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THE ROLE OF STRATEGIC AIRLINE ALLIANCES IN AFRICA

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Abstract

This paper looks at the impacts of strategic airline alliances on African aviation. Globally, there has been an on-going trend towards airlines coordinating their activities via strategic alliances and joint ventures. These alliances affect market competition including the quality and costs of the services provided. Despite the economic benefits found in prior analyses of alliances in other markets there has been very limited study of alliance participation by African airlines. Our analysis suggests, among other things, that membership of one of the three global alliances could benefit African airlines, add to their passenger flows, and enhance regional economic integration.

Key words: Africa's strategic air alliances; airline economics; airline cooperation; airline networks
JEL Listing: K21, L93, N37, R4

INTRODUCTION

The United Nations forecasts that the 2020 Covid-19 pandemic will reduce global international air passengers by between 2.63 and 2.91 billion passengers from 2019 levels, with a fall of 92% in seat capacity in the second quarter of the year, including a 94% decline in Africa.[1] The longer-term implications are more uncertain. Although it seems likely that Covid will change airlines, it is unlikely to change fundamental airline economics. This paper looks at one of the pre-Covid developments in African aviation that may provide for a more robustness recovery of the sector and, in the long term, playing a greater role integrating Africa's economies. This involves strategic airline alliances linking fragile African airlines with stronger carriers from other regions.

Prior to 2020, overall African's economy, albeit unevenly, was gradually beginning to grow. The continent's average year-on-year real gross domestic product growth rate was 5.2% over the preceding decade. There is no consensus as to the forces behind this. The continent is rich in mineral resources and exploitation of this has become easier. It has seen notably greater political stability than in the past, and this has been combining

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[1] https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf

with more foreign direct investment and multilateral aid. Despite of this, the physical geography of the continent with its many inhospitable zones, combined with a lack of fixed infrastructure and adequately trained labor, is, however, limiting economic development. Transportation is a particular problem given the size of the mega-region, its relatively low overall population density, and the rapid spread of urbanization.

Air transportation acts as a lubricant to international trade and development, carrying some 35% of world trade by value[2]. It is the main mode for the rapidly expanding tourism sector and is important for exporting "exotics" (flowers and fruits), and for the movement of high value/low volume components. With a few national exceptions, however, Africa lags in terms of air transportation infrastructure (airports and air traffic control) and complementary surface access facilities. Our attention is on the pre-Covid changes that have been occurring in Africa's airline sector, and particularly on the influence of strategic alliances. The latter are sanctioned cartel arrangements aimed at overcoming natural and institutional impediments to trade in air services.

Globally, many airlines have sought to improve their services by integrating them with other carriers. Their aim being to generate greater network economies and, in some cases, circumvent restrictive air service agreements. While a large share of trade in aviation services is now provided under the umbrella of mega-global alliances this is not, however, the situation in Africa. Why this is so is not the story we are interested in. Rather we are concerned with the greater advantages, if any, that African alliance members have enjoyed and how these carriers have been accepted into established alliances.

We begin by outlining important and germane trends in Africa's aviation markets. The focus is almost entirely on airlines. There are also issues regarding the efficiency of air traffic control and of many of Africa's airports, but these are not dealt with. They are governed within institutional structures that are largely independent of the airlines and their regulation. We move to provide a broad outline of airline activities in Africa together with some comments on the role of alliances. This provides a segue into an empirical assessment of the role of airline alliances in the continent.

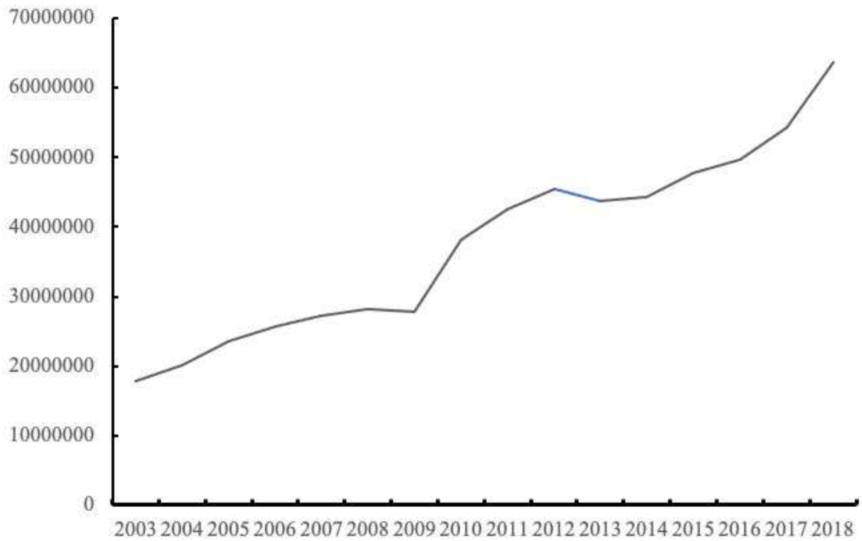
AIRLINE MARKETS IN AFRICA

After Antarctica, Africa is the world's smallest continental airline markets. The continent has a population of 1.3 billion living in 54 countries, and its geography is characterized by vast distances and increasingly by large urban concentrations (Lubbe and Shornikova, 2017; Button et al, 2015). In 2019, Africa had 731 airports and 419 airlines, but the majority were small, locally oriented, and unprofitable. Despite representing 15% of the world's population Africa's has just 2.1% of its commercial large aircraft, with seven countries accounting for 90% of the fleet.[3] Added to this, the African airline fleets are generally old.[4]

[2]https://www.iata.org/en/iata-repository/publications/economic-reports/airline-industry-economic-performance---december-2019---report/
[3]Data extracted from UN International Civil Aviation Organization sources.
[4]Amankwah-Amoah and Yaw (2010) provide some thoughts on this.

African carriers are relatively small, especially in Sub-Saharan Africa and overall lose money – $100 million in 2018 according to the International Air Transport Association (IATA). They benefit little from limited economies of density and scope, and many are subjected to considerable political interference. There has been marked instability with carriers regularly entering and leaving the market. More recently, African airlines have had to compete with large Gulf carriers, such as Emirates, and Turkish Airlines on inter-Continental routes (Pirie, 2017). There were discussions pre-Covid involving South African Airways, Kenya Airways, Air Mauritius, and RwandAir to form an alliance to more effectively combat this competition; what may be seen as a defensive cartel (Herold and Paha, 2018). There have also been efforts at creating multilateral air transportation common markets, including the formation in 2018 of a Single African Air Transport Market (SAATM) aimed at removing barriers to aviation trade within Africa. As it becomes operational it will cover about 80% of the African market.[5]

There had been something of an upturn in African aviation until Covid hit – see Figure 1 for trends in Sub-Saharan Africa.[6] Forecasts for aviation activities in Africa were also by historic standards optimistic. Boeing Commercial Airplane (2019), for example predicting that traffic to, from, and within Africa would grow annually by 5.9% a year between 2019 and 2038, with intra-African traffic increasing by 6.5%, and traffic involving Africa and the Middle East and Asia-Pacific growing by 7.6% and 6.7% respectively. As indicated earlier, however, the post-Covid forecasts are now very pessimistic.



Note: Air passengers carried include both domestic and international aircraft passengers of air carriers registered in Sub-Saharan Africa.
Source: World Bank

Figure 1. Trend in air passenger traffic for Sub-Saharan Africa (2003-2018)

[5]Whether the aims of the SAATM will be met cannot be foretold, but previous experiences with efforts at forming multilateral air services agreements, such as the Yamoussoukro Decision, did not proved very successful (Lubbe and Shornikova, 2017; Njoya, 2016).
[6]See: https://data.worldbank.org/indicator/IS.AIR.DPRT?end=2005&start=2005&view=map

One way of improving the economics of African airlines could be by linking into non-African carriers' networks. But this has been limited so far. Historically, non-African airlines, and notably those from former colonial powers, have acquired financial holdings in African carriers (Meichsner et al, 2018). Examples include, British Airways acquiring 18% of South African Airways in 1996, Air France with Tunisair (5.6% in 1948), Royal Air Maroc (2.7% in 2000), and Air Mauritius (2.8% in 1967).[7] There have recently also been limited attempts to develop joint ventures. The most notably involves Qatar Airways and Royal Air Maroc agreeing to jointly operate several routes. Additionally, a few joint ventures have been attempted in air cargo; e.g., DHL Global Forwarding and Ethiopian Airlines formed one in 2018.

The liberalization of passenger services which began in the US with the enactment of the 1978 Airline Deregulation Act, and was internationalized through the adoption of Open Skies policies by the US in the 1990s was a factor in the creation of alliances. The outcome of open skies policies, however, has not been totally free trade. In most countries domestic feeder services remain the monopoly of national "citizens" with limitations on foreign ownership. This prevents the provision of seamless services between trip origins in one country and destinations in another when travelers move from beyond gateway airports.

To circumvent some of these institutional restrictions, and in particular the inability to carry domestic feeder traffic to and from international flights, airlines began to form alliances (Barla and Constantatos, 2006; Ito and Lee, 2007). For example, a US carrier in partnership with a German carrier would provide domestic US feed to both airlines' transatlantic routes and the German airline would service feed from its end of the routes. There are now three major global airline alliances each with 20 or more partner airlines – SkyTeam, Star Alliance, and oneworld. They carried nearly 2,086 million passengers in 2016, about 60% of the world's total. Academic studies have generally found in favor of alliances, although with some caveats regarding hub domination and impediments to new entrants participating in markets.[8]

In some markets, alliances have been further developed as joint ventures. These involve airlines in specific markets to align service offerings, share costs and revenue, as well facilitating risk spreading more generally (Bilotkach, 2019). For all practical purposes, a joint venture is a merger that applies only to certain defined routes and requires government antitrust immunity. Examples include Delta's Transatlantic partnership with KLM/Air France, Alitalia, and Virgin Atlantic, and United Airlines' transpacific partnership with ANA. The defining feature of a joint venture is so-called "metal neutrality", as all costs and revenues are shared among the partners irrespective of whose aircraft is used.[9]

Consideration of the role alliances have played in African aviation is timely, and not just in terms of the implications of Covid. We have already noted the largely failed efforts to remove bilateral barriers to international trade in air services in Africa. Njoya

[7]There have been also been efforts to develop pan-African airlines. These have, often for political reasons, not fared well. Amankwah-Amoah (2017) provides an account of the history of Air Afrique.
[8]More recent analysis of the subject include, Brueckner and Singer (2019) and Calzaretta et al (2017).
[9]For example, Delta does not care if a Transatlantic customer is on a Delta plane, or partner's plane of say KLM or Air France. Behind the scenes, costs and revenues are divided. Both alliances and joint ventures normally require the governments involved to grant immunity from antitrust laws.

(2016) attributes part of this failure to lack of cooperation between African carriers and airlines from elsewhere. But new institutions are emerging that will require new thinking on the part of airlines and policy makers. The 2018 initiative to form an African Continental Free Trade Area (AfCTA), and associated with it the SAATM, has gone ahead despite the pandemic. This should offer new opportunities of all kinds. But it will involve not only the continent's airlines having challenging business decisions to make, but also governments having to rethink the institutional structures within which airlines operate.

Our focus is on outcomes for some of the major African airlines that have joined global strategic alliances. Their engagement has been a recent trend, although we do not speculate extensively on why this is so. Amankwah-Amoah and Debrah (2011), however, provide useful background material to their emergence. There may have been a reluctance of nationalistic African carriers to join alliances generally dominated by European and US airlines. On the other side, it may have been that the latter have not been keen to have Africa's smaller, and often poorly managed and aged fleets, as close business partners. In some cases, African airline may not have a useful hub to fit within an alliance's network. Our interest, however, is in whether the African airlines that do belong to strategic alliances benefit from their membership.

DATA AND MODEL

Data

Data on the African aviation market, although improving, are still considerably less comprehensive than for US and European, or even Asian, markets. Much of the data used here are from the Official Airline Guide (OAG) combined with that available in African Airlines Association (AFRAA) annual reports supplemented from other official sources. The data, which covers 2011 to 2018, relate to the major African airlines. They provide an unbalanced panel of the main African airlines that were in the market over the period.

Our underlying intuition is that through economies of density, scope, and market presence emanating from membership of a global alliance, African airlines receive a boost to their passenger flows and load factors. With an average of 60.7%, prior to Covid Africa's airlines had the lowest load factors in the world.[10] On the cost side, alliance-specific efficiencies can be gained through shared back office functions, maintenance facilities and operational staff as well as marketing advantages of integrated frequent flyer programs. Economies of market presence, basically offering travelers a wider choice of connecting services, can increase passenger volumes. Assuming that transaction costs of membership are relatively low, and that the airlines are efficient in their dynamic third-degree price discrimination (yield-management), membership of an appropriate alliance can help improve their financial performances.[11]

Dependent variables

We examine two physical metrics that are likely targets (dependent variables) for airlines when joining an alliance; greater passenger numbers and higher load factors.

[10] https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf

[11] Membership of alliances often change as market conditions and the performance of individual carriers vary. It is implicitly assumed throughout that carriers form the optimal partnership when joining an alliance.

One could argue that financial measures are superior, and these have been used in other market areas. In the African context, where subsidies are widespread and often opaque, their usefulness is less certain. In addition, both physical measures have pedigrees in the alliance literature.

In less regulated markets, airlines price-discriminate in a variety of ways; e.g., by the date of a flight, the time of a flight, when seats are booked, the class of seat, loyalty, and the number of seats available. Some elements of these differences in fares reflect cost differentials, but a large element is designed to capture passengers' consumers surplus, i.e., "pricing down the demand curve." The development of computerized booking systems allows for a continual up-dating of the fares offered, and hence dynamic yield management (Escobari et al, 2019). Given the low marginal costs of filling an extra airline seat once a schedule has been established, efficient yield management and large numbers of passengers should produce higher net revenues. The fundamental difference in looking at load factors, as well as passenger numbers, relates to how extra passengers are accommodated. Simply considering passenger numbers makes no explicit allowance for any efficiency gains in the use of aircraft and crew, whereas load factors can be interpreted as an efficiency measure. Furthermore, load factors, differently from passenger volumes, do not depend on airline size.

Passenger numbers have been used by Dresner and Windle (1996), Whalen (2007), Bilotkach and Hüschelrath (2012), and others to assess alliance performance. Their logic being that airlines pay particular attention to their traffic levels. For example, South African Airlines (2018) explicitly states that passenger numbers are a key metric in measuring performance. However, increased aggregate traffic does not automatically increase net revenues for allied airlines. As Flores-Fillol and Moner-Colonques (2007) demonstrate, if there is a minimum size of increasing returns to economies of density then traffic volume will rise, but dependent on factors such as competition from other alliances and the ability of the new alliance to effectively differentiate their products, profits may fall. The beneficiaries may in this case be passengers who enjoy greater levels of consumer surplus.

Load factor also has been used in analyzing alliances (e.g., Wan et al, 2009; Yimga and Gorjidooz, 2019; and Bilotkach and Hüschelrath, 2019). This metric differs from passenger numbers by introducing notions of economic efficiency. An airline can increase its capacity by either adding to its fleet or by making better use of the seats it has available. Load factor captures the latter effect, as well allowing for the former.

In terms of data, OAG annual seats is combined with AFRAA Annual Reports of load factors. This combination is preferred to using AFRAA passenger estimates because of inconsistences in the latter's data. Where there exist missing load-factor data the average of the previous and the following years (if available) are used or the value of the closest year for the airline.

The variable of interest, *Alliance*, may be considered endogenous with respect to both passenger volume and load factor. While it is true that being alliance member may improve a carrier's performance in terms of passengers and/or load factor, it is also true that alliances tend to favor new members that offer safe services, robust traffic levels, and network complementarity (Park, 1997; Forbes and Lederman, 2009). Initially, this possibility is ignored in our calculations, and alliance membership is treated as a straightforward exogenous influence on passengers, but then it is introduced as having endogenous effects.

There are differences between the strategic alliances and the details of individual membership. In many cases this results from differing national policies, for example national competition laws. But these variations are unlikely to make a significant difference to the implications of being a member. This also holds for the limited joint ventures involving African carriers. If an airline is a member of one of the three strategic alliances (SkyTeam, oneworld, Star Alliance) this is reflected in an unweighted binary variable taking a value of unity for membership. In fact, the Star Alliance, with Egyptair, Ethiopian Airlines, and South African Airlines as members, probably offers more benefits to most African countries than others. Skyteam only has Kenya Airways as a member, and this is from 2010.[12] Additionally, Ethiopian only joined Star Alliance in December 2011 and because of the transition into this its associated dummy is set at unity for 2011. Results are very similar, however, if 2012 is assumed the starting date.

Independent variables

Several controlling factors are considered, some of which enter the analysis as instruments.

Prices of airline tickets are largely dependent on a potential passenger's willingness-to-pay. They are determined by dynamic price discrimination or yield management. Because of a lack of good data on this - there is nothing like the 10% US airline ticket sample - distance is sometimes taken as a proxy for fare. Given that airline costs fall per kilometer travelled as the fixed and high costs of take-offs/landing are spread over more kilometers, one would expect a negative relationship with passengers. In previous studies of African aviation, however, this has not been the case – see for example, Button et al (2017) and Grosche et al (2007).

The explanation may lie in multicollinearity of distance with other excluded variables. Because, forecasting is not an objective here this is not seen as a major issue. Alternatively, the positive effects of distance fit with a pattern of transportation whereby aviation has a comparative advantage over longer distances where effective competition is least. This is in line with many corridors in Africa. It may also reflect the proportion of intercontinental, business orientated routes in an airline's portfolio for which demand tends to be more inelastic and which are served by full-service airlines (International Air Transport Association, 2008). The link between load factor and distance, however, may be expected to be positive. Longer flights tend to use larger aircraft, carry more belly-hold cargo, serve truck routes, and are often restricted as to when services can be scheduled. These make it more efficient to consolidate traffic.[13]

The route kilometers flown by an airline is extracted from OAG data as the ratio of an airline's seat kilometers divided by airline seats. The variable can also provide insights

[12]Oneworld's sole African representative is South Africa's Comair, a very small British Airways franchise holder handling short-haul services. It is not included in the analysis.

[13]In 2019, in the US Southwest, seen as a low-cost carrier, enjoyed a load factor of 83.5%. Airlines that served a mixed domestic/international market involving longer average distances had higher load factors; Delta, 87.7%, United, 85.8% and American 86.9% (https://www.google.com/search?client=firefox-b-1-d&q=BTS+airline+load+factors).

into the business models of an airline. Short-haul markets tend to have a predominance of low-cost airlines whereas long- and medium haul markets are served by larger, generally full-service carriers. Here we consider the effects of a distance break effect at 2,500 kilometers with *Distance* being a dummy variable for the longer flights. This conforms to the convention used within the industry.

Service *Quality* in transportation is generally treated in terms of variables such as journey time, non-stop trips, and frequency of service. Here it is expressed as the average flight frequency per route. This offers a measure of service density. Using OAG data the number of an airline's yearly frequency is divided by number of airline yearly airport-pairs. A=>B and B=>A are considered as separate routes to capture the effects of direct services.

Aviation *Safety* has long been an issue in Africa and has been a deterrent to flying. Globally aviation has an extremely good safety record, 1.35 accidents for every million flights in 2018. While Africa had the worst accident record between 2013 and 2017, recently, however, this has improved with no jet hull loss in 2018 and 1.39 per million flights in 2019. While some African carriers, notably South African Airways and Ethiopian Airlines, have good safety records, others fall short. Specific problems are posed by a climate which can be challenging, infrastructure that is poor, and shortages of experienced, skilled personnel (Gwilliam, 2011).
While measurement is difficult because of small samples, those focusing on the aviation safety market have found from event studies that, with rare exceptions, carriers' businesses recover quite rapidly after an accident. For this reason, we use the sum of accidents in the previous five years.[14] Most previous studies have been incident related looking at the link between an airline incident and its subsequent performance in terms of the airline's share price (Bosch, et al, 1998), its profits (Rose, 1990) or its air fares (Zotova, 2017).[15]

Many African airlines are entirely or partly government owned. This may be for a variety of reasons. Airlines serve a strategic role, both in the military sense and in terms of offering standby capacity at times of civilian crises, such as natural disasters. They can also serve an integrative, political role in the administration of a country. While some of these objectives may be obtained through regulation, a controlling degree of ownership of an airline provides more direct power to influence its activities. A range of studies, however, support the argument that direct government control can adversely affect the performance of carriers. Gillen et al (1989), for example, found government ownership reduced productivity of Air Canada by 23% between 1964 and 1981. Similar findings are found in Davies (1971) regarding Australian airlines.

Inefficiencies seem to arise in imperfect markets and especially when a publicly owned airline is not subjected to adequate competitive pressure. Policy actions and academic work looking at many sectors suggest that the cut-off point at which the level of government ownership affects a company's behavior is 51% (e.g., Abramov et al,

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[14]The data were extracted from https://aviation-safety.net/database/. We compute the number of accidents in the five years before and divided it by the ratio of the frequency in the current year. We adjust to obtain accidents per 1000 flights.

[15]Because airline alliances value the safety records of its members this may introduce an endogeneity problem. Airlines seek to join an alliance to improve their financial performance which, *ipso facto*, will affect their subsequent safety record. Allowing for such long-term lags is beyond the scope of this paper.

2017). Given the two dependent variables used, passengers and load factors, the implications for significant government ownership are not always clear. For passengers, it can be positive because government involvement may engender stability into an otherwise volatile market and thus support greater demands for travel.[16] The load factor coefficient is basically an efficiency indicator. A negative coefficient for this suggests the presence X-inefficient - a lack of managerial incentive to minimize costs. The *Majoritygovernment* dummy variable reflects whether government has a majority ownership of an airline.[17].

Geographically Africa is divided by the Sahara Desert. The northern part of the continent is largely comprised of several the Maghreb countries which have long-established economic relationships with other countries bordering on the Mediterranean. Many also have well established and substantial tourism industries that rely on air transportation. To examine the effects of this on airline alliances, a dichotomous dummy, *Sub-Saharan*, is used to distinguish carriers based south of the Sahara from those based in North Africa.

To reflect the effects of aggregate market trends in aviation on individual airline services the variable *Aggregatepassengers* is used. These data are World Bank estimates of annual passengers carried in Africa. An alternative to this would be to use OAG data on annual international seats available. The trouble is that airlines adjust their capacity following changes in demand; *Aggregatepassengers* encapsulates this reaction. (In fact, using seat availability has minimal effect on the estimates derived.)

Finally, because *Alliance* may be considered endogenous with respect to both passenger volume and load factor, we consider a set of variables that may explain alliance membership. These are selected to capture both the factors that influence airlines wanting to join an alliance and those that stimulate an alliance to accept them (Gaggero and Bartolini, 2012). These instruments are selected so as not to directly affect passenger volume or load factor.

An airline carrying a large proportion of national traffic may negatively affect its prospects of participating in internationally oriented alliances. While domestic services are important for feed, most alliances seek large international airlines as partners because of global network synergies. The variable adopted here identifies national carriers that focus on their domestic rather than on international markets on the basis that they are less likely to join an alliance. We compute *Domesticshare* as the share of the domestic seats on the aggregate number of seats provided by a specific carrier to ensure the instrument is not correlated with passengers.

The fear of being left behind is something suggested by Gaggero and Bartolini (2012) as important in encouraging alliance membership. If others are entering alliances, then a carrier may feel excluded and seek to join – basically a "bandwagon" effect. As a

[16]This line of reasoning follows Spiller's (2013) argument that economic regulation (government ownership being an extreme version of regulation) is often aimed at limiting instability in naturally volatile markets. It helps to reduce the contracting hazards for firms and individuals located in an area. A listing of existing and defunct carriers is to be found at http://www.aerotransport.org/ providing some indication of market volatility.

[17]A government–private sector ownership dummy was tested but added nothing to the specifications adopted.

measure of this pressure, we use the number of airlines joining any alliance in prior periods, our *Alliancepressure* variable.

Airlines that have been in the market for some time (*Yearsinbusiness*) are likely to have benefitted from economies of experience.[18] They are likely to know their markets better and how to manage their costs more effectively than newer airlines. The underlying theory is that the longer a supplier works with a technology and in a particular market, the more productive it will be in using that technology (Yelle, 1971). This will result in an airline being more commercially stable, making it more attractive to an alliance seeking new partners.[19]

Table 1 provides summary details of the main variables used in the analysis.

Table 1. Summary African airline data (2011-18)

Variable	Observations	Mean	Standard Deviation.	Minimum	Maximum
Passengers	251	1916572	2910579	5088	1.38e+07
LoadFactor	251	0.636	0.103	0.413	0.813
Alliance	251	0.127	0.334	0	1
Quality	251	247	208	13	1408
Safety	251	0.092	0.236	0	1.846
Distance	251	0.120	0 .325	0	1
Sub-Sahara	251	0.725	0.4470	1	0
Majoritygovernment	251	0.709	0.455	0	1
Alliancepressure	251	3.916	3.610	0	11
Yearsinbusiness	251	42.211	25.058	0	86
Domesticshare	251	0.378	0.288	0	1
Aggregatepassengers	251	776e+07	8670080	6.68e+07	9.52e+07

RESULTS

Passengers

To gain a basic understanding of the situation, initial estimates of the implications for passenger numbers of alliance membership are obtained using standard ordinary least squares (OLS) estimation and, given the nature of the data set, a basic panel regression as specified by Equation 1.

$$\text{Log}Passengers = \alpha_0 + \alpha_1 Alliance + \alpha_2 Quality + \alpha_3 Safety + \alpha_4 Distance + \alpha_5 \text{Sub-Sahara} + \alpha_6 Majoritygovernment + \alpha_7 Aggregatepassengers + \varepsilon. \quad (1)$$

The results are given in Tables 2 and 3. In both cases the analysis provides a reasonable fit to the data with most variables being highly significant. Importantly, and irrespective of whether estimated using OLS or a robust panel random approach, the *Alliance* variable takes a positive sign and is significant at the one percent level thus confirming

[18]The concept goes back to the work of Oi (1962) and the idea of labor being a quasi-fixed factor. Basically, there is engrained capital in the labor and workings of a firm, in this case an airline.

[19]Although well-established carriers are not necessarily the most productive, *Yearsinbusiness* may influence, besides *Alliance* membership, the passenger volume or the load factor. However, this is not a methodological issue because of the presence of other instruments in the estimation.

that strategic alliance membership increases the passengers an African airline carries. The coefficient, however, seems large given the nature of the model specification. It is probable that it is capturing a pure size effect because larger airlines are usually the ones that become alliance members.

Table 2. Ordinary-least squares estimates (*Dependent variable: log-passengers*)[20]

	Coefficient	S.e.	t-value	P>|t |
Alliance	2.089	0.346	6.040	0.000
Quality#	0.639	0.257	2.480	0.176
Safety#	-1.357	-1.380	-2.120	0.041
Distance	0.642	2.040	3.230	0.049
Sub-Sahara	-1.354	0.396	-3.420	0.002
Majoritygovernment	0.514	0.311	1.660	0.107
Agggregatepassengers#	0.963	0.617	1.560	0.127
Constant	-7.074	11.723	-0.600	0.550

Expressed in log form
*The Ethiopian Alliance variable starts from 2011 when it entered into Star in December. This implies that *Alliance* is fixed in the dataset. As a result, running a panel fixed effect model sees *Alliance* becoming insignificant; the same as when airline dummies are introduced in the ordinary-least squares regression.
R-squared = 0.593; Root mean sum of errors = 1.000; Number of observations = 251

Table 3. Robust panel random effect estimates (*Dependent variable: log-passengers*)

	Coefficient	S.e.	z-value	P>|z|
Alliance	2.240	0.435	5.200	0.000
Quality#	0.850	0.188	4.511	0.000
Safety#	-0.472	0.406	-1.160	0.245
Distance	-0.166	0.218	-0.760	0.447
Sub-Sahara	-1.445	0.405	-3.570	0.000
Majoritygovernment	0.291	0.194	1.500	0.134
Aggregatepassengers#	0.785	0.467	1.680	0.093
Constant	-4.775	8.870	-0.540	0.590

Expressed in log form
R-squared; within groups = 0.361, between = 0.600, overall = 0.544; Number of observations = 251; Observations per group; minimum = 1; average = 7.2; maximum = 8; Number of groups =35.

The signs of coefficients for nearly all control variables correspond with *a priori* expectations. The exception is *Distance* which, when using ordinary-least squares estimation, takes a positive sign. As noted earlier, however, this is not out of line with prior studies of African aviation. The high level of significance of the *Sub-Sahara* dummy in both estimations confirms a geographical separation in markets between the Mediterranean oriented markets of Africa and those, often landlocked countries, south of the Sahara. Most of the former have long-standing colonial and trading links with France, Spain, and Italy, and have enjoyed significant flows of tourists from the European Union over recent years.

[20]Cluster options are used to indicate that the observations may be correlated within airlines.

From a policy perspective, the variable indicating majority government shareholding of an airline (*Majoritygovernment*) has a positive effect, albeit it statistically insignificant. This may be a weak reflection that state control of an airline adds stability to the market and this attracts more passengers. Additionally, carriers registered in Sub-Saharan countries have, as anticipated, lower passenger levels than those in other parts of Africa. As expected, the number of flights per route, our *Quality* variable is positive, although significant only in Table 2.

These single equation models that typify much prior work on airline alliances in larger, more developed markets such as the Atlantic, implicitly assume carriers have the freedom to choose to join an alliance if they wish, and if deciding to do so, which one. In practice it is a two-way decision. Alliances decide whom they take as new members. There are thus endogeneity problems. These are compounded in the analysis by the discrete nature of the *Alliance* variable. To circumvent this, and encompass the identification issue, we adopt Wooldridge's (2010) approach to handling endogenous binary variables.

Formally, being Y the dependent variable of interest (*Passengers*), A the binary endogenous variable (*Alliance*), Z a vector of instruments (*Alliancepressure, Dominantshare* and *Yearsinbusiness)* and X a vector of control variables (*Quality*, *Distance*, etc.), a three-step procedure is used to handle the problem. First, a binary choice model is estimated of dichotomous variable A on Z and the set of controls X. Second, the fitted probabilities of $\widehat{A}$ estimated in the first step are obtained. Finally, a two-stage least squares (2SLS), instrumental regression model, regressing Y on A and X, using $\hat{A}$ as an instrument for A is used.

This procedure differs from standard 2SLS because it does not neglect the binary property of the endogenous variable. This means the estimates are not biased. Second, it avoids the very severe assumptions on the error terms and the functional form required by simply inserting the fitted probabilities of the probit in place of the endogenous variable.[21] The generated instrumental variable approach does require that instruments are partially correlated with *Alliance*.[22]

The specification adopted is thus;

$$Alliance = \lambda_0 + \overline{\beta Z} + \overline{\gamma X} + \xi \tag{2}$$

$$\log(pass) = \theta_0 + \theta_1 Alliance(\widehat{Alliance}) + \overline{\delta X} + \tau \tag{3}$$

where, $\overline{Z}$ is the vector of valid instruments and $\overline{X}$ is a vector of variables explaining passenger flows or variables clearly explaining $Alliance$, but less likely uncorrelated with the error term in Equation 3. $Alliance(\widehat{Alliance})$ indicates that the predicted Alliance from the probit ($\widehat{Alliance}$) is used as instrument for $Alliance$ in Equation 3.

[21]Wooldridge (2010) also highlight that the procedure is robust to misspecification in the probit model (i.e., estimates are consistent and errors asymptotically valid errors when standard corrections for heteroskedasticity are used in the IV estimation).

[22]An and Chan (2008) underline the desirable robustness property stemming from the use of fitted probabilities as an instrument for the dummy (*Alliance*) implies that there is no need to have a perfectly correct specification of the selection equation (Equation 2 in the text). This is important when the determinants of the dummy endogenous variable are not particularly well-defined.

The probit specification must contain additional instruments not simultaneously listed in Equation 3. As valid instruments, these should be uncorrelated with errors in Equation 3 but are at least partially correlated with *A*.

The estimates derived for both the probit analysis and the subsequent 2SLS estimations regarding passenger numbers are set out in Table 4. The probit regression examining why airlines are members of a strategic alliances are seen in the upper part of the table. The model provides a good overall fit (at least in terms of its R-squared) and its relevance being supported by F values for the instruments that exceed ten.

Table 4. Endogenous dummy variable specification (Passengers)

Probit regression for alliance membership (Dependent variable: alliance membership)

	Coefficient	S.e.	z-value	P>|z|
Quality#	5.160	1.297	3.980	0.000
Safety#	6.566	2.929	2.240	0.025
Distance	1.027	0.706	1.450	0.146
Sub-Sahara	-0.293	1.270	-1.020	0.309
Majoritygovernment	-6.109	1.491	-4.100	0.000
Alliancepressure#	0.105	0.561	0.190	0.851
Yearsinbusiness#	10.786	3.768	3.670	0.000
Domesticshare	-6.786	3.708	-1.830	0.067
Aggregatepassengers#	-6.764	4.541	-1.510	0.131
Constant	60.178	78.771	0.760	0.445

Expressed in log form.
Pseudo R-squared = 0.794; Log likelihood = -19.690; Number of observations = 251.

Instrumental variable regression for passengers (Dependent variable: log-passengers)

	Coefficient	S.e.	z-value	P>|z|
*Alliance**	1.955	0.242	8.090	0.000
Quality#	0.661	0.099	6.670	0.000
Safety#	-1.328	0.408	-3.350	0.001
Distance	0.668	0.212	3.150	0.002
Sub-Sahara	-1.370	0.160	-8.570	0.000
Majoritygovernment	0.514	0.148	3.470	0.001
Aggregatepassengers#	0.971	0.587	1.650	0.099
Constant	-7.307	10.695	-0.680	0.495

Expressed in log form.
*Instrumented using the probit equation.
Adj,R-squared = 0.580; F(7, 242) = 45.400; Number of observations = 251

The instruments also have the expected signs. *Alliancepressure* exerts a positive influence on the probability of joining an alliance, while *Domesticshare* is negative even if with marginal significance. *Yearsinbusiness* picks up the importance of experience on alliance membership. The other explanatory variables behave well. As expected, airline alliances tend to favour companies that are more private sector oriented, are based outside of Sub-Sahara Africa, offer more frequent services and have a strength in offering international and longer services. Perhaps surprisingly, *Safety* takes a perverse sign, but is not significant.

Turning to the second stage, we see that the *Sub-Sahara* based carrier coefficient is negative and highly significant and carriers from that region have been significantly less successful in attracting passengers. *Safety* and *Quality* also provide significant effects conforming to expectations and the results of earlier studies. The implications of government control over airlines on passenger numbers, however, transpires to be positive, although small and not strongly significant. This provides some very weak support for the transaction-costs concept of government interventions, and the positive effects on demand for airline services that government investment may produce (Spiller, 2013). Aggregate demand in the African market would, from the probit analysis of alliance membership, have a counter-cyclical effect. This is possibly because alliances take time to be negotiated and introduced and thus are not seriously affected by cycles. In the second stage there is a positive coefficient as expected but of no real significance.

The *Alliance* variable, as instrumented, is positive and significant suggesting, as with the single equation results, that soft-cartel arrangements between airlines are providing positive benefits in terms of passenger numbers. The standard errors are also robust in the presence of arbitrary heteroskedasticity.

Load factors

Turning to load factor as the target variable of airlines, the results of the second stage of the two-stage analysis are seen in Table 5. Alliance membership is again instrumented using *Alliancepressure, Dominantshare, and Yearsinbusiness* and thus the probit results seen in Table 4 are not repeated here.

Table 5. Endogenous dummy variable specification (Load factor)

Instrumental variable regression for passengers (Dependent variable: load factor)				
	Coefficient	S.e.	t- value	P>|z|
*Alliance**	0.084	0.021	4.020	0.000
Safety#	-0.175	0.035	-4.930	0.000
Quality#	-0.023	0.008	-2.640	0.009
Distance	0.067	0.018	3.670	0.000
Sub-Sahara	-0.052	0.014	-3.720	0.000
Majoritygovernment	-0.055	0.013	-4.300	0.000
Aggregatepassengers#	0.064	0.051	1.260	0.209
Constant	-0.343	0.929	-0.370	0.713

Expressed in log form.
*Instrumented using the probit equation.
Adj R-squared = 0.290 F(7, 242) = 15.850; Number of observations = 251

The second part of the 2SLS estimation using the instrumented *Alliance* variable, sees key variables generally having high explanatory powers and taking expected signs given the nature of the left-hand variable. From a regulatory perspective the highly significant negative coefficient associated with majority-state ownership of an airline contrasts with the positive coefficient found in Table 4. This provides supporting evidence that, while government involvement may be targeted at increasing passenger numbers, following the transactions-cost theory of regulation (as seen in Table 4), this is at the expense of significantly lower load factors. Basically, transactions-cost regulation buys robustness in a market at the price of lower short-term technical efficiency.

Our quality variable is negatively associated with load factor. This is probably the result of the attributes of the variable used. *Quality* as defined here, reflects the frequency of services on routes. While this, as we saw in Table 4, may well attract more patronage, as in the US case of low-cost carriers, higher frequencies are often associated with quick aircraft turn-round times, limited-interlining, and thus lower load factors.

From an industrial and policy perspective, the highly significant and positive *Alliance* variable offers replication support for studies of airline activities in more developed markets. Load factors significantly rise when airlines coordinate their activities. The 3.9% increase in load factor in the context of airline economics is not a trivial increase.

Conclusions

There are several reasons why airlines often seek to join an alliance. In some cases, it is a traditional attempt at rent seeking by developing market power. More pronounced, and especially in the international services markets between economies, is the argument that they are formed to circumvent regulatory regimes that reduce the efficiency of the airlines. There is also a case that the internal institutional structure of an alliance may reduce costs within the industry by generating network economies across the airline system; a sort of Coasian argument for minimizing costs through managed integration (Coase, 1937). Finally, there are defensive alliances that seek to contain excessive competition in the industry and thus avoid the disruptions of an empty core. While a combination of these factors seems relevant for Africa, here we have looked at the broader issues of the impacts of strategic alliance membership on individual airlines' performances.

We have quantified some of the factors influencing the role strategic global alliances play in Africa's airline industry. Our estimates indicate that membership of alliances has overall had a positive effect in terms of two major performance metrics used by airlines officials – passenger numbers and load factors. Speculating a little, the larger African members of the main alliances seem to have benefited when their networks complement those of their non-African alliance partners. This has allowed them to support major African hubs within dumbbell, double-hubbed network configurations. Ethiopian Airlines at Addis Ababa Bole International Airport and South African Airways at Johannesburg's O.R. Tambo International Airport, both members of strategic alliance epitomize this.

Regarding the immediate future, outside of Africa airlines are adopting an array of short- and long-term strategies to survive and, post-pandemic, to move forward (Albersa and Rundshagen, 2020). The African carriers have neither the internal resources nor the likely government support to adopt many of these measures, nevertheless some airlines will survive and some governments are providing limited support. What is suggested here is that once the global economy picks up again, there is evidence that African airlines would benefit from aligning themselves if possible, with carriers based in more substantial aviation markets. The analysis has suggested some of the features that make specific African carriers potential alliance partners.

REFERENCES

Abramov, A., Radygin, A., Entov, R. and Chernova, M. (2017) State ownership and efficiency characteristics, *Russian Journal of Economics*, 3, 129-57.

Albersa, S. and Rundshagen, V. (2020) European airlines' strategic responses to the COVID-19 pandemic, *Journal of Air Transport Management* 87, 101863.

Amankwah-Amoah, J. (2017) Pan-African strategic alliance, global competition: a case study of Air Afrique. In K.J. Button, G. Martini and D. Scotti (ed) *The Economics and Political Economy of African Air Transport*, Routledge, London, pp. 137-48.

Amankwah-Amoah, J. and Debrah, Y.A. (2011) The evolution of alliances in the global airline industry: A review of the Africa experience, *Thunderbird International Business Review*, 53, 37–50.

Barla, P. and Constantatos, C. (2006) On the choice between strategic alliance and merger in the airline sector: The role of strategic effects. *Journal of Transport Economics and Policy*, 40, 409-24.

Bilotkach, V. (2019) Airline partnerships, antitrust immunity, and joint ventures: What we know and what I think we would like to know. *Review of Industrial Organization,* 54, 37–60.

Bilotkach, V. and Hüschelrath, K. (2012) Airline alliances and antitrust policy: The role of efficiencies, *Journal of Air Transport Management*. 21, 76-84.

Bilotkach, V. and Hüschelrath, K. (2019) Balancing competition and cooperation: Evidence from transatlantic airline markets, *Transportation Research A*, 120, 1-16

Boeing Commercial Airplane (2018) *Current Commercial Outlook, 2019-2038*. http://www.boeing.com/resources/boeingdotcom/commercial/about-our.

Borenstein, S. and Zimmerman, M. (1988). Market incentives for safe commercial airline operation, *American Economic Review*, 78, 913-35.

Bosch, J-.C., Woodrow Eckard, E. and Singal, V. (1998) Competitive Impact of Air Crashes: Stock Market Evidence, *Journal of Law and Economics*, 41, 503-19.

Brueckner, J.K. and Singer, E. (2019) Pricing by international airline alliances: A retrospective study, *Economic of Transportation*, 20, 1000139.

Button, K.J., Martini, G. and Scotti, D. (2015) Connecting African urban areas: airline networks and intra-Sub-Saharan trade. *Journal of Transport Geography*, 42, 84–9.

Button, K.J., Martini, G. and Scotti, D. (2017) The African air transport network. In K.J. Button, G. Martini, and D. Scotti (eds.) *The Economics and Political Economy of African Air Transport*, Routledge, London, pp. 40-60.

Calzaretta, R.J., Eilat, Y. and Israel, M.A. (2017) Competitive effects of international airline cooperation, *Journal of Competition Law and Economics*, 13, 501-48.

Coase, R.H. (1937) The nature of the firm, *Economica* 4, 386-405.

Davies, D.G. (1971) The efficiency of public versus private firms, the case of Australia's two airlines. *Journal of Law and Economics*, 14, 149-65.

Escobari, D., Rupp, N. and Meskey, J (2019) An analysis of dynamic price discrimination in airlines, *Southern Economic Journal*, 85, 639-62.

Flores-Fillol, R. and Moner-Colonques, R. (2007) Strategic formation of airline alliances. *Journal of Transport Economics and Policy,* 41, 427–49.

Forbes, S.J. and Lederman, M. (2009) Adaptation and vertical integration in the airline industry. *American Economic Review,* 99, 1831–49.
Gaggero, A.A., and Bartolini, D. (2012). The determinants of airline alliances. *Journal of Transport Economics and Policy*, 46, 399-414.
Gillen, D.W., Oum, T.H. and Tretheway, M.W. (1989) Privatization of Air Canada: Why it is necessary in a deregulated environment. *Canadian Public Policy*, 15, 285-.99
Grosche, T., Rothlau, F. and Heinzl, A. (2007) Gravity models for airline passenger volume estimation. *Journal of Air Transport Management*, 13, 175-83.
Gwilliam, K.M. (2011) *Africa's Transport Infrastructure: Mainstreaming Maintenance and Management*. World Bank, Washington DC.
Herold, D. and Paha, J. (2018) Cartels as defensive devices: Evidence from decisions of the European Commission 2001–2010, *Review of Law and Economics*, 14, 1-31.
International Air Transport Association (2008) *Air Travel Demand,* IATA, Geneva.
Ito, H. and Lee, D. (2007). Domestic code sharing, alliances, and airfares in the US airline industry. *Journal of Law and Economics*, 50, 355–80.
Lubbe, B. and Shornikova, S. (2017) The development of African air transport. In K.J. Button, G. Martini and D. Scottie (eds) *The Economics and Political Economy of African Air Transport*, Routledge, London, pp.16-39.
Meichsner, A.A., O'Connell, J.F. and Warnock-Smith, D. (2018) The future for African air Transport: Learning from Ethiopian Airlines. *Journal of Transport Geography*, 71, 182-97.
Njoya, E.T. (2016) Africa's single aviation market: The progress so far, *Journal of Transport Geography*, 50, 4-11.
Oi, W.Y. (1962) Labor as a quasi-fixed factor, *Journal of Political Economy*, 70, 538–55.
Park, J.-H. (1997) The effect of airline alliances on markets and economic welfare, *Transportation Research Part E*, 33, 181-95.
Pirie, G. (2017) Persian Gulf and Turkish Airlines in Africa. In K.J. Button, G. Martini and D. Scottie (eds) *The Economics and Political Economy of African Air Transport*, Routledge, London, pp.80-98.
Rose, N.L. (1990) Profitability and product quality: Economic determinants of airline safety performance. *Journal of Political Economy*, 98, 944-64.
South African Airways (2018) *Integrated Report for the Year Ending 31 March 2017*, South African Airways, Ekurhuleni.
Spiller, P. (2013) Transactions cost regulation, *Journal of Economic Behavior and Organization*, 89, 232-42.
Wan, X., Zou, L. and Dresner, M. (2009) Assessing the price effects of airline alliances on parallel routes. *Transportation Research Part E,* 45, 627–41.
Wooldridge, J.M. (2010) *Econometric Analysis of Cross Section and Panel Data.* MIT Press, Cambridge, Mass.
Yelle, L.E. (1971) The learning curve: historical review and comprehensive survey. *Decision Science*, 10, 302-28.
Yimga, J. and Gorjidooz, J. (2019) Airline code-sharing and capacity utilization: evidence from the US airline Industry, *Transportation Journal*, 58, 280-308.
Zhang, A. and Zhang, Y. (2006) Rivalry between strategic alliances. *International Journal of Industrial Organization.* 24, 287–301.
Zotova, I. (2017) Post-crash airline pricing: A case study of Alaskan Airlines Flight 261, *Economics of Transportation*, 10, 18-22.