

The importance of former colonial patterns in Africa on the market for airline services

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Abstract

This paper focuses on trends in the geographical distribution of air transportation growth in Africa paying particular attention to the overhanging legacy effects of the period of European colonization. We examine the role of the colonial pasts on clusters of air movements within African between 1998 and 2011. Of particular interest is whether the patterns of air service supply have changed over this period, and, if so, whether there has been a movement away from any linkages that may have existed between the old colonial blocks. The attention is focused mainly on the former French and British colonies of sub-Saharan Africa because of commonality in their periods of European oversight, and the scale of colonies involved. The approaches of the two colonizing countries towards their colonies also differed. We find evidence that there are some residual linkages between countries within these blocks of former colonies, perhaps because of commonalities in their official languages and institutional frameworks, that has led to stronger intra-group air services networks emerging, although the exact patterns are somewhat different to much of the conventional wisdom regarding colonial legacies.

Introduction

As Anderson and van Wincoop (2004: 691) argue, “Trade costs, broadly defined, include all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself; transportation costs (both freight costs and time costs), policy barriers (tariffs and nontariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, and local distribution costs (wholesale and retail).” Perhaps missing from this list, or it may be considered subsumed under “information costs” or some of the other listed items, are the challenges of overcoming cultural and linguistic diversities. Our interest here is in the role that common institutions and language can play in fostering international trade in air services within Africa, and in particular the role that former patterns of colonization has been playing in this.

Air transportation is the fastest growing mode of transportation, being important to the tourist industries, to the transportation of high value/low weight products, and in the growth of the exotic fruit and flower industries, as well as providing accessibility of business travelers to diverse markets. Despite this, although perhaps not surprisingly, the air transportation market in Africa is one of the thinnest in the world. Forecasts by

Boeing Commercial Airplane (2014) and others, however, suggest that there is potential for growth over the next 20 years. The continent's air transportation infrastructure - its airports and air navigation systems - is of generally poor quality and large parts of the region are completely devoid of anything that can meaningfully be called 'infrastructure' (Goldstein, 2001). There are also institutional challenges. Transportation is both an input into the costs of trading other goods and services, but is also something that is traded in its own right. In this context, many African countries deliberately protect their airlines from competition, seeking monopoly profits and foreign exchange from their services rather than prioritizing them as an input for wider economic development (Button, 2010). These general types of situation are not unique to aviation in Africa, and extend across all modes of transportation, but it is perhaps most pronounced for the region and its aviation sector.¹

What is very different institutionally about Africa compared to other mega regions is that virtually all its constituent countries were, until comparatively recently, colonies of industrialized European states. The concern here is not whether this was to the overall economic benefit of these African countries, or the normative matter of whether it produced desirable political and social change, but rather with what the implications have been for their air transportation sectors.² The general role of colonization in the development of Africa has been widely debated, but here we focus on what has happened since the independence movement across the continent, and upon whether the legacy of a colonial past has influenced the aviation networks that have emerged.³ The issue is essentially one of whether colonization, by introducing common languages of governance and common bases of legal systems, across grouping of countries, has left a legacy that has facilitated more air services within the major colonial groupings than between them, or with other countries that remained independent or were colonized by a minor power.

Before moving to the current situation, some words of background as to why we are interested in the role of colonization in Africa and air transportation.

Some Background

The major colonizations of Africa in the 19th and early 20th centuries were motivated by a diversity of forces and often dependent on the colonial power concerned. Coastal areas, that generally had a much longer history of colonization, acted as nodes, basically serving as victualing and refueling stations in maritime logistics chains, and as access point to the hinterland.⁴ The discovery of various raw materials useful for

¹ The World Bank's Logistics Performance Index provides a systematic, comparative analysis of the general patterns of logistics found in Africa; <http://lpi.worldbank.org/international/global>

² For accounts of the role of air transportation during the colonial period, see McCormack (1976; 1989) and Pirie (2004)

³ We do not survey the trade costs literature, Anderson and van Wincoop do this, but simply note that there are numerous studies highlighting the costs of difference in language between potential partners (e.g. Melitz, 2008), and in cultures (e.g., Rauch and Trindade, 2002). Easterly and Levine (1997) consider the particular challenges of Africa in detail.

⁴ Gwilliam (2011) provides a history of African colonialism with a focus on transportation.

industrial production led to greater involvement inland, although from a transportation perspective, the emphasis was on the extraction of bulk materials, and with this on rail transportation. In quantitative terms, between 1876 and 1914, the UK gathered territories around the globe embracing 9 million sq. km and a population of 146.6 million, France took 9.7 million sq. km inhabited by 49 million people, Germany, 2.9 million sq. km and 12.3 million people, and Italy, 3.6 million sq. km and 7.2 million people, all of this largely in Africa.

By 1945, the entire continent - with the exception of Ethiopia and Liberia - had been colonized by a combination of European states, with the Union of South Africa gaining independence in 1910. Belgium, France, Great Britain, Italy, Portugal, and, in lesser way, Spain, all had involvements in Africa, as Germany had until the end of the First World War. The immediate post World War II period saw this continued engagement of European powers in the continent.

The differing attitudes of the colonial powers towards their domains influenced the ways transportation was viewed and subsequently the ability of African states to develop their own transportation policy in the post-colonial period, although the interests of the colonial powers dominated. In terms of political attitudes, Belgium and Portugal did not permit any political activity in their territories, Great Britain governed each of territories separately, allowing a degree of self-determination on internal matters in some, while France colonies as an integral and indissoluble part of metropolitan France, with entirely parallel political systems and processes. In all cases, pressure for independence grew rapidly after World War II, with the Belgian Congo gaining independence in 1960, and by the end of 1968, all the British and French colonies were independent, and Portugal withdrew from Angola and Mozambique by 1975.

Fragmentation, often along lines of arbitrary national boundaries, accompanied independence, and especially so in the case of the former French colonies, with adverse consequences for African citizens. In the private sector, subdivision frustrated scale economies and skewed the structure of the overall economy toward peasant agriculture, while in the public sector, its small scale raised the cost of public and quasi-public goods. The fragmentation of countries also resulted in some wasteful investment as small countries developed their own ports and transit corridors to neighboring landlocked countries (Limbo and Venables, 1999).

Analysis of the subsequent impact of colonialism on the economic performance of ex-colonies is growing, but that on trade between them, and particularly trade in services is still limited. We do not offer a survey, but provide a very few observations of relevance regarding what has emerged from this work.

Some of the more general analysis, for example Klerman *et al* (2008), has highlighted variations in the economic trajectories of former French and British colonies resulting from different educational policies, finding support specifically for sub-Saharan Africa by Agbor *et al* (2011). Legal traditions imposed on colonies also appear in some studies to have resulted in differential growth rates with those following the British common law approach growing faster after independence than those following a civil

law tradition (La Porte *et al*, 2008; Levine, *et al*, 2002); there are, however, dissenting views, e.g., Acemoglu and Johnson (2005). Colonization left differing legacies of tax systems, the British approach for example, as emphasized by Austin (2008) was cheaper to administer than that through the direct rule exercised by France, and tax rates were lower. The argument here being that with lower taxes, there was less distortion in the British colonies leaving a greater tradition of internal free trade.

The use of a fixed exchange rate regime, the *Franc de la Communauté Financière en Afrique*, linked its colonies closely with the French economy where as the British colonies operated with floating exchange regimes with the flexibility that this afforded them in trade. Added to this, as Grier (1999) emphasizes, Britain had a free trade policy from 1830, and as from 1846, British colonies were no longer forced to give British goods preferential treatment. These colonies thus had a long history of free trade, while France enforced mercantilism and protectionism throughout the colonial period.

Air transportation in Africa

Our focus here is on the air-services trade between sub-Saharan countries. Thus we are concerned with those African countries that are fully or partially located south of the Sahara, excluding Sudan, even though it sits in the eastern portion of the Sahara desert. We exclude North Africa because its constituent countries have a different tradition of colonization going back much longer, and have well established trading ties with Europe going back well before the 19th century. Given their history and common religion, intra-regional economic linkages and integrated trade patterns are much more extensive than those between sub-Sahara nations.

The air transportation of Africa is not only very limited, but also very focused in its geographical coverage. Dependent on the units of measurement used, Africa represents less than 2% of the world passenger aviation market, and less than 1% of the cargo market. Boeing Commercial Airplanes (2012) forecasts, based on projected trends in such things as GPD, fuel prices, and demographical factors, that African revenue passenger kilometers will grow on average by 5.7% per annum between 2013 and 2032, and cargo by 6.6% compared to global growth of 5% for each. Airbus' (2012) forecasts are slightly lower for Africa, for example 5.1% per annum for revenue passenger kilometers. This outpaces global trends slightly, but it is from a low base.

A major issue is the lack of genuine interconnectivity within the African air transportation network despite efforts over the years to improve this⁵. While there have been initiatives, largely forged by the US, to open external services to market forces that same trend has not been seen within the Continent, where African carriers conduct most of the trade (Table 1). This is despite efforts at institutional reform. Modern legal initiatives began in 1961 when ten African nations signed the Treaty on Air

⁵ There are some hub and spoke structures (Ssamula, 2012) based upon Johannesburg, Abuja, and Nairobi, but many of the routes are thin. Arvis and Shopherd (2012) provide a more rigorous of the linkages between airline networks in Africa using a connectivity index.

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Transportation in Africa (the Yaoundè Treaty) that established a jointly owned airline, AirAfriqué, although this went into liquidation in 2002. More importantly from a market liberalization process, and moving away from the rigid bilateral air services agreements that had grown up after the Chicago Convention in 1944, was the 1988 Yamoussoukro Declaration. This represented an African initiative to prepare for the international ripple-out effects of economic deregulation in the US, the movement towards an integrated European air market, and the growth of Open Skies policies elsewhere.

Table 1. Airline passengers and African carrier’s market share (2012)

Market	Flights	% African Airlines	Seats	% African Airlines
Intra-Africa	906,533	96	88,536,230	92
Africa/Europe	64,958	40	10,862,093	35
Africa/North America	2,892	51	795,889	54
Africa/Middle East	30,249	40	5,599,714	37
African Asia	7,743	80	1,981,649	80

Source: African Airlines Association

The Declaration committed African States, both individually and collectively, to achieve the phased integration of their airlines within eight years. Progress, however, was slow. The 1997, the Banjul Accord for an Accelerated Implementation of the Declaration was adopted by Ghana, Sierra Leone and the Gambia, with Cape Verde, Guinea Bissau and Nigeria, recognized the region representing these States as a single geographical commercial air transportation operations zone. The Yamoussoukro Decisions of 1999 subsequently committed its 44 signatory countries to deregulate air services, and promote regional air markets open to transnational competition. Subsequent progress, however, has been slow even when it has taken place. But as Schlumberger (2010) has shown reform can be beneficial where it does occur. When the Nairobi-Johannesburg route was fully opened up in 2003, passenger volumes increased 69-fold. When the domestic South African market was liberalized, passenger volumes increased by 80%, and on average in the Southern African Development Community routes that were liberalized saw fares drop by 18%.

Overall, however, there remains little practical integration of national airline networks in Africa; there has been much rhetoric involving politicians and lawyers, and international bodies such as the UN’s International Civil Aviation Organization but very little has actually been achieved, despite the considerable global evidence of the importance of air transportation in stimulation economic development; e.g. about 35% of world trade by value goes by air. Some countries pursuing unilateral approaches have been exceptions and seen significant increases in traffic and adjustments in their networks – e.g., Ismaila *et al* (2014) and Daramola and Jaja (2011) discuss Nigeria. There are also some supportive findings that individual airports in Africa have yielded considerable economic benefits for the regions in which they are located; e.g., Irandu (2006) on Nairobi in Kenya.

In addition to broader public policy regarding air service agreements, there are also issues regarding the nature of the airlines involved – e.g., over a quarter of routes in

Africa are served by a monopoly carrier with 80% of traffic carried by African carriers going on 20% of the airlines. In some regions the concentration is particularly pronounced; e.g. in 2013, 53% of the top routes in East Africa had a single carrier (Schlumberger and Weisskopf, 2014). Protectionism is often motivated by a fear that the 'flag' national carrier will be unable to compete with the continent's larger carriers from Kenya, Ethiopia and South Africa, as well as intercontinentally with competitors from the Gulf and beyond. Change often occurs as a measure of crisis management. For example, in 2013 it took the collapse of Air Malawi for Kenya Airways to be allowed to operate between Malawi and other countries, despite existing 'fifth freedom' rights under the Yamoussoukro Decision that theoretically allow an airline to carry revenue traffic between foreign countries as a part of services connecting them to its own country.

As Pirie (2014) here highlighted, at the more micro level there has also been little stability in Africa's airline markets with continual turn over of airlines; e.g. 31 ceased to provide services in sub-Saharan Africa between 2001 and 2007, and of the 37 airlines launched between 2002 and 2012 across Africa as a whole, all failed (Heinz, and O'Connell, 2013).⁶ Management is equally unstable, and in 2010/2011 half of the state-owned airlines that were members of the African Airlines Association lost their chief executives in less than a year. Added to this there is a tendency to adopt excessive gauges for services, using large aircraft on routes more suited to medium or even small aircraft; this contributes to the 69.7% load factor for African based passenger services compared with a global figure of 79.2% (African Airlines Association, 2103)

In addition to restricting competition, and thus limiting the number of flights, some 20 countries also subsidized to their flag carriers, basically using scarce resources to prop up inefficient airlines. In addition, at least half of Africa's airlines 'benefit' from being 51% state owned. The situation has also acted to prevent the growth of low cost airlines that have been a major stimulus to greater economic efficiency in other macro-regional markets (Schlumberger and Weisskopf, 2014). Similarly support has been given to large national airports irrespective of the demands for their services.

Regarding the carriers, in part because of political interference, less efficient flag airlines have tended to remain in the market preventing natural hub-and-spoke system being developed by African airlines (Heinz and O'Connell, 2013). As a result, African domicile carriers have found it hard to compete with non-African airlines. Indeed, if we combine both intra-Africa and inter-continental traffic involving Africa, then 80% of traffic goes by non-African airlines. Adding to this, although there are exceptions, most notably South Africa, policy has focused on trunk-haul services to the neglect of domestic feeder services, services often provided by low cost carriers elsewhere. In addition, there is a tendency to direct resources on the major international gateway airports, often 'gold plating them', using revenues from other airports in their support.

⁶ There is some indication of some increasing stability in the sub-Saharan market with the larger carriers joining strategic alliances – South African and Ethiopian in the Star Alliance and Kenyan in SkyTeam, and

There is a shortage of skilled labor in Africa, corruption, over staffing, a strong travel agency network that takes 7% commission, thin routes, low Internet penetration, poor and lack of investment opportunities for fleet modernization. In terms of future labor issues, the growth of mega-markets such as China, will in particular put increasing pressure on demands for pilots, with Sub-Saharan Africa having to compete globally for the limited personnel (Boeing Commercial Airplanes, 2012). One outcome of this is low average utilization of aircraft – some 6.9 hours a day compared to 9.9 for European carriers – and low load factors – 69.7% in 2010 compared with a global average of 75.2%. This has led to considerable market instability with 37 new airlines being launched in the decade from 2000, and 37 failing. The Continent also has a poor safety record with 23% of the world's jet hull losses occurring there in 2010, or put another way, in 2012 African airlines had one accident for every 270,000 flights against the industry average of one accident per five million flights.

Model and data

Virtually every African country was colonized or under the control of a major European power after World War II. Because our attention is on intra-African air services, however, we look largely at the French and UK colonies and protectorates.⁷ Other countries did have their imperial domains, for example Belgium had Rwanda, Burundi, and the Democratic Republic of the Congo, and Portugal had Guinea-Bissau, Mozambique, Cape Verde, São Tomé and Príncipe, and Angola, and some colonies were jointly controlled such as Somalia by Italy and the UK, but the importance of these were all relatively small. The two groupings of countries we focus on, and their dates of independence are seen in Table 2.

Data limitations that are discussed in more detail below limit the nature of the empirical analysis that can be performed; there is no information, for example, on airfares or the number of passengers that are carried. The analysis thus focuses entirely on considering factors influencing the supply of seats on each major origin-destination pair in sub-Sahara Africa. The lack of a fully specified system embracing both supply and demand is a clear limitation, but perhaps less of an issue in the context of a product that is often supplied by state enterprises, in which the infrastructure is state owned, and that operates within a tradition of strong market regulation.

While we earlier highlighted the differing British and French attitudes towards their colonies, within their domains they did introduce a number of common features that seem likely to have impacted intra-grouping interactions. Both colonial powers, as they became entrenched, introduced a common language to the higher administrative levels of governance to facilitate control and information flows. In many cases English or French is retained as an official language and this provides a tangible benchmark as to whether colonization had some enduring internal impact on a country. The cases of

⁷ African countries are described using their current English language names.

this are seen in Table 2 in bold, and these countries form the two blocks of former colonies that we examine.⁸

Table 2. United Kingdom and French colonies that became independent after World War II (English and French as official language in bold)

United Kingdom
Libya (1951)*, Egypt (1952), Sudan (1956)**, Ghana (1957), Cameroon (1960)†, Somalia (1960)††, Nigeria (1960), Sierra Leone (1961), South Africa (1961), Tanzania (1963), Uganda (1962), Kenya (1963), Malawi (1964), Zambia (1964), Gambia (1965), Botswana (1966), Lesotho (1966), Mauritius (1968), Swaziland (1968), Seychelles (1976), Zimbabwe (1980).
France
Libya (1951)*, Tunisia (1956), Morocco (1956), Guinea (1957), Cameroon (1960)†, Togo (1960), Mali (1960), Senegal (1960), Madagascar (1960), Benin (1960), Niger (1960), Burkina Faso (1960), Côte d’Ivoire (1960), Chad (1960), Central African Republic (1960), Republic of Congo (1960), Gabon (1960), Algeria (1962), Comoros (1960)#, Djibouti (1977).

Notes: *Jointly between UK, France, and Italy; ** jointly between UK and Egypt; † jointly between UK and France; †† jointly between UK and Italy; # jointly between France and Madagascar

What we are concerned with is whether the colonization period left indelible marks on the ways that air transportation has developed within these blocks as opposed to other parts of Africa. Of course, there are other factors that we need to control for.⁹

Our analysis embraces pooled data related to trade and air travel involving those countries in the *Official Airline Guide* that are in Southern Africa, Central/Western Africa, and Eastern Africa, and had scheduled airline services from 1998 to 2011.¹⁰ Some countries are omitted because of lack of reliable data GDP and/or trade flows (i.e. Djibuti, 2009 to 2011; Somalia, Reunion, Sao Tome and Principe, 1998 to 1999; Mayotte 2009; Congo 1997).¹¹ This leaves 2,593 observations allowing calculation of

⁸ Looking at 160 countries for 1994, Hummels (1999) found that lack of a common language between trading partners had an impact equivalent to a tax of seven percent assuming a trade elasticity of eight.

⁹ The basic framework for the analysis is a conditional Tinbergen gravity model of the form:

$$x_{ij} = \alpha_1 y_a + \alpha_2 y_b + \sum_{m=1}^M \beta_m \ln(z_{a,b}^m) + \epsilon_{a,b}$$

where: x_{ij} is the log of exports of air services from country a to country b ; y_a and y_b are the relative attractiveness of a and b (notably logs of GDP of the exporting and importing countries, and of their populations); and $z_{a,b}^m$ is a set of trade barriers, most importantly distance between the main airports.

A number of fixed effects, allowing for particular features of the time period or countries involved, capture the conditionality of the model. The underlying theory of the gravity framework in an international trade context is laid out in Freenstra (2003)

¹⁰ www.oag.com

¹¹ The relevant countries are thus; Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote D'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Togo,

the coefficients in a largely log-linear specification. The quality of the data is not up to the highest standard and only considers the scheduled seats that are officially offered on airline timetables. This is nothing like the 10% sample of passengers that provides reams of data on fares, etc. for the US domestic market. But even the published schedules provided by the *Official Airline Guide* have intrinsic limitation. African air transportation is notorious unreliable and simply the listing of a scheduled flight with a given capacity provides no certainty that this was provided, while other ‘scheduled’ flights can take place outside of the official schedules.¹²

There has been a gradual liberalization of air transportation markets in Africa that have sought to remove many of the rigid bilateral controls over fares and capacity, of which the Yamoussoukro Decision of 1999 is the most important. This is allowed for by using dummy variables for the signatories for years after 2000. The variables included in the analysis and their description are:

- $Seats_{a,b}$ is aggregate number of seats on non-stop flights offered between countries a and b (*Source: Official Airline Guide* database). There is considerable variation in the annual seats provided per route, with an average of 45,325 and a standard deviation of 73,383.
- GDP_a and GDP_b , are the gross domestic products per capita of countries a and b. *GDP*. It is measured as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It makes no deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current United States dollars converted from domestic currencies using single year official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used (*Source: World Bank*)
- *Kilometers* is the average distance flown between the major airports in each country in kilometers (*Source: Official Airline Guide* database)
- $Population_a$ and $Population_b$ are the populations of a and b taken from World Bank sources
- $France_{a,b}$ is a dummy variable taking a unitary value if both countries involved are former French colonies where French is one of the official languages.
- $France_{a,other}$ is a dummy variable taking a unitary value if one country is a former French colony and the other is not.
- $Britain_{a,b}$ is a dummy variable taking a unitary value if both countries involved are former British colonies where English is one of the official languages.
- $Britain_{a,other}$ is a dummy variable taking a unitary value if one country is a former British colony and the other is not.

Uganda, Zambia, and Zimbabwe.

¹²An example of this in Asia, which is also a rapidly growing market and with generally more reliable data, is the case of flight QZ8501 that crashed on December 28, 2014 while flying between Indonesia and Singapore. While seen as scheduled flight this was not part of the Air Service Agreement between these two countries.

- $Landlocked_a$ is dummy variable taking a unitary value of one if country is landlocked, and $Landlocked_{a,b}$ if both origin and destination countries are landlocked. Fifteen of our countries are landlocked.¹³ The World Bank (Limdo and Venables, 1999) has estimated that such countries pay about 50% more in transportation costs than coastal countries, and have up to 60% lower volumes of trade. We adjust for the possible effects of this on air transportation in our analysis.
- $Yamoussoukro$ is a dummy variable taking a value of one if both origin and destination nations in sub-Sahara Africa are signatories of the Yamoussoukro Air Liberalization Agreement. There has been some discussion over the overall effectiveness of the agreement (Schlumberger, 2010).
- $Year_x$ is a unitary dummy variable for each observation year, excluding 1998 for identification reasons. It is included to capture any broader, macroeconomic trends, such as the global economic recession from 2007 that may affect intra-African airline markets.

The model we estimate is an attempt to identify the determinants of the aviation network over the period 1998-2011 and is given by the following equation:

$$\begin{aligned} \text{Ln}Seats_{a,b} = & \alpha + \text{Ln}\beta_1GDP_a + \text{Ln}\beta_2GDP_b + \text{Ln}\beta_3Kilometers + \text{Ln}\beta_4Population_a + \\ & \text{Ln}\beta_5Population_b + \beta_6France_{a,b} + \beta_7France_{a,other} + \beta_8Britain_{a,b} + \\ & \beta_9Britain_{a,other} + \beta_{10}Landlocked_a + \beta_{11}Landlocked_{a,b} + \beta_{12}Yamoussoukro \\ & + \sum\beta_xYear_x + \epsilon \end{aligned} \quad (1)$$

Equation (1) is applied to an unbalanced panel data set with temporal (year) effects. Estimation is performed by applying the Least Squares Dummy Variable (LSDV) econometric model.

Results

The results of the regression LSDV estimates, taking the number of scheduled seats offered, are seen in Table 3. The results for Models 1 and 2 make use of the full data set. Models 3 and 4 use a slightly smaller data-base that excludes routes of less than 200 kilometers and less than 2,000 seats. The aim of this is to take out more limited services that are more likely to be driven by local circumstances rather than any longer-term legacy effects. Models 1 and 2 (and 3 and 4) differ in that flights between the former colonies and other destinations are not isolated; their inclusion in the Models 2 and 4 specifications seeks to explore for any particular weakening of links outside of the colonial blocks compared to airline routes more generally in Africa.

Table 3. Model estimates

Variable	Model 1	Model 2	Model 3	Model 4
Constant	-0.105	-0.290	0.169	0.149
log $Population_a$	0.293***	0.320***	0.297***	0.323***
log $Population_b$	0.307***	0.311***	0.330***	0.330***

¹³ Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Ethiopia, Lesotho, Malawi, Mali, Niger, Rwanda, South Sudan, Swaziland, Uganda, Zambia and Zimbabwe.

$\log GDP_a$	0.319***	0.335***	0.310***	0.320***
$\log GDP_b$	0.266***	0.276***	0.284***	0.291***
$\log Kilometers$	-0.440***	-0.457***	-0.526***	-0.538***
$France_{a,b}$	0.718***	0.449***	0.630***	0.326***
$Britain_{a,b}$	0.687***	0.378***	0.600***	0.264***
$France_{a,other}$		-0.279***		-0.357***
$Britain_{a,other}$		-0.270***		-0.272***
$Yamoussoukro$	-0.100	-0.068	-0.153**	-0.127*
$Landlocked_{a,b}$	0.142*	0.018	0.052	-0.078
$Landlocked_a$	-0.312***	-0.375***	-0.290***	-0.363***
$Year_{1999}$	0.118	0.103	0.063*	0.057
$Year_{2000}$	0.256**	0.238*	0.205*	0.198
$Year_{2001}$	0.216	0.186	0.216	0.194
$Year_{2002}$	0.151	0.127	0.114	0.099
$Year_{2003}$	0.175	0.148	0.109	0.092
$Year_{2004}$	0.084	0.054	0.442	0.029
$Year_{2005}$	0.122	0.093	0.044	0.029
$Year_{2006}$	0.071	0.032	-0.008	-0.034
$Year_{2007}$	-0.015	-0.064	-0.094	-0.127
$Year_{2008}$	0.054	-0.005	0.025	-0.021
$Year_{2009}$	0.022	-0.034	0.018	-0.020
$Year_{2010}$	0.071	0.007	0.008	-0.041
$Year_{2011}$	-0.097	-0.165	-0.165	-0.215
Observations	2593	2593	2437	2437
R ²	0.295	0.304	0.316	0.329
Adjusted R ²	0.289	0.297	0.398	0.322

Significance: *** >1% level, **>5%level, *>10%level

The overall fits of the models, given the degrees of freedom involved, is well within those that that are normally deemed acceptable. The standard distance and attractor variables, the incomes and populations of the origin and destinations countries, that conform to the conventional Tinbergen gravity models all emerge as highly significant. They take the expected sign, with the impedance factor having negative coefficients in all cases and the relative attractors positive coefficients.

Particularly germane to this study, the key colonial effect variables have both the signs associated with a positive ‘colonial legacy’ and are highly significant in all specifications. Equally, we see in Models 2 and 4 a strong negative effect being revealed for trade in air services between the colonial block countries and other African states. The coefficients $Britain_{a,other}$ and $France_{a,other}$ are consistently negative and highly significant suggesting the colonial legacy block have greater levels of intra-group trade in air services, than is the norm in Africa, but also that their trade with non-block countries is less than the norm in Africa. While these findings are as we expected, the magnitude of the coefficients for the trade-in air services within blocks, larger for the French than the British block, run against much of the conventional wisdom found in the general trade literature. The latter argue that the focus of French colonial policy on directing trade to the priorities of the ‘home’ country left its colonies less prepared for wider trade development, including intra-group trade, than Britain’s freer trade approach. We have no explanation for this, other than that the

conventional wisdom may be excessively focused on the trade in goods that was the core of the policies of the colonial period.

Regarding the other control, variables there is no indication that the efforts at Yamoussoukro to initiate Open Skies across Africa has been successful, indeed the associated coefficients are negative, although only weakly significant where significant at all. This reflects some of the concerns expressed by Schlumberger (2010), but may also, on the other hand, support Goldstein's (2001) view that prior to Yamoussoukro there was an excess capacity of small, inefficient state supported carriers that needed weeding out and that the Declaration facilitated this resulting in surviving carriers being more economically sustainable.

The landlock variables suggest that if one end of a service involves a landlocked country then there are highly statistically limitations on the air services trade. The picture is less clear when both countries are landlocked with small, generally positive but insignificant effects. The set of dummy variables capturing changes over time seldom appear to be significant, but the coefficients do largely capture the anticipated effects on African services of a downturn in the global air market with the advent of the 'Great Recession'.

Conclusions

The growth of air transportation in Africa has been relatively slow, but there are indications that it is now speeding up as the Continent's economy grows, and as civil conflicts have tended to abate. The paper has explored the longer-term implications of colonization in Africa on this development, focusing on the extent to which the former period of colonization has shaped the pattern of the air services that are provided. While the evidence supports the idea that there are residual effects of colonialism on airline network development, the detailed pattern is somewhat different to that posited in much prior analysis of African colonialism would suggest. In particular, being a former French colony seems to have been more beneficial than being a British one. Why a common colonial heritage is an advantage when intra-block of trading airline services is unclear, and not easily tested, but the wider findings regarding common languages and institutions would seem relevant.

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