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International demand for the Douro (Portugal) river cruises: A gravity model approach

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Abstract
Cruises on the Portuguese Douro river have been growing at a much faster pace than overall outbound tourism to Portugal, suggesting that the river is part of a worldwide trend that has been organized by global cruise operators. A gravity model is used to analyse the main factors affecting the international demand for Douro river cruising over the period from 2007 to 2014. The numbers of international passengers are positively determined by income per capita of origin country and by the population size of the leading countries of outbound tourism to Portugal.

Keywords
gravity model, international demand, panel data, river cruises

The world's navigable rivers are rapidly developing into tourist hotspots, and river cruising has become an important tourism segment, overcoming tourism's overall performance (UNWTO, 2016a). Similarly, international demand for river cruising in Portugal, particularly in the Douro, is also a thriving phenomenon which has been growing at an average annual rate of 18% during the period 2007–2014 (Table 1).

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Table 1. Passengers travelling in the Douro cruises and hotel guests, 2007–2014 (annual growth rate).

Demand	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	2007–2014
Douro river cruise passengers (%)	18	−6	12	20	6	40	35	18
Hotel guests in the Douro (%)	−11	−8	5	4	−12	38	4	3
Hotel guests in Portugal (%)	1	−4	5	3	−1	10	14	4

Note: APDL: Administração dos Portos do Douro, Leixões e Viana do Castelo.
Source: Instituto Nacional de Estatística (2016); APDL.

Besides the upward trend, river cruising is considered a niche segment within cruising (Prideaux et al., 2009), and research has largely been directed towards the maritime segment (e.g. Brida et al., 2012; Chang et al., 2017; Chen et al., 2016; Lee and Ramdeen, 2013; Petrick, 2002; Silvestre et al., 2008). Likewise, river cruising has received scarce attention from academics, and the extant literature is mainly synoptic, providing a general overview of river cruising either in Europe (Jones et al., 2016; Vuksanović et al., 2013) or within specific regional frameworks (Guedes and Joukes, 2016; Rebelo et al., 2015).

This research looks at the macroeconomic determinants affecting international demand for river cruising on the Douro by applying an extended gravity model to a balanced panel data comprising river cruise passengers.

The results provide useful information for entrepreneurs and policymakers, namely, on how different international river cruising markets interact with the Douro. Marketing strategies should tackle new consumer dynamics and take advantage of cross-selling opportunities out of traditional sectors in the Douro such as the wine *filière* as well as the importance of the landscape's sustainability conjoined with United Nations Educational, Scientific and Cultural Organization (UNESCO) significance for cruise companies and consumers.

International demand for river cruising in the Douro

Tourism in the Douro is a highly polarized phenomenon that has been spreading geographically at different momentums which is seemingly associated with its polymorphic landscape that can be condensed into two elements: the river and the *terroir* (Rebelo et al., 2015). Somehow the river Douro has been able to generate more tourism flows than the *terroir*, a behaviour that can be clearly recognized by comparing the annual growth rate of cruise passengers and hotel guests in the Douro region (Table 1).

During the period under analysis, the number of cruise passengers more than tripled. Likewise, passenger growth can also be attributed to new entrants in the industry. Companies operating cruise boats have been increasing their fleet at an annual average rate of almost 17% (Administração dos Portos do Douro, Leixões e Viana do Castelo (APDL)) between 2007 and 2014, namely, American companies (e.g. Uniworld and Viking Cruises) through leasing contracts. Although this issue reflects the supply side, it seems to act as a factor that enhances the Douro's performance by adding commercial value (and attractiveness) to the Douro as a river cruise destination.

When contrasting both river cruise passengers and outbound tourism trends to Portugal, there is evidence that river cruising can be viewed as a neophyte phenomenon and that changes in market

Table 2. River cruise passengers and outbound tourists to Portugal, 2007 and 2014.

2007				2014			
Countries	OT	RC	Share (RC/OT) (%)	Countries	OT	RC	Share (RC/OT) (%)
France	472,937	12,020	2.5	United States	277,020	17,118	6.2
United States	249,824	2449	1.0	France	942,943	11,508	1.2
United Kingdom	1,208,389	1642	0.1	United Kingdom	1,380,146	7808	0.6
Netherlands	283,525	242	0.1	Germany	874,226	6668	0.8
Finland	65,061	203	0.3	Canada	124,840	1571	1.3
Germany	665,585	146	0.0	Australia	46,107	1567	3.4
Switzerland	101,144	110	0.1	Luxembourg	20,910	1318	6.3
Sweden	96,771	86	0.1	Netherlands	378,052	1103	0.3
Belgium	140,502	68	0.0	Finland	60,174	1090	1.8
Norway	76,899	60	0.1	Spain	1,375,803	1057	0.1
Spain	1,302,797	31	0.0	Denmark	76,368	1016	1.3
Canada	77,995	14	0.0	Belgium	199,465	722	0.4
Luxembourg	10,819	13	0.1	Sweden	123,689	632	0.5
Italy	378,641	2	0.0	Switzerland	169,580	590	0.3
Austria	77,391	2	0.0	Norway	73,217	439	0.6
Australia	28,556	2	0.0	Italy	337,915	422	0.1
Poland	66,128	0	0.0	Poland	125,262	411	0.3
Denmark	60,084	0	0.0	Austria	76,437	398	0.5
Global share			0.3	Global share			0.8

Note: OT: outbound tourists; RC: river cruise passengers.
Source: UNWTO (2016b) and APDL (2016).

shares are taking place. In 2007, the global river cruising was approximately 0.3% of the main outbound tourism countries to Portugal, achieving 0.8% seven years later (Table 2).

Likewise, a reconfiguration of the leading markets is occurring. In 2014, the United States was the most important market for river cruising on the Douro, overtaking France, which had previously held this position. At the same time, other wealthy and remoter countries (such as Australia and Canada) are increasing river cruising's share of the overall outbound tourism sector to Portugal as well as other Central and Northern European countries (e.g. Luxembourg and Denmark), which denotes an important modification in terms of international market demand.

The determinants of these trends are not unambiguously clear, which call for the use of the gravity model to probe the key macroeconomic factors influencing international demand for river cruising in the Douro.

Theoretical and empirical framework

The gravity model is a workhorse in several questions addressed in international trade. Since tourism is considered as trade in service statistics, the gravity approach is also used to assess international determinants of tourism flows (Huang et al., 2012; Santeramo, 2015). In this research, an expanded version of a basic gravity model is used for the Douro river cruises, as expressed by the following equation:

Table 3. Definition of variables and basic statistics.

Variable	Description	Data source	Mean	SD
TD_{jt}	Number of international passengers of Douro river cruising from country of origin j in year t (thousands)	APDL	1.602	2.948
$PGDP_{jt}$	Per capita GDP of country j in year t (constant 2005 US$, thousands)	World Bank	42.399	15.149
POP_{jt}	Population of country j in year t (millions)	World Bank	43.882	69.375
$DIST_j$	Geographical distance of country j from Portugal in kilometres	CEPII	3.359	3.799
CPI_{jt}	Relative price proxied by the ratio of the consumer price indices of Portugal to the country j in year t	World Bank	1.009	0.021
ER_{jt}	Nominal ER of country j's currency vis-à-vis the euro	Fxtop.com	2.464	2.722
EDU_{jt}	Average number of years of education by country j's adult population (25 years and older) in year t	UNESCO	11.813	1.195
$EURO_j$	Dummy variable taking the value 1 if country j has adopted the euro and 0 otherwise	CEPII	0.500	—

Note: APDL: Administração dos Portos do Douro, Leixões e Viana do Castelo; CEPII: Centre d'Etudes Prospectives et d'Information International; SD: standard deviation; ER: exchange rate. The mean and SD of variables are calculated by pooling the data for the period 2007–2014.

$$\ln TD_{jt} = \beta_0 + \beta_1 \ln PGDP_{jt} + \beta_2 \ln POP_{jt} + \beta_3 \ln DIST_j + \beta_4 \ln CPI_{jt} + \beta_5 ER_{jt} + \beta_6 EDU_{jt} + \beta_7 EURO_j + \alpha_j + u_{jt}$$

where TD_{jt} denotes the number of international passengers of Douro river cruising from country of origin j in year t. The definition and descriptive statistics of the dependent variable and explanatory variables are present in Table 3.

A country effect α_j might be correlated with explanatory variables, and u_{jt} is the standard classical error model assumed to be uncorrelated with explanatory variables and independent and identically distributed $(0,\sigma_u^2)$.

As the econometric analysis only focuses on the Douro river cruises, the functional form of the model presents two specific features: It eliminates the need of accounting for the Gross Domestic Product (GDP) and the population of Portugal; the supply of tourism can be controlled using time fixed effects (FE).

The model includes explanatory variables that are time varying, time invariant (DIST and EURO), and some of them are correlated with individual effects. Thus, the Hausman–Taylor's[1] (HT) estimator was deemed appropriate.

Data and results

The data used in this study comprises a balanced panel of 144 observations of the annual number of international passengers of the Douro river cruising from 2007 to 2014, covering the beginning of the activity of river cruising on the Douro and the systematic collection and publication of data. The panel includes 18 origin countries[2] which account for approximately 97% of the total number of cruise passengers in 2014.

Table 4 presents the results of the pooled ordinary least squares (OLS) estimation, random effects (RE), FE and the HT estimator. Time effects are included in all estimators. The eventual heteroscedasticity and serial correlation were corrected using a clustered robust estimator. All the data panel models were estimated and tested empirically for the sake of completeness.[3] The Hausman and

Table 4. Determinants of international demand for Douro river cruising, 2007–2014.

Variables	Pooled OLS	RE	FE	HT
ln PGDP	1.946*** (0.388)	2.075*** (0.435)	9.668* (5.346)	8.829* (5.296)
ln POP	1.132*** (0.217)	1.160*** (0.217)	25.118*** (8.211)	15.039* (8.328)
ln DIST	−1.207*** (0.268)	−1.187*** (0.278)		−2.156 (12.474)
ln CPI	−10.280 (9.570)	−4.659 (11.722)	0.444 (12.210)	0.323 (9.826)
ER	0.063 (0.117)	0.053 (0.133)	0.166 (1.013)	0.169 (0.878)
EDU	0.539** (0.251)	0.483* (0.276)	0.119 (0.580)	0.215 (0.651)
EURO	0.881 (0.805)	0.821 (0.871)		4.458 (18.216)
Constant	−11.938*** (2.657)	−11.978*** (2.819)	−106.273** (37.453)	−75.385* (40.118)
Time effects	Yes	Yes	Yes	Yes
Time effects significance	9.12 [0.000]	75.97 [0.000]	4.57 [0.000]	
Hausman test			34.82 [0.000]	
Breusch–Pagan LM test		1.76 [0.092]		
Number of observations	144	144	144	144
R^2	0.61	0.61	0.20	

Note: RE: random effects; FE: fixed effects; HT: Hausman–Taylor; ER: exchange rate. Robust standard errors are given in parentheses. The values in [.] indicate the *p*-values.
*Coefficients are significant at 10% level.
**Coefficients are significant at 5% level.
***Coefficients are significant at 1% level.

Breusch–Pagan Lagrange multiplier (LM) tests reject the pooled OLS and RE models, and therefore, the FE model is preferred. Nevertheless, the impact of time-invariant variables such as the DIST and EURO is most appropriately estimated in an HT model, in which the Sargan–Hansen test results validated the use of the exogenous variables as instruments for the time-invariant regressors.

The results of HT model indicate that, as expected, the GDP per capita and population size have a positive and statistically significant impact on international demand. These results are common to all data panel models estimated (Table 4).

Specifically, higher income origin countries present a greater ability to purchase river cruise packages to the Douro river. This is consistent with the results of other studies that employed the gravity model to investigate the international tourism demand (Huang et al., 2012; Santeramo, 2015). The income elasticity above one indicates that Douro river cruises share some characteristics of luxury goods. Additionally, as the size of the country of origin increases, measured by total population, the demand for cruises in the Douro also rises. Large countries are the major contributors to outbound tourism, as found in the international tourism market by other studies applying the gravity model (e.g. Huang et al., 2012).

The expected positive influence of education on consumption of cultural services is verified in all estimated models. Nevertheless, this is not statistically significant in the HT model. This result could be consequence of the high correlation between education and GDP per capita, which makes the independent assessment of the impact of each variable difficult.

The coefficient of geographical distance is negative as expected (the closer the distance from the country of origin, the more attractive will be the service on offer), but it is not statistically

significant. This seems coherent with the commercial and operating dominance of American companies (e.g. Uniworld and Viking Cruises) through leasing agreements of ships with a Portuguese cruise operator (Douro Azul), allowing cost-effective river cruise packages which include air travel from further away countries such as the United States, Canada and Australia.

Moreover, the non-significance of the relative price (CPI), exchange rate (ER)[4] and EURO variables suggests that the relative cost of living in Portugal, the depreciation/appreciation of the euro and sharing a common currency are not drivers of international demand in Douro river cruising.

Conclusions

This article focuses on the demand-side determinants of river tourism taking into account the case of the Douro. Starting in 2007, cruises on the Douro river have been growing at a much faster pace than the overall outbound tourism to Portugal, suggesting that the Douro is part of a worldwide trend that has been meticulously organized by global cruise operators who have been successful in organizing a comprehensive and synchronized supply (e.g. air travel, cruising and accommodation) and distribution (e.g. online selling and travel agencies) chain. This seems to be one of the reasons that could explain why the coefficient of geographical distance is not statistically significant.

The international demand for the Douro river cruises is determined by the real GDP per capita and the population size of the countries of origin, meaning that a country with a higher real GDP per capita or/and greater market size has more potential to generate demand. These findings could explain the actual top market share achieved by large and rich countries, such as the United States, France, United Kingdom and Germany. River cruises share the same characteristics of cultural goods and services, and thus may be considered luxury goods. In fact, the consumer buying a cruise package to the Douro river will also be purchasing a hybrid experience that has as its backbone both cruising and cultural heritage immersion. River cruise operator's programmes tend to value the UNESCO insignia of Douro valley and mix river cruising with cultural touring experiences (both in the *terroir* and central urban nodes such as Lisbon and Oporto) which seem to densify and add value to the overall river cruise experience.

The disclosure of GDP and population size as influential factors that drive international demand for the Douro river cruises is a valuable evidence for public authorities to target emerging markets with higher per capita incomes and growing populations seeking unique cultural experiences. Therefore, it is central to consider prospective markets, namely, China, which still have a residual impact on river cruising in the Douro but is already an embryonic market in the wine filière, which is the fabric of the Alto Douro Wine Region landscape, classified by UNESCO. This is the most iconic segment of the Douro river, well embossed on river cruise brochures, and thus seemingly considered to be an inductor for river cruising consumer decision-making.

Thus, the growth and sustainability of river cruising in the Douro seems to be communally dependent on the wine filière and landscape's sustainability. Therefore, future research should focus on assessing the impact of the UNESCO landscape on river cruising by both understanding its asset value for cruise operators as well as its significance as an internal driver for consumers. Additionally, upcoming studies should consider the analysis of the potential interaction of wine filière and river cruising on marketing strategies as well as on planning more innovative river cruise packages as a pull factor, which requires a better understanding of the individual characteristics and attitudes of the tourists, topics that have been out of this research.

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Notes

1. The Hausman–Taylor is based upon an instrumental variable estimator using the individual means of exogenous regressors as instruments for the time-invariant regressors that are correlated with individual effects (Baltagi et al., 2003; Hausman and Taylor, 1981). This approach is also used by Culiuc (2014).
2. Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Norway, Poland, Spain, Sweden, Switzerland, United Kingdom and United States.
3. The estimates use $\ln(1 + TD_j)$ as a way of dealing with zeros in the dependent variable, an approach often used. Nonetheless, as recommended by Silva and Tenreyro (2006), we also estimated the gravity equation by Poisson pseudo-maximum likelihood. The results (available upon request) corroborate the findings of the former panel models.
4. For the sake of completeness, other measures of real exchange rate (e.g. Culiuc, 2014) were tested, and the results maintained exchanged (available upon request).

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