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Effects of enhanced air connectivity on the Kenyan tourism industry and their likely welfare implications

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ABSTRACT

This paper investigates the links between air connectivity, tourism benefits and welfare. It improves on the common practice in the literature by demonstrating avenues of tourism expansion and their welfare implications using both a partial and a general equilibrium model. The results of the gravity model show that there is a strong connection between air connectivity factors and incoming passengers. Simulation results of tourism expansion brought about by improved connectivity demonstrate that all household groups experience an improvement in their welfare but with lower impact on low-income agricultural households. The study concludes that formulating policies that address the air connectivity gap in Kenya would benefit the tourism sector and all households if co-ordinated with rural development initiatives.

1. Introduction

The importance of safe, secure and efficient air connectivity as a vital lever for development is widely recognized (Bannò & Redondi, 2014; Ivy, Fik, & Malecki, 1995; Rana & Karmacharya, 2014). Moreover, the connectivity brought by air transport is vital for the transportation of people and goods, especially in regions where surface transport networks are underdeveloped. Regarding the importance of air connectivity to tourism development, Van Houts (1984) argues that while mass tourism was possible by other means of transport, the great step forward was achieved by developments in commercial aviation. In other words, international accessibility by air is essential for the development of any tourism destination and for integration into the global economy. Travel and tourism's capacity to sustain a wide range of jobs through its diverse supply chains gives the sector great potential to drive economic growth and welfare. It is estimated that over 54% of all tourists worldwide arrive by air and their spending creates 285 million jobs of which 5.8 million are in Africa (ATAG, n.d.). In Kenya, an estimated 410,000 people are directly employed in areas supported by the steady influx of overseas visitors, most of whom arrive in the country by air, and contributed $0.8 billion to GDP in Kenya in 2014 (IATA, 2017).

Though there are obvious links between tourism and aviation, both tend to be treated separately (Forsyth, 2006). It has been argued that, until recently, international aviation agreements were negotiated between countries without regard to any impacts they might have on other industries, especially tourism (Dwyer, Forsyth, & Dwyer, 2010; Forsyth, 2006). Consequently, the economic impact of alternative civil aviation regimes has often been investigated with no explicit reference to their benefits for tourism. Previous studies on the relationship between air transport and tourism have shown significant correlation between direct air services (Koo, Lim, & Dobruszkes, 2017; Tveteras & Roll, 2014) airport development (Debbage, 2002; Duval & Schiff, 2011), taxation (Abeyratne, 1993), air transport liberalisation (e.g. Findlay & Forsyth, 1988; Forsyth, 2006; Graham, Papatheodorou, & Forsyth, 2008; Papatheodorou, 2002; Turton & Mutambirwa, 1996; Warnock-Smith & O'Connell, 2011) and tourism benefits. The impact of developments in tourism on the demand for air transport has also been investigated. Bieger and Wittmer (2006) pointed out that the development of attractions such as theme parks have been important in creating large and regular traffic streams that in Europe are now supporting some low-cost carriers. Thus, the amount of travel to or from a country is also a function of the attractiveness of the region as a place to visit. The strong complementarities between air transport and tourism to certain regions mean that the performance of tourism is dependent on both market conditions and on government policy prevailing in the aviation industry and vice-versa. This implies that both industries should be considered

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simultaneously.

Although some studies have investigated the economic impacts of changes in tourism resulting from changes in air connectivity measured as improvement in access (ComMark, 2006), the welfare implications of improved air connectivity are yet to be studied. Moreover, previous studies can be characterised as macro and meso analysis with far too little attention paid to micro analysis, namely the distributional and household welfare impacts of air connectivity. This paper investigates the links between air connectivity, tourism benefits and household welfare using two quantitative techniques, namely a gravity model and a Computable General Equilibrium (CGE) model. The gravity model was used to estimate the impact of air connectivity improvements on the Kenyan tourism industry. The elasticities estimated from the gravity model were incorporated into a tourism-focused CGE model for Kenya to examine the welfare implications of additional tourist spending resulting from improved connectivity. This research provides an important opportunity to advance the understanding of the tourism and welfare impacts of connectivity improvements and may be useful for policy makers in assessing the impact of aviation policy changes.

The paper first gives a brief overview of aviation and tourism in Kenya, followed by a review of literature on air connectivity and consumer benefits. Next, it documents the process of constructing and estimating the elasticity parameters used in CGE simulations. It then highlights the main features of the CGE model and the simulation results from the Kenyan CGE model. Finally, it summarizes the main findings and acknowledges the limitations of the research.

2. Aviation and tourism in Kenya

Together the tourism and aviation industries account for 40% of total services exports from Kenya (Fig. 1) (IMF, n.d.). They also play a critical role in the country's long-term development blueprint, Vision 2030, geared towards lifting Kenya to middle income status over the next decade and helping millions of Kenyans out of poverty (KIPPRA, 2013). Akama (2002) showed that Kenya provides a good example of an African country which has embraced tourism as an important tool for socio-economic development. In 2012, the country enjoyed a remarkable increase in air passenger and international tourism receipts, which were estimated at US$2 billion (Fig. 2). According to IATA (2017) spending by foreign tourists supported a further US$1.7 billion gross value-added contribution to the country's GDP. This means that 5.1% of the country's GDP is supported by the air transport sector and foreign tourists arriving by air. In 2014, foreign tourists spent US$0.8 billion in Kenya, supporting restaurants, hotels, transport providers, and others who cater to tourists (IATA, 2017).

Air transport on the other hand accounts for 24.07% of the country's service exports. According to the Kenyan Civil Aviation Authority, the country has witnessed a steady increase in total passenger movements, which rose from less than 1 million in 1990 to 9.3 million in 2016 (Office of the Auditor-General, 2018). The air transport industry is estimated to have supported a US$1.5 billion gross value-added contribution to GDP in Kenya in 2014 (IATA, 2017). The World Bank estimated the total number of air passengers at about 4 million in 2014 (Fig. 2).

It should be noted that the share of visitors to Kenya arriving by air increased from 56% in 1995 to 79% in 2014 (KNSB, 2015). This can be partly explained by the adoption of a market approach to the provision of air services in Kenya in recent years. Thus, the country has embarked on liberalisation of the air transport sub-sector since the 1990s. Examples of such policies include the successful privatisation of Kenya Airways in 1996 and the review of a number of existing bilateral agreements with African countries in line with the Yamoussoukro decision (Njoya, 2013). According to ICAO (2017), the country has signed over 57 Bilateral Air Service Agreements (BASAs) and the majority of these agreements are liberal with no restrictions on frequency and capacity.

3. Air connectivity and consumer benefits

Recent evidence suggests that growth in air connectivity, defined as the extent to which nodes in a network are connected to each other, brings benefits to consumers, businesses and countries by decreasing travel costs and time, facilitating contacts and trade and stimulating productivity and investments (Morphet & Bottini, 2012; Burghouwt & Wit, 2015; Burghouwt, 2016; Burghouwt, 2017). Governments can influence connectivity outcomes by formulating policies that address the drivers of connectivity such as traffic rights, restrictions on airport use, airport charges and taxes (Burghouwt, 2016).

There are many models available to measure connectivity which can be summarised into two types: (1) physical models, that is counting connections and (2) utility based models or generalised cost models which take into account all inconveniences passengers face when travelling between two points such as travel time, transfer time, airport access time and ticket price (Arvis & Shepherd, 2011; Burghouwt & Redondi, 2013). Different models attach different weight to each of the factors mentioned above. For instance, Morphet and Bottini (2012) measure air connectivity using a variety of measures including total passenger movements, airfares, the number of direct destinations and travel time. They argue that these factors can serve as standalone proxies or may be combined to create a measure capturing different features of the air-transport market. The connectivity measure used in this study attaches weight to airfares, direct services and air transport policy.

In recent years, the investigation of the likely benefits of air services on tourism in the context of specific countries and regions has constituted a significant area of interest in both tourism and transport

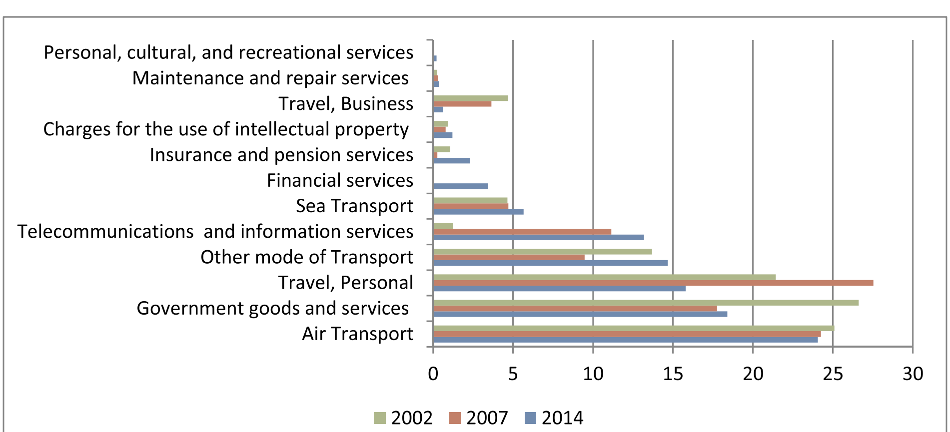

Fig. 1. Composition of country's service export basket (percent).

Fig. 2. International tourist arrivals, tourism receipts and passengers' carried.

research. A large and growing body of literature has investigated the impact of air transport policy on tourism development (Dresner & Tretheway, 1992; Maillebiau & Hansen, 1995; Schipper, Rietveld, & Nijkamp, 2002; Papatheodorou, 2002; Forsyth, 2006; ComMark, 2006; Graham et al., 2008; SH & E, 2010; Duval & Schiff, 2011; Dobruszkes & Mondou, 2013; InterVISTAS, 2014, 2015). Liberalisation of air services has been identified as a major contributing factor to the growth of the tourism industry (ComMark, 2006; InterVISTAS, 2014).

InterVISTAS (2015) found that liberalisation of the EU market led to a doubling of the rate of growth in air traffic in the EU. They found a positive relationship between the volume of international air services and key economic variables including GDP growth, employment, consumer surplus and tourism. Similarly, Piermartini & Fache Rousová, (2008) concluded that bilateral air passenger traffic is significantly affected by BASA liberalisation, with positive effects corresponding to the length of time that the BASA has been in operation. In the same vein, Grosso (2008) found a positive and significant relationship between a more liberal bilateral air service regime and air passenger flow using a gravity model. At the most conservative estimate, he found that doubling the Air Liberalisation Index between APEC economies would increase air traffic flow by 4.5%. Other issues such as the role of airport infrastructure have been investigated (Debbage, 2002; Duval & Schiff, 2011; PWC, 2014). Aviation taxation (Abeyratne, 1993) and connectivity in the global air transport network have also been explored (Arvis & Shepherd, 2011).

4. CGE scenarios generation: air connectivity and the Kenyan tourism industry

This section aims to produce a foundation for simulation scenarios of CGE analysis of the Kenyan tourism industry and its welfare implications for the Kenyan economy. The approach adopted here constructs and estimates a gravity model of Kenyan airline passenger flows. The gravity model was originally developed to explain international trade flows (e.g. Tinbergen (1962) and has gained popularity in migration (e.g. Gallardo-Sejas, Pareja, Llorca-Vivero, & Martínez-Serrano, 2006; Lewer & Van den Berg, 2008), tourism (e.g. Uysal & Crompton, 1985; Vera Rebollo & Ivars Baidal, 2009; Eryiğit, Kotil, & Eryiğit, 2010; Lorde, Li, & Airey, 2016), air transport (e.g. Cristea, Hillberry, & Mattoo, 2015; Dresner & Tretheway, 1992) and other conjugate research disciplines with appropriate modifications. Bilateral trade theoretical foundations can be found in Linnemann (1966) and Anderson (1979) and bilateral air traffic specific theory behind the gravity model in Schipper et al. (2002). Gravity model elasticity estimates are then used as a justification of CGE scenarios. Total passengers are used instead of total tourist arrivals by air due to lack of data over the studied period. Total tourist air arrivals are available for 2007 and 2008 only and represent approximately 51% of all air arrivals (World Bank, 2010). Data are also available since 2009 for tourists arriving at Nairobi and Mombasa airports, which are the first and second largest airport in Kenya (Kenya Tourist Board, n.d.). Nairobi airport is the country's major gateway accounting for approximately 75% of total passenger traffic in Kenya (Kenya Tourist Board, n.d.). According to the World Bank (2010), while scheduled flights are available to the second largest country's airport, Mombasa Airport, tourists from Europe coming to the coast during peak season generally arrive on charter flights.

Though CGE is a powerful tool for tourism economic impact evaluations, scenarios are often intuitive (e.g. Njoya & Seetaram, 2018). The approach adopted here is a step further in CGE scenario generation. It allows higher numerical precision for tourism economic implications modelling with CGE on the example of Kenya. The gravity model output provided may also be regarded as a standalone preliminary analysis of the state of Kenyan air connectivity development and a contribution to the relevant literature (Duval, 2013), which is scarce for the African continent and Kenya in particular (InterVISTAS, 2014).

For the specific purposes of this section, a panel consisting of 88 countries over the period from 2002 to 2014 for the variables presented in Table 1 has been produced. Countries are selected with the aim to formulate diverse groups of countries with heterogeneous characteristics to maximise sample representability, while the time window of the study is dictated by the data availability and their relevance.

Annual frequency of the data collected suggests 1144 observations for our investigation, however, data on Global Conflict Risk Index (GCRI) as provided by EU External Action Service as well as data on country by country specific trade flows as provided by World Integrated Trade Solution (WITS) are incomplete. Overall, missing values reduce the panel to 645 observations where 199 GCRI and 300 trade data observations are missing. Nevertheless, panels of a similar size are common in the literature and considered fruitful for investigation (Martínez-Zarzoso & Nowak-Lehmann, 2003; Khadaroo & Seetanah, 2008; Lorde et al., 2016). Overall, the Kenyan panel is well represented by the data commonly used in gravity models (Abate, 2016; Cristea et al., 2015; Lewer & Van den Berg, 2008; Park & Jang, 2014) with modifications to accommodate air connectivity measures as defined by Morphet and Bottini (2012), the openness of international air transport policy, airline fares and the number of direct destinations. A general model specification used for estimations is given below:

$$lnpas_{it} = \beta_0 + \beta_1 lnfare_{it} + \beta_2 lngdp_{it} + \beta_3 lnpop_{it} + \beta_4 lndist_i + \beta_5 lnconf_{it} + \beta_6 lntrade_{it} + \beta_7 apol_{it} + \beta_8 dirserv_{it} + \beta_9 comlang_i + \beta_{10} border_i + \varepsilon_{it}.$$

Table 1
Data description.

Variables	Description	Data source
$lnpas_{it}$	$\ln(\sum pas_{lt})$; natural logarithm of total passenger flow between Kenya and country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$.	Sabre Market Intelligence
$lnfare_{it}$	$\ln\left(\sum\left(\frac{pas_{at}}{pas_{lt}}\right)*fare_{at}\right)$; natural logarithm of weighted average trip fare between Kenya and country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$. Note: weighted average is computed on the basis of passenger share of air transport's company a out of total passenger flow.	Sabre Market Intelligence
$lngdp_{it}$	$\ln(gdp_{kt} * gdp_{lt})$; natural logarithm of GDP per capita product for Kenya k and country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$.	IMF
$lnpop_{it}$	$\ln(pop_{kt} * pop_{lt})$; natural logarithm of population for Kenya k and country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$.	World Bank
$lndist_{i}$	$\ln(dist_{k} * dist_{l})$; natural logarithm of distance product between Kenya k and country l for $l \in [1;88]$. Note distance is constant over time t.	Great circle distance
$lnconf_{it}$	$\ln(\mathrm{conf}_{kt}*\mathrm{conf}_{lt})$;$\ln(\mathrm{conf}_{kt}*\mathrm{conf}_{lt})$;natural logarithm of conflict index sum for Kenya k and country l for $l \in [1;88]$ and $t \in [2002;2014]$.	GCRI
$lntrade_{it}$	$\ln(imp_{lt} * exp_{lt})$; natural logarithm of import and export product from and to country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$.	WITS
$apol_{it}$	categorical variable: 1 for restrictive policy and 0 for liberal policy between Kenya and country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$. Note: liberal policy is set if Air Liberalisation Index (ALI) ≥ 14.	WTO
$dirserv_{it}$	categorical variable: 1 for direct flight availability and 0 for the opposite between Kenya and country l at a time t for $l \in [1;88]$ and $t \in [2002;2014]$.	Sabre Market Intelligence
$comlang_{it}$	categorical variable: 1 for common language and 0 for the opposite between Kenya and country l for $l \in [1;88]$. Note common language is constant over time t.	United Nations off. Languages
$border_{it}$	categorical variable: 1 for common border and 0 for the opposite between Kenya and country l for $l \in [1;88]$. Note border is constant over time t.	United Nations World Map

Unlike other gravity models (e.g. Beine, Bertoli, & Fernández--Huertas Moraga, 2016; Fally, 2015), our gravity specification does not include Multilateral Resistance (MR) as in relevant transport and air connectivity-oriented investigations (Zhang, Zhang, Zhu, & Wang, 2017). Nevertheless, in our pool of estimation methods, we further include and discuss approaches allowing satisfactory control of potential MR effects as in relevant investigations by Zhang and Zhang (2016) and Zhang et al. (2017).

Our panel is illustrated with high-resolution scatterplots in Figs. A1 and A2 in the Appendix. Figs. A1 and A2 present typical associations for selected dependent-independent variables' pairs for Kenya. It can be observed that for every pair, apart from distance, association seems stable over time. Distance between countries is constant and thus the weakening relationship with time can be rationalized by the positive trends in income, population and trade, hence making distant flights affordable and justified. Distance is the great circle distance between Nairobi airport and the capital city airport of the route endpoints measured in kilometres.

Additional preliminary data analyses are supplemented with the correlation matrix in Table 2. We used a WTO Secretariat devised a measure of air liberalisation (the Weighted Air Liberalisation Index or WALI) to assess the degree of openness of air services agreements (ASA) between Kenya and its trading partners. The different provisions of air liberalisation index on market access features of air services agreements are weighted based on their importance in removing obstacles to trade in air services according to the judgments of sector experts (WTO ASAP Database, 2018). The cut-off for the air service liberalisation index is set at 14 because a weight of 14 to the provision of ASAs allows foreign airlines to service a country if their principal place of business or substantial ownership and effective control is in the foreign country (Piermartini and Fache Rousová, 2008). Ismaila, Warnock-Smith, and Hubbard (2014) and Njoya, Christidis, and Nikitas (2018) have adopted a similar approach in the measurement of the economic impact of air transport liberalisation in Africa. In addition to the WTO database, we have consulted many official documents, memoranda of understanding, the website of the Kenyan civil aviation authority and publications by the International Civil Aviation Organisation to incorporate in our analysis the newly revised or signed agreements not recorded in the WTO ASAP database.

The unit of measurement for data series in Figs. A1 and A2 is provided in Table 1.

From Table 2, distance has a strong correlation with airline fare implying potential estimation problems due to multicollinearity (e.g. correlation is higher than 0.75). Other independent variables have low correlation (less than 0.55) and are unlikely to pose a threat due to multicollinearity (Khadaroo & Seetanah, 2008; Park & Jang, 2014). Therefore, we further conduct a Variance Inflation Factor (VIF) analysis to ensure that there is no harmful impact on our estimations by the potential multicollinearity problem.

Inspecting scatterplots further implies that common border category is a well-defined group with higher passenger flow on average. This is likely due to poor Kenyan road and alternative transport infrastructures (e.g. Schlumberger & Weisskopf, 2014). Direct service availability is another well-defined category with considerable scale. Direct services and common border are strongly correlated with passenger numbers for every scatterplot. For air transport policy association patterns are also noticeable. The liberal policy category has higher flow of passengers with lower fare on average from the passenger-fare scatterplot. Less policy restrictions imply lower fees and charges, hence lower costs of service production. Cheaper inputs can stimulate market entry, leading to a more competitive environment which in turn rationalizes lower fares.

The pool of estimation methods considered here is fairly standard (e.g. Park & Jang, 2014; Zhang et al., 2017; Zhang & Zhang, 2016). That is, pooling our panel across sections, controlling for year (time) and country specific (individual) fixed effects (FE), and random effect (RE) estimations. We employ standard least-squares based and Poisson Pseudo Maximum Likelihood (PPML) approaches to estimate our gravity

Table 2
Correlation matrix.

	lnpas	lnfare	lngdp	lnpop	lndist	lnconf	lntrade
lnpas	1	***	***	***	***	***	***
lnfare	−0.5259	1	***	***	***	***	***
lngdp	0.1351	0.3546	1	***	***	***	***
lnpop	0.2472	0.1780	−0.1877	1	***	***	***
lndist	−0.2826	0.8295	0.5489	0.2690	1	***	***
lnconf	0.0587	−0.1342	−0.2612	0.3356	−0.1176	1	***
lntrade	0.6643	−0.2079	0.3640	0.3909	0.0337	0.0827	1

Note: *** denotes that obtained correlation is not zero with 95% confidence.

model. It is important to highlight that individual FE estimations cancel out multicollinearity problem as distance is constant over time and also accounts for MR effects (Siliverstovs & Schumacher, 2009; Zhang & Zhang, 2016). Moreover, the PPML approach effectively controls for MR (Fally, 2015). Individual FE if combined with time FE shall be robust in dealing with non-stationarity of the log transformed data (Wooldridge, 2010). An inclusive and less subjective approach to stationarity typically includes a panel data unit root test (Khadaroo & Seetanah, 2008), however, reliability of the stationarity tests on the panel of 13 periods may not be sufficient due to some variables' serial correlation (e.g. positive trends in income per capita and population) (Im, Pesaran, & Shin, 2003). On the other hand, with the benefits of individual and time FE, both approaches are typically argued as limited in estimating effects of other constant variables such as common language (English) and common border. Therefore, RE estimations are always worth considering. Analysis with RE requires considering additional assumptions behind the method. For example, it assumes no correlation of the residuals with the individual effects (Wooldridge, 2010). Therefore, the Hausman test is often informative if a decision is to be made on the FE and RE estimation methods (Hausman, 1978). It tests RE coefficient estimates for statistical difference from FE coefficients. If coefficients' difference is significant, RE output is believed to be inconsistent. If the opposite is true, RE is preferred as it is believed to be more efficient than FE estimations.

Estimation results are presented in Tables 3 and 4. All estimations for FE and RE were performed in R with the "plm" package of Croissant and Millo (2008), while PPML estimations were made with appropriate glm command specification from the standard "stats" R package. The first set of estimations' results are presented in Table 3. Note that the dependent variable under Poisson estimations is not log transformed due to the technical specifics of this estimation method, however obtained coefficients still have similar interpretations to the standard pooling with and without FE controls or RE estimations (Fally, 2015; Siliverstovs & Schumacher, 2009). Since missing years of the Kenyan trade data make capturing recent or comprehensive policy changes more problematic, Table 4 also presents estimation results for two points in time, 2005 & 2013. The 2005 & 2013 year data set is an unbalanced panel of 172 observations with 4 observations missing due to incomplete data for conflict index for 2005. Choice of the years for these estimations is driven by the trade and conflict data availability and relevance to the periods of two different phases for Kenyan air connectivity progress. Before we proceed analysing estimations' output in Tables 3 and 4 it is important to highlight that the Hausman test conducted for all panels rejects consistency of the RE output. Therefore, controlling for FE warrants the most robust results among those reported.

Following the approach of others (e.g. Keum, 2010; Khadaroo & Seetanah, 2008) we target not only coefficient estimates but also statistical significance of the coefficients. Statistical significance is an obvious and straightforward strength indication for the research argument provided. However, data and other constraints faced in practice often impose certain limitations on the methods available to the researchers and conclusion robustness (Koo et al., 2017; Park & Jang, 2014), therefore we report statistical significance for the heteroscedasticity robust standard errors.

Firstly, airline fare is significant at 0.1% level for all estimation methods presented in Tables 3 and 4, apart from the PPML-pool with individual FE in Table 4, where it is statistically significant at the 5% level. Secondly, price elasticity estimates for individual FE and individual plus time FE in Table 3 are quite close to those reported by Abate (2016) for the African continent. Elasticity estimates are less than one implying lower sensitivity to price changes. However, FD (natural individual plus time FE estimator in only two period panels) output from Table 4 may be an indication that the price flexibility is on the rise. Thirdly, from the reported VIF in Tables 3 and 4 and as may be also expected from the correlation matrix in Table 2, distance consistently has the highest potential multicollinearity threat. Therefore, estimations not controlling for individual FE, which cancel out the impact of the time constant independent variables, such as distance, may not be considered reliable. Note that we adopt a cut-off point for multicollinearity negative impacts at VIF = 5, though less conservative multicollinearity practices allow VIF = 10 thresholds as discussed in O'Brien (2007) among others. Given our VIF selected threshold, PPML estimations, while controlling for individual and/or time FE may be also concerning as fare and GDP per capita independent variables in Tables 3 and 4 computed VIF exceed the selected threshold for this estimation approach.

Direct service category is also strongly significant. For individual and individual plus time FEs and FD in Tables 3 and 4 respectively it is significant at the 1% level, while for PPML when controlling for individual and time FE it is significant at the 5% level. Table 4 FD output indicates that from 2005 to 2013 the addition of direct service flights increased the number of passengers by 45.6% $([\exp(0.3737)-1]\cdot 100)$. This can be considered as a substantial addition of passengers through improved air connectivity for the period. From Table 4, we also note that PPML with both FE reports 74.75% $([\exp(0.5572)-1]\cdot 100)$ contribution by the direct services addition. This is a less expected result, since PPML is often believed to provide more conservative estimates of gravity coefficients (Fally, 2015). On the other hand, we observe a more expected pattern of coefficients for PPML in Table 3. We articulate PPML higher coefficients in Table 4 by the reported VIF, which are estimated higher than 10 for both fare and income for the PPML settings in Table 4.

Controlling for individual FE in Table 3 indicates that a destination

Table 3
Kenya passengers flows gravity model estimation outputs.

	OLS - pool	PPML-pool	OLS-pool		PPML-pool		RE	FE-within	PPML-pool	FE - within	PPML-pool
lnfare	−1.2899 ***	−1.0901 ***	−1.3443	*2.8169* ***	−1.1292	***7.6625*** ***	−0.8767 ***	−0.8074 ***	−0.5101 ***	−0.7440 ***	−0.4147 ***
lngdp	0.2830 ***	0.3576 ***	0.2268	*2.9652* *	0.3639	***6.2596*** ***	0.4554 ***	0.3530 ***	0.2325 ***	0.5645 ***	0.4069 ***
lnpop	0.2971 ***	0.3392 ***	0.2839	*2.4578* ***	0.3524	*3.4245* ***	0.5009 ***	0.9851 ***	0.8369 ***	1.1131 ***	0.8642 ***
lnconf	−0.3576 *	−0.5211 ***	−0.4562	*1.5356.*	−0.6549	*2.0716* ***	−0.0589	−0.0283	0.0391	0.1220	0.2397
lntrade	0.0731 **	0.1135 ***	0.0772	*2.8381* **	0.1120	*3.2011* ***	0.0213 *	0.0131	0.0018	0.0154	0.0018
apol	−0.3971 **	−0.0911	−0.2981	*1.5501.*	0.1545	*1.4239* ***	−0.0155	0.0442	0.0397	0.0488	−0.0045
dirserv	0.6413 ***	0.4932 ***	0.6725	*1.6702* ***	0.5005	*1.7137* ***	0.1882 ***	0.1595 **	0.0745.	0.1478 **	0.0935 *
FE – Time	No	No	Yes	*1.7547*	Yes	*1.8463*	No	No	No	Yes	Yes
FE - Indv.	No	No	No	-	No	-	No	Yes	Yes	Yes	Yes
Distance	Yes	Yes	Yes	***6.5704***	Yes	***28.4869***	Yes	No	Yes	No	Yes
Comlang	Yes	Yes	Yes	*1.0787*	Yes	*1.5412*	Yes	No	Yes	No	Yes
Combord	Yes	Yes	Yes	*1.5366*	Yes	*3.8291*	Yes	No	Yes	No	Yes

Note: (***), (**), (*) and (.) denote 0.1%, 1%, 5% and 10% statistical significance levels. Computed VIF are reported in *italic*.

Table 4
Estimation output for 2005 & 2013 model.

	OLS - pool	OLS-pool		RE	FD	PPML-pool	PPML-pool		PPML-pool	PPML-pool
lnfare	−1.4739 ***	−1.5933	*4.4402* ***	−1.3478 ***	−1.1799 ***	−1.3125 ***	−1.2766	***13.6897*** ***	−0.7633 *	−0.7848 ***
lngdp	0.2975 ***	0.2282	*4.3116* *	0.4488 ***	0.5254 ***	0.2985 ***	0.3172	***12.0497*** **	0.1949.	0.1499
lnpop	0.3357 ***	0.2909	*3.3570* **	0.4431 ***	1.0239 ***	0.2679 ***	0.2796	***5.2532*** **	0.8677 ***	0.8172 **
lnconf	−0.4437	−0.4667	*1.4455.*	−0.0556	0.1257	−0.4445.	−0.4306	*1.8598.*	0.4648	0.4544
lntrade	0.0735 *	0.0821	*3.0844* **	0.0415	0.0115	0.1319 ***	0.1301	*3.3559* ***	−0.0021	−0.0011
apol	−0.3104.	−0.1726	*1.4115*	−0.0863	0.0451	−0.0715	−0.0834	*1.4193*	0.0267	0.0257
dirserv	0.6615 ***	0.6766	*1.7674* ***	0.4677 **	0.3737 **	0.4931 **	0.4868	*1.7252* *	0.5519 *	0.5572 *
FE - Time	No	Yes	*1.8152*	No	No	No	Yes	*2.7126*	No	Yes
FE - Indv.	No	No	-	No	No	No	No	-	Yes	Yes
Distance	Yes	Yes	***7.5159***	Yes	No	Yes	Yes	***34.3653***	Yes	Yes
Comlang	Yes	Yes	*1.0776*	Yes	No	Yes	Yes	*1.5512*	Yes	Yes
Combord	Yes	Yes	*1.6112*	Yes	No	Yes	Yes	*4.6961*	Yes	Yes

with a direct service has higher passenger flow by 17.3% ($[\exp(0.1595)-1]\cdot 100$) on average, while also considering time FE provides a similar estimate for average direct flight contribution of 15.92% ($[\exp(0.1478)-1]\cdot 100$) more passengers per destination. As may be expected, PPML output with individual and time FE provides a more conservative estimate for average direct flights' contribution suggesting 9.81% ($[\exp(0.0935)-1]\cdot 100$) more passengers per destination with a direct service. The most conservative estimate for direct flights' contribution is provided by PPML with individual FE only, where a destination with a direct flight has a higher passenger flow by 7.73% ($[\exp(0.0745)-1]\cdot 100$) on average. Next, for all FE variations including PPML outputs in Table 3 indicate that income and population are statistically significant. Income elasticity is less than one, which is an indication that air transport is considered a necessity rather than a luxury, though for the context of African income, the luxury interpretation is less straightforward (Abate, 2016). Population elasticity estimates, which are close to one, indirectly confirm the lack of transport alternatives in Kenya and the necessity to use air transport. Similar can be also concluded from the income and population outputs in Table 4.

Another coefficient which is often of interest and not straightforward to model is air transport policy (Gillen, Harris, & Oum, 2002; Piermartini & Fache Rousová, 2008). Piermartini & Fache Rousová, (2008) demonstrate that air transport policy has both a statistically and economically significant effect on passenger flow. However, policy has to be in place for a long time to allow its positive effects to be captured. Here, air transport policy has the form of a categorical variable with the expectation that a route governed by a restrictive air transport policy will have fewer travellers on average, controlling for other effects. Certainly, this may be regarded as a rigid and simplistic approach to capturing air transport policy (e.g. ALI index has a range from 0 to 50). An alternative strategy is to avoid the transformation of the air transport policy index into a categorical variable and instead employ any of the liberalisation indices themselves (Cristea et al., 2015; Zhang & Findlay, 2014). However, liberalisation indices' association with passenger flow may not be explicit. Warnock-Smith and O'Connell (2011), Dobruszkes, Mondou, and Ghedira (2016) and Wang, Tsui, Liang, and Fu (2017) indicate that air transport liberalisation is connected to passenger flow through fare reduction. One of the scatterplots in Fig. A2 confirms this for Kenya. If fare and air transport policy indices are both included in the model, unbiasedness of such analysis cannot be insured. To avoid that, Abate (2016) employs ALI as an instrument for fares when modelling passenger flows, while Piermartini & Fache Rousová, (2008) as well as Koo et al. (2017) simply do not include fares in the analysis. In the Kenyan context the air liberalisation index is available only for 27 countries with little change over time and is unlikely to provide a good approximation of fares for 88 countries over 13 years. It may be worth considering a smaller panel with two-stage estimation approaches, as in Abate (2016), to study the impacts of aviation openness in Kenya more carefully.

5. Modelling the welfare effects of tourism by CGE model

Using a partial equilibrium model, namely a gravity model, it has been demonstrated in the first part of this research that better airline connectivity would lead to an increase in passenger numbers and incoming tourists. A question that arises in connection with increased tourism is whether increased tourist spending will lead to an improvement or a worsening of the household well-being? This question can be answered by modelling the effects of various tourism shocks on household welfare. Although the economic impacts of tourism expansion and to some extent their welfare implications have been extensively explored in several CGE studies (Dwyer, Forsyth, & Spurr, 2005; Dwyer, Forsyth, Spurr, & Van Ho, 2003; Forsyth, 2006; Kweka, 2004; Narayan, 2004; Njoya & Seetaram, 2018), there has been little investigation of the avenues of tourism expansion combining econometrics and CGE models.

The most widely used approach to welfare analysis is to look at household incomes. An alternative method is to look at consumer surplus. In this paper, the welfare implications of air connectivity are measured by the equivalent variation (EV) built into a CGE model, which has the advantage of a constant comparison point (Hosoe, Gasawa, & Hashimoto, 2010). In most CGE studies, welfare is measured using compensations and equivalent variations, as first proposed by Hicks (Blake, Arbache, Sinclair, & Teles, 2008). Previous studies have found a positive relationship between tourism expansion and welfare (e.g. Blake, Durbarry, Sinclair, & Sugiyarto, 2001; 2008; Li, Blake, & Cooper, 2011; Pratt, 2014). Blake et al. (2008) developed a CGE model of the Brazilian economy to estimate the distributional and welfare effects following an expansion of tourism. Welfare was measured by EV for Brazil as a whole and compensated equivalent variation for the four household groups in the model. The authors found that the welfare gain to Brazil of a 10 per cent increase in foreign tourist expenditure is around \$0.106 billion, implying that the country benefits by \$45 for every \$100 of additional tourism spending. Concerning distributional impacts, the results suggest that the welfare gains accrue primarily to households with low (but not the lowest) income. Blake et al. (2001) used the 'Nottingham' CGE model, incorporating Tourism Satellite Accounts as the fundamental data input to estimate the impacts of three illustrative cases for the USA, namely a rise in foreign tourist expenditure, an increase in air transport productivity, and the removal of indirect taxes. The results suggested that a 10 per cent increase in foreign tourist expenditures would lead to an increase in economic welfare by \$5.8bn, just under 0.1% of GDP.

Li et al. (2011) developed a CGE model for China to examine the economic impact of international tourism on the Chinese economy. The authors measure the impact on households or economic welfare by the equivalent variation, thereby comparing the impact generated in the ex-ante estimation with that generated in the ex-post estimation. While in the ex-ante simulation welfare is projected to increase by US\$118 million and US\$236 million in the low and high scenarios respectively, the ex-post estimation shows that there would be a welfare loss of US \$297 million brought by a US\$1238 million decrease in international tourism demand. This means that every US$100 decrease in tourism demand would cause US$25 decrease in welfare. Pratt (2014) assesses the impact on tourism and welfare of a devaluation of the Fijian dollar using a CGE model. Residential welfare (in terms of EV) is defined as the utility the representative household receives. The results show that a 20% decrease in the nominal exchange rate would have mixed effects on the economy and a decrease in overall Fijian residents' welfare by 14.3%.

As in Blake et al. (2008), Li et al. (2011) and Pratt (2014), a tourism-focused CGE model including a welfare measure was developed to investigate the effects of changes in tourism spending resulting from change in air connectivity on households' welfare in Kenya. Previous studies on tourism in Kenya have applied partial equilibrium techniques to highlight a number of issues, such as employment, training and domestic tourism (Sindiga, 1996a; 1996b); or policy issues (Dieke, 1991); or factors influencing tourists' destination choice (Mutinda & Mayaka, 2012; Summary, 1986) and general equilibrium models to investigate the impact of tourism expansion on poverty (Njoya & Seetaram, 2018).

The tourism-focused CGE model is a derivative of the standard trade model of a single economy developed by Decaluwé, Lemelin, Robichaud, and Maisonnave (2010), and its basic structure is thus familiar. Only a brief overview of the model is provided here (a full equation listing is available on request). The economy under consideration is assumed to be composed of a set of competitive industries, each of which use the given endowments of primary factors of production (in a constant elasticity of substitution (CES) technology) along with the output of the other sectors (in fixed-proportions according to a Leontief function). This joint product is composed in turn of a domestic and an exportable commodity, with the transformation between the two based on a constant elasticity of transformation (CET function). Twenty household groups maximise a Stone-Geary utility function subject to the budget constraint. Having allocated expenditure across the consumption commodities, a second-level optimisation procedure allocates consumption of each commodity across domestic and imported commodities in the product category using a CES function. Thus, trade relationships are modelled using the Armington assumption that goods are differentiated by country of origin.

The specification of tourism demand and welfare is where this model diverges from the standard model. Analogous to household demand, tourism demand is obtained by maximizing the utility function of the individual tourist function to its budget constraint. The model is capable of capturing the welfare effects of changes in the air transport and tourism sectors and thus can help answer the question whether the expansion of these sectors is likely to advance or restrict the Kenyan broader development goal of inclusive growth.

Like in many CGE models, the Stone-Geary utility function – sometimes called Linear Expenditure System (LES) – is used to model household behaviour. The Stone-Geary function is often used to model problems involving subsistence levels of consumption (Annabi, Cockburn and Decaluwé, 2006). Consumers first set aside subsistence levels of goods ($\sum p_j\gamma_{j,h}$) and then allocate remaining budget ($R_h - \sum p_j\gamma_{j,h}$) in proportion to preferences ($\alpha_{i,h}$). For a developing country such as Kenya, subsistence consumption considerations are of major importance and should be taken into account within theoretical analyses (Steger, 2000, pp. 21–60). The LES demand function is derived from the following utility maximization program:

$$\max U = \prod \left(q_{i,h'} - \gamma_{i,h}\right)^{\alpha_{i,h}} \; s.t. \sum_i p_i q_{i,h} = R_h \text{ and } \sum \alpha_{i,h} = 1$$

where

$q_{i,h'}$ consumption of good i by household h.

$\gamma_{i,h}$ predetermined subsistence levels of consumption.

$\alpha_{i,h}$ marginal share of commodity c in type h household consumption.

Budget (show how consumers allocate their discretionary expenditures).

R_h income of household h.

P_i price of the ith good.

The EV measure of welfare for the LES function is based on discretionary income, which is determined endogenously as the difference between total household consumption and minimum consumption. The resulting demand for the consumption of commodity i is the sum of the minimal and discretionary components: Consumption of commodity c by type h households

$$p_i q_{i,h} = p_j\gamma_{j,h} + \frac{\alpha_{i,h}}{p_i}\left(R_h - \sum p_j\gamma_{j,h}\right)$$

$$EV_h = \left(R_h - \sum p_j\gamma_{j,h}\right)\prod\left[\frac{\overline{P}_i}{\overline{\overline{P}}_i}\right]^{\alpha_{i,h}} - \left(\overline{R}_h - \sum p_j\gamma_{j,h}\right),$$

where

$R_h - \sum p_j\gamma_{j,h}$ is supernumerary or residual income.

$EV_{(h)}$ equivalent variation for households.

$\overline{P}_i$ initial consumer price of composite goods.

6. Closure rules

Macroeconomic closure is achieved as follows. We define the numéraire of the model as the domestic producer price index. The exchange rate adjusts to clear the current account balance. The current account balance and the government expenditure are fixed. Investment is saving-driven and capital is assumed mobile across activities and fully employed. Labour is also fully mobile at fixed wage.

7. Simulation design

Unlike previous studies (Adams & Parmenter, 1995; Blake, 2000; Dwyer et al., 2003; Narayan, 2004; Njoya & Seetaram, 2018) this study makes explicit the source of the stimulus to the tourism sector. A tourism boom occurs as the result of air transport policies designed to improve air connectivity or because of promotion policy (Wattanakuljarus & Coxhead, 2008). Wattanakuljarus and Coxhead (2008), for example, simulate a 10% increase in inbound tourism in Thailand assuming the rate of tourism growth attributed to a successful past tourism promotion policy doubles relative to other growth rates in the economy. Here we aim at establishing a comprehensive CGE output discussion with a good portfolio of scenarios based on the Kenyan gravity model output. Our focus lies on investigating strengthening connections (i.e. direct flights) between Nairobi and other international destinations. To demonstrate growing tourism impact on the Kenyan economy through improved connectivity we select three countries with the highest number of passengers for the year 2014 and with no direct service. They are Italy (≈ 106000 passengers), Germany (≈ 78000 passengers) and Canada (≈ 22000 passengers). For each country we develop 5 scenarios which are illustrated in Table 4 where:

- $\Delta_{tourist}$ - impact on foreign tourist arrivals, computed as foreign tourist share of the total air arrivals (51% based on data from the World Bank and Kenya Tourist Board) times the estimate of impact of direct services on passenger volumes;
- $\Delta_{spending}$- impact on foreign tourist spending (in million KES), proportional to the volume of foreign tourist spending times the foreign tourist share of the total air arrivals times the estimate of the impact of direct services on passenger volumes.

Scenarios in Table 5 are based on a 95% confidence interval for the estimated coefficients. For the direct service with individual FE (within) estimated coefficient from Table 3, we subtract 2 standard errors for a very pessimistic, subtract 1 standard error for a pessimistic, actual coefficient for a moderate, add 1 standard error for an optimistic and add 2 standard errors for a very optimistic tourists' response scenarios on the introduction of direct services. To be specific, 0.1595 individual FE

Table 5
Changes in tourist arrivals and tourism spending (in million KSH) under different scenarios.

	Scenario	Italy, 5.93% tourists share		Germany, 5.65% tourists share		Canada, 2.51% tourist share	
		$\Delta_{tourist}$	$\Delta_{spending}$	$\Delta_{tourist}$	$\Delta_{spending}$	$\Delta_{tourist}$	$\Delta_{spending}$
1	$([\exp(0.2595)-1]*100)=29.63\%$	15139	1756.58	14435	1673.643	6431	743.51
2	$([\exp(0.2095)-1]*100)=23.31\%$	11909	1381.91	11356	1316.659	5058	584.92
3	$([\exp(0.1595)-1]*100)=17.29\%$	8834	1025.02	8423	976.6212	3753	433.86
4	$([\exp(0.1095)-1]*100)=11.57\%$	5911	685.91	5637	653.5284	2511	290.32
5	$([\exp(0.0595)-1]*100)=6.131\%$	3132	363.47	2987	346.3079	1330	153.84

(Total foreign tourist spending in 2014 according to WTTC (2015) KES 9997.3 million).
Note: 1 = very optimistic; 2 = optimistic; 3 = moderate; 4 = pessimistic; 5 = very pessimistic.

coefficient for direct services from Table 3 has a standard error of 0.05 and produces our moderate scenario in Table 5, namely 17.29% change in tourist arrivals, with 0.1595+(0*0.05) standard error. Very optimistic and optimistic scenarios are obtained by adding to the above FE coefficient (2*0.05) and (1*0.05), respectively, while very pessimistic and pessimistic scenarios involved removing from the coefficient (−2*0.05) and (−1*0.05), respectively.

Such an approach enables the incorporation of the output of the gravity model in the CGE model in an integrated and flexible manner, making it possible for policy makers, businesses, destinations managers and planners to amplify the impacts on the tourism industry and the wider economy resulting from the introduction of direct flights. This also constitutes a range of forecasts covering other FE estimations for direct flights provided in Table 3. The coefficient with both individual and time FE, 0.1478 in Table 3 or 15.92% impact, is close to our baseline scenario and may be less intriguing to investigate. On the other hand, if there is less concern on the multicollinerarity impacts on the estimated coefficients and their significance, an alternative scenario for direct services impact can be employing our PPML estimate with individual and time FE in Table 3. That is, 0.0935 in Table 3 or 9.81% overall impact and is in between our pessimistic and very pessimistic scenarios in Table 5. Furthermore, Abate (2016) finds that routes governed by restrictive bilateral arrangements in Africa have 23% higher fares on average than those with a liberal aviation policy. For price elasticities obtained here, under individual FE in Table 3, it implies a scenario with an 18.6% (−23% ·[−0.8074]) increase in passenger flow, which is again very close to the moderate scenario in Table 5 for selected countries in our analysis. Combined scenarios such as the introduction of a direct service and decrease in price on the destination are also possible given the gravity model outputs and are straightforward to investigate if necessary. Here we keep our investigation to scenarios for benefits and realistic expectations of policy implementation on the per flight level. More scale compressive or macroeconomic impact assessment of direct flights can be also conducted by employing estimation results we report for our gravity model in Table 4. For example, a detailed welfare impact assessment of additional direct flight services within 2005–2013 period may be conducted with the CGE simulations stressed by the 45.6% (as per the FD direct service coefficient in Table 4) increase of total passengers and corresponding tourists' inflow. This outlines the benefit of combining the gravity model with CGE analysis. Scenarios have clear origin and their impacts are easily traced and comparable if research or policy evaluation objectives are different from the ones considered in our work.

8. Simulation results

The results obtained from the CGE simulation are presented in Table 6 and Fig. 3. For lack of space, we present only the simulation results of an enhanced connectivity between Kenya and Italy.[1] As shown in Table 5, the increase in tourism spending brought about by improved connectivity would cause an increase in real GDP, total household income and welfare. While all household groups experience an improvement in welfare measured by equivalent variation under all scenarios, it is apparent from the table that the welfare impact of changes in tourism spending differs between rural and urban households with the highest gains accruing to urban households. These results are congruent with the findings by Kweka (2004) who argue that urban areas will benefit more from a 20% increase in tourism in Tanzania than rural ones.

Table 6
Change in GDP, income and welfare (in million KSH) from improved connections between Kenya and Italy.

	Real GDP	hurb income	hrur income	hurb welfare	hrur welfare	Total household welfare
Scenario 1	24.52	14.50	4.42	26.68	6.79	33.47
Scenario 2	20.44	11.05	3.49	20.34	5.21	25.55
Scenario 3	14.31	8.28	2.57	15.00	4.72	19.72
Scenario 4	10.22	5.52	2.21	5.65	1.41	7.06
Scenario 5	6.13	2.76	0.91	1.06	0.78	1.84

hrur = rural household; hurb = urban household.

Overall, in all scenarios lower income households in urban areas and upper income households in both rural and urban areas record the highest increase in welfare (Table 6). According to the decile expenditures presented in the Kenyan social accounting matrix, the lowest first decile in the urban and rural areas represent the lowest (expenditure) income households; the next three represent the lower income; the next four represent the middle expenditure households and the last two represent the upper income households. Fig. 3 presents the welfare impact of tourism expansion on both rural and urban households by deciles. For example, the urban poorest households record the highest increase in welfare (0.043% corresponding to 0.89 million KSH) in Scenario 1, whereas the lowest increase is experienced by the rural household group at the third expenditure decile (0.003% or 6.32 million KSH in scenario 1). The low values of welfare change in monetary terms for urban households at the lower decile reflect the fact that few urban households fall into the bottom end of the national income distribution, with non-agricultural income, representing 84% of their income source (see Fig. 4). Moreover, in order to understand the results presented above, it is important to understand the distribution of household income in Kenya by source since the benefits of increase in tourism spending are likely to be higher if tourism-related activities constitute a

[1] Results for other scenarios considered in section 5.2 are available on request.

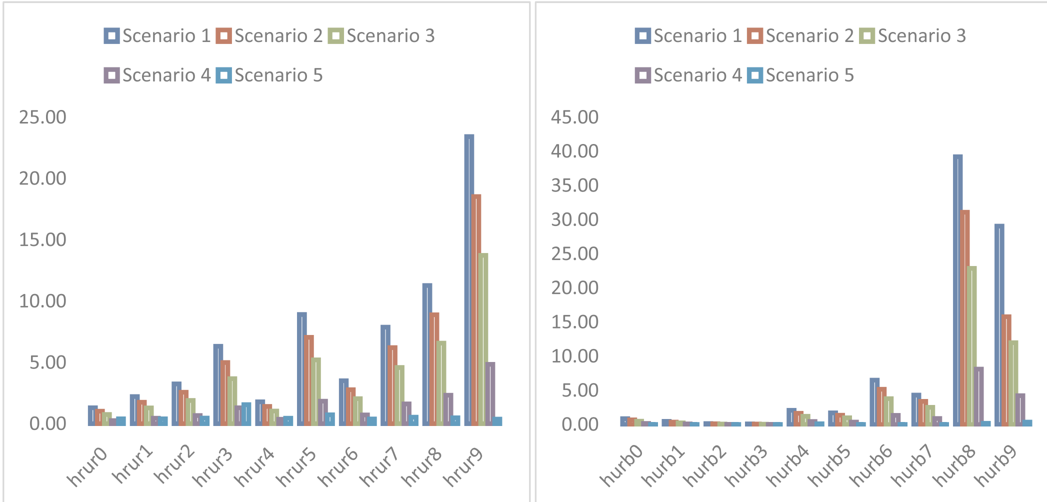

Fig. 3. Change (in million KSH) in welfare of rural (left panel) and urban (right panel) households by expenditure decile from enhanced connectivity between Kenya and Italy.

greater proportion of the household income.

As shown below services' income account for a large percentage of the total income of urban households. Rural households on the other hand receive a higher percentage of their income from agricultural activities, which falls as tourism expands. Tourism's detrimental effects on agriculture result from competition for limited factors of production, namely land, labour and other natural resources. This also explains why urban households as a whole experience the fastest growth in welfare as compared to rural households. The decile groups with the highest increase in the rural region include the medium and upper expenditure households. Moreover, tourism expansion results in a reduction in the activity levels of land-intensive export industries, namely agriculture. The simulation results show that capital incomes grow faster than labour incomes. On the other hand, the drivers of labour demand are industries mainly classed as urban, such as construction, food and beverage, air services and accommodation. The higher returns to labour in these industries raise the income of urban households.

The disproportional distribution of the benefits of tourism expansion between households can further be explained by the terms of trade effects as noted by Gooroochurn and Sinclair (2005), Mahadevan, Amir, and Nugroho (2017) and Pratt (2015). Gooroochurn and Sinclair (2005) investigate the efficiency, equity, and economy-wide effects of tourism taxation in Mauritius using a CGE analysis, concluding tourism taxation leads to an improvement in the terms of trade. The authors argue that welfare increases because the higher consumption associated with higher terms of trade outweighs the reduction in consumption as a result of the lower GDP. Mahadevan et al. (2017) indicated that an increase in inbound tourism in Indonesia is expected to improve the terms of trade. Thus, inbound tourism growth would lead to an increase in the demand for the Indonesian rupiah resulting in an appreciating exchange rate. The effect of this is a fall in foreign demand for Indonesian exports and hence a fall in the local currency of exports. As the world prices for imports and exports are assumed fixed, the price of imports denominated in local currency decrease by the same extent as the appreciation in Indonesian rupiah. The authors show that the price of imports decreases more than that of exports, leading to an improvement in terms of trade.

Pratt (2015) pointed out that an increase in tourism attributed to Borat has had a negative net benefit to Kazakhstan residents. The trade balance worsened as total exports decreased and total imports increased. The author demonstrated that the price of foreign exchange decreases by 0.04% and the price of the bundle of tourism goods and services increases by 0.01%, resulting in an increase the terms of trade. An improvement in the terms of trade means that export prices are

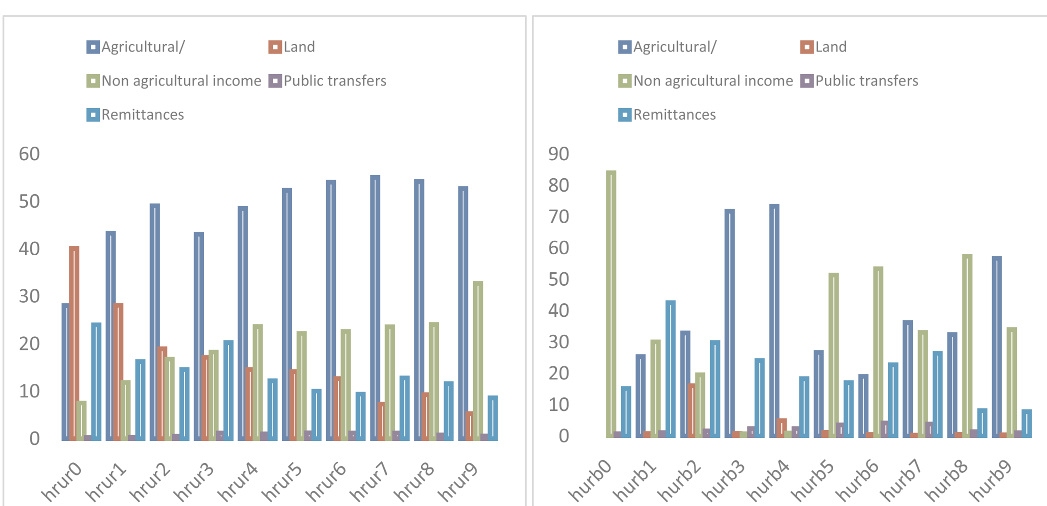

Fig. 4. Income from each source as a % of total income.

increasing faster than import prices. Therefore, there will be a fall in exports and an increase in the quantity of imports.

Our findings show that tourism expansion leads to a worsening of the balance of trade as total exports decrease by 0.04% and total imports increase by 0.08%. Although Kenya as a whole benefits from increased tourism, the economic gains to rural areas are lower than the gains to urban areas, which can be attributed to rural areas' heavy reliance on agricultural activities, whose exports decline following tourism expansion and real exchange rate appreciation.

The findings show that the price of foreign exchange decreases by 0.01% and the price of the bundle of tourism goods and services increases by 0.004% resulting in an increase in the terms of trade. Moreover, the results show that the price of imports denominated in local currency decreases faster (0.009%) than that of exports (0.007%), meaning an improvement in the terms of trade. Overall, these findings are in line with findings reported by Pratt (2015) and Mahadevan et al. (2017).

Overall, this study shows that affordable and regular access by air transport is crucial to the successful development of international tourism in Kenya. Tourism development stemming from an efficient air transport network would improve total welfare. A policy implication emerging from these simulations is that strengthening the links between the tourism and the rural farmers is likely to maximise the tourism benefits accruing to rural poor households.

9. Conclusion

This paper has investigated the impact of improvements in air connectivity on tourism development and welfare in Kenya. Data show that air transport in Kenya is a crucial component of the tourism industry. Kenya, like many other destinations in Africa, is a long-haul attraction for tourists from major source markets meaning that the impact of air connectivity factors is potentially strong. In this respect, the regulatory conditions governing air transport are likely to play a crucial role in the demand for tourism which in turn is valuable for Kenyan consumer wellbeing. Moreover, demonstrating the avenues of tourism expansion is important, since micro analysis of the tourism impact on different households' welfare through improved air connectivity, is the main distinction and target of our work.

To achieve this, CGE and SAM data for Kenya have been supported with a gravity model analysis of the factors for the passenger flow formation based on the additional panel characterizing Kenyan aviation. First, by the means of the gravity model it has been demonstrated that there is a strong connection between air connectivity factors and Kenyan passenger flows. Then, since the room for direct services' introduction is abundant for Kenya, we focused on this air connectivity factor for stimulus of the tourists' inflow. Focusing on the highest frequency destinations with no direct services we further showed that narrowing the air connectivity gap can be beneficial for the Kenyan households at the particular destination level. Moreover, scenario generation offers versatile approaches for policy makers. If a direct service introduction is unlikely, it is straightforward to approximate how to achieve a similar positive impact on households through fare reduction since its elasticity is available. This would require policy makers considering incentives to airlines such as fees or tax cuts for fare reduction. On the one hand, this may point out that our gravity model and scenarios developed upon its output are still basic and can be further improved. We are currently updating our data sets and aiming to address this in our future work providing more insight on the economics of tourism in Africa. Future studies may attempt incorporating more complex models for estimating elasticities and stress testing economies for their particular sectors with CGE under fewer generalizations and with more precision than here.

Certainly, CGE output importance should not be underestimated and policy makers should consider these findings in their decision making and tourism planning given our output, especially for rural households. Although tourism expansion benefits all household groups, low-income agricultural households experience the least change implying policies targeting welfare growth compensation of this particular group. Overall, our analysis has a clear indication and should be appealing to policy makers. Long-term and sustainable benefits of tourism both at the local and national level of the Kenyan economy can be enhanced if, on the one hand, constraints on air connectivity are resolved and on the other hand, there is policy coordination with rural development.

This research had several limitations. Air passenger traffic adjusted by the proportion of tourist arrivals by air in 2006 and 2008 cannot correspond precisely to the actual tourist numbers by air over the entire study period. Nevertheless, due to the availability of reliable data on the share of total air passenger traffic by travel purposes, this approach is currently the most feasible for research of this kind in the context of Kenya. Another source of weakness in this research, which could have affected the findings, is the focus on inbound tourism only, leaving scope for a more in-depth study into the welfare effects of improved air connectivity on both inbound and outbound tourism. While improved air connectivity will foster more visitors to a country, it will also enable more travel by citizens abroad. On the other hand, the study still provides a valuable insight into what is a significantly under-researched emerging market environment on the impact of aviation reform and tourism growth.

Another possible improvement to the research could have been the introduction of imperfect competition in the CGE model. The welfare implications of air connectivity were investigated under the assumptions that markets are competitive. As pointed out by Blake, Gillham, and Sinclair (2006), service industries are imperfectly competitive owing to a variety of products, high mark-up and restrictions to entry. Future research also might estimate the tourism and welfare implications of government subsidies to airlines as a way of reducing airfares or any other options for financing these subsidies.

Author contribution

Dr Tchouamou Njoya: Construction of a tourism-focus social accounting matrix for Kenya; Construction of the CGE model for Kenya; CGE simulation and analysis of the CGE model results; Literature review on tourism-focused CGE models. **Artur Semeyutin**: Data collection and development of the database for the gravity model; Development of the gravity model; Simulation, analysis and discussion of the gravity model results. **Dr Nick Hubbard**: Literature review on air connectivity and tourism; Contribution in the introduction and conclusion sections.

Appendix

Table A1
Changes in GDP, income and welfare (in million KSH) from improved connections between Nairobi between Kenya and Germany.

	GDP	hrur income	hurb income	hrur welfare	hurb welfare	Total household welfare
Scenario 1	24.11	6.06	1.42	43.73	51.99	95.72
Scenario 2	18.92	4.76	1.11	34.44	38.44	72.88
Scenario 3	14.04	3.53	0.83	25.93	30.12	56.05
Scenario 4	9.4	2.36	0.55	17.08	18.35	35.43
Scenario 5	4.97	1.26	0.29	9.77	15.17	25.94

Table A2
Changes in welfare (million KSH) of households by expenditure decile resulting from improved connections between Kenya and Germany.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
hrur0	1.25	0.98	0.73	0.49	0.26
hrur1	2.13	1.67	1.24	0.83	0.44
hrur2	3.11	2.45	1.82	1.21	0.64
hrur3	5.02	3.75	3.21	2.36	1.24
hrur4	1.72	1.35	1.00	0.67	0.35
hrur5	6.51	3.69	3.16	2.33	1.76
hrur6	3.35	2.64	1.06	1.31	0.69
hrur7	7.5	5.9	4.38	2.94	1.55
hrur8	5.76	6.44	6.27	2.20	1.22
hrur9	7.38	5.57	3.06	2.74	1.62
hurb0	0.83	0.65	0.49	0.32	0.17
hurb1	0.43	0.34	0.25	0.17	0.09
hurb2	0.12	0.1	0.07	0.05	0.03
hurb3	0.09	0.07	0.05	0.04	0.02
hurb4	2.00	1.57	1.17	0.78	0.41
hurb5	1.64	1.29	0.96	0.64	0.34
hurb6	6.21	4.88	3.62	2.43	1.28
hurb7	4.1	3.23	2.4	1.6	0.85
hurb8	7.41	9.38	4.85	4.64	7.74
HURB9	29.16	16.93	16.26	7.68	4.24

Table A3
Change in GDP, income and welfare (in million KSH) from improved connections between Kenya and Canada.

	GDP	hrur income	hurb income	hrur welfare	hurb welfare	Total household welfare
Scenario 1	10.69	6.06	1.42	24.70	34.17	58.86
Scenario 2	8.40	4.76	1.11	18.30	22.38	40.68
Scenario 3	6.23	3.53	0.83	13.69	15.41	29.10
Scenario 4	4.17	2.36	0.55	8.63	8.72	17.35
Scenario 5	2.21	1.26	0.29	5.10	5.21	10.31

Table A4
Change in welfare (million KSH) of households by expenditure decile resulting from improved connections between Kenya and Canada.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
hrur0	0.55	0.43	0.32	0.22	0.11
hrur1	0.95	0.74	0.55	0.37	0.20
hrur2	1.38	1.09	0.80	0.54	0.29
hrur3	2.68	2.11	1.56	1.04	0.56
hrur4	0.76	0.60	0.44	0.30	0.16
hrur5	3.78	2.97	2.20	1.47	0.78
hrur6	1.49	1.17	0.87	0.58	0.31
hrur7	3.34	2.63	1.95	1.30	0.69
hrur8	3.77	2.75	2.18	1.56	0.99
hrur9	5.99	3.82	2.80	1.27	1.03
hurb0	0.37	0.29	0.22	0.14	0.08
hurb1	0.19	0.15	0.11	0.08	0.04
hurb2	0.06	0.04	0.03	0.02	0.01
hurb3	0.04	0.03	0.02	0.02	0.01
hurb4	0.89	0.70	0.52	0.35	0.18
hurb5	0.73	0.57	0.43	0.28	0.15
hurb6	2.76	2.18	1.60	1.08	0.57
hurb7	1.82	1.43	1.06	0.71	0.38
hurb8	6.67	3.11	2.70	1.47	0.44
hurb9	20.63	13.86	8.72	4.57	3.35

Scatterplots in Fig. A1 provide a closer look on these variables conditional on aviation policy, direct service, common language and common border categories of the Kenyan panel.

Scatterplots in Fig. A2 illustrate association of Kenyan passenger volumes with fare, per capita income, population, trade and distance flown conditional on time.

The basic structure of the production of the domestic and composite commodities, domestic supply and demand, imports and exports and final demand is laid out in Fig. A3.

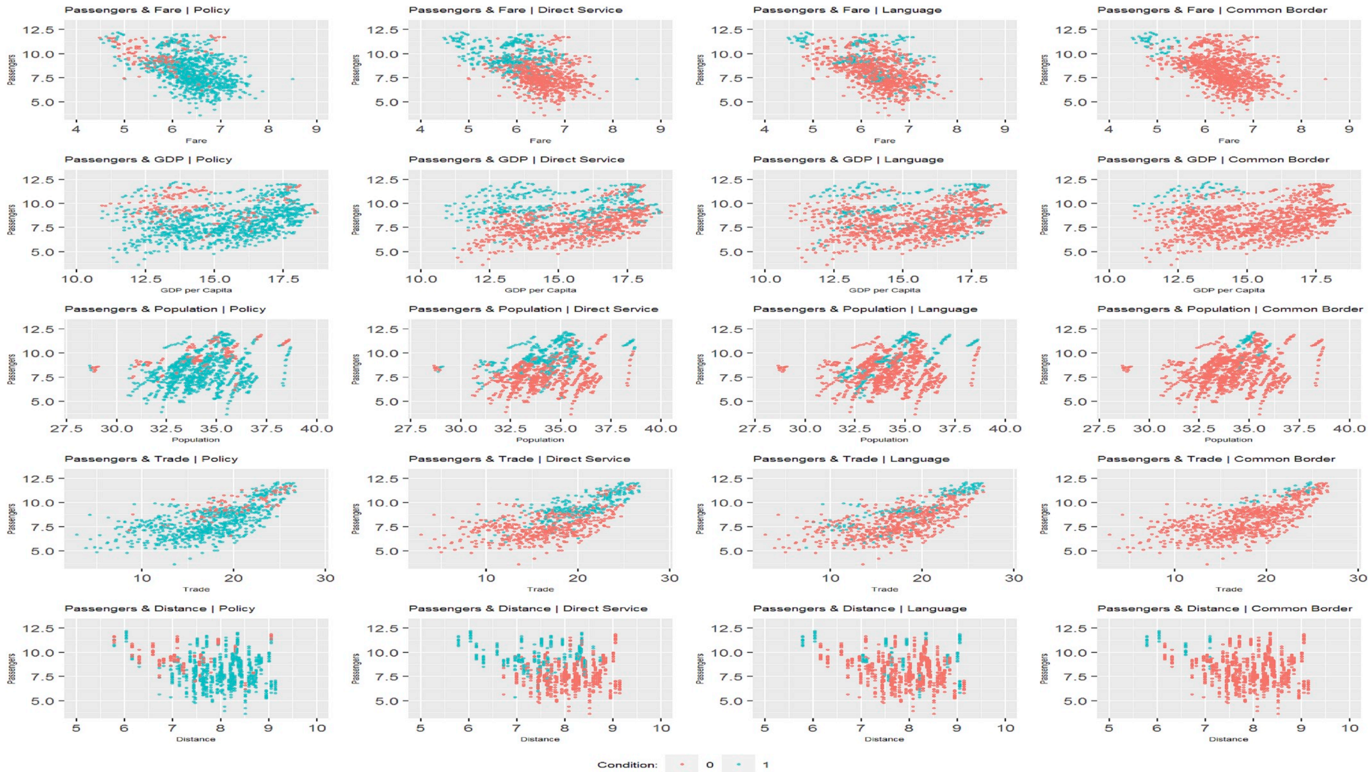

Fig. A1. Scatterplots for Kenyan total passenger flow and airline fare, income per capita, population, trade and distance for 88 countries and years from 2002 to 2014 conditional on the categorical variables as listed in Table 1

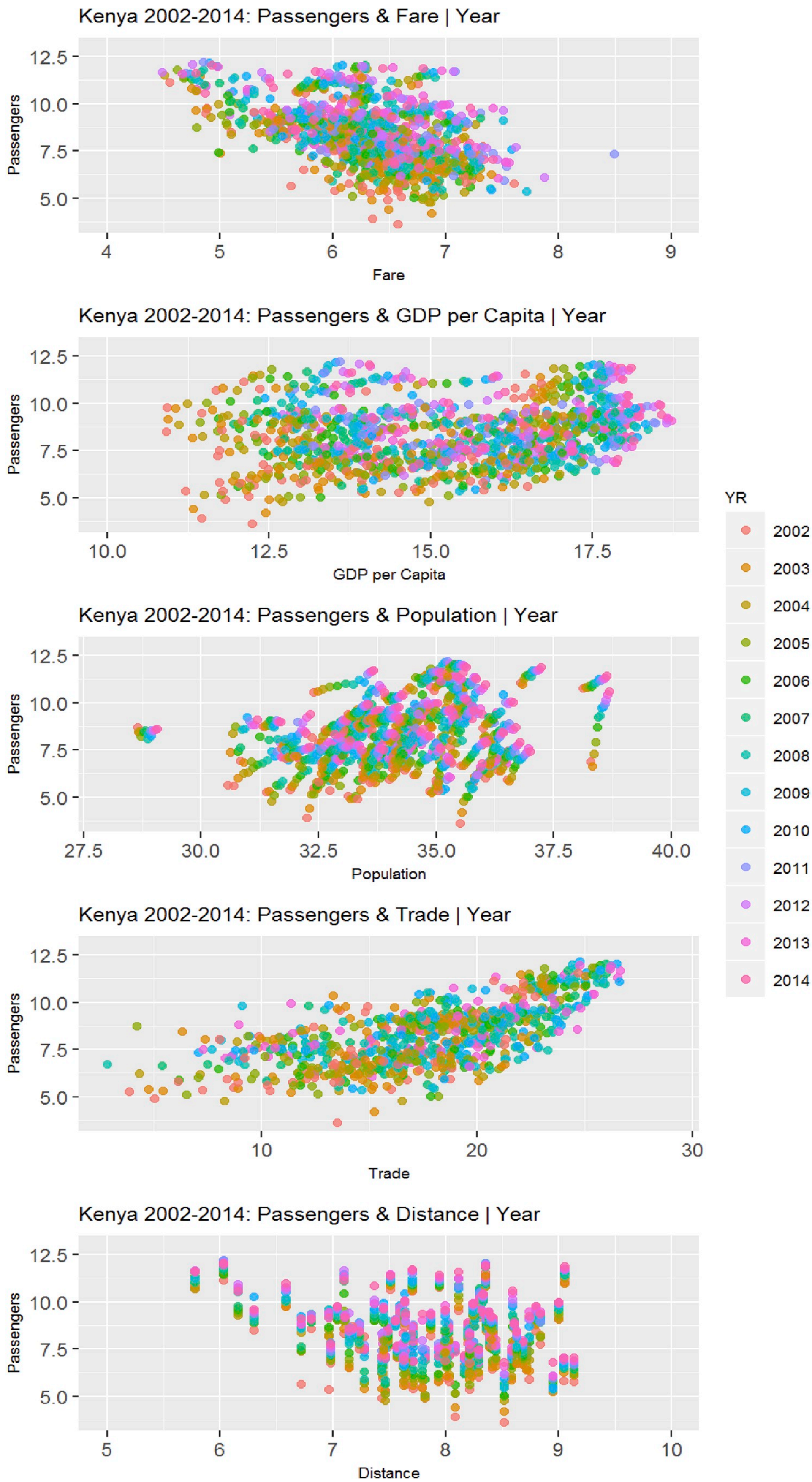

Fig. A2. Scatterplots for Kenyan total passenger flow and airline fare, income per capita, population, trade and distance for 88 countries and years from 2002 to 2014

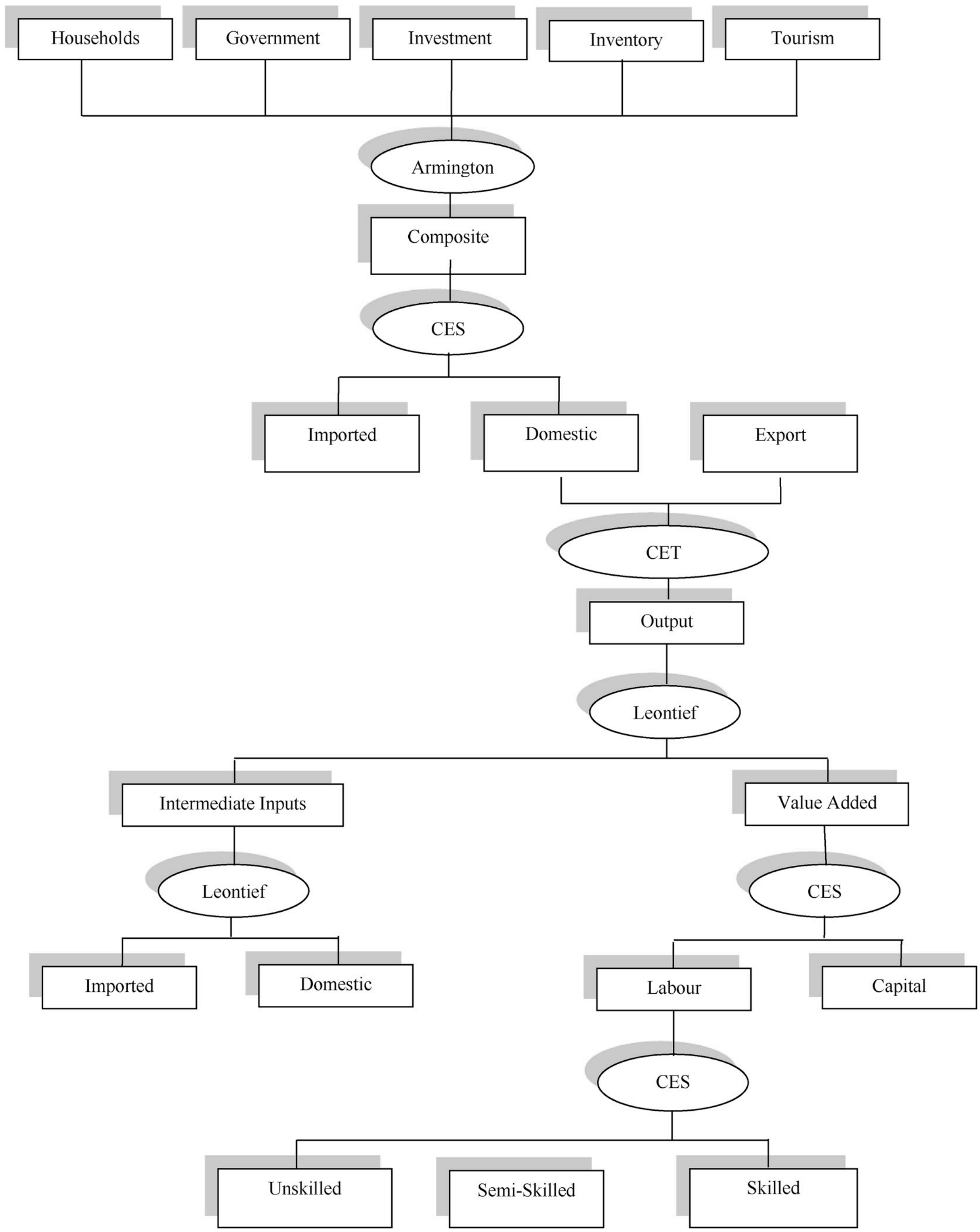

Fig. A3. CGE model structure

Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tourman.2019.104033.

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