive effects of air services liberalization on passenger traffic. Cristea et al. (2015) found that liberalizing air service agreements between Turkey and Arab countries could result in a traffic growth of about 30 percent. In the Philippines, Manuela (2017) found that airfare per kilometre was, on average, 10 percent lower on routes with at least two airlines after liberalization. Previous studies have also documented the effects of air services liberalization on passenger traffic in the advanced countries such as U.S. and Europe. Maillebiau and Hansen (1995) estimated that liberalization of air services between the U.S. and five European countries would result in a traffic growth of 56 percent. Earlier on, Button (1998) found that passenger traffic increased by 55 percent following the U.S. deregulation in the period between 1978 and 1988, while the real costs of travel fell by about 17 percent on major routes. These studies provide strong evidence of the positive relationship between air services liberalization and passenger traffic.

Another area of research has focused on the effects of air cargo liberalization. In studying the impact of open skies on air cargo markets, Micco and Serebrisky (2006) found that air services liberalization reduces air freight costs by 9 percent and increases the share of imports by

[4] https://data.worldbank.org/indicator/IS.AIR.PSGR.

[5] https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.

[6] https://data.worldbank.org/indicator/ST.INT.ARVL?locations=TZ.

[7] As we explained in the paper, 0.05% drop in fare price that we find is rather marginal. This is unsurprising because, as Abate (2016) discovered, routes within Africa regulated by liberal policies offer higher service quality but have very little effect on pricing.

air by 7 percent in developed and upper-middle-income developing countries. However, the authors also discovered that air services liberalization does not have the same effect on air freight costs in lower-middle-income and low-income developing countries. Similarly, Geloso-Grosso and Shepherd (2009) investigated the impact of open skies on trade in goods by industry and concluded that certain sectors are more sensitive to the degree of aviation liberalization than others. The authors found that bilateral liberalization leads to an increase in trade volume of manufactured goods, time-sensitive products, and parts and components. In fact, they observed that a unit increase in the air liberalization index is correlated with a 4 percent increase in bilateral parts and component trade.

Several studies have analysed the impact of air service liberalization on various regions or economic communities, and the results are well-documented. IATA Consulting & InterVISTAS (2014, 2021) conducted studies on implementing the Yamoussoukro Decision in 12 countries and successfully implementing the Single African Air Transport Market (SAATM) across all 55 African Union nations. They found that such implementation would lead to a significant increase in traffic volume and a decrease in average fare. For instance, implementing the Yamoussoukro Decision would lead to an increase in traffic between 51 percent and 141 percent and reduce fares by 25 percent to 35 percent. Implementing SAATM would increase intra-Africa traffic volume by 51 percent and decrease average intra-Africa fare by 26 percent. Abate and Kincaid (2018) studied the effect of fully liberalizing restricted routes between five East African Community countries and found that it would reduce average fare by 9 percent and increase traffic and frequencies by 29 percent and 41 percent, respectively. Furthermore, Geloso-Grosso and Shepherd (2009) showed that liberalizing traffic rights for air cargo services between Asia-Pacific Economic Cooperation (APEC) countries would stimulate trade by increasing bilateral trade by 1.3% for every one-point increase in the air liberalization index score. Myburgh (2006) examined the effect of relaxing bilateral air services restrictions between 12 Southern African Development Community (SADC) countries and found that it would lead to a fall in fares and an increase in demand, with air fares being 18 percent lower on liberalized routes. Surovitskikh and Lubbe (2015) investigated the impact of liberalization in five different markets, including the intra-African market, East African, North African, West African, and the SADC regional markets. Their findings showed that granting fifth freedom rights to airlines operating in the intra-African market would increase passenger traffic by between 2 percent and 4 percent, and a unit increase in capacity or cooperative arrangements such as code sharing would stimulate traffic growth by between 5 percent and 43 percent, depending on the Air Liberalization Index (ALI) variant used. In the SADC region, a unit increase in capacity would increase traffic flows within the region by between 10 percent and 1 percent, depending on the ALI variant used.

The impact of aviation liberalization is influenced by the location, and it is important to note this. For instance, while West and Central Africa have implemented the Yamoussoukro Decision, its implementation in East, North, and Southern Africa is limited. Surprisingly, despite the variance in liberalization levels, the air traffic in less liberalized regions is more advanced, and this could be attributed to factors such as the generally higher operating costs in West and Central Africa (Njoya, 2016).

In summary, there is an extensive body of literature on the impact of air travel liberalization on air travel demand in various countries and economic groups (see Table 1a in the appendix). However, there is a noticeable gap in the literature when it comes to intra-Africa air travel in general, and specifically, there is a lack of studies on Tanzania. This is particularly important given the recent policy changes implemented by the Tanzanian government and the country's economic significance in the East African Community (EAC). Therefore, investigating the effect of air travel liberalization in Tanzania on intra-African air travel demand is a crucial and challenging task.

## 3. Methodology

### 3.1. Models specification

To assess the effect of air transport liberalization on intra-Africa travel, we specify three distinct regression models as explained under sub-sections 3.1.1 through to 3.1.3.

#### 3.1.1. Effect of SAATM on fare

Our empirical analysis begins with the specification of a yearly fare price model. We use the cross-sectional time series dimension of the Sabre data to, first, quantify the impact of liberalization on air fare price. A significant effect of international air transport liberalization is its effect on fares. Like any other liberalization policy, Tanzania's air transport policy has the potential to enhance air travel demand. Nonetheless, we begin our analysis by simply assuming that the influence of this policy on demand for air travel is indirect. In other words, demand for air travel grows either because of decreased fares, improved service quality, or both. Arguably, these variables (i.e., fares and service quality) are more likely to be directly affected by regulatory policy changes. Theoretically, a regulatory environment that is overly restrictive encourages airlines to engage in collusive behaviour, which results in increased fares (Dresner & Tretheway, 1992). On the other hand, a relaxing of the regulatory framework results in increased competition, which ultimately results in lower fares. As a result, we specify the following fare model:

$$lnFare_{ijt} = \delta_i + \varnothing_i + \gamma_i + \vartheta_1 (BASA)_{jt} + \vartheta_2 (lnPAS)_{ijt} + \mathbf{Z}'\vartheta + v_{ijt} \tag{1}$$

Where $(BASA)_{jt}$, our main variable of interest, is the policy change variable that captures the effect of Tanzania's air transport liberalization. We define and describe how we generate this variable in section 3.2. We expect $(BASA)_{jt}$ to have negative coefficient for the afore-said reasons. $(lnPAS)_{ijt}$ is the number of passengers travelling between country pairs $i$ and $j$. We acknowledge, however, the potential simultaneity effect on fares of $(lnPAS)_{ijt}$ which is more of an empirical matter. This equation is estimated using data on airline fares and number of passengers for each country pair.[8] Increased demand may result in higher fares if capacity constraints exist, especially in terminal capacity and airside infrastructure, or it may result in reduced fares if the airlines/carriers achieve economies of scale.[9] The country, bilateral partner country, and year fixed effects are denoted by $\delta_i$, $\varnothing_i$, and $\gamma_i$, respectively, while the idiosyncratic error term is given by $\mu_{ijt}$. **Z** is a vector containing control variables including the price of fuel, the distance between largest airline markets/airports, and the per capita GDP. The fixed effects for country ($\delta_i$) and year, ($\gamma_i$), account for unobserved variation in the plane operating cost across routes and time periods. In equation (1), we treated $(lnPAS)_{ijt}$ as endogenous to avoid simultaneity bias. We explain how we handled this in section 4.5.

#### 3.1.2. Effect of fare on passenger flow

Following our argument for model (1) that liberalization of Tanzania's air sector can potentially reduce air travel price or improve service

[8] It would have been ideal to use data on fares and passengers for each country pair using peak and off-peak seasons of each year. Due to data scarcity, we could not do this, however.

[9] According to the theoretical viewpoint of Dresner and Tretheway (1992), the influence of demand on fare depends on the location of the marginal cost curve where airlines operate. If the airlines operate on the upward sloping part of the marginal cost curve, more passengers mean more money because there may be a short-run capacity limitation. When airlines operate on the downward section of their marginal cost curve, the passenger variable might be negative. The negative effect is caused by excess capacity or traffic density economies (Nero, 1998).

quality (or both) due to increase competition, we specify a demand equation[10] to examine the effect of fare on passenger flow within the famous gravity-type model described in the literature.[11]

$$lnPAS_{ijt} = \delta_i + \varnothing_i + \gamma_i + \varphi_1 (lnFare)_{ijt} + X^{'}\varphi + \varepsilon_{ijt} \quad (2)$$

Where $lnPAS_{ijt}$ is the number of passengers travelling between country pairs $i$ and $j$. $(lnFare)_{ijt}$ is the trip fare measured in hundredth of U.S dollar. As out main variable of interest in this equation, we expect $\varphi_1$, the coefficient of $(lnFare)_{ijt}$ to report a negative sign which will indicate the slope of the demand curve for Tanzania's air travel between 2009 and 2018. The country, bilateral partner country, and year fixed effects are denoted by $\delta_i$, $\varnothing_i$, and $\gamma_i$, respectively, while the idiosyncratic error term is given by $\varepsilon_{ijt}$.

However, $\mathbf{X}'$ is a vector in equation (2) which includes the standard control variables,[12] i.e., determinants of air transport demand, including destination risk, trade ties, visa openness, distance (between Tanzania and country $j$, in kilometres), language (i.e., countries having a similar (official) language with Tanzania, and contiguity (i.e., shared common border between countries). As Piermartini and Rousov'a (2013) point out, the effect of distance on passenger flow is almost certainly nonlinear. Passengers favour air transport over other modes of transportation as the distance between two countries widens. However, for countries that are geographically distant from one another, distance becomes an 'unavoidable' factor for air passenger movement, as social and economic contacts between countries tend to diminish with distance. Additionally, aviation fares become prohibitively expensive beyond a certain distance, thereby reducing passenger flow. Therefore, we added one other variable (namely, square of distance) to account for the opposing impacts of distance on passenger flow.

Moreover, the probable presence of alternative forms of transport means there will be a negative influence of common border on passengers' flow volume.[13] For example, if a partner country (j) shares a colonial history and common (official or local) language with Tanzania, then we will expect a higher passenger flow, ceteris paribus. Finally, in vector $\mathbf{X}'$, equation (2) accounts for extra factors, called 'generating' variables that reflect future travellers' catchment region. These variables are the population and GDP of the end destination countries, which are predicted to expand in tandem, resulting in increased passenger flows. For estimation reasons, we converted all continuous variables into natural logarithm to work elasticity. Due to the obvious simultaneous determination of demand and supply, we treated the fare variable, i.e., $(lnFare)_{ijt}$, as endogenous. We explain how we handle endogeneity problem in section 3.4.

### 3.1.3. Effect of SAATM on passenger flow

Finally, our empirical analysis specifies a yearly passenger flow model. To examine air transport flows (demand) between countries, we define the following gravity-type model:

$$ln\ PAS_{ijt} = \delta_i + \varnothing_i + \gamma_i + \beta_1 (BASA)_{jt} + X^{'}\boldsymbol{\beta} + \mu_{ijt} \quad (3)$$

In equation (3), $PAS_{ijt}$ represents the number of air passengers travelling from Tanzania (country $i$) to an external partner (country $j$) in year $t$. The country, bilateral partner country, and year fixed effects are denoted by $\delta_i$, $\varnothing_i$, and $\gamma_i$, respectively, while the idiosyncratic error term is given by $\mu_{ijt}$. $X^{'}$ contains a vector of control variables already defined in equations (1) and (2). In this equation (3), our main explanatory variable of interest is $(BASA)_{jt}$. Needless to reiterate here that Tanzania's aviation policy seeks, among other things, to foster a competitive aviation market via significant improvement in the market access for airlines. Therefore, since competition arising from liberalizing the Tanzania's aviation sector unequivocally results in lower fare prices and/or improved service quality, more travellers are expected to fly. Therefore, we expect $(BASA)_{jt}$ to have a statistically significant positive effect on $PAS_{ijt}$, i.e., total annual number of air passengers. Again, we converted all the continuous variables into natural logarithmic to enable us to interpret the resulting respective coefficient estimates as elasticity. Table 1b provides data source and variables definition/measurement as used in this study.

## 3.2. Deriving openness indicators for air transport services

One of the main issues in aviation liberalization research is how to define/measure the liberalization policy since various aspects of liberalization measure different things. Basically, Tanzania's liberalization of air transport involves at least three dimensions: designation, frequency, and capacity. Using a single proxy/dimension may result in unreliable and/or unstable results. Consequently, it would be logical to combine a number of these dimensions to account for the many features of this variable to obtain accurate, reliable, and stable results. The Principal Component Analysis (PCA) is one method for achieving this goal. PCA is a classic multivariate technique created with the goal of aggregating heterogeneous numerical measures (such as BASA in our case) to derive a unified measure. Since its inception in the early 20th century, the use of PCA in applied research has gained momentum.

In contrast to continuous data, where application of PCA is straightforward, there are several implications when categorical variables are used directly in the typical PCA, as such data violate the distributional assumptions where continuous variables are required.[14] In addition, categorical data tend to exhibit high skewness and kurtosis, particularly when most data points are clustered in a single category. As a remedy, Kolenikov and Angeles (2009) proposed Categorical PCA (CATPCA) approach to effectively handle categorical variables. By utilizing polychoric correlations, they demonstrate that the approach of conducting PCA on a set of dummy variables can be possible in similar

[10] One critical variable that worth including in this equation is flight frequency which captures the intensity of flights flying between Tanzania and country j. Due to data paucity, we were unable to incorporate flight frequency into the air travel demand equation (2). Data produced by Sabre contains only direct flights and the length of the data we use is only between 2009 and 2018. It is more likely, however, that demand between origins and destinations is dependent on both direct and indirect flights. Therefore, estimating the air travel demand equation (2) using just direct flights may probably produce counter-intuitive results.

[11] The gravity model has proved useful for a variety of purposes, including studying international human migration, trade, among other things. Application of the gravity model to the study of air transport demand has a long history. This model has seen some recent application such as Piermartini & Rousov'a, 2013; Winston & Yan, 2015; Abate, 2016.

[12] The number of control variables here in the X vector in equation (2) are higher than those in the Z vector in equation (1). This is because equation (1) models the determinants of fare price while equation (2) examines the determinants of passenger flow. Thus, factors like destination risk, trade ties, visa openness, distance, etc. are more likely to have direct effect on passenger flow than on fare, or that their effect on fare is indirect (see also Abate & Christidis, 2020).

[13] In theory, a common border is an indication of proximity between countries/cities which, supportably, reduces the demand for air travel due to proximity between cities. In practice, however, a common border does not prevent long distance between cities (e.g., about 1650 km between Kinshasa (Congo Rep.) and Kigali (Rwanda), only one border to cross (DR. Congo); conversely, about 550 km between Kampala (Uganda) and Bujumbura (Burundi) but two borders to cross (Tanzania and Rwanda)). We are thankful to the anonymous reviewers for raising this important point.

[14] Typically, the PCA assumes that the variables are multivariate normal (i.e., continuous). Using categorical data clearly violates this assumption. In our case, the three dimensions of BASA (designation, capacity, and frequency) are all binary. Using them in the PCA manner where continuous variables are required is clearly inappropriate.

manner with a typical PCA. On pages 141–143, Kolenikov and Angeles (2009) set out the procedure and/or mechanisms for using the CATPCA to obtain a measure for categorical variables. Therefore, we applied the polychoric correlation and then proceed with the standard procedure for conducting CATPCA as outlined by the authors. We then generated a measure for BASA that captures over 60 percent of the variance in the principal components. The principal component loadings range between 0.46 and 0.62. The scree plot (Fig. 1) shows that the first component is highly significant due to its Eigenvalue being greater than one. Therefore, we retained only one component in generating the BASA index. Section 3.2.1 defines and explains how the three dimensions of liberalization have been codified and then applied to generate BASA index using the CATPCA.

### 3.2.1. *Definition and generation of BASA*

We define BASA as a contractual agreement between two countries (e.g., Tanzania and another African country) to liberalize commercial air transport services by permitting authorised airlines of the contracting countries to fly commercial flights for the transportation of passengers/goods into designated ports between the two countries. In addition, BASAs typically govern the frequency and capacity of international air services, as well as price and other commercial considerations. BASAs foster international air connectivity between nations, which encourages and promotes the movement of people, goods, trade, and tourists. It often addresses traffic rights, usage of intermediary routes, type of aircraft, safety regulatory standards, competitiveness, ownership policy, design, and control of airlines, etc., so that both countries can benefit from the agreement.

In this study, the creation of the BASA liberalization indicator considers three important indices: airline designation, flight frequency, and flight capacity. Designation means any airline which has been designated and authorised by a state party to exercise its traffic rights under the bilateral air services agreement. Designation can be either single, double, or multiple. Single designation means that only one airline of each country is permitted to operate (very restrictive), double designation means only two airlines are permitted to operate (restrictive), and multiple designation permits each nation to designate more carriers to perform air services under the air transport agreement (liberal). If the designation is either single or double, we classify this as "restrictive" and assigned a code of zero (0). On the contrary, we classify the multiple designation as "liberal", and we assigned a code of 1. Therefore, as a component that we used to generate BASA, designation is a dummy variable, taking a value of 1 for liberal policy between Tanzania and other African countries, and zero (0) for restriction.

While capacity of flight refers to the passengers (or aircraft size) that can be carried, frequency of flights refers to the number of flights that

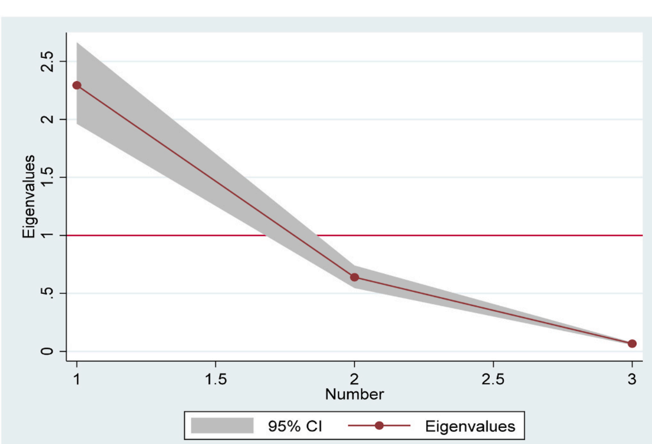


**Fig. 1.** Scree plot of Eigenvalues (after CATPCA for generating BASA).

can be operated between the bilateral partners. If the capacity restricts the number of passengers or an aircraft size, we assigned a code of zero (0) and thus considers it as restrictive. But if there is no limit (or any aircraft size is allowed), we classify this as liberal, and thus assigned a code of 1. For example, the bilateral agreement between Tanzania and Somalia states single designation, up to 2 per week for Aircraft capacity of up to F28, once a week for B720. This is very restrictive. On the other hand, the bilateral agreement with Zimbabwe is liberal: multiple designation, No restriction on weekly frequencies; No restriction on aircraft capacity. This is liberal. In short, we assigned a code of zero (1) where capacity is restricted, and a code of 1 where it is not. We also assigned a code of zero (0) where frequency is restricted and a code of 1 where it is not (i.e., liberal) (Fig. 2 in the appendix provides examples of the signed agreements between Tanzania and other countries).

## 3.3. *Estimation issues/procedure*

Three major econometric issues arise when estimating demand and fare equations. The first is simultaneity bias, which arises from the fact that equilibrium demand and supply (fare) are simultaneously determined. Second, due to the panel nature of our dataset, heteroskedasticity is a potential concern. Consistent with Abate and Christidis (2020), we use the two-stage least-squares (2SLS) approach to estimate equations (1) and (2) to mitigate these problems. In the demand model (i.e., equation (2)), we utilize price of fuel as instrument for fare.[15] Costs of fuel account for a substantial part of carriers' operating costs, much more so during our sample period, when jet fuel prices more than quadrupled between 2011 and 2013. In equation (1), we instrument for demand (i.e., $(lnPAS)_{ijt}$) using dummy variables for common language/colonial relationship, bilateral trade volume, and a variable for the population of endpoint countries. We mitigate heteroskedasticity issue by using the robust standard errors in our estimations.

Estimation procedure that we follow involves, first, an examination of the collinearity issue among the covariates using the correlation matrix (see Table 1a). For each of the three equations, we do not observe serious correlation among the covariates except between distance and fare, which is unsurprising because fare price significantly depends on distance between the origin and the destination points. For these two (i.e., fare and distance), we observed a correlation value in excess of 0.7 for each of the three equations. In standard panel data econometrics, Pesaran (2015) set a benchmark of 0.8 before correlation should be considered serious issue among covariates. For this reason, therefore, we declare no serious correlation among the covariates. To further support this decision, we use the variance inflation factor (VIF) which is a measure of how much estimates have been inflated due to collinearity (see Table 1b). For all the three equations, we observe a value of 2 as the highest average VIF which is clearly less than the stipulated benchmark of 5 set out by Gujarati (2014).

Second, we examine potential cross-sectional dependence (CSD). For each equation (i.e., (1), (2), and (3)), we tested for CSD using the Pesaran test procedure with a null hypothesis of no CSD. For each of the three tests, we obtained a highly insignificant probability values (see Table 2), indicating the failure to reject all the respective null hypothesis. This guarantees absence of CSD across the panels, i.e., the heterogenous cross-sections are interdependent.

We finally apply the noble 2SLS estimator for endogeneity/simultaneity reasons in estimating equations (1) and (2), and for equation (3),

[15] It is worth noting that the Hansen/Sargan test of overidentification cannot be obtained when only one instrument (i.e., fuel price) is used. Therefore, we could not produce overidentification test results in the summary of results for equations (2) and (3). This is the result of not being able to find additional suitable instruments.

**Table 1a**
Correlation analyses.

Equation (1)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fare | 1 | | | | | | | | |
| 2 | BASA | 0.40 | 1 | | | | | | | |
| 3 | Passengers | −0.38 | −0.39 | 1 | | | | | | |
| 4 | Fuel price | 0.96 | 0.49 | −0.43 | 1 | | | | | |
| 5 | Distance | 0.77 | 0.46 | −0.34 | 0.79 | 1 | | | | |
| 6 | GDP per capita | 0.15 | 0.08 | −0.25 | 0.14 | 0.10 | 1 | | | |
| 7 | Destination risk | 0.03 | 0.33 | −0.26 | 0.06 | −0.05 | 0.38 | 1 | | |
| 8 | Common border | −0.33 | −0.02 | 0.11 | −0.29 | −0.30 | −0.35 | 0.08 | 1 | |
| 9 | Common language | −0.47 | −0.33 | 0.20 | −0.52 | −0.41 | 0.05 | 0.28 | 0.33 | 1 |

Equation (2)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Passengers | 1 | | | | | | | | |
| 2 | Fare | −0.38 | 1 | | | | | | | |
| 3 | Destination risk | −0.26 | 0.03 | 1.00 | | | | | | |
| 4 | Population | 0.38 | −0.22 | −0.44 | 1 | | | | | |
| 5 | GDP per capita | −0.25 | 0.15 | 0.38 | −0.15 | 1 | | | | |
| 6 | Vias openness | −0.14 | −0.18 | 0.28 | −0.42 | −0.12 | 1 | | | |
| 7 | Common language | 0.20 | −0.47 | 0.28 | 0.15 | 0.05 | 0.19 | 1 | | |
| 8 | Common border | 0.11 | −0.33 | 0.08 | 0.13 | −0.35 | 0.02 | 0.33 | 1 | |
| 9 | Distance | −0.42 | 0.78 | −0.03 | 0.02 | 0.16 | −0.39 | −0.38 | −0.27 | 1 |

Equation (3)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Passengers | 1 | | | | | | | | | | |
| 2 | BASA | −0.39 | 1 | | | | | | | | | |
| 3 | Fare | −0.38 | 0.40 | 1 | | | | | | | | |
| 4 | Distance | −0.36 | 0.28 | 0.74 | 1 | | | | | | | |
| 5 | GDP per capita | −0.25 | 0.08 | 0.15 | 0.10 | 1 | | | | | | |
| 6 | Trade | 0.44 | −0.50 | −0.54 | −0.57 | −0.02 | 1 | | | | | |
| 7 | Population | 0.38 | −0.28 | −0.22 | 0.05 | −0.15 | 0.13 | 1 | | | | |
| 8 | Destination risk | −0.26 | 0.33 | 0.03 | −0.05 | 0.38 | −0.04 | −0.44 | 1 | | | |
| 9 | Visa openness | −0.14 | −0.23 | −0.18 | −0.32 | −0.12 | 0.10 | −0.42 | 0.28 | 1 | | |
| 10 | Common border | 0.11 | −0.02 | −0.33 | −0.30 | −0.35 | 0.05 | 0.13 | 0.08 | 0.02 | 1 | |
| 11 | Common language | 0.20 | −0.33 | −0.47 | −0.41 | 0.05 | 0.38 | 0.15 | 0.28 | 0.19 | 0.33 | 1 |

**Table 1b**
Variance inflation factor (VIF).

| Equation (1) | | | Equation (2) | | | Equation (3) | | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | VIF | 1/VIF | Variable | VIF | 1/VIF | Variable | VIF | 1/VIF |
| **Passengers** | 1.69 | 0.59 | Fare | 2.90 | 0.35 | BASA | 2.26 | 0.44 |
| **BASA** | 1.83 | 0.55 | Destination risk | 1.88 | 0.53 | Fare | 2.98 | 0.34 |
| **Fuel price** | 3.78 | 0.26 | Population | 1.84 | 0.54 | Distance | 2.24 | 0.44 |
| **Distance** | 2.27 | 0.44 | GDP per capita | 1.60 | 0.62 | GDP per capita | 1.65 | 0.61 |
| **GDP per capita** | 1.51 | 0.66 | Visa openness | 1.55 | 0.65 | Trade | 1.95 | 0.51 |
| **Common border** | 1.42 | 0.70 | Common border | 1.68 | 0.59 | Population | 1.92 | 0.52 |
| **Common language** | 1.86 | 0.54 | Common language | 1.47 | 0.68 | Visa openness | 1.84 | 0.54 |
| **Destination risk** | 1.75 | 0.57 | Distance | 2.08 | 0.48 | Common border | 1.55 | 0.64 |
| | | | | | | Common language | 1.86 | 0.54 |
| | | | | | | Destination risk | 2.35 | 0.43 |
| **Mean VIF** | 1.97 | | Mean VIF | 1.88 | | Mean VIF | 2 | |

**Note:** All continuous variables are in natural logarithmic.

**Table 2**
Pesaran's test of cross-sectional independence.

| | Test score | p-value | Average absolute value |
|---|---|---|---|
| Equation (1) | 6.842 | 0.000 | 0.419 |
| Equation (2) | 27.486 | 0.000 | 0.479 |
| Equation (3) | 24.338 | 0.000 | 0.464 |

we used the fixed effect estimator due to absence of endogeneity.[16] We find alternative estimators such as generalised methods of moment (GMM), dynamic OLS, and fully modified OLS unsuitable. This is because GMM applicable for models containing large cross-section with short time periods (Pesaran, 2015). Fully modified OLS and dynamic OLS can handle endogeneity issue efficiently, nonetheless, they are only

[16] This is because equation (3) does not include fare as a control variable which, if included, will give rise to endogeneity/simultaneity problem. Including fare is not justifiable since BASA also affects fare, as captured by equation (1).

appropriately applicable when dealing with cointegrated series, i.e., to estimate long-run relationship among variables that are cointegrated (Manson et al., 2017).

## 4. Empirical results and discussions

Here, we present a summary of the various estimations based on the models explained in section 3. We discussed these results in relation to our study objective, theories we presented above, as well as the extant literature.

### *4.1. Discussion of results*

#### *4.1.1. Summary statistics*

The summary statistics shown in Table 3 reveal that the average one-way air fare from Tanzania to other cities was approximately $653, with the lowest fare being $108 and the highest fare being nearly $8600. The standard deviation, a measure of variability, demonstrates that the fare price changed annually by more than £690 between 2010 and 2018. However, the average passenger flow (one way) over this time was greater than 44,600, with a minimum of 276 passengers and a maximum of more than 686,400 people. Moreover, the standard deviation for this variable indicates that the passenger flow widely varied (i.e., over 76,500 passengers every year). The average price of fuel was $79.3, with minimum and maximum prices of $43.6 and $111.6, respectively. For BASA, we note that Tanzania's air liberalization policy is liberal regarding most of the countries in our sample, encompassing between 70 and 90 percent of them in terms of destination, frequency, and capacity. However, frequency coverage appears to be the highest (i.e., 90%), although capacity and destination coverage are each 70%. However, only 10–30% of these countries are subject to the policy's restrictions.

**Table 3**
Summary statistics.

| Variable | Obs. | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| Demand variables | | | | | |
| **Number of passengers (one way)** | 330 | 44691.1 | 76531.2 | 276.0 | 686049.9 |
| **Fare** | 330 | 653.1 | 691.5 | 108.4 | 8639.0 |
| **Fuel/oil price** | 330 | 79.3 | 25.13 | 43.64 | 111.63 |
| Liberalization policy variables | | | | | |
| **BASA by designation (Yes = 1)** | 330 | 0.7 | 0.5 | 0 | 1 |
| **BASA by frequency (Yes = 1)** | 330 | 0.9 | 0.3 | 0 | 1 |
| **BASA by capacity (Yes = 1)** | 330 | 0.7 | 0.5 | 0 | 1 |
| Country-pair variables | | | | | |
| **Distance between cities** | 330 | 3652.63 | 1934.2 | 514 | 7323 |
| **GDP per capital (of the two cities)** | 330 | 2795039 | 3114569 | 272402.8 | 1.37E+07 |
| **Trade (between the cities)** | 330 | 1.37E+10 | 6.20E+10 | 5.750358 | 4.50E+11 |
| **Population (of the two cities)** | 330 | 1.59E+13 | 2.15E+13 | 1.68E+09 | 1.21E+14 |
| Gravity variables | | | | | |
| **Visa openness** | 330 | 0.4 | 0.3 | 0 | 1 |
| **Common border (Yes = 1)** | 330 | 0.3 | 0.5 | 0 | 1 |
| **Common language (Yes = 1)** | 330 | 0.5 | 0.5 | 0 | 1 |
| **Destination risk** | 330 | 35.6 | 23.2 | 0.9 | 88.6 |

The average distance between largest airline markets/airports was approximately 3653 km, with a minimum of 514 km (from Mombasa, Kenya, to Dar es Salam, Tanzania) and a maximum of 7323 km (from Sal, Cape Verde to Dar es Salam, Tanzania). The average GDP per capita between the origin and destination cities was approximately $27,900, with a minimum of $27,200 and a maximum of $137,000. These statistics suggest that the cities have a relatively low-income level. The average population between the two cities (destination and origin) was 15 million, with a minimum of 16 million and a maximum of 121 million, respectively. As for the gravitational variables, we observe that just 40% of these countries require visas for entry. We also observe that just 30% of the countries in our sample have a common border with Tanzania, 50% share a common language, and the destination risk ranges from an average of 36% to a maximum of 88%, indicating that travel to some countries is risky.

#### *4.1.2. Effect of liberalization on fare*

We give results from specifications that control for country-fixed effects to utilize within-country time series variance in the data, as well as specifications that control for more rigorous country-pair fixed effects. Using the country-pair fixed effects permits us to account for time-invariant variables (such as distance) that may influence bilateral flows. For most part, we observe that the models with country-pair fixed effect models have a higher R-squared but less precise estimates than models including both country-fixed and country-pair variables. The models with country-pair fixed effect capture the within variation of data to assess the "causal link" and are more consistent than the model with country-fixed effects, supporting the assertion that liberalization causes a reduction in fares and an increase in the passenger flow. Models with both country-fixed and country-pair variables exploit the within and between variations in the data which, arguably, provide more insight.

As mentioned earlier, our estimation strategy involves first assessing the effect of liberalization on fare. Table 4 presents estimates from the demand model specified in Equation (1). For this equation, three different models were estimated: one with only passenger flow and BASA but no controls (model 1), another with these two and country-pair variables (model 2) and the other which contains all these and the gravity variables (model 3). In the first two models (i.e., models 1 and 2), BASA, our main variable of interest reports insignificant coefficient values ranging from 0.040 to 0.067. This is unsurprising because of the obvious omitted variables (i.e., fuel price and the gravity variables) that are critical to estimating the gravity (demand) model. The resulting R-squared for these models (0.03 and 0.48) also indicate lower explanatory powers of these model which, again, accentuate the need to include the gravity variables. In model (3), however, we observe a statistically significant coefficient of −0.046 for BASA. This suggests that, on average, Tanzania's air liberalization policy has discernible negative effect on fare price. In other words, a unit reduction in air transport restriction will reduce the fare price by approximately 0.05%, ceteris paribus. Nonetheless, this size of the drop in the fare price is rather marginal. This may be explained by the fact that air travel demand in Africa is still considered a luxury service since many Africans cannot afford it due to low growth of income per capita.[17] Abate (2016) also discovered that routes within Africa regulated by liberal policies offer higher service quality but have no effect on pricing. Micco and Serebrisky (2006) also show that air services liberalization does not reduce air freight costs in lower-middle-income and low-income developing countries. In addition, this coefficient also represents price elasticity of BASA, i.e., the responsiveness of fare price to changes in liberalization

[17] The insignificant coefficient of GDP per capita reported in Table 4 also adds a layer of support to this stance.

**Table 4**
Effect of liberalization on fare (Two-stage least squares estimates).

| VARIABLES | (1) No controls | (2) Country-pairs | (3) All variables |
|---|---|---|---|
| Passengers (*ln*) | −0.386*** | −0.402*** | 0.106 |
| | (0.069) | (0.055) | (0.146) |
| BASA | 0.040 | −0.067 | −0.046*** |
| | (0.034) | (0.052) | (0.003) |
| GDP per capita (*ln*) | | −0.048 | 0.052 |
| | | (0.036) | (0.047) |
| Distance (*ln*) | | | 0.506** |
| | | | (0.127) |
| Fuel price (*ln*) | | | 1.258*** |
| | | | (0.202) |
| Common border | | | −0.062*** |
| | | | (0.006) |
| Common language | | | 0.066*** |
| | | | (0.002) |
| Destination risk (*ln*) | | | −0.117* |
| | | | (0.062) |
| Constant | 9.980*** | 5.422*** | 4.036*** |
| | (0.706) | (1.992) | (0.246) |
| Country fixed effect | Yes | Yes | Yes |
| Time fixed effect? | Yes | Yes | Yes |
| Country-pair fixed effect | No | Yes | No |
| Observations | 330 | 330 | 330 |
| R-squared | 0.0345 | 0.4814 | 0.6316 |
| Adjusted R-squared | 0.0011 | 0.4773 | 0.6279 |
| F-stats | 9.17 | 72.01 | 311.73 |
| F-stat (p-value) | 0.0000 | 0.0000 | 0.0000 |
| Endogeneity test (p-value) | 0.0000 | 0.0006 | 0.0003 |
| Overidentification test (Hansen p-value) | 0.0032 | 0.3119 | 0.2017 |
| **First Stage Regression:** | | | |
| Dependent variable: Passengers (*ln*) | | | |
| **Excluded instrument:** | | | |
| Trade (*ln*) | 0.087*** | 0.092*** | 0.097*** |
| | (0.013) | (0.015) | (0.019) |
| Population (*ln*) | 0.176*** | 0.226*** | 0.213*** |
| | (0.026) | (0.100) | (0.029) |
| Partial R-squared | 0.2360 | 0.2264 | 0.1806 |
| F-test of IV. | 26.93 | 62.46 | 85.09 |

**Note:** Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. (*ln*) indicates natural logarithmic.

policy, which in this case, is than unity (i.e., inelastic). Overall, these results are consistent with some extant literature. For example, by studying air transport patterns spanning 14 years between 28 European Union (EU) countries and 27 external partners on 4 continents with varied degrees of liberalization, Abate and Christidis (2020) demonstrate that the EU's external policy results in about 6–23% reduction in fare price.

Most of the remaining independent variables exhibit plausible signs and are statistically significant at 5% level or lower. From the results of Table 4, it appears that fair price increases with increasing distance between nations which suggests that air travel is the preferable mode of transport for longer trips. Similarly, the air transport flow between neighbouring partner nations (i.e., countries that share a border) is shown to be lower, most likely due to the presence of alternative modes of transportation. Fuel price also appears to have a significant impact on fares, reflecting the impact of an airline's operation costs on fares, i.e., the higher the operation costs, the higher the fares. Common (official) language appears to play a role in fare pricing, which is unsurprising given that countries that share a language/culture tend to interact more for economic and social reasons. Surprisingly, while the number of passengers (i.e., demand), per capita GDP (i.e., income) appears to have an insignificant effect, destination risk appears to have a significant effect on the price of a trip. These outcomes can be explained by a lack of competition, significant disparities between African countries in terms of GDP per capita, and concentration of conflicts in remote areas, away from major cities where most flights originate and terminate.

It is clear from Table 4 that the predictive power of model 3 performed better than for models 1 and 2. The adjusted R2 jumped from 3% (model 1), to 48% (model 2) to 63% (model 3). All coefficients in each model are jointly significant as evidenced by F-stats.

#### 4.1.3. Effect of fare on passenger flow

While the results presented in Table 4 are generally in line with our expectations, the estimation data we utilized are quite aggregate. As stated previously, the policy variable has a direct effect on market demand, suggesting that liberalization policy may potentially affect the supply side of the market as well. For example, changes in the number of passengers are dependent on the fare price that strikes a balance between the supply and demand, which, in turn, are contingent on certain market conditions. In equation (2), we modelled demand (i.e., passenger flow) as a function of fare and "gravity" variables. Therefore, Table 5 presents the effect of fare on passenger flow (i.e., air travel demand) to account for the indirect effect of the demand and supply equilibrium.

Most of the estimated coefficients are consistent with our expectations. Our main variable of interest is fare which we observe to exert significant negative effect on passenger flow at 1% level (or higher) across all models. Specific to model (3) in Table 5, the results suggest that a 1% increase in fare would lead to a decrease in passenger flow by about 0.7%. In this regard, the responsiveness of passenger flow (i.e., air travel demand) to changes in fare price is, therefore, inelastic. The estimates are also in line with previous findings (Abate, 2016; Njoya et al., 2018; Adler et al., 2018).

The estimated coefficient for population, distance and visa openness as reported in Table 5 are also consistent with our expectations. While the negative coefficients on Visa openness indicates high barriers to entry (i.e., lack of openness), the positive coefficient on distance suggests that long distances are associated with higher passenger flows. This is even more pronounced as distance further increases, as indicated by the positive coefficient of distance square. Similarly, higher population is associated with high passenger flow. The estimated coefficient for GDP per capita shows an unexpected result that high GDP per capita is negatively correlated with passenger flow. It should be noted that African countries such as Gabon and Seychelles have a high GDP per capita but are very small in terms of population. Some other small countries in terms of GDP per capita such as Rwanda and Togo have successfully positioned themselves as business and aviation hubs. These are possible explanations to the above finding.

In model 3, the adjusted R-squared is above 55%, an indication that the explained variations in our model are reasonably fair. The F-statistic indicates that regressors in each column and in all regressions are jointly significant at 1% confidence level.

#### 4.1.4. Effect of liberalization on passenger flow

The estimates we obtained, so far, establish the significance influence of liberalization (i.e., BASA) on fare price (Table 4), and in turn, fare price prompted a significance influence on passenger flow (Table 5), thereby reinforcing our argument that the effect on liberalization on air travel demand is indirect: first affecting fare price and then passenger flow. Therefore, to analyse the effect of liberalization on passenger flow, we estimated equation (3) and summarised the results in Table 6. As with preceding estimations, we estimated three distinct models: one with only BASA but no controls (model 1), one with BASA and country-pair variables (model 2), and one with all these and gravity variables (model 3).

In models (1) and (2), the coefficients of BASA report insignificant

 

**Table 5**
Effect of fare on passenger flow (Two-stage least squares estimates).

| VARIABLES | (1) | (2) | (3) |
|---|---|---|---|
| | No controls | Country pairs | All variables |
| Fare (*ln*) | −0.986*** | −0.611** | −0.676*** |
| | (0.118) | (0.315) | (0.206) |
| Population (*ln*) | | 0.306*** | 0.439*** |
| | | (0.051) | (0.072) |
| GDP per capita (*ln*) | | −0.088 | −0.101** |
| | | (0.106) | (0.051) |
| Distance (*ln*) | | | 2.512*** |
| | | | (0.593) |
| Square of distance (*ln*) | | | 4.996*** |
| | | | (0.237) |
| Destination risk (*ln*) | | | −0.041** |
| | | | (0.018) |
| Visa openness (*ln*) | | | −0.804*** |
| | | | (0.211) |
| Common language | | | 0.063 |
| | | | (0.127) |
| Common border | | | −0.335** |
| | | | (0.172) |
| Constant | 15.750*** | 68.726*** | 72.016*** |
| | (0.785) | (9.002) | (9.144) |
| Country fixed effect | Yes | Yes | Yes |
| Time fixed effect? | Yes | Yes | Yes |
| Country-pair fixed effect | No | Yes | No |
| Observations | 330 | 330 | 330 |
| R-squared | 0.2786 | 0.4277 | 0.5513 |
| Adjusted R-squared | 0.2559 | 0.4138 | 0.5405 |
| F-stats | 12.95 | 58.22 | 89.04 |
| F-stat (p-value) | 0.0000 | 0.0000 | 0.0000 |
| Endogeneity test (p-value) | 0.0000 | 0.0034 | 0.0016 |
| **First Stage Regression:** | | | |
| Dependent variable: Fare (*ln*) | | | |
| **Excluded instrument:** | | | |
| Fuel price (*ln*) | 1.037*** | 1.207*** | 1.309*** |
| | (0.032) | (0.133) | (0.126) |
| Partial R-squared | 0.9123 | 0.8127 | 0.8218 |
| F-test of IV. | 1024.25 | 1362.04 | 1406.17 |

**Note:** Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. (*ln*) indicates natural logarithmic while NA indicates not applicable. The Hansen overidentification test p-value could not be reported here because we used one instrument (Fuel price) for fare.

**Table 6**
Effect of liberalization on passenger flow (Fixed Effect estimates).

| VARIABLES | (1) | (2) | (3) |
|---|---|---|---|
| | No controls | Country pairs | All variables |
| BASA | −0.050 | −0.077 | 0.156** |
| | (0.098) | (0.092) | (0.037) |
| GDP per capita (*ln*) | | −0.406*** | −0.517*** |
| | | (0.038) | (0.055) |
| Trade (*ln*) | | 0.082*** | 0.093*** |
| | | (0.026) | (0.031) |
| Population (*ln*) | | 0.966*** | 0.972*** |
| | | (0.464) | (0.031) |
| Visa openness (*ln*) | | | −0.984*** |
| | | | (0.204) |
| Destination risk (*ln*) | | | −0.107** |
| | | | (0.052) |
| Constant | 9.539*** | 36.290*** | 39.056*** |
| | (0.079) | (1.827) | (1.947) |
| Year fixed effect? | Yes | Yes | Yes |
| Country fixed effect? | No | No | No |
| Observations | 330 | 330 | 330 |
| R-squared: | | | |
| Within | 0.4140 | 0.4096 | 0.4219 |
| Between | 0.2344 | 0.2045 | 0.2566 |
| Overall | 0.1888 | 0.2011 | 0.2123 |
| F-stats | 17.64 | 84.07 | 106.11 |
| P-value (F-stats) | 0.0000 | 0.0000 | 0.0000 |

**Note:** Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. (*ln*) indicates natural logarithmic. We dropped fare because BASA also affects fare which, in turn, affects passenger flow as captured by equation (1). We conducted an F-test for the country-fixed effect and the results did not support including it in model (3).

negative values (−0.050, and −0.077), respectively, which are clearly counter-intuitive as per our prior expectations. This is rather unsurprising because of the obvious omission of the gravity variables that are critical in these equations. Incorporating these variables provide better estimates as reported in model (3). Therefore, while we acknowledge the obvious omitted variables bias in model (1) and (2), we are contended that results of model (3) are robust and conform to our expectations. It is interesting to note that estimated coefficients have maintained the same pattern in terms of signs.

In general, the results correspond to our anticipations. In countries where liberal BASA is in operation, air passenger traffic is on average higher than in countries that have restrictive BASA arrangements with Tanzania. The coefficient estimated by our model is 0.156, corresponding to an estimated average increase of 16.9%.[18] This means that between 2010 and 2018, Tanzania's air transport liberalization successfully increased the flow of passengers travelling within Africa by an average of 16.9%. This growth is rather modest in comparison to findings from a sample of other countries. Abate and Christidis (2020) report, for instance, that the EU's external policy on air travel successfully increased the flow of passengers (i.e., air travel demand) by over 27% between 2002 and 2014. Nevertheless, considering that the EU is the most integrated macro-region, it is expected that it would have a higher volume of air traffic due to various reasons such as tourism, entertainment, business, education, medical care, etc., even after controlling for the primary factors (e.g., income) that affect air transportation (Dobruszkes & Vandermotten, 2022). Given the nature of African countries and the type/reason for travel, the 16.9% increase shown by our estimates is a reasonable reflection of intra-African air travel demand.

Other empirical studies in air travel literature also exemplify the vital role of liberalization in passenger flow. Foster and Briceño-Garmendia (2010) demonstrate that liberalizing intra-African air travel and intensifying air safety regulation and training are required to improve intra-African air travel, whereas Abate (2013) found that liberalized states in Ethiopia experienced a 40% increase in departure frequency in comparison to restricted states. This is consistent with the findings of Ismaila et al. (2014), whose findings indicate that liberalization agreement had a significant effect on international routes to Nigeria, as removing restrictions increased traffic by 33%. Earlier on, Myburgh et al. (2006) also found that liberalized routes in the South African Development Community had 18% lower fares than non-liberalized routes. And in a more comprehensive study, Burghouwt et al. (2015) established that liberalization exhibit positive benefits such as lower prices, increased demand, enhanced connectivity, and broader economic gains through trade and tourism.

Among the control variables reported in Table 6, we observe that destination risk appears to have significant effect on passenger flow. But in general, the other variables have reasonable signs and are statistically significant at 1% level.

[18] This is obtained by the expression: $e^{(0.156)-1}$, where 0.156 is the coefficient of BASA from Table 6.

Finally, we reported the respective first stage estimates for the excluded instruments for the endogenous variables (passenger flow and fare) in each table (i.e., Tables 4, 5). These variables were satisfactorily predicted by our instruments, resulting in strong F-statistics. The Sargant-Hansen test reported in Table 4 established the validity of our instruments, confirming that they are uncorrelated with the error term (i.e., $cov(z,\mu) = 0$). The reported partial R-squared, however, establishes the required correlation between the endogenous variables (fare and passenger flow) and the excluded instruments, thereby satisfying the requirement for relevance of the instruments, i.e., $cov(z, x) \neq 0$. The endogeneity p-values reported in the various tables, on the other hand, confirm that fare price and passenger flow are, indeed, endogenous.

## 5. Conclusion and policy implications

This paper examines the effects of the recent changes in aviation policy in Africa with reference to the provisions of bilateral air services agreements between Tanzania and the rest of African countries. Specifically, it has been argued that air services liberalization has stimulated traffic growth, reduced fare, and enhanced service quality. The objective of this study was to empirically assess the economic impacts of the liberalization of air services between Tanzania and other African nations. Specifically, we analyse the impact of Tanzania's air liberalization policy on intra-African air travel demand by exploiting the cross-sectional time series dimension of the Sabre data for a panel of African nations with which Tanzania has a bilateral air liberalization agreement between 2010 and 2018. We provide a variety of regression models, which we empirically estimate using the Fixed Effect estimator, and two-stage least squares estimator that is robust to endogeneity bias.

There are three principal findings from of this study which are highly related. First, it was demonstrated that the effect of liberalization on fare is marginal, thus indicating the air transport is not very sensitive to fare. But, unlike previous finding by Abate (2016) showing that air transport liberalization has no impact on fares, our study show that liberalization has an impact albeit small. This implies that while intra-Africa air transport remains a luxury, this finding is indicative of an increase in recent years in the demand for price sensitive leisure travel driven by increase sustained economic growth and the growth of the middle class. Second, and related to the first, is that the responsiveness of passenger flow to changes in fares is inelastic. It was observed that a 1% increase in fare would result in a 0.7% decline in passenger flow. The result is in line with previous findings by Abate (2016), Abate and Kincaid (2018) and Njoya et al. (2020). Third, it was found that air passenger traffic flow is on average higher in countries that have liberal BASAs with Tanzania as compared to the countries with restrictive BASAs. The result shows that between 2010 and 2018, Tanzania's air transport liberalization successfully increased the flow of passengers travelling within Africa by an average of 16.9%, which, when compared to findings from other countries, is rather modest.

This study has various implications for both theory and practice. Theory wise, the research suggests that removing restrictions on designation, frequency and capacity for intra-African air transport will lead to a (slight) decrease in fares and an increase in the passenger flow. It is probable that the rise in the number of passengers will enhance load factors. Load factors are a crucial measure of productivity and have consistently remained above 80% in Europe and North America in the years preceding COVID-19. However, in sub-Saharan Africa, they have been notably lower.

The policy implication of this study suggests that there may be a requirement to advocate for more liberal Bilateral Air Services Agreements (BASAs) that align with the Single African Air Transport Market. SAATM is expected to generate benefits for Tanzania and the continent beyond air traffic, encompassing social, economic, and political integration, as well as intra-Africa trade. However, the magnitude of these advantages will rely on the level of air transport development and the context of social, economic, and political integration and trade at both the national and sub-regional levels (Tolcha et al., 2021). The government might want to contemplate the possibility of easing visa requirements to the country. An interesting finding from the study indicates that eliminating limitations on intra-African mobility would be crucial in promoting aviation integration and air connectivity across Africa. According to the Africa Visa Openness Index generated by the African Development Bank and the African Union, in 2021, Africans did not require visas to enter 25% of the countries in the region, and 24% of the countries allow them to obtain visas on arrival. However, they still require visas to enter 51% of the countries. Tanzania has made substantial progress in reducing restrictions on the movement of people by welcoming Africans from 16 countries without a visa and allowing Africans from 25 countries to acquire visas on arrival. Nonetheless, the country still mandates Africans from 12 countries to obtain a visa before travelling.

A drawback of this study is the inability to assess the impact of regulating fifth freedom rights, which is a crucial provision of SAATM, owing to data constraints. Future research could examine the effect of fifth freedom rights and other SAATM provisions, such as full air cargo service liberalization and liberalized air tariffs. Moreover, future study could explore the impact of SAATM on flight frequency, which was not analysed in this study due to insufficient data.

## CRediT authorship contribution statement

**Eric Tchouamou Njoya:** Conceptualization, Methodology, Study design, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Aliyu Isah:** Methodology, Study design, Software, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

## Appendix

**Table 1a**
Summary of literature on air transport liberalization policy

| Category | Authors | Main Results | Cases Analysed | Methodology |
|---|---|---|---|---|
| Impact on fares and passengers | Piermartini and Rousova (2008) | Raising the air liberalization index from the 25th percentile to the 75th percentile may lead to a 30% rise in traffic volume. | 184 countries | Gravity model |
| | Ismaila et al. (2014) | Liberalization would result in a traffic growth of 33%–137%. | Nigeria | Cross-sectional regression model |

(*continued on next page*)

**Table 1a** (*continued*)

| Category | Authors | Main Results | Cases Analysed | Methodology |
|---|---|---|---|---|
| | Cristea et al. (2015) | Liberalization would in a traffic growth of about 30%. | Turkey and Arab countries | Gravity model |
| | Manuela (2017) | Airfare per kilometre on routes with a minimum of two airlines decreased by 10%. | The Philippines | Econometric model |
| | Maillebiau and Hansen (1995) | Liberalization would result in a traffic growth of 56%. | U.S. and five EU countries | Econometric model |
| | Button (1998) | After the US deregulation between 1978 and 1988, passenger traffic increased by 55%. | U.S. | Qualitative study |
| | Abate (2016) | Liberalized air transport within Africa exhibited enhanced service quality, but fares were unaffected by liberal policies. | Ethiopia | Two-stage-least-squares method |
| | Njoya et al. (2018) | Compared to markets with restricted market access, liberalized routes witnessed a 14% decline in airfares and a 28% increase in departure frequencies. | European Union and African countries | Econometric model |
| | InterVISTAS-ga (2006) | After liberalization, traffic rose by an average of 12–35%, sometimes surpassing pre-liberalization rates by over 50%. | 1400 country-pairs worldwide | Gravity model |
| Air cargo markets | Micco and Serebrisky (2006) | Liberalization reduces air freight costs by 9% and increases the share of imports by air by 7%. | Developed and emerging economies | Cross-sectional regression model |
| | Geloso, Grosso, and Shepherd (2009) | A one-unit increase in the air liberalization index correlates with a 4% increase in bilateral parts and component trade. | APEC countries | Gravity model |
| Regional aspects | IATA & InterVISTAS (2014) | Implementing the Yamoussoukro Decision would result in a traffic increase of 51%–141% and a fare decrease of 25%–35%. | 12 countries African Union nations | Gravity model |
| | IATA & InterVISTAS (2021) | SAATM implementation would lead to a 51% rise in intra-Africa traffic volume and a 26% reduction in average intra-Africa fare. | 54 African countries | Gravity model |
| | Myburgh (2006) | Liberalization would lead to an 18% decrease in fares and an increase in demand. | 12 SADC countries | Econometric model |
| | Surovitskikh and Lubbe (2015) | Intra-African traffic growth could be boosted by 2–4% with fifth freedom rights. | Intra-African and regional markets | Econometric model |
| | Abate and Kincaid (2018) | Liberalization is projected to decrease the average fare by 9% and increase traffic and frequencies by 29% and 41%, respectively. | Five East African Community countries | Two-stage-least-squares method |
| | Doove et al. (2001) | Restricted routes may see an increase in costs for discount fares, ranging from 3% to 22%. | Asia Pacific | Econometric model |
| | Abate and Christidis (2020) | EU's air service agreements with regional blocs result in a 6–23% reduction in average base fares and a 27% surge in passenger volumes when contrasted with bilateral agreements. | European Union and regional blocks | Two-stage-least-squares method |

**Table 1b**
Data source and variables definition/measurement

| Variable | Measurement/definition | Sign expected | Data source |
|---|---|---|---|
| **Total passenger flows** | Natural logarithm of total passenger flow between Tanzania and country j | + | Sabre Market Intelligence |
| **Distance** | The unweighted average distance between Tanzania's largest airline market/airport and Country j's largest airline market/airport, measured in kilometres. | + | Great circle distance |
| **Total population** | Natural logarithm of the product of total population of Tanzania and country j | + | World Bank development indicators |
| **GDP per capita** | Natural logarithm of the product of GDP per capita of Tanzania and country j (in millions of USD) | + | World Bank development indicators |
| **Trade** | Natural logarithm of import and export product from Tanzania and to country j (in millions of USD) | + | World Integrated Trade Solution |
| **Visa** | 1 if visa is required and 0 otherwise | − | https://www.visaopenness.org |
| **Fare** | Unweighted (route-based) average round-trip airfare for the most popular route between the capital cities of two countries (in hundredth of USD). | − | Sabre Market Intelligence |
| **BASA** | We used CATPCA to generate this variable. See section 3.2 | ± | Government of Tanzania |
| **Common border** | 1 if country i shares border with Tanzania, and 0 if otherwise. | ± | https://geology.com/world/world-map.shtml |
| **Common Language** | 1 for common language and 0 for the opposite between Tanzania and country j | + | United Nations official Languages |
| **Destination risk** | Natural logarithm of conflict index sum for Tanzania and country j | − | Global Conflict Risk Index |

**B. SIGNED BILATERAL AIR SERVICES AGREEMENTS**

| S/No. | Country | Designation | Frequency/ Type of Aircraft | Date of last review | Date of initiation for the first time | Operating Carriers |
|---|---|---|---|---|---|---|
| 1. | Singapore | Multiple | • Unlimited weekly frequencies<br>• Any size of aircraft | • Reviewed in July 2013;<br>• Signed in September 2013 | 16 August 1986 | No airlines operate |
| 2. | Germany | Multiple | • Up to 14 per week<br>• Any aircraft size | • Reviewed in December 2006;<br>• Signed in September 2012 | 29 December, 1978 | Condor Air |
| 3. | Jordan | Multiple | The designated airlines shall be free to decide on frequencies and capacity to operate the agreed services | • No review;<br>• Signed in January 2011<br>• Reviewed on 7 December 2017 by amending the BASA. | 19 February 2010 | No airlines operate |
| 4. | Turkey | Multiple | • Up to 14 per week<br>• Any aircraft size | • No review;<br>• Signed in February 2010 | 6 October 2009 | Turkish Airlines |
| 5. | Mozambique | Multiple | • Determined by the designated airlines<br>• Any aircraft size | • Reviewed in July 2009;<br>• Signed in August 2009 | 29 October 1977 | Air Mozambique (LAM) |
| 6. | Burundi | Multiple | • Unlimited frequencies<br>• Any aircraft size | • Reviewed on 31 July 2008<br>• Signed on 2 April 2009. | 8 December 1977 | Air Tanzania |
| 7. | China | Multiple | • To be agreed between contracting parties<br>• Any aircraft size | • No review;<br>• Signed in April 2008 | 23 May 2006 | No airlines operate |
| 8. | Rwanda | Multiple | • Up to 14 per week<br>• Any aircraft size | • No review;<br>• Signed in September 2006 | 30 May 2006 | Rwanda Air |
| 9. | Thailand | Multiple | • Unlimited frequencies<br>• Any aircraft size | • Reviewed in May 2005;<br>• Signed in August 2006 | 20 May 2005 | No airlines operate |

**Fig. 2.** Signed Bilateral Air Service Agreement between Tanzania and other countries.
**Source:** Carved from: https://www.tcaa.go.tz/ctrback/docs/XSW1DN1GZTSo20230726164640.pdf

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