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The border effect in European air transport

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This article deals with the analysis of the border effect in European air transport. The border effect measures how trade or transport flows are diminished when they cross a national border. This topic has attracted a great deal of attention within trade, but it is still little studied within transport. Existing studies have estimated that the border effect diminished air passenger transport flows by a factor of five to six. However, there have been many changes in the European economy and transport since those studies. Our estimate based on a new data set suggested the existence of a border effect in European passenger air traffic flows, albeit with a lower value of around two. A possible reason for the lower value is the growing integration of the European economy and the development of low-cost carriers in Europe between 2000 and 2019. Our econometric analysis also found differences in border effects among European countries. No significant border effect was detected for France, but we did find high and significant effects for Germany, Spain, and Poland. These differences can be attributed to different intensities of intermodal competition on domestic routes.

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1. Introduction

The border effect is an empirical regularity that affects both international trade and transport. National borders create an obstacle that significantly diminishes mutual exchange. The seminal paper in the analysis of the border effect was one by McCallum (1995), who analysed trade patterns among Canadian provinces and US states. Controlling for GDP, population, and mutual distance, he concluded that, on average, Canadian provinces were 22 times more likely to trade with other Canadian provinces than with US states. This revelation attracted a great deal of attention because it seemed hard to believe that such an open border could create such a trade obstacle. Much subsequent research has tried to confirm or refute this result. Despite significant advances in methodology and estimation techniques, the border effect is an important and significant determinant of international trade flows (Havránek – Iršová 2017).

The literature on the border effect in the field of international trade is very rich. In contrast, there is only scarce evidence of border effects in international transport, although the impact of borders on transport flows has generally been recognized (Gerondeau 1997, Nash 2015). The evidence on the border effect in land passenger transport is limited, with scarce evidence from Rietveld (2012). More evidence can be found within air transport, where two specialized studies have emerged (Klodt 2004, Hazledine 2009) with estimates for the border effect lying in the range of five to six.

There has been a conjecture that the border effect may actually have become smaller over the past two decades. The reason for this conjecture is the development of low-cost carriers, which have opened and developed many new international connections (Calzada – Fageda, 2019). In addition, the liberalization of air transport in Europe (Mason et al. 2016) may have stimulated a decline in the border effect. Anecdotal evidence that can support this conjecture can be derived from Eurostat figures, where from 2005 to 2017 the number of passengers at the top five international routes in European passenger air transport grew by 45% while the top five national routes declined by 11% (EU 2005, 2017). The aim of the present paper is to estimate what the value of the border effect in European air transport was in 2019. It further aims to analyse whether border effects can be different for different countries.

The methodology of the paper utilizes the standard augmented gravity model. The explained variable is the seat capacity on European air routes in November 2019, regressed on GDP, population, distance, and a border dummy. In addition, other control variables were utilized, such as common language and tourist destinations. The structure of this paper is as follows. It starts with a literature review that analyses the border effect in trade and transport. Section 3 describes the methodology and data that we utilized. Section 4 includes results and interpretations, and Section 5 concludes.

2. Literature Review

The question of how much national borders change the volume of trade has been widely analysed. This flow of literature started with a seminal paper by McCallum (1995), who investigated the border effect in the context of the Canada–US border. McCallum utilized data on the trade of Canadian provinces with other Canadian provinces and US states. His methodological approach was to use a gravity equation in log-linearized form, controlling for GDP and distance. A dummy variable for domestic trade (Canadian interprovincial) was estimated as 3.09, which, after exponentiating,[4] generated a border effect of 22. This was an unexpectedly large value. McCallum documented these effects through the example of the gravity model predicting that Ontario and Quebec should export about 10 times as much to California as to British Columbia. The distance is roughly the same, but Californian GDP is 10 times that of British Columbia. In reality, however,

[4] $e^{domestic}$ = border effect; $e^{3.09} = 21.98$

both Ontario and Quebec exported more than three times as much to British Columbia as to California (McCallum, 1995).

These results were surprising and in contradiction to economic intuition. This paper started a long stream of literature that attempted to verify, explain, or contradict the border effect. A review by Havránek and Iršová (2017) stated that, based on an analysis of 61 studies dealing with the border effect in international economics, the average estimated value for the domestic dummy was 2.7, generating a border effect as high as 15. This finding means that regions have been 15 times more likely to trade with a region in the same country than with foreign regions (controlling for GDP, distance, and other factors; Havránek – Iršová 2017).

A great deal of attention has been devoted to the issue of why the border effect exists at all. Head and Mayer (2013) argued that imperfect information, very localized tastes, and distribution networks are the main reasons. A different explanation has been offered by Guiso et al. (2009). They concentrated on how cultural biases affected economic exchange with the help of data about bilateral trust between European countries. They concluded that there were still important cultural barriers in Europe with a powerful influence from a shared language and religion. De Groot et al. (2004) added that countries with similar institutional quality levels may have been familiar with one another, which reduced transaction costs and the border effect.

Surprisingly, the border effect has not been analysed much within transport economics. Zijlstra (2020) examined the border effect in airport choice. He documented that air travellers were reluctant to use a foreign airport to depart for their trips. An analysis of the border effect in passenger land transport has been provided in Rietveld (2012). He analysed the barrier effects of transport borders and the implications for transport infrastructure. He noted that borders discouraged spatial interactions and that although the border effect in Europe has declined over the previous 15 years, it remained substantial. He defined five barrier effects from borders in transport: preferences, public sector regulations, institutions, information, and transport costs. Depending on the type of infrastructure, he estimated Europe's border effect for passenger land transport in the range of 1.4–3.3.

There have been two econometric studies dedicated to this topic, namely Hazledine (2009) and Klodt (2004). Hazledine (2009) analysed national and international departures from five Canadian airports and estimated whether there were differences between destinations within Canada and those abroad. His methodology was an augmented gravity model of passenger air travel that utilized data for 212 non-tourist goals. Hazledine proxied the number of passengers by the number of seats. After controlling for city population, GDP per capita, and distance, he estimated the domestic coefficient's value as 1.8, yielding a border effect as high as 6. The second study dealing with the border effect was by Klodt (2004), who analysed the ridership numbers from German airports to domestic and international destinations. He estimated a border effect on the level of 3–5. An important factor was that a common language at origin and destination diminished the border effect. The contemporary literature in the area of air transport suggests that national borders have remained an important factor in the determination of transport flows (Dobruszkes 2021).

The development of the border effect may be able to help us to understand better the broader changes in the European and world economy. The ongoing liberalization of air transport has stimulated air ridership. In comparison with the values from land passenger transport and trade, the border effect in air transport seems to be the lowest. This inference implies that international air passenger travel has borne the lowest transaction costs and could be a primary source of international trade initiatives. We can summarize that borders have mattered significantly in both trade and transport. There is a great deal of evidence within trade, but the evidence on transport has been limited. This paper aims to contribute to this topic with an analysis of European air data from 2019.

3. Methods and Data

The paper involves the standard augmented gravity model of transport. The gravity model is a standard tool for estimating trade relationships (Anderson 2011, Shepherd 2013). The model has been very successful in empirical practice, but it has been criticized for having weak micro-foundations. This disadvantage has been recently overcome by advances in theory (Head – Mayer 2014). There have also been improvements in the estimation of gravity models (Mátyás 1997, Anderson – van Wincoop 2003, Silva – Tenreyro 2006). In addition, the gravity model is utilized within air transport as a way to estimate origin–destination relationships, although usually without explicitly controlling for the border effect (Grosche et al. 2007, Matsumoto 2007, Zhang – Zhang 2016).

In accordance with previous studies, the following model specifications were estimated:

$$Seats_i = \beta_0 + \sum_{j=1}^{5} \beta_j \, cv_{j,i} + \beta_6 DOMESTIC_i + \epsilon_i, \quad (1)$$

$$Seats_i = \beta_0 + \sum_{j=1}^{5} \beta_j \, cv_{j,i} + \beta_6 DOMESTIC_i + \beta_7 LANGUAGE_i + \epsilon_i, \quad (2)$$

$$Seats_i = \beta_0 + \sum_{j=1}^{5} \beta_j \, cv_{j,i} + \beta_6 DOMESTIC_i + \beta_7 LANGUAGE_i + \beta_8 TOURIST_i + \epsilon_i, \quad (3)$$

$$Seats_i = \beta_0 + \sum_{j=1}^{5} \beta_j \, cv_{j,i} + \beta_7 LANGUAGE_i + \beta_8 TOURIST_i + \sum_{k=9}^{13} \beta_k \, cd_{k,i} + \epsilon_i. \quad (4)$$

The models were estimated in a standard log-linearized form. All of our model specifications included control variables (cv_j) such as the logarithm of GDP per capita, the logarithm of the population in both the origin and destination cities, and the logarithm of the length in kilometres between city airports. The variable LENGTH was defined as the geodetic distance between airports. The geodetic distance between any two points is longer than the straight-line distance between the same two points. The geodetic distance should therefore better represent the length of the flight. This formed the gravity model's core with attracting (GDP and population) and distracting (distance) forces. Next, a dummy for domestic flights was added to measure the border effect (equations 1–3). The further controls that have been included in the model are dummies for a common language (equation 2), tourist destinations (equation 3), and country (cd_k) to measure the border effect for each country (equation 4). The variable LANGUAGE was defined as 1 when the official language of the country from the destination matched the official language of the country from the origin. The variable TOURIST was defined as capturing discrepancies between the population and the number of flights in a given location. This definition corresponded to tourist destinations not in proximity to a large city. These locations are islands that are not accessible by land transport (roads and railways are not possible). The country variables were 1 when the flight was a domestic flight within the given country. The selection of the dependent variable was an important choice. We used the variable SEATS as a proxy for the total number of passengers on the route, which aligns with the existing literature (Hazledine 2009, 2017). The number of seats can be a suitable proxy for passenger numbers because it is less prone to fluctuations than the number of passengers is. Table 1 provides a list of model variables.

The principal source of data about traffic flows was a Kiwi.com database. Kiwi.com is an online travel agency specializing in finding itineraries in air transport services to decrease the final price. The Kiwi.com database of flights is quite extensive, covering almost all existing connections. We have utilized access to this unique database to obtain individual data about origin–destination flows. We chose all non-zero traffic flows that originated or terminated in one of four selected countries: Spain, France, Germany, and Poland. These countries were chosen because they form a land block in Europe, and there is therefore a realistic option for intermodal competition against air. At the same time, these are large countries that have significant domestic and international air passenger traffic. The UK was excluded because of Brexit. The total number of unique destinations was 217, and the total number of observations (connections) in our data set was 1,574. Data were collected over three days in November 2019, specifically from Thursday to Saturday (28–30 November). November was chosen as a typical non-holiday month. The seat capacity was estimated as the frequency multiplied by the seat capacity of the plane used on the given route. Figure 1 shows a unique map depicting the number of domestic and international seats for the monitored airports. The figure captures the noticeable differences among countries. For example, Spain showed a predominance of domestic flights, whereas Poland showed a predominance of foreign flights. Interestingly, there were also areas with disproportionately more total seats than their importance would suggest (e.g. the islands of Ibiza and Mallorca). These locations were characterized by a pre-dominance of domestic flights. For this reason, we found it reasonable to control for these factors (countries, specific locations) within the estimated regression models.

Our data set included only flights that originated or terminated in one of our four selected countries. Destinations were limited to the EU, Switzerland, Norway, and Iceland. Other non-EU countries and overseas departments were not included. Collecting data in November meant that only a minimal number of tourist destinations were among the destinations. The data contains some of them, including the almost exclusively Spanish airports of Lanzarote, Fuerteventura, Gran Canaria, Tenerife, Ibiza, Malila, Menorca, and Mallorca. There was no set minimum flight length; the data were unidirectional and only direct flights were included. We acknowledge that there are significant limitations to the data set. The data was collected only for three days in the autumn. We did not have at our disposal origin–destination data that would enable us to deal with transfer traffic or the issue of hub airports and connecting flights.

Table 1. Model variables

	Description	Unit	Source
Dependent variable			
SEATS	*Number of available seats on the route.*	Seats	Kiwi.com
Independent variables – control variables			
GDP 1	*Regional GDP per capita at origin.*	USD; thousands	Eurostat; OECD
POP 1	*Population at origin.*	People; thousands	Eurostat; OECD
GDP 2	*Regional GDP per capita at destination.*	USD; thousands	Eurostat; OECD
POP 2	*Population at destination.*	People; thousands	Eurostat; OECD
LENGTH	*Geodetic distance between origin and destination.*	km	Kiwi.com
Independent variables – dummy variables			
DOMESTIC	*= 1 when flight was domestic.*	Binary	
LANGUAGE	*= 1 when the main language at destination was the same as at origin.*	Binary	
TOURIST	*= 1 when there was a discrepancy between the number of flights and the population in a location.*	Binary	
FRANCE	*= 1 when there was a domestic flight in France.*	Binary	
POLAND	*= 1 when there was a domestic flight in Poland.*	Binary	
GERMANY	*= 1 when there was a domestic flight in Germany.*	Binary	
SPAIN	*= 1 when there was a domestic flight in Spain.*	Binary	

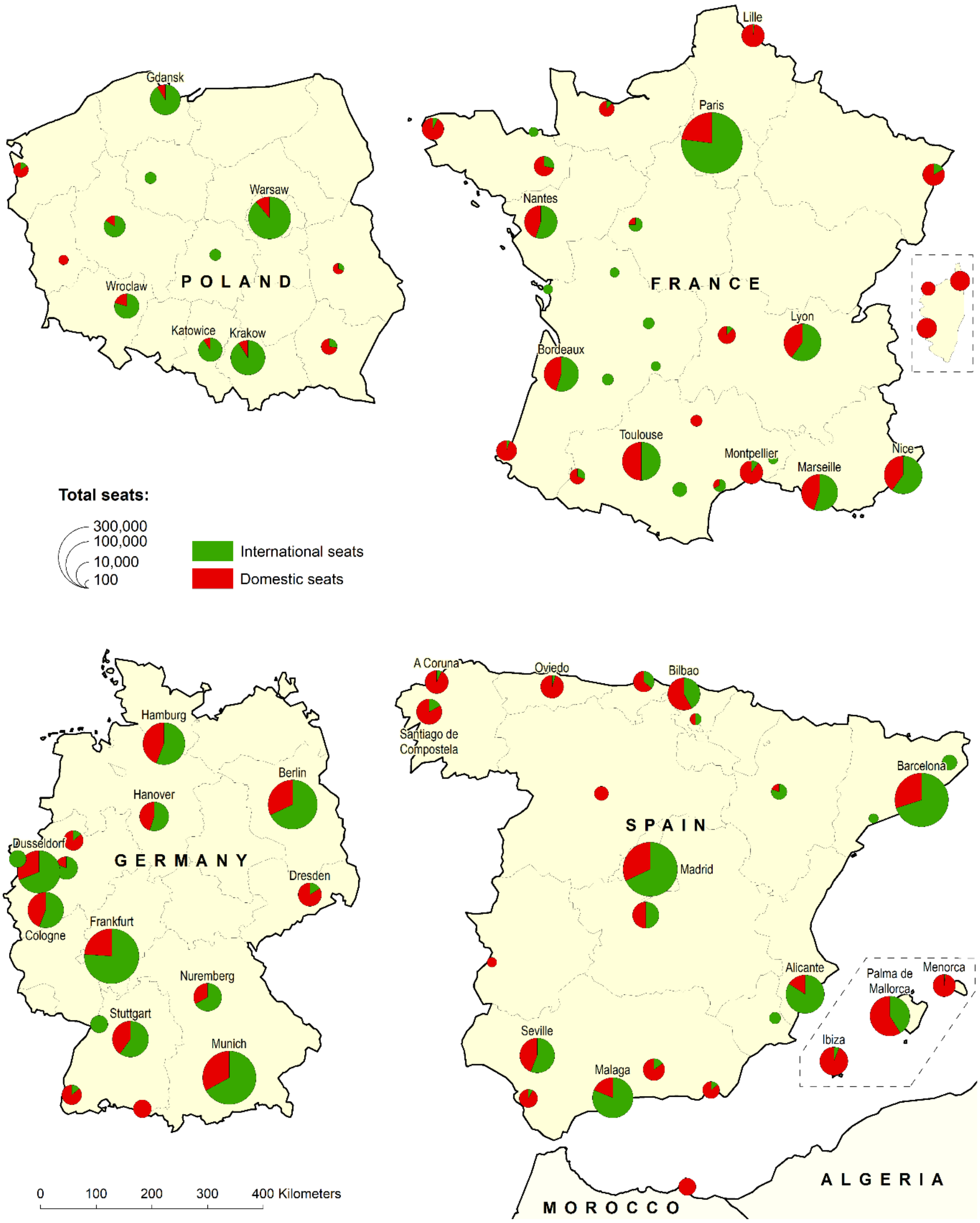

Figure 1. *Map of domestic and international seats*

4. Results and Discussion

Table 2 presents the results of our estimation. Model 1 is the baseline regression, Models 2 and 3 controlled for a common language and tourist destinations. Model 4 distinguished the border effect according to country (France, Germany, Spain, Poland). The coefficients for GDP, population, and length had the expected signs, and their values were in line with previous studies. The domestic coefficient in Models 1–3 was between 0.52 and 0.74, which after exponentiating yielded a border effect in the range of 1.7–2.1, which was both statistically significant from zero and less than had been identified in previous studies. The border effect was smaller when the estimation controlled for a shared language at the origin and destination (Models 2–4) and when it controlled for tourist destinations (Models 3–4).

Table 2. Regression results

	Model 1 OLS ln SEATS	Model 2 OLS ln SEATS	Model 3 OLS ln SEATS	Model 4 OLS ln SEATS
ln GDP1	0.35***	0.32***	0.32***	0.38***
	(0.05)	(0.06)	(0.06)	(0.06)
ln POP1	0.45***	0.46***	0.47***	0.46***
	(0.03)	(0.03)	(0.03)	(0.03)
ln GDP2	0.49***	0.46***	0.45***	0.48***
	(0.04)	(0.05)	(0.05)	(0.05)
ln POP2	0.28***	0.29***	0.30***	0.30***
	(0.02)	(0.02)	(0.02)	(0.02)
ln LENGTH	-0.15***	-0.14***	-0.15***	-0.12**
	(0.05)	(0.05)	(0.05)	(0.05)
DOMESTIC	0.74***	0.56***	0.52***	
	(0.08)	(0.11)	(0.11)	
LANGUAGE		0.22**	0.23**	0.26**
		(0.10)	(0.10)	(0.11)
TOURIST			0.28***	0.18*
			(0.10)	(0.10)
FRANCE				0.14
				(0.14)
POLAND				0.84***
				(0.18)
GERMANY				0.61***
				(0.17)
SPAIN				0.72***
				(0.15)
const	−1.30**	−1.35**	−1.37**	−1.77***
	(0.59)	(0.59)	(0.58)	(0.60)
Observations	1,574	1,574	1,574	1,574
R squared	0.371	0.373	0.376	0.383
ln L	−2,009	−2,007	−2,003	−1,994

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Why were our values lower than those from the previous studies by Hazledine (2009) and Klodt (2004)? Our lower value for the domestic coefficient (0.52–0.74) in comparison with Hazledine's (1.59–1.84) may have been due to differences between North American and European geography and the air transport market where distant Canadian locations may stimulate the border effect (Anderson – van Wincoop, 2003). The more relevant comparison is with the study by Klodt (2004), which used departures from German airports to other European destinations. We identified a much lower domestic coefficient even compared to Klodt's values (1.02–1.60). Part of the variation between our results and previous results may be related to differences in research methodology. The differences may be partly due to the definition of the observed flights included in the data set (see Hazledine, 2009) or in the slightly different specifications of the gravity models used. Although there were differences in the form of the specification and the selection of origin airports, we think that the main reason for the lower values for the border effect was in the real markets.

The enlargement of the EU and the Schengen Area has stimulated the growth of cross-border traffic. Increased economic integration and the free movement of people has encouraged migration and tourism within the EU. These developments could have stimulated a decline in Europe's border effect during 2000–2019. The growth in demand was also reflected on the supply side when low-cost carriers opened new air routes more often for international traffic than for European national traffic (Calzada – Fageda 2019). Therefore, we interpreted our estimations as indicating an actual decline in Europe's border effect over the past 20 years. However, the border effect is expected to change again as a result of the current COVID-19 pandemic and the military conflict in Ukraine. Total air passenger transport has declined spectacularly after 2020. This fall has also been unequal, with international traffic falling more sharply than national traffic. This development has probably significantly changed the border effect after 2020. The structure and dynamics of this development is a fruitful topic for further research.

Model 4 included four individual country variables to measure the differences in the border effect among France, Germany, Poland, and Spain. The domestic dummy was insignificant in France and highly significant in Germany, Poland, and Spain. We thus did not find any border effect at all for France. How could this be possible? We think that the intense competition of high-speed rail with airlines on France's domestic lines effectively nullified France's air transport border effect. High-speed rail has also been developed in Spain and Germany, but the frequencies for major destinations have been lower for Spain and Germany than they have for France. This development can be documented in many examples where national air transport passenger flows diminished significantly due to the opening of national high-speed rail lines (Dobruszkes et al. 2014). The broad development of the high-speed rail network in France could be a major source for not finding a significant border effect for France.

Table 3. Border effect results

MODEL/PAPER	GEOGRAPHY	DOMESTIC DUMMY	BORDER EFFECT
Model 1	FR+PL+DE+ES	0.74	2.10
Model 2	FR+PL+DE+ES	0.56	1.75
Model 3	FR+PL+DE+ES	0.52	1.68
	FRANCE	-	-
	POLAND	0.84	2.32
	GERMANY	0.61	1.84
Model 4	SPAIN	0.72	2.05

To control for idiosyncrasies in our estimations, we performed some robustness checks. We have experimented with other variables, checked the results for sub-samples, and played with different specifications. The results of these robustness checks were satisfactory because they did not alter the basic results of our estimations. As for the limitations of our approach, the most significant are the following. The first is the concentration on the number of available seats, which was chosen as the explained variable. It would be interesting to compare the results with passengers as the dependent variable. Such data could be extracted from the International Air Transport Association or Eurostat and could be an interesting topic for further research. Secondly, we have not controlled for many other factors that can influence the border effect and affect its value. On the other hand, we have used a similar specification as in the previous studies by Klodt and Hazledine. Thirdly, we were unable to differentiate among direct and connecting flights due to limitations in our data sets, and we therefore could not work with origin–destination data. Fourthly, due to our data limitations, we were not able to take into account the issue of cross-border airports that can attract passengers from neighbouring countries.

5. Conclusion

This article aimed to estimate the border effect in European air passenger transport in 2019. We estimated its level as 1.68–2.32, meaning that national air passenger flows in Europe were roughly two times as high as the international flows for matching pairs of cities. Another significant result from our estimation was that the border effect was very different for different European countries. We found no border effect for France and significant border effects for Germany, Spain, and Poland. We have interpreted this as the result of differences in the level and intensity of intermodal competition on the national market, especially between air and high-speed rail. The current COVID-19 pandemic will undoubtedly influence the level of the border effect. The spectacular fall in air transport traffic has been disproportional between domestic and international traffic, and very probably the COVID-19 crisis will have a lasting impact on travel behaviour. Therefore, it can be expected that the border effect will go up in the upcoming period.

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References

Anderson, J. E. (2011). The gravity model. *Annual Review of Economics*, *3*(1), 133–160.

Anderson, J. E. and van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, *93*(1), 170–192.

Calzada, J. and Fageda, X. (2019). Route expansion in the European air transport market. *Regional Studies*, *53*(8), 1149–1160.

De Groot, H. L., Linders, G. J., Rietveld, P. and Subramanian, U. (2004). The institutional determinants of bilateral trade patterns. *Kyklos*, *57*(1), 103–123.

Dobruszkes, F., Dehon, C. and Givoni, M. (2014). Does European high-speed rail affect the current level of air services? An EU-wide analysis. *Transportation Research Part A: Policy and Practice*, *69*, 461–475.

Dobruszkes, F. (2021). A global business? Mapping the densest passenger airline routes. *Journal of Transport Geography*, *92*.

EU (2005). *EU transport in figures 2005*.

EU (2017). *EU transport in figures 2017*.

Gerondeau, C. (1997). *Transport in Europe*. Artech House.

Grosche, T., Rothlauf, F. and Heinzl, A. (2007). Gravity models for airline passenger volume estimation. *Journal of Air Transport Management*, *13*(4), 175–183.

Guiso, L., Sapienza, P. and Zingales, L. (2009). Cultural biases in economic exchange?. *The Quarterly Journal of Economics*, *124*(3), 1095–1131.

Havranek, T. and Irsova, Z. (2017). Do borders really slash trade? A meta-analysis. *IMF Economic Review*, *65*(2), 365–396.

Hazledine, T. (2009). Border effects for domestic and international Canadian passenger air travel. *Journal of Air Transport Management*, *15*(1), 7–13.

Hazledine, T. (2017). An augmented gravity model for forecasting passenger air traffic on city-pair routes. *Journal of Transport Economics and Policy (JTEP)*, *51*(3), 208–224.Hazledine (2014)

Head, K. and Mayer, T. (2013). What separates us? Sources of resistance to globalization. *Canadian Journal of Economics/Revue canadienne d'économique*, *46*(4), 1196–1231.

Head, K. and Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. In *Handbook of international economics* (Vol. 4, pp. 131–195). Elsevier.

Klodt, H. (2004) Border effects in passenger air traffic. *Kyklos*, *57*(4), 519–532.

Mason, K., Morrison, W. G. and Stockman, I. (2016). Liberalization of air transport in Europe and the evolution of 'low-cost' airlines. In *Liberalization in Aviation: Competition, Cooperation and Public Policy;* Forsyth, P., Gillen, D., Hüschelrath, K., Niemeier, HM, Wolf, H. eds. (pp. 141–156). Routledge.

Matsumoto, H. (2007). International air network structures and air traffic density of world cities. *Transportation Research Part E: Logistics and Transportation Review*, *43*(3), 269–282.

Mátyás, L. (1997). Proper econometric specification of the gravity model. *World Economy*, *20*(3), 363–368.

McCallum, J. (1995). National borders matter: Canada-US regional trade patterns. *The American Economic Review*, *85*(3), 615–623.

Nash, C. (2015). When to invest in high speed rail. *Journal of Rail Transport Planning & Management*, *5*(1), 12–22.

Rietveld, P. (2012). Barrier effects of Borders: Implications for border crossing infrastructures. *European Journal of Transport and Infrastructure Research*, *12*(2), 150–166.

Silva, J. S. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, *88*(4), 641–658.

Shepherd, B. (2013). *Gravity model of international trade: A user guide*. United Nations Economic and Social Commission for Asia and the Pacific.

Zhang, Y. and Zhang, A. (2016). Determinants of air passenger flows in China and gravity model: Deregulation, LCCs, and high-speed rail. *Journal of Transport Economics and Policy (JTEP)*, *50*(3), 287–303.

Zijlstra, T. (2020). A border effect in airport choice: Evidence from Western Europe. *Journal of Air Transport Management*, *88*, 101874.