The contribution of human migration to tourism: the VFR travel between the EU28 member states

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Abstract

This study explores the correlation between human migration and that part of tourism due to people visiting friends and relatives (VFR) in a foreign country. We first compared the network structure of migration stocks and tourism flows between the 28 member countries of the European Union over the period 2000-2012. Then, we performed several econometric analyses to study the main tourism determinants and the correlations between migration to tourism. The paper derives from the discussion of the results an estimate of the contribution to the overall tourism phenomenon due to VFR.

Complex-network analysis and gravity models were the investigation methods preferred.

Keywords: VFR travel; human migration; tourism; complex-network analysis; gravity model

1. Introduction

Visiting friends and relatives (VFR) represents a significant form of tourism. According to the Association of British Travel Agents (ABTA, 2011), the VFR market in UK has grown faster than both leisure-based and business-based travel since 1984. Moreover, visits to or from distant kin and friends due to special and unrepeatable events like births, birthdays, graduations, weddings, or funerals make the VFR travelling less vulnerable to seasonality and economic conditions than leisure-based and business-based trips.

Despite such positive aspects, which stress the economic value of VFR travellers within the context of the tourism industry, for many years this form of worldwide mobility has been largely overlooked by researchers and tourism operators. As individuals assumed to travel only for the purpose of visiting friends and relatives and staying in the house of people they came to visit (Backer, 2012a; Griffin, 2013; Kotler *et al*, 2006), VFR tourists were perceived as a kind of traveller beyond the influence of tourism planners (Seaton & Palmer, 1997) and as minor contributors to tourism receipts (Shani, 2013).

Some literature has taken a different direction and proved divergent evidence on how VFR travel complements the fulfilment of social obligations with pleasure, leisure, tourism activities, and a range of other practices (Janta *et al*, 2015) with one of them at a time constituting the primary purpose of the visit (Backer, 2012a; Janta *et al*, 2015; Moscardo *et al*., 2000). These arguments have gained strength lately, increasing the attention on the real economic value of VFR tourism (Backer, 2012a; Backer & King, 2015; Moscardo *et al*., 2000) as well as on the social and community dimensions of VFR tourism (Backer & King, 2015; Griffin, 2013; Shani, 2013).

Looking at the main geographical areas of interest, many studies have dealt with VFR travel in Australia and New Zealand (Backer, 2007; Backer, 2008; Backer, 2009; Backer, 2012a; Backer, 2012b; Becken & Gnoth, 2004; Cave *et al*., 2003, Jackson, 1990; McKercher, 1996; Min-En, 2006; Morrison *et al*., 1995), the USA and Canada (Braunlich & Nadkarni, 1995; Kim *et al*., 2014; Lehto *et al*., 2001; Navarro & Turco, 1994; Trites *et al*., 1995; Yuan *et al*., 1995), and the UK (Basu, 2004; Basu, 2007; Boyne, 2001; Boyne *et al*., 2002; Cohen & Harris, 1998; Denman, 1988; Hay, 1996; Seaton. & Tagg, 1995).

Several books (Backer & King, 2015; Hall & Williams, 2002) and papers (Gheasi *et al*., 2011; Jackson, 1990; Janta *et al*., 2015; Williams & Hall, 2000) have also explored the nexus between VFR and migration. In fact, VFR travel and migration are strictly interconnected and permanent international migration is, rather obviously, a precondition for VFR mobility (Jackson, 1990). At the same time, tourism encourages migration. Indeed, VFR tourism represents a form of temporary migration that may inform future permanent migration through the creation of ‘search spaces’ and mobility competencies (Williams & Hall, 2002).

In this paper, we built our analysis on the robust evidence explored in economic literature suggesting that tourism flows from country *i* to country *j* may be affected by the stock of immigrants present in the former country and coming from the latter one. In fact, immigration has a positive impact on tourism demand in host countries because it fosters visits from friends and relatives living in the country of origin: VFR indeed. Studies explicitly presenting such robust positive relationship include: Dwyer et al. (2010), Seetaram (2012a, 2012b), and Seetaram & Dwyer (2009) for Australia, Prescott et al. (2005) for Canada, Tadesse & White (2012) for USA, Gheasi *et al*. (2011) for UK, and Law *et al.* (2013) for New Zealand, Leitão & Shahbaz (2012) for Portugal, Massidda *et al*. (2014) for Itay.

Our analysis expands upon such tourism-migration literature by estimating the contribution of VFRs to tourism flows on an intra-European scale over the period 2000-2012. In doing this, we did not disaggregate official tourism data by purpose of visit or type of accommodation, which was proved to underestimate the size of VFR travel (Jackson, 1990; Backer, 2012a). Instead, we indirectly estimated VFR mobility by including the stock of immigrants present in a country *i* and originating from country *j* as an explanatory factor for tourism in country *i*.

Complex-network analysis and gravity-like models were the preferred investigation methods. In particular, for each year under study, we first built two country-to-country networks to map and reveal the pattern of connections between states as shaped by migration stocks and tourism flows, respectively. The 28 member countries of the European Union (EU28, from now onward) represented the nodes of the networks whereas tourism flows and human migration stocks worked as links between them. Network attributes were quantitatively measured and results displayed visually to show the topology of the EU28 migration-tourism nexus. For each network and year we computed all the statistics needed to characterise the correlation patterns between the two networks under study.

This paper contributes to the existing literature in three ways. First of all, the use of complex-network analysis represents a new and effective approach for tourism studies (see Baggio *et al*., 2010, Scott *et al.*, 2008; Scott and Law, 2013; Shih, 2006 and references therein). Actually, tourism is a network industry "where interdependence is essential (Bjork & Virtanen, 2005) and collaboration and cooperation between different organisations within a tourism destination creates the tourism product (Pechlaner et al., 2002; Tinsley & Lynch, 2001)" (Scott *et al.*, 2008, p. 15). Tourism in a country is made of a series of hierarchical networks (Pearce, 1996), "and network theory may therefore help to understand the collective nature of organisational action, constraint and coordination within tourism." (Scott *et al.*, 2008, p. 16).

In spite of such suitability for tourism applications, only a few studies have examined a tourism destination and its flows from a network perspective and use the quantitative method of network science (see van der Zee & Vanneste, 2015 for an overview of the literature on tourism networks). None of them deals with VFR mobility.

In this study, network analysis is used to support the investigation of the impact of migration stocks on tourism flows, exploring the topological structure of the two networks both analytically and visually.

Secondly, this is the only study comparing tourism and migration on an intra-EU28 scale using an extensive panel dataset, retrieved by combining several sources of raw data available on the WEB. In this, our study counteracts the general remission of scholars and practitioners to consider the application of Big Data to the field of travel, tourism, hospitality and leisure (Baggio, 2016).

Finally, the determinants of correlation patterns between the two networks are studied with a particular focus on the flow of tourism due to human migration. In particular, the paper derives from the discussion of results an estimate of the contribution of VFR travellers to the overall tourism phenomenon, thus allowing us to evaluate how much the intra-European tourism market benefits from VFRs.

The rest of the paper is as follows: in the next session we describe the data sets and methods used in the empirical analysis discussed in section 3. Section 4 illustrates and comments on the results while Section 5 concludes the paper.

2. Data and methods

Migration data used in the study were extracted from the OECD International Migration Database and integrated, when necessary, with data downloaded from EUROSTAT. Migration status was defined in terms of nationality. We referred to migration stocks rather than to flows, as the former are representative of a long-term equilibrium (Brucher and Siliverstovs, 2006) and are based on national censuses that make data more reliable than the annual report of migration flows. Moreover, migration stocks have already been used in several studies (Ortega and Peri, 2009; Brucher and Siliverstovs, 2006; Greogger and Hasson, 2011, among others).

Tourism data were provided by the World Tourism Organization (UNWTO, 2014), the Statistics and Tourism Satellite Account, and integrated with tourism data available on the national statistical office of the individual countries, when necessary. We limited ourselves to data about visits on a country-by-country basis including at least one overnight stay and omitting day trips.

Country-specific data such as gross domestic product in purchasing power parity (GDPppp) was extracted from the International Monetary Fund (IMF) – World Economic Outlook (WEO) database (version October 2015). Between-country geographical distance (DIST), computed as the distance between the capital city of the origin and destination countries, and several dummy variables indicating whether two countries share a common border (BORD) and/or a common official/primary language (LANG), have ever had colonial ties (COLON), share a common colonizer after 1945 (COL45), and are parts of the same country (*SMCTR*) were instead downloaded from CEPII dataset (Mayer & Zignago, 2011). All these variables were assumed to be pull and push factors (determinants) for the tourism flows. Data collection was completed in December 2015.

We selected data for the years 2000, 2005, 2010, and 2012 (latest available meaningful data) in order to have a reasonable timeframe to highlight significant variations, if any. For each of the four years, we only used data for countries present in both the tourism and migration dataset. Once cleaned, our unbalanced panel included 1884 observations. Data employed in the paper were representative of more than 95% of bilateral migration stocks and tourism flows in the EU28 area, in each year.

3. Empirical analysis

To study the pattern of connections between member states for every year under study, we built two weighted directed networks: one for the bilateral migration stock and one representing the bilateral flow of tourists between any two countries (nodes), i and j, in the graph. Connections between countries in the network were represented by links whose weight measured the stock of migrants or tourism flow from country i and present in country j in year y.

The freely-available Python NetworkX (Hagberg *et al.*, 2008) and igraph (Csardi & Nepusz, 2006) libraries were used to describe and characterise the two networks by several basic metrics: order, size, density, average path length, and assortativity (for a complete description of these metrics see da Fontoura Costa *et al.*, 2007; Newman, 2010).

Density is the proportion of the actual number of links, m, in the network to the maximum number of links it may have. Is it computed as:

$$Density = \frac{m}{\frac{n(n-1)}{2}},$$

where n is the total number of nodes in the network (order), and m defines the size of the network. This measure can vary from 0 (all links are unconnected) to 1 (all possible connections exist).

The average path length ($AvgPL$) is the average distance between all pairs of nodes in the network

$$AvgPL = \frac{\sum_{i \neq j} d_{ij}}{n(n-1)},$$

where d_{ij} is the length of the shortest path connecting nodes i and j.

The $AvgPL$ is a measure of the efficiency of the network since it calculates the average number of steps needed to reach each node starting from any other node in the network. Lower values of $AvgPL$ are therefore more desirable than high ones.

The assortativity coefficient measures the correlation between pairs of linked nodes. “Assortativity is expressed as a scalar value, ρ, in the range $-1 \leq \rho \leq 1$” (Noldus & Van Mieghem, 2015, p. 1). When ρ is positive the network is said to be assortative: nodes with a high number of connections (degree) are, on average, connected to other nodes with high degree, and low degree nodes are, on average, connected to other low degree nodes. When $\rho = 0$ the network is non-assortative. The network is disassortative otherwise.

To compare the two networks under study and their evolution over time, tourism and migration network structures were also characterised by measuring their division in groups called modules (also communities or clusters). A community is a group of nodes densely interconnected to one another but only sparsely connected with the rest of the network. We also calculated the modularity index Q (Newman and Girvan, 2004), and its normalized measure Q_{norm} (Du *et al.*, 2009) to allow for the comparisons between networks with different number of communities.
A modularity index, Q, is "the fraction of all links that lie within a community minus the expected value of the same quantity that could be found in a graph having nodes with the same degrees but links placed at random. The index is always smaller than one, and can be negative when the network has no community structure, or when a subgroup has less internal links than towards the other groups" (Baggio, 2011, p. 184).
Finally, we inspected whether the two networks showed any correlated behaviour by representing tourism network links versus migration network links in each year in a scatter plot on a log-log scale. Each bubble in the graph represented an ordered pair of countries (i, j) with positive tourism flows and migration stocks. Migration stocks and tourism flows between two countries were supposed to increase with their size and decay with their distances. Therefore, borrowing from Fagiolo and Mastrorillo (2014) we set the size of bubbles directly proportional to the product of country GDPs and inversely proportional to their geographical distance ($\text{GDPppp}_i \times \text{GDPppp}_j / \text{DIST}_{ij}$).
Supported by the results from the network analysis, causal links from migration to tourism within EU28 were studied by carrying out a gravity analysis. In particular, we performed a set of gravity-like econometric exercises to test if and to which extent tourism from country i to country j could be enhanced the more the stock of migrants coming from i and settled in j. We started with a very simple and basic gravity model assuming tourism flows from country i to country j to increase with their size and decay with the distance between the two countries. The corresponding gravity model showed the following specification:

$$\ln TOUR_{ij}^{y} = \kappa + \beta_1 \ln(GDPppp_i^{y}) + \beta_2 \ln(GDPppp_j^{y}) + \beta_3 \ln(DIST_{ij}) + \varepsilon_{ij}^{y}\,. \qquad (1)$$

where *ln* denotes natural logarithm, $TOUR_{ij}^{y}$ is a measure of the tourism flow from country i to country j in year y, κ is a constant, $GDPppp_{\bullet}^{y}$ stays for the gross domestic product (measured in purchasing power parity) of country • in year y, and $DIST_{ij}$ is the distance in kilometers between the two countries i and j. ε_{ij}^{y} is the random error term. $\beta_{\bullet}$ are the coefficients to be estimated. *GDPs* in *ppp* are used as an indicator of the dimension of the origin and destination markets whereas the physical distance between countries proxies the transportation costs.
We also included year fixed effects to account for the potential role of EU enlargements on migration and tourism flows. In fact, our analysis refers to the actual composition of EU made up of 28 member states. Yet, the EU was not always as big as it is today. In 2000, the first year in our dataset, EU was made up of 15 member states: Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Denmark, Ireland, the United Kingdom, Greece, Spain, Portugal, Austria, Finland, and Sweden. In 2005, ten more countries had already joined the EU: Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovakia and Slovenia. In 2007, after the accession of

Bulgaria and Romania, the number of member states reached 27. Only in 2013, with the accession of Croazia, the European Union reached the current composition.

Country-fixed effects were also included into the model specification to control for time-invariant unobserved heterogeneity. Mátyás (1997) and Wall (2000) stressed the importance of including such unobserved heterogeneity in empirical gravity models based on panel data.

To represent other resistance factor, the regression specification (1) was then enlarged to include several dummy variables in the gravity model: geographical proximity (*BORD*), common official/primary language (*LANG*), colonial ties (*COLON*), a common colonizer after 1945 (*COL45*), and being parts of the same country (*SMCTR*). In fact, it is reasonable to assume that many of those factors might influence tourism flows between two countries. The resulting gravity equation looked as follows:

$$\ln TOUR_{ij}^{y} = \kappa + \beta_1 \ln(GDPppp_i^y) + \beta_2 \ln(GDPppp_j^y) + \beta_3 \ln(DIST_{ij}) + \beta_4 BORD + \\ + \beta_5 LANG + \beta_6 COLON + \beta_7 COL45 + \beta_8 SMCTR + \varepsilon_{ij}^{y}. \qquad (2)$$

Since the main purpose of the study is to account for VFR tourism on an intra-EU28 scale, we further enlarged the equation (2) by including migration stocks as an explanatory variable for tourism flows. In fact, the introduction of bilateral human migration from country i to country j allowed us to some extent to control for VFR travel. However, the introduction of migration stocks in the equation (2) would inevitably bias the coefficients on gravity variables due to the common gravity forces (GDP, population, distance, colonial linkages, and so on) governing both tourism and migration. To avoid this, we first computed the residuals from the specification of a gravity model for migration very similar to equation (2) except for the dependent variable[1]. These residuals (*MIGR_res*) were then used as an independent variable in the tourism gravity equation. The estimated regression then became:

$$\ln TOUR_{ij}^{y} = \kappa + \beta_1 \ln(GDPppp_i^y) + \beta_2 \ln(GDPppp_j^y) + \beta_3 \ln(DIST_{ij}) + \beta_4 BORD + \\ + \beta_5 LANG + \beta_6 COLON + \beta_7 COL45 + \beta_8 SMCTR + \beta_9 \ln(MIGR\_res) + \varepsilon_{ij}^{y}. \qquad (3)$$

Finally, in a fourth specification of the gravity equation we added a control variable related to country centrality in the migration network. The introduction of a network effect in the equation allowed us to better understand the role played by the intricate web of migration corridors in the tourism relationships among the EU28 countries. In fact, tourism from country i to country j might increase proportionally to how central the two countries are in the migration network. Closeness index[2] was the node centrality measure added in the gravity equation (4)[3]:

$$\ln TOUR_{ij}^{y} = \kappa + \beta_1 \ln(GDPppp_i^y) + \beta_2 \ln(GDPppp_j^y) + \beta_3 \ln(DIST_{ij}) + \beta_4 BORD +$$

[1] The estimation results of the migration gravity model as well as the model specification are not shown in the paper for reasons of space. However, results and detailed information are available upon request.

[2] Closeness centrality of a node v is defined as the inverse of the sum of the shortest paths between the node v and all other nodes in the graph.

[3] Our results are robust to the alternative measure of betweenness centrality.

$$+\beta_5 LANG+\beta_6 COLON+\beta_7 COL45+\beta_8 SMCTR+\beta_9 \ln(MIGR_{ij}^{y}\_res)+$$
$$+\beta_{10}\ln(CLOS_{ij}^{y})+\varepsilon_{ij}^{y}, \qquad (4)$$

where $CLOS_{ij}^{y}$ is the sum of country *i* and country *j* closeness centrality in the migration network.

4. Results and discussion

The results from the network analysis are shown in Table 1.

Table 1.: Network analysis of tourism flows and migration stocks.

	Tourism				Migration			
	2000	2005	2010	2012	2000	2005	2010	2012
Node count	28	28	28	28	28	28	28	28
Link count (unweighted)	560	630	654	654	610	540	563	622
Density (unweighted)	0.741	0.833	0.865	0.865	0.807	0.714	0.745	0.823
Average path length (unweighted)	1.188	1.167	1.135	1.135	1.056	1.000	0.970	0.963
Assortativity (weighted)	0.037	0.047	-0.004	-0.016	-0.018	0.038	-0.005	0.001
Modularity (weighted)								
no. of communities	4	3	4	3	5	5	4	4
Q	0.167	0.158	0.145	0.148	0.248	0.225	0.245	0.247
Q_{norm}	0.223	0.237	0.193	0.222	0.310	0.281	0.327	0.329

The two networks count the same number of nodes, one per country as in the actual composition of the European Union. Our dataset, therefore, includes all the EU28 member states that, as the high density proves, are in most cases connected to each other by the mobility of people. Both the tourism and migration mobility show an increasing efficiency as measured by the average path length. Indeed, the decreasing value of such metrics through the years considered depicts an improved (on average) attitude of countries to be part of the network dynamics, no matter what the purpose of mobility (tourism of migration) is.

Interestingly, the two networks seem to be characterized by countries (nodes) showing no preferential connection. Indeed, an assortative coefficient very close to zero identifies uncorrelated (nonassortative) networks, namely structures where each country does not show any preferential associative behaviour with the rest of the network.

Yet, in the last years, the tourism network shows a trend towards a disassortative behaviour, to be read as an increasing preference of people in the EU28 countries for less connected (probably less crowded) tourism destinations.

If the two networks look quite similar with reference to the already discussed metrics, tourism flows and migration stocks show a different topology when studying the division of their structure in modules.

For all the years except 2010, the migration network shows a division of countries into a number of communities higher than the communities in the tourism counterpart. The division of EU28 member states in modules is represented for the year 2005 in Fig. 1.

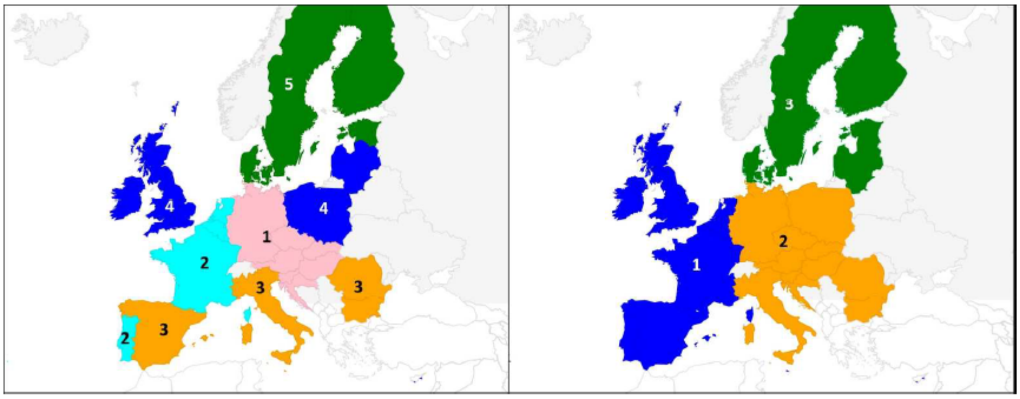

Figure 1. EU28 member states grouped in modules for the year 2005 (migration network on the left and tourism network on the right).

The picture to the left shows the communities in the migration network, whereas the three modules on the right belong to the network of tourism flows. For the networks under study, communities might correspond to a segmentation of tourism in geographical areas and immigrants' spatial preferences.

The comparison between the two community structures clarifies how human mobility in EU28 generates connections with a different strength, depending on the purpose of travelling to another country.

Yet, the two structures overlap each other to a good extent. Indeed, as better shown by the alluvial diagram[4] in Fig. 2, the two network structures characterise mainly for a different number of communities (5 for migration and 3 for tourism) and less for their internal composition.

In particular, countries in modules 1, 2, and 5 of the migration network keep their strong reciprocal connectivity in the modules 2, 1, and 3 of the tourism network, respectively.

[4] An alluvial diagram is used to map changes in networks. It is made of blocks and stream fields. "Each block in a row of the alluvial diagram represents a cluster, and the height of the block reflects the size of the cluster […]". "The clusters are ordered from bottom to top by size, with mutually nonsignificant clusters placed together and separated by a third of the standard spacing". Stream fields between the blocks reveal the changes in the cluster assignments. "The height of a stream field represents the size of the components contained in both blocks connected by the stream field" (Rosvall and Bergstrom, 2010).

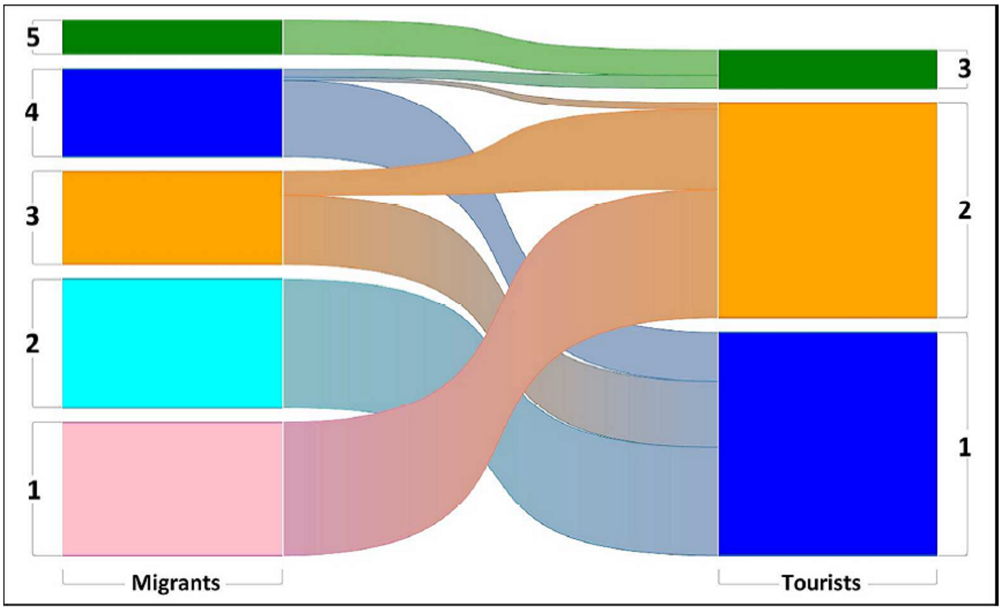

Figure 2. Comparison of the communities for the migration and tourism networks for the year 2005.

The stream fields in the alluvial diagram reveal that the three big blocks in the tourism network are largely the result of a melting process between the communities in the migration network. The only exceptions are for Spain, Poland, and Lithuania, which belong to different clusters in the migration and tourism networks. Similar conclusions hold for the other years under study.

As displayed in Table 1, groups in the migration network have a higher modularity than groups in the tourism structure, but it is still very low. Therefore, a modularity structure of mobility inside the EU28 countries exists but is not well defined. In other words, preferred paths in the mobility of people between EU28 countries exist but are not very strong, either for tourism or for immigration.

Finally, a comparison between the two networks shows that link weights are positively related. The bubble chart in Fig. 3 (log-log scale) clearly shows that a higher tourism link weight is often associated with a higher migration link weight. Many bubbles located in the north-east part of the plot are also characterized by bigger marker size. Not surprisingly, the plot actually shows that higher link weights are correlated with larger country sizes and smaller distances.

Building on these results, the regression analysis (Table 2) better shows and measures the determinants of tourism and the impact of migration stocks on tourism flows. We used ordinary least squares (OLS) to fit to the data the specification discussed in section 3.

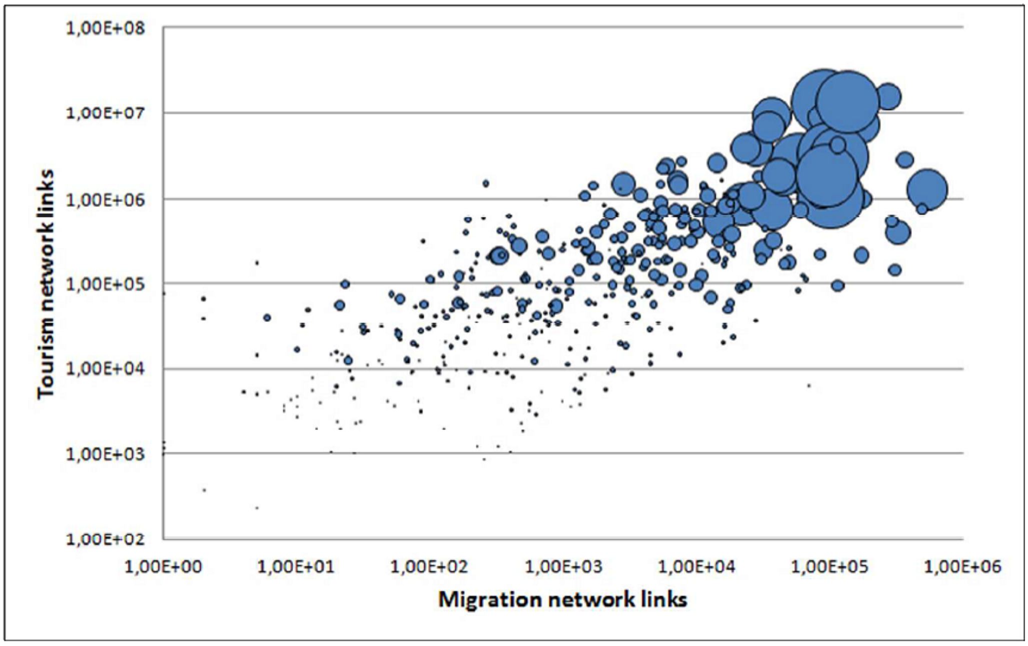

Figure 3. Tourism vs migration network links (year 2005, log-log scale).

The first column in Table 2 reports our findings for the barebones gravity specification (eq. 1) where GDPs and distance are the only controls. The first evident result is that all the coefficients of variables enter the model with the expected sign and are highly significant. In spite of its simplicity, the regression attains a high R^2 coefficient, namely, the model is able to explain a high proportion (about 64%) of tourism mobility in EU28.

By adding the geographical, historical and linguistic control variables to the gravity model (eq.2), the R^2 increases to 0,664. As the adjusted R^2 (Adj R^2) makes clear, the increased explanatory power of the model is not the result of only the increased number of variables. Indeed, common borders (*Contiguity*) and a colonial relationship after 1945 (*Colony 45*) have a significant impact on the dependent variable and a sign in line with existing literature.

In particular, a common border leads to more than a 150% increase in the number of tourists between two countries (the approximation e^{β}-1 is used to convert coefficients on dummy variables). Tourism react even more strongly to a colonial tie after 1945. However, the remaining dummy variables do not appear significant for explaining tourism in the EU28.

Finally, the third regression adds a gravity variable rarely featured in the tourism literature in order to measure how much migration stocks drive flows in the particular form of VFR travelling. As already described in section 2, residuals were first computed from a migration gravity model and then used in eq. 3 as a control variable for VFR tourism.

Table 2. Gravity model estimations – full-sample (pooled) ordinary least-square (OLS) fit.

	Gravity model specification			
	(1)	(2)	(3)	(4)
CONST	8.579***	6.598***	6.598***	6.733***

	(0.343)	(0.459)	(0.432)	(0.422)
Log Origin GDP in ppp	0.737***	0739***	0.739***	0.573***
	(0.021)	(0.020)	(0.019)	(0.026)
Log Destination GDP in ppp	0.863***	0.833***	0.832***	0.627***
	(0.022)	(0.022)	(0.020)	(0.030)
Log Distance	-0.859***	-0.576***	-0.576***	-0.608***
	(0.042)	(0.059)	(0.055)	(0.054)
Contiguity		0.945***	0.945***	0.973***
		(0.114)	(0.107)	(0.104)
Official common language		-0.078	-0.078	-0.234*
		(0.153)	(0.144)	(0.142)
Colony		0.177	0.177	0.098
		(0.177)	(0.166)	(0.163)
Colony 45		2.093***	2.093***	2.641***
		(0.465)	(0.437)	(0.431)
Same country		-0.019	-0.019	0.045
		(0.147)	(0.138)	(0.135)
Log Migration (residuals)			0.230***	0.206***
			(0.015)	(0.015)
Log Closeness				4.625***
				(0.497)
Country specific fixed effects	YES	YES	YES	YES
Year fixed effecs	YES	YES	YES	YES
Observations	1884	1884	1884	1884
R^2	0.641	0.660	0.699	0.713
Adj R^2	0.638	0.656	0.695	0.707

Note: Robust standard errors in parentheses. *, **, *** indicate that coefficients are significant at 10, 5, and 1 percent levels respectively.

As the results in Table 2 show, the gravity equation augmented with migration residuals increases the explanatory power of the model to 0.695 (Adj R^2). The coefficient for migration enters the model with the expected sign and is highly significant. In economic terms, the value for the coefficient gives an approximation of the elasticity of tourism flows to migration stocks estimated, on average, for all the years and countries in the panel. Therefore, a one percent increase in the stock of immigrants in a EU28 country increases (on average) the tourism flow in that country by 0.230%. With this coefficient being the main focus of our investigation, its estimate with the model presented is definitely in line with the findings of previous studies dealing with the immigration-tourism link, and confirms a clear and positive relationship between migration and VFR tourism. In Prescott *et al.* (2005), for instance, the elasticity of tourism arrivals in Canada from 22 OECD countries with respect to the stock of immigrants is estimated around 0.31. In Dwyer et al. (2010) the purpose of VFR accounted for 24.7% of total arrivals from 29 countries in Australia in 2009 with an estimated elasticity of 0.658. A 1% increase in the stock of immigrants leads to a 0.37%

increase in inbound VFR tourist flows in the UK, according to Gheasi *et al.* (2011). Closer to our estimate is the magnitude (0.205) of the coefficient for the migration variable in Genç (2013) concerned with the tourism-migration nexus in New Zealand for the years 1981–2006. A positive and statistically significant coefficient of about 0.315 is also reported in Etzo *et al.* (2014) for the VFR tourism motivated by the stock of foreign immigrants residing in Italy.

As a further contribution to the debate on the tourism-enhancing effect of migration, our econometric analysis gives prominence to a feature never before investigated in the literature. Indeed, results from the gravity equation expanded with country centrality in the migration network provide evidence that a network effect is present in the causal link going from migration to tourism. As expected, the more central a pair of countries is within the migration graph, the larger the flow of tourism between them. The impact of countries centrality on tourism flow is strong, significant, and signed in line with previous studies.

Supported by the high value of goodness-of-fit of the models discussed and the high significance level of the coefficient calculated, we used eq. 3 and 4 to estimate the percentage of tourism due to VFR mobility. In rough terms, the regression equation can be used to estimate a value of the dependent variable Y based on a selected value of the independent variable X. Thus, with a number of immigrants only representing about 3% of total population in the EU28 countries, the average tourism flow in 2012 correlated to such migration stock was calculated to be around 3400 people.

5. Conclusions

In this paper, we indirectly estimated VFR mobility over the period 2000-2012 by looking at the contribution of human migration stocks to tourism flows on an intra-European scale. We built our analysis on the robust evidence explored in economic literature, which suggests that tourism flows from country i to country j may be affected by the stock of immigrants present in the former and coming from the latter. For each year under study, we first built two country-to-country networks to map and reveal the pattern of connections between states as shaped by migration stocks and tourism flows, respectively.

The study of the topological structure of the two networks, and their comparison, has revealed meaningful similarities between the two networks. In particular, migration stocks and tourism flows in the EU28 over the years considered seem featured by a trend towards increasing efficiency and a preference for less connected countries.

We also assessed the determinants of tourism flows and whether a network effect is present in the causal link going from migration to tourism by fitting to the data several gravity models. In particular, in the last two equations, we added migration residuals and country centrality among the regressors. Results suggest that the higher the stock of immigrants in a country, the higher the flow of incoming tourists. We argued that this positive contribution to tourism is mainly due to the mobility of VFRs because of the nexus between VFR travel and migration. This tourism-enhancing effect of migration stocks is further suggested by country centrality: the more central a pair of countries is within the migration graph, the larger the flow of tourism between them.

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