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Abstract: In this paper, we examine the impact of non-stop flights on the connectivity of European cities with distant locations from the rest of the world. We use data on inter-city passenger flows including non-stop and connecting traffic so that we have a precise measure of the economic and social links between cities. We apply a matching procedure and run regressions using instrumental variables to deal with the potential endogeneity bias of the variables for non-stop flights. We find a strong causal relationship between the amount of total traffic and the supply of non-stop long-haul flights in the considered inter-city markets. Traffic increases from the shift from 'not having' to 'having' non-stop flights can be more than double. Such increase in the amount of traffic does not seem to be related with a systematic change in fares.

Keywords: Air transportation; inter-city connections; matching analysis; instrumental variables

0. Introduction

The availability of non-stop flights improves substantially the ease of communication between the territories involved since the shift from 'not having' to 'having' non-stop flights can reduce travel times by 30 percent or more. Furthermore, this reduction in time costs is not necessarily related with an increase in monetary costs. However, the amount of passengers that stop at one - or more- airport to reach their final destination (connecting passengers) may be high, particularly in long-haul inter-city pair markets. To this point, total passenger flows between two cities including non-stop and connecting passengers provides a precise measure of the economic and social links between those cities.

Non-stop flights in long-haul city-pairs have been traditionally operated by airlines through big hub airports.[1] However, several factors have lead to an increase in the provision of long-haul flights from airports out of main hubs. i) Congestion at the main hubs are associated with lower quality levels in the form of delays and cancellations (Brueckner, 2002; Mayer and Sinai, 2003). ii) Passengers may have a higher preference for direct flights than they had in the past (Berry and Pia, 2010) iii) New aircraft models like the Airbus A350 or the Boeing 787 Dreamliner may allow for the provision of long-haul flights in thin routes, iv) Changes in the airline market like the arrival of

[1] By adopting this strategy, airlines are able to reduce their costs through the exploitation of density economies and covering their network of routes with fewer flights (Brueckner and Spiller, 1994).

low-cost carriers (e.g; Norwegian) to the long-haul market or the increasing presence of airlines from North America and Asia in European airports.

These trends may imply that cities with mid-size airports take benefit from the globalization through the increased connectivity with the rest of the world. However, such cities are generally well connected by means of frequent flights (and usually low fares) to the big hub airports. Thus, they may take benefit from global connections through hub airports as well. Looking at data from Official Airlines Guide (OAG) for mid-size European cities, we can observe that the amount of traffic to distant cities may be very high even without having non-stop flights. While the advantages of non-stop flights in relation to connecting flights are clear in terms of convenience and the time spend on the trip, the new offer of non-stop flights may just lead to a change from connecting to non-stop traffic and do not imply necessarily a relevant generation of additional traffic. Furthermore, it is not clear whether non-stop flights are going to lead to cheaper flights.

In this paper, we examine the impact of non-stop long-haul flights on the connectivity of cities taking advantage of the variation in the supply of non-stop long-haul flights from European cities with mid-size airports. In this regard, we use total air passenger flows from European cities to large urban areas from the rest of the world.

We estimate a model that quantifies that impact on traffic flows and fares in inter-city markets using data that account for the true origin and destination of passengers. In particular, we examine the causal relationship between the number of non-stop flights, on the one side, and traffic flows and fares on the other side. Furthermore, we examine the change in total traffic and fares with the shift from ‘not having’ to ‘having’ non-stop flights. As controls, we include population and income of endpoints of the route, city-pair and time fixed effects.

A major econometric challenge in this analysis is the potential endogeneity bias of the variable for the number of non-stop flights; to deal with this issue we apply a matching procedure to have a sample with comparable routes in terms of traffic and we run regressions using the instrumental variables technique. Our instruments are based on the supply of flights of the destination cities to Europe or to all over the world.

Various studies have undertaken empirical analyses about the economic impact of air traffic. The traditional approach is to examine the causal relationship between some aggregated indicator of airport size and measures of urban or regional economic performance, such as, employment, income or number of firms. Here, we can mention some studies using samples of U.S. urban areas (Bilotkach, 2015; Brueckner, 2003; Green, 2007; Sheard, 2014), European regions (Albalate and Fageda, 2016; Bel and Fageda, 2008) or individual European countries like Italy (Percoco, 2010;

Cattane et al., 2016). A major shortcoming of these studies is that the economic effect of air services is related primarily to enhanced connections to specific destinations. Indeed, air transportation may have different economic effects on its urban area or region. An expanding airport might increase the number of employees directly or indirectly or, alternatively, increase the number of tourists. Additionally, air traffic can facilitate face-to-face contacts thus facilitating the delivery of tradable services, tourism flows and increasing the attractiveness for business investment. This latter effect can be captured most appropriately by referring to bilateral air traffic data.

In this regard, some recent studies that use bilateral air traffic data are more related with this paper. Giroud (2012) uses data from the U.S. manufacturing sector to show that new airline routes bring about an increase in investments within firms and an increase in a plant's total factor productivity, while Hovhannisyan and Keller (2015) report a significant positive impact of U.S. business travel to foreign countries on patenting rates. Fageda (forthcoming) shows that -using data for Barcelona to the rest of the world - the availability of non-stop flights offered at a sufficient frequency increases the amount of foreign direct investments. Finally, Alderighi and Gaggero (2017) shows that air transport services positively affect the export of Italian manufacturers.

Previous studies using bilateral air traffic data analyze the causal relationship between some measure of the economic links between cities (investments, trade, patenting rates) and the supply of non-stop flights. In this paper, we have available data on the total number passengers and the fares that they paid in inter-city pair links including those passengers that make several stops to reach their final destination. Furthermore, we focus on intercontinental inter-city markets so that aviation is the only feasible mean to connect these cities and connecting flights are viable substitutes for non-stop flights. Hence, we can use these data to have a global measure of the economic and social links between the considered cities including business trips, trips for leisure and visiting friends and relatives which account for tourism and immigration flows and even the trade of high-added value products in relation to their weight as they are usually moved in commercial flights for passengers.[2]

Furthermore, these previous studies focus on United States or an individual European country or urban area, while here we examine the global connections of a sample of many European cities. In this regard, we provide fresh insights about the air connectivity of mid-size cities. Finally, we apply a novel approach to deal with the potential endogeneity bias of the supply of non-stop flights.

The rest of this paper is organized as follows. In the next section, we detail the sample used and provide relevant information about the data used in the empirical analysis. Then, we explain the empirical equation that we estimate and discuss some econometric issues that we must address. In

[2] Of course, some flights are just for cargo but they represent a low proportion of the total activity of European airports and cargo flights are usually dedicated to the heaviest products that can be moved by plane.

the following section, we show the results of the econometric estimates. The last section is devoted to the concluding remarks.

1. Data

Our aim is to examine the impact of non-stop long haul flights on the connectivity of European cities. We restrict our sample of cities to be able to build a feasible dataset with sufficient variation in the supply of non-stop long-haul flights. Hence, we focus on cities that are able to generate a high amount of traffic to many intercontinental destinations but excluding those with the biggest airports that have high levels of intercontinental connectivity.

Hence, our sample of European cities has mid-size airports. We include cities with airports having more than 10 million passengers excluding the main hubs. By main hubs, we mean airports with more than 50 million passengers (Amsterdam, Frankfurt, Istanbul, London, Madrid, Moscow, Paris, Rome). We also exclude tourist destinations like islands in the south of Europe as our focus is on inter-city links. Overall, we have 32 cities for which we can generally make the distinction between large cities from big countries (eg; Ankara, Barcelona, Lyon, Manchester, Milan, Munich, San Petersburg) and the main city of small countries (e.g; Athens, Brussels, Budapest, Dublin, Lisbon, Stockholm). The European cities in our sample have more than one million inhabitants with the exception of Dusseldorf, Edinburg, Geneva and Stuttgart that have more than five hundred thousand inhabitants. To this regard, note that differences in the quality of passenger transportation networks across major cities in Europe are mainly related to the availability of direct intercontinental flights as they are well connected through a dense network of highways, trains and short-haul flights.

Regarding non-European cities, we include cities that have the largest airports in different geographical areas; Africa, East and South of Asia, Latin America and the Caribbean, Middle-East and North America. We do not consider cities in nearby areas like North of Africa or Central Asia because our focus is on long-haul flights. From the Middle East, we only include Abu Dhabi, Doha and Dubai given their leading position in air traffic flows between Europe and Asia and the fact that distance is more than 4,000 kilometers in links to most of European cities of our sample. Furthermore, we do not consider cities from Oceania because non-stop flights to Europe were not technically viable in the considered period. Overall, the 74 non-European cities have more than one million inhabitants (except Doha) and most of them more than two million inhabitants. Table 1 indicates the cities included in our sample.

Table 1. Sample of cities

Origin (Europe)	Destination (Rest of the World)

Ankara, Athens, Barcelona, Berlin, Birmingham, Brussels, Bucharest, Budapest, Cologne, Copenhagen, Dublin, Dusseldorf, Edinburg, Izmir, Geneva, Glasgow, Hamburg, Helsinki, Lisbon, Lyon, Manchester, Milan, Munich, Oslo, Prague, San Petersburg, Sofia, Stockholm, Stuttgart, Vienna, Warsaw, Zurich	Atlanta, Abu Dhabi, Bangkok, Bangalore, Baltimore, Belo Horizonte, Beijing, Bogotá, Bombay, Boston, Buenos Aires, Caracas, Chennai, Chicago, Dallas, Dhaka, Delhi, Denver, Detroit, Doha, Dubai, Guangzhou, Guayaquil, Hanoi, Ho Chi Min, La Havana, Hong Kong, Houston, Islamabad, Jakarta, Johannesburg, Karachi, Kinshasa, Kolkata, Kuala Lumpur, Lagos, Las Vegas, Los Angeles, Lima, Luanda, Manila, Memphis, Mexico city, Miami, Minneapolis, Montreal, Nairobi, Nagoya, Nanjing, New York, New Orleans, Orlando, Osaka, Philadelphia, Phoenix, Rio de Janeiro, Salvador de Bahia, San Diego, San José (CR), San Francisco, Santa Cruz (BO), Santiago de Chile, Santo Domingo, Sao Paulo, Seattle, Shenzhen, Seoul, Shanghai, Singapore, Taipei, Vancouver, Washington, Tokyo, Toronto

We exploit the information at the carrier-route level provided by Official Airlines Guide (OAG) and RDC aviation for the period 2010-2016 on a quarterly basis. OAG provides marketing Information Data Tapes (MIDT data) through the Traffic Analyzer product. The information contained in the OAG dataset includes the total traffic and fares (in US dollars) in city-pair markets of all over the world.

Traffic data include local passengers (who fly directly between the two cities) and connecting passengers. Connecting passengers include behind, bridge, and beyond traffic. For example, on the route Barcelona-Atlanta, behind traffic include passengers flying from Valencia to Atlanta through Barcelona, beyond traffic include passengers from Barcelona to Miami through Atlanta, and bridge traffic include passengers with an additional stop in behind or beyond itineraries.

Obviously, there is a strong correlation between the total number of passengers and the total number of flights across city-pair markets. In fact, this is the main challenge of our empirical analysis. However, the number of connecting passengers in long-haul links may be high. Even with non-stop services, connecting passengers may still represent an important proportion of the total air market (see data below).

Looking at the last quarter of 2016, we may find thin routes with non-stop air services and thick routes without direct services. Indeed, some routes with less than 1,000 passengers (including non-stop and connecting passengers) have non-stop air services like for example Cologne-Boston, Helsinki-Chicago, Brussels-Luanda, Helsinki-Guangzhou, Lisbon-Philadelphia, Oslo-Doha, or Edinburg-Chicago. In contrast, if we look at the city pair markets within the 10% densest in our sample (more than 5,800 passengers) we have that 53 out of 219 routes do not have direct services. This is the case, for example, for Dusseldorf-Shanghai, Milan-Manila, Geneva-Bangkok, Vienna-Tokyo, Budapest-Nova York, Barcelona-Mexico, Berlin-Bangkok, Barcelona-Tokyo, Manchester-Bangkok or Barcelona-Seoul.

Fares data refer to bookings made by Global Distribution systems. Bookings made directly with an airline are excluded from the MIDT dataset. According to the numbers provided by OAG officials, our fare data represent around half of total bookings when low-cost airlines are not operating in the route. Such percentage is lower when low-cost airlines are present in the city pair as many of them do not report MIDT data. This is a limitation of our fare data that must be taken into account although in many of the city pairs for which we are concerned, network airlines rather than low-cost airlines are providing services. Note that our fare data refer to the one-way link. RDC aviation provides data on the supply side including the total number of non-stop flights provided in city-pair markets.

As controls, we include population and the gross national income per capita of both endpoints of the route. The data for population are expressed at the urban level and the information comes from the United Nations (World Urbanization Prospects), while for income is at the country level and it comes from the World Bank (World Development Indicators).

We have 2250 routes that sum about 64,000 observations. 191 of these routes have non-stop services in all periods, and 37 have it in discontinued periods. Furthermore, we have 116 new routes with non-stop air services. By new routes we mean that scheduled non-stop air services have been initiated after the first quarter of 2010.[3] The rest of potential city-pair markets do not have non-stop air services in the whole period but they still may have a lot of (connecting) traffic. By scheduled non-stop air services, we mean to provide at least one flight per week.

Table 2 shows data for variables of traffic, flights and fares to have preliminary evidence of the impact of new non-stop air services. In this regard, we focus in this table on a sample of new routes (routes with non-stop air services after the initial period) and we apply mean-tests to examine the differences before and after having non-stop flights. The availability of non-stop flights seems to lead to double the total traffic of the city-pair. Furthermore, there is a reduction in the amount of connecting traffic. Thus, two effects are taken place; a substitution effect from connecting to non-stop traffic, and additional traffic generated by the new air services. The amount of connecting traffic is still relevant after having non-stop services (about one third of total traffic). It is also remarkable that, on average, new air services are provided with high frequencies (close to a daily flight). So the change may be big, from no services at all to a daily service. Finally, we do not find significant differences in fares.

Tabla 2. Mean t-test for new routes

Variable	$D^{air\_services} = 0$	$D^{air\_services} = 1$	T-test
Total traffic	2920.05	6328.339	-28.82***

[3] Discontinued routes have non-stop air services in the initial period but later the service is cancelled for some or all periods.

Local traffic	49.27	4009.88	-55.01***
Connecting traffic	2870.77	2318.45	6.76***
Non-stop flights	0.42	71.60	-69.70***
Number observations	1810	1337	
Fares	489.19	476.18	1.18
Number observations	1387	1047	

Table 3 provides additional evidence on the impact of new air services. Looking at the same sample as in table 2 (new routes), we show the change in traffic, non-stop flights and fares after having non-stop air services for a sub-set of representative routes. Our sample comprises 116 new routes and showing information for each of them may not be helpful. We show the information for a set of representative routes including thin and thick routes, and different periods with initial services.

First of all, note that most of new routes have to do with cities in North America, Asia or Middle-East. There are only three new routes to Latin America cities; Brussels to Santo Domingo and Munich to Mexico city and La Havana. There are always direct flights to some few cities from Barcelona, Lisbon and Milan, and from Munich and Zurich to Rio de Janeiro. Furthermore, there are no new routes to an African city. There are discontinued or permanent services from Brussels to Kinshasa, Luanda and Nairobi, Lisbon to Johannesburg and Luanda, and Zurich to Johannesburg and Nairobi. There are much more city-pairs with non-stop services to cities from North America, east and south of Asia and Middle East than those reported in table 3. To this point, note that in the appendix we show the results of regressions for subsamples focusing on the different geographical areas considered.

An additional issue to consider is that we may find some very dense routes in terms of traffic before direct flights are in place. This is for example the case of the city-pairs Milan-Delhi, Dublin-San Francisco, Copenhagen-Los Angeles, Manchester-Hong Kong, Dublin-Los Angeles or Brussels-Tokyo. Otherwise, we may find very thin routes before the arrival of non-stop flights where most of traffic is non-stop once the direct services are in place. This is the case of Brussels-Santo Domingo, Dusseldorf-Abu Dhabi, Warsaw-Doha, Edinburg-Doha, Cologne-Bangkok or Helsinki-Guangzhou. We may also find initial periods with non-stop services in 2010, 2016 or in the middle of the period.

In spite of the diversity of routes included in table 3, we can observe that direct flights usually lead to increases in traffic of double or more. Such substantial increase is taking place for city-pair markets with different previous traffic levels, different geographical areas or different initial periods. It is more difficult to find a regular pattern for fares; in some cases, there are substantial fare reductions, in others no significant changes and still in others remarkable increases.

Table 3. Examples of new routes impact

Route	Date of new air services	Total traffic before	Total traffic after	Non-stop flights after	Share local traffic after	Fares before	Fares after
Berlin-Miami	20103	2941.33	5790.48	37.84	45.66	381.39	262.27
Copenhagen-Toronto	20103	1853.5	3494.2	63.26	54.27	419.56	411.72
Milan-Delhi	20104	7616.67	14932.44	50.52	33.94	368.95	253.50
Helsinki-Singapore	20111	1975.5	4082.65	91.15	89.18	1291.75	515.13
Lisbon-Miami	20112	1609.2	3381.76	51.91	63.21	556.02	363.90
Dusseldorf-Beijing	20112	4331.4	7598.6	45.56	53.37	721.73	406.22
Brussels-Bangkok	20114	8353	12722.33	43.57	42.64	408.76	332.64
Copenhagen-Shanghai	20121	4218	8648.6	66.65	60.00	885.36	469.47
Dusseldorf-Abu Dhabi	20121	862.37	4152.55	176.25	95.09	191.23	281.83
Brussels-Santo Domingo	20121	504.37	3993.75	20.3	91.56	N.A	N.A
Dublin-Washington	20122	4053	6963.31	86.52	54.42	498.57	487.57
Warsaw-Beijing	20122	3638	5985.21	36.52	55.71	231.04	222.00
Manchester-Washington	20122	2163.77	3940.78	65.36	58.64	626.68	601.91
Barcelona-Dubai	20123	3310.9	10335.7	125.61	81.94	495.65	547.20
Lyon-Dubai	20124	1486.54	3921.52	25.23	74.71	243.75	256.94
Warsaw-Doha	20124	222.18	1814.05	86.05	90.46	214.63	370.42
Geneva-Beijing	20132	3294.38	7535.66	42.46	62.49	808.73	691.88
Berlin-Chicago	20132	1674.76	4475.26	66.8	65.93	595.04	450.83
Birmingham-Delhi	20133	4799.5	6483.75	73.35	62.39	321.62	181.80
Barcelona-Beijing	20142	4444.17	7403.53	13	26.98	254.89	194.95
Dublin-San Francisco	20142	8627.94	15117.64	73.81	52.86	572.36	693.38
Dusseldorf-Tokyo	20142	4902	10755.27	90.54	68.30	809.63	875.29
Edinburg-Doha	20142	457	1988.72	77.45	85.32	435.78	620.92
Copenhagen-Los Angeles	20142	7263.74	13331.81	33.90	48.12	433.70	338.59
Munich-Houston	20142	1492.76	2399.66	84.72	60.60	706.06	741.65
Munich-Mexico city	20142	2414.41	4884.45	62.27	65.80	530.59	710.81
Zurich-Abu Dhabi	20142	661.17	3353	85.90	84.15	635.55	542.65
Stockholm-Los Angeles	20142	5663.94	10690.27	51.09	51.58	455.12	463.78
Oslo-Orlando	20143	2355.44	4356.7	17	62.91	264.38	290.42
Vienna-Seoul	20143	6469	11421	32.7	39.35	688.19	590.92
Manchester-Hong Kong	20144	10756.35	14307.88	47.66	36.52	503.38	473.37
Milan-Seoul	20151	6514	11284.15	40.12	45.05	700.42	581.55
San Petersburg-Shanghai	20153	1591.5	5019.6	18.83	27.84	284.36	190.36
Stockholm-Hong Kong	20153	4130.09	7094.66	55.66	54.36	629.61	581.31
Dublin – Los Angeles	20153	6661.45	12046	61.33	45.61	498.25	479.55
Brussels-Tokyo	20154	5622.52	10408.2	86.8	62.70	787.03	569.92
Prague-Beijing	20154	2574.43	6382.8	35.8	53.14	N.A	N.A
Warsaw-Tokyo	20161	2873.33	6862.5	38	58.75	466.51	531.50
Cologne-Bangkok	20161	258.5	6805.5	26	96.04	438.09	295.88
Helsinki-Guangzhou	20162	183.2	1612.66	33.66	80.10	N.A	N.A
Barcelona-Washington	20162	3707.16	6436	52.33	46.30	470.03	493.03
Vienna-Shanghai	20162	3785	10532	76.33	67.11	508.88	401.65
Munich – La Havana	20163	1972.80	5148	18	40.86	N.A	N.A
Prague-Shanghai	20163	3203.88	6768.5	39	32.91	349.68	230.38

Note: The numbers are mean values before and after the city-pair is operated with regular air services (at least one flight per week)

2. Empirical Strategy

Our empirical model is based on the logics of gravity models where air passenger flows between two cities depend on the economic and demographic size of each city and on the distance between them (Zhang, Lin and Zhang, 2017).We also assume that fares are related with demand shifters (the economic and demographic size of the two cities) and a cost shifter as it is distance. However, the effect of distance (along with other time-invariant unobserved variables) is captured by city-pair fixed effects. Taking this into account, the essential variable in our analysis – an indicator for the provision of long-haul flights – may capture a reduction in the time spend on the trip, a more convenient service and different monetary costs. In this regard, we estimate the following model for the city-pair *k* in period *t*:

$$Y_{kt} = \alpha + \beta_1 Air\_services_{kt} + \beta_2 Pop\_origin_{kt} + \beta_3 Pop\_destination_{kt} + \beta_4 GNIpc\_origin_{kt} + \beta_5 GNIpc\_destination_{kt} + \gamma'_{route} + \eta'_{year} + \nu'_{quarter} + \varepsilon_{akt} \quad (1)$$

where the dependent variable, Y, are the total number of passengers (including non-stop and connecting traffic) or the mean fares weighted by traffic. As explanatory variables, we include an indicator of the supply of air services that may be the total number of non-stop flights or a dummy variable that takes a value of 1 when the route has air services. We consider that a route has air services when there is at least one non-stop flight per week. As controls, we include the population and gross national income of origin and destination cities.

The data used present a panel structure so that we need to use the techniques typically applied within the framework of panel data models. In this regard, a clear advantage of the city-pair fixed effects model is that it allows us to control for omitted variables that are correlated with the variables of interest and which do not change over time (Verbeek, 2000). The city-pair fixed effects model focuses on the within variation of data so that it controls for the effect of time invariant variables like the distance in the non-stop link. Furthermore, we add year dummies to control for yearly shocks that are common to all routes and quarter dummies to control for seasonal effects.

All continuous variables are expressed in logarithms except the variable for the number of non-stop flights. Note that 87% of observations have 0 values so that the use of logarithms would imply to lose a very high amount of (and essential) information. For the total number of passengers, 0.1% of observations have 0 values so that the use of logarithms implies to lose very few observations

(93). In gravity models, it is usual to express the continuous variables in logs so that we prefer to keep the logs as long as it is possible.

The main variable of the analysis is that for the non-stop flights. We may expect that the total number of passengers will be higher in city-pairs with non-stop air services. Less clear is the effect of this variable on fares.

The variable of non-stop flights should capture a reduction in travel time between the origin and destination cities. In this regard, travel time can be broken down into in-vehicle time; waiting time, which is calculated as the difference between the actual and real time of departure; and, access time from the infrastructure.[4] In the case of air transportation, another relevant component of the time costs is layover time, which affects flights that include a stop; the layover time includes the transfer time from one plane to another and the time waiting at the terminal for the connection.

The availability of non-stop flights should reduce in-vehicle time substantially as the itinerary is shorter than that of flights with intermediate stops and, by definition, layover time is zero on non-stop flights. Note we should add the risk associated with missing the connection as an extra cost of the fastest indirect connection. Furthermore, waiting time is directly related to the service frequency. Thus, non-stop flights may reduce the waiting time and this reduction will be proportional to the flight frequencies offered.

Hence, the availability of non-stop flights should imply a redistribution of traffic from connecting to local traffic, but it also may imply to generate new traffic. That is, some potential travelers that before do not flight, now they flight. Here we do not have as outside option to travel with another transportation mode. Thus, we may have a quality and a quantity effect.

Regarding fares, several effects with different sign may take place simultaneously. First, the cost of the non-stop trip for airlines is lower than connecting the cities with two flights (or more) and connecting flights imply longer itineraries. Furthermore, more flights may be associated with more opportunities to generate traffic and hence to exploit density economies or they may be associated with more competition as long as more than one airline is providing services. So we could expect that non-stop flights reduce fares. However, the availability of non-stop flights imply to offer the flight with a higher quality due to the time reduction mentioned above and airlines offering non-stop flights may have some market power given that connecting flights are imperfect substitutes.

[4] Given that most trips are made in order to undertake an activity at the destination, the demand for transportation services depends not only on the monetary price of the trip but also on the travel time, since the latter implies a disutility for the transport user (Button, 2010). Note that the sensitivity of business passengers to time is much higher than that of leisure passengers

Furthermore, we do not have available information on the proportion of the different fare classes which is a limitation of our fare data. It may be the case that the proportion of business passengers with high-order fare classes is higher for new passengers in non-stop flights given that the sensitivity to time of business passengers is very high. In any case, it is not clear whether the cost effect overcome the quality/market power effect.

An important econometric challenge is the potential simultaneous determination of demand (passengers) and supply (fares, flights). To deal with this problem, we apply two complementary procedures. First, we apply a matching procedure and we re-estimate equation 1 with the observations that have common support.

Matching procedures eliminate the possible bias by pairing observations in the treated city-pairs (with non-stop air services) and control city-pairs (without direct flights) having similar characteristics. In our context, we consider as the key characteristic the total traffic of passengers so that in the matching analysis we pair treated with control observations having similar levels of traffic in the initial period. Following Rosenbaum and Rubin (1983), we first estimate the probability of being treated conditional on the pre-existing characteristic that differ between groups (total traffic) with a logistic model, obtaining the propensity score for each observation. In a second step, we match the observations in the treated and control groups with respect to the propensity score using the first nearest neighbour algorithm. This algorithm matches treated observations with the control that has the closest propensity score. Then, we drop all the observations without common support and re-estimate equation 1.

Furthermore, in the matching sample, we apply an instrumental variables procedure. We use two alternative instruments. First, we use the total number of flights from the non-European city to European airports excluding the corresponding endpoint of the route. Hence, for example, in the link Brussels-Chicago we consider the total flights from Chicago to Europe (excluding Brussels). And second, we use the total number of flights of the airports of the Non-European city. Following the same example, we use the total number of flights of Chicago airports (excluding flights to Brussels).

Finally, the estimates may present heteroscedasticity and temporal and cross-sectional autocorrelation problems. We apply the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity and the Wooldridge test for autocorrelation in panel data. Both tests show that we may have a problem of heteroscedasticity (in some regressions) and autocorrelation, which must be addressed. Hence, the standard errors are robust to heteroscedasticity. Following Bertrand et al. (2004), we allow for an arbitrary variance-covariance structure by computing the standard errors in clusters by city-pair to correct for autocorrelation in the error term both at the cross-sectional and temporal levels.

3. Estimation and results

Table 4 shows the descriptive statistics of the variables used in the empirical analysis, while table 5 shows the correlation matrix. The variation of all variables is in general high and correlation between explanatory variables does not seem to be high enough to expect a multicollinearity problem, particularly with the non-stop flights variables.

Table 4. Descriptive statistics of the variables used in the empirical analysis

Variable	Mean	St. Deviation	Minimum value	Maximum value
Total traffic	2029.599	4147.88	0	86593
Fares	517.93	307.61	100.09	6136.72
Non-stop flights	10.989	38.75	0	639
$D^{air\_services}$	0.02	0.14	0	1
Pop_origin	1960.31	1208.48	479.85	5308.6
Pop_destination	8263.31	6988.97	528.50	38139.6
GDPpc_origin	40031.37	19180.42	8297.48	89818.3
GDPpc_destination	26118.26	22247.13	318.07	72671

Table 5. Correlation matrix of the variables used in the empirical analysis

Variable	Traffic	Fares	Flights	$D^{air\_services}$	Pop_o	Pop_d	GDPpc_o	GDPpc_d
Traffic	1							
Fares	-0.007	1						
Flights	0.77	0.02	1					
$D^{air\_services}$	0.15	-0.02	0.23	1				
Pop_o	0.05	-0.05	-0.01	0.006	1			
Pop_d	0.17	0.04	0.07	-0.02	0.01	1		
GDPpc_o	0.09	0.12	0.09	0.03	-0.51	-0.02	1	
GDPpc_d	0.11	0.08	0.17	0.09	-0.01	-0.31	-0.003	1

Table 6 shows the results of the equation that considers the total number of passengers as dependent variable. We find a significant increase of traffic when the number of non-stop flights is higher. However, the magnitude of the effect differs for the different regressions. When we consider the whole sample, the traffic increase is about 7 percent. This number increases to 17 percent when we consider the matching sample. Finally, the traffic increase is about 30-45 percent when we apply an instrumental variables procedure on the matching sample. Note that both instruments pass the under-identification and over-identification tests although the instrument that is based on the flights from the destination city to Europe is stronger (according to the partial R^2 of the first stage). In any case, the traffic increase associated with more frequencies is substantial and the potential bias of the simultaneous determination between traffic and flights seems to sub-estimate the real effect.

When we consider the dummy variable for scheduled non-stop air services, we exclude the observations for city-pairs that have always direct flights or have them at the beginning of the period (this is also done in the fare equation). Hence, we can isolate more clearly the impact of the change from not having to having non-stop air services. Taking this into account, the traffic increase is very high. The traffic increase is about 60 percent for the whole and matching samples. When we use an instrumental variables procedure, the traffic increase is more than 100 per cent. The instruments pass the tests but it seems advisable to trust more on the stronger instrument. Recall that the descriptive statistics suggest that the total traffic between the city pairs may more than double when non-stop flights are available as it is suggested in the estimations that apply both matching and instrumental variables.

Table 7 shows the results of the equation that considers the mean weighted fares as dependent variable. Regarding the relationship between fares and flights, we find a negative relationship although it is only statistically significant when we use the whole sample. The magnitude of the effect is in general high but it varies a lot across the regressions. It ranges from 7 percent in the estimation with the matching sample to 46-48 percent in the estimation with the whole sample or with the matching sample using the stronger instrument. Probably, the estimation for about 45 per cent is the most reliable. Thus, our results suggest that we may have a strong mean effect of non-stop flights on fares but the standard deviation (dispersion) is even higher.

When we consider the dummy variable for scheduled non-stop air services, we also find a negative effect but it is only relatively high in the estimation using instrumental variables with the weaker instrument (but not statistically significant). Overall, we do not find a substantial effect from the change to have non-stop flights, while it seems that the relationship between fares and frequencies is relevant although not statistically significant. This suggests that enjoying low fares with non-stop flights it requires achieving high frequencies. High frequencies may imply that airlines have been able to exploit density economies derived from channeling many passengers. Furthermore, high frequencies may be related with airline competition taking into account that most of the non-stop links are offered by just one airline (or as much two).

Table A1 in the appendix show the results for different subsamples distinguishing between the different geographical areas of the Non-European cities; North America, Asia, Middle East, Latin America and Caribbean and Africa. Regarding traffic, we find similar results for North America, Asia and Middle East than for the whole sample. Note that cities for these subsamples represent the higher number of observations, most of city-pairs with non-stop air services and almost all new links. For Latin America, results are also similar when we do not apply an instrumental variables procedure. Note that the instrumental variables procedure is applied here in a sample with few observations. For Africa, we do not find evidence of positive effects but this may be related with the few city-pairs with direct services. Regarding fares, we do not find a regular pattern as results vary depending on the regression.

Overall, our results suggest a high increase of traffic due to the availability of non-stop flights. Such increase may be explained by the increased quality derived from less time spent on the trip and less inconvenience associated with connections. Furthermore, the better quality of non-stop flights does not lead to higher fares (in fact it seems that even may lead to lower fares). So, we find clear evidence of a positive and strong effect of non-stop flights on the global connectivity of cities.

Table 6. Estimation results (demand equation)

	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
Non-stop_flights	0.0062 (0.00042)***	-	0.0075 (0.0005)***	-	0.012 (0.0012)***	-	0.019 (0.002)***	-
$D^{air\_services}$	-	0.59 (0.05)***	-	0.63 (0.05)***	-	1.63 (0.13)***	-	2.58 (0.55)***
Pop_origin	0.24 (0.24)	0.19 (0.42)	-0.29 (0.57)	0.12 (0.70)	-0.14 (0.29)	-0.70 (0.52)	0.04 (0.51)	-1.49 (0.68)**
Pop_destination	0.69 (0.18)***	0.95 (0.21)***	0.51 (0.34)	1.18 (0.32)***	-0.36 (0.40)	0.11 (0.43)	-1.44 (0.63)**	-0.91 (0.90)
GNIpc_origin	0.54 (0.13)***	0.69 (0.13)***	0.36 (0.27)	0.35 (0.31)	0.16 (0.26)	0.19 (0.33)	-0.09 (0.34)	0.04 (0.57)
GNIpc_destination	1.89 (0.24)***	1.88 (0.16)***	0.67 (0.28)**	0.30 (0.28)	0.93 (0.30)***	0.31 (0.39)	1.26 (0.38)***	0.32 (0.57)
Intercept	-25.24 (2.65)***	-28.69 (3.61)***	-5.38 (5.42)	-10.73 (6.87)	-	-	-	-
Route fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.22	0.22	0.44	0.48	0.38	0.14	0.15	-0.82
F – Joint sign.	265.26***	237.21***	62.03***	52.67***	46.36***	36.19***	28.43***	18.54***
Num. observations	60388	54060	6300	5432	6300	5432	6300	5432
Partial R^2 – instruments	-	-	-	-	0.20	0.08	0.05	0.02
F – Joint sign instruments (first stage)	-	-	-	-	65.85***	51.53***	20.65***	8.74***
Underidentification test (Kleibergen-Paap rk LM statistic.	-	-	-	-	31.68***	28.24***	33.22***	14.92***
Hansen J statistic (overidentification test of all instruments)	-	-	-	-	0.02	0.26	2.46	2.09

Notes: Standard errors in parentheses (robust to heteroscedasticity and clustered by route). Statistical significance at 1% (***), 5% (**), 10% (*). IV-1 (sample, IV-2 .all)

Table 7. Estimation results (fare equation)

	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
Non-stop_flights	-0.00089 (0.00029)***	-	-0.00014 (0.0005)	-	-0.0009 (0.0009)	-	-0.0018 (0.0018)	-
$D^{air\_services}$	-	-0.027 (0.03)	-	-0.02 (0.04)	-	-0.09 (0.16)	-	-0.20 (0.25)
Pop_origin	0.20 (0.15)	0.35 (0.12)***	0.89 (0.15)***	0.95 (0.15)***	0.87 (0.17)***	1.02 (0.21)***	0.85 (0.23)***	1.13 (0.29)***
Pop_destination	-0.16 (0.19)	-0.24 (0.11)**	-0.08 (0.23)	-0.0009 (0.27)	0.07 (0.25)	0.09 (0.28)	0.23 (0.38)	0.23 (0.40)
GNIpc_origin	0.17 (0.07)**	0.20 (0.07)***	0.07 (0.15)	0.11 (0.19)	0.10 (0.15)	0.12 (0.19)	0.14 (0.17)	0.13 (0.21)
GNIpc_destination	-0.61 (0.08)	-0.64 (0.08)***	-0.67 (0.18)***	-0.76 (0.18)***	-0.72 (0.19)***	-0.76 (0.19)***	-0.76 (0.20)***	-0.75 (0.19)***
Intercept	10.00 (1.35)***	9.55 (1.51)***	6.16 (3.48)*	5.50 (3.69)	-	-	-	-
Route fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Quarter fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.05	0.05	0.07	0.07	0.07	0.07	0.07	0.06
F – Joint sign.	82.90***	80.18***	19.74***	21.43***	18.38***	22.26***	17.23***	22.73***
Num. observations	41517	36366	4995	4239	4995	4239	4995	4239
Partial R^2 – instruments	-	-	-	-	0.21	0.07	0.05	0.02
F – Joint sign instruments (first stage)	-	-	-	-	60.04***	44.82***	19.53***	9.76***
Underidentification test (Kleibergen-Paap rk LM statistic)	-	-	-	-	28.77***	31.01***	32.61***	17.25***
Hansen J statistic (overidentification test of all instruments)	-	-	-	-	0.02	0.19	0.34	0.10

Notes: Standard errors in parentheses (robust to heteroscedasticity and clustered by route). Statistical significance at 1% (***), 5% (**), 10% (*).

4. Concluding remarks

In this paper, we have shown the strong causal relationship between the amount of total traffic and the supply of non-stop long-haul flights. Furthermore, such increase in the amount of traffic does not seem to be related with a systematic change in fares. Thus, the traffic increase may be related with an increase of quality.

Our results have been obtained in a context where connecting flights could be potentially competitive in relation to non-stop flights; our sample includes as origin European cities well connected with the main hubs and as destination distant cities from the rest of the world.

In spite of this substantial impact on traffic, our data shows that many inter-city markets are not connected with non-stop flights although they have close relationships as suggested by their dense traffic levels. This suggests that the interests of airlines may not be coincident with those of cities. Airlines may prefer to operate in a few airports to save costs although it may also be the case that the airline market is imperfect in the sense that some profitable flights are not been offered.

As we mention in the introduction, some market forces has already enhanced the connectivity of mid-size cities; congestion at hub airports, technological and managerial innovation associated with new aircraft models and low-cost carriers and globalization in the airline market.

Given the strong impact of non-stop flights on the economic and social links between cities, it may be advisable to promote airport policies to attract airlines that are willing to offer them. The tools available for airport managers include lowering charges, increasing capacity, allocate to interested airlines the best gates and check-in desks, engage in marketing initiatives of the cities. Furthermore, at a country level, the promotion of open skies policies may help in promoting non-stop long-haul flights beyond the main hubs. Europe has an open skies agreement with United States and Canada from 2008, and also with some nearby countries like Morocco or Georgia. Results of our analysis suggest that it could be advisable to promote liberalization policies.

Our analysis also suggests potential negative externalities associated with the concentration of traffic in main hubs, aside of the well-know externality associated with congestion. Such negative externality has to do with the loss of direct connectivity of mid-size cities and the associated loss of economic links with other cities. However, this does not mean that our paper justifies the public intervention to promote de-hubbing strategies by airlines. A project for future research could be to investigate this issue.

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Appendix. Table A1. Estimates for geographical areas (demand and fare equations).

	North America							
	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
	Demand	Fares	Demand	Fares	Demand	Fares	Demand	Fares
Frequencies	0.0043 (0.0005)***	-0.00084 (0.0004)***	0.0064 (0.0007)***	-0.0018 (0.0011)	0.0139 (0.003)***	-0.005 (0.003)	0.041 (0.012)***	-0.016 (0.01)
$\mathbf{D}^{air\_services}$	0.51 (0.05)***	-0.32 (0.07)***	0.49 (0.005)***	-0.26 (0.009)***	1.92 (0.38)***	-0.53 (0.52)	3.09 (0.79)***	-1.75 (0.02)***
Num. obs	21628	20851	2632	2613	2632	2613	2632	2613
	Asia (except Middle East and Central Asia)							
	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
	Demand	Fares	Demand	Fares	Demand	Fares	Demand	Fares
Frequencies	0.0052 (0.0007)***	-0.0026 (0.07)**	0.0056 (0.0005)***	-0.0019 (0.0018)	0.0142 (0.006)***	0.004 (0.007)	0.0138 (0.004)***	-0.0046 (0.006)
$\mathbf{D}^{air\_services}$	0.27 (0.09)***	0.04 (0.11)	0.41 (0.008)***	0.011 (0.12)	0.80 (0.34)***	0.23 (0.50)	1.50 (0.58)***	-0.05 (0.71)
Num. obs	21415	20066	2128	2100	2128	2100	2128	2100
	Middle East							
	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
	Demand	Fares	Demand	Fares	Demand	Fares	Demand	Fares
Frequencies	0.007 (0.0007)***	0.00018 (0.001)	0.009 (0.0008)***	-0.0001 (0.001)	0.011 (0.001)***	-0.0006 (0.003)	-0.015 (0.04)	-0.026 (0.06)
$\mathbf{D}^{air\_services}$	0.97 (0.10)***	0.26 (0.15)*	1.01 (0.11)***	0.21 (0.15)	1.57 (0.24)***	0.40 (0.83)	1.92 (1.18)*	2.16 (3.03)
Num. obs	2524	2473	784	781	784	781	784	781
	Latin America and Caribbean							
	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
	Demand	Fares	Demand	Fares	Demand	Fares	Demand	Fares
Frequencies	0.009 (0.002)***	0.0011 (0.003)	0.013 (0.007)*	0.0006 (0.008)	-0.01 (0.01)	0.028 (0.01)**	-0.05 (0.12)	0.07 (0.14)
$\mathbf{D}^{air\_services}$	0.92 (0.41)***	-0.42 (0.53)	0.80 (0.33)**	-0.32 (0.46)	-1.91 (2.50)	2.78 (2.28)	-0.27 (0.88)	3.51 (2.95)
Num. obs	10597	8780	420	402	420	402	420	402
	Africa							
	Full sample (I)		Matching (II)		Matching with IV-1 (III)		Matching with IV-2 (IV)	
	Demand	Fares	Demand	Fares	Demand	Fares	Demand	Fares
Frequencies	0.003 (0.004)	-0.001 (0.009)	-0.007 (0.002)**	0.004 (0.005)***	-0.11 (0.11)	-0.03 (0.17)	-0.14 (0.12)	0.18 (0.26)
$\mathbf{D}^{air\_services}$	-	-	-	-	-	-	-	-
Num. obs	4224	3886	336	336	336	336	336	336

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Durán Weitkamp, C. (GRIT)**; Martín Bofarull, M.** (GRIT) ; **Pablo Martí, F.**
"Economic effects of road accessibility in the Pyrenees: User perspective"
(Gener 2008)

XREAP2008-02
Díaz-Serrano, L.; Stoyanova, A. P. (CREB)
"The Causal Relationship between Individual's Choice Behavior and Self-Reported Satisfaction: the Case of Residential Mobility in the EU"
(Març 2008)

XREAP2008-03
Matas, A. (GEAP)**; Raymond, J. L.** (GEAP)**; Roig, J. L.** (GEAP)
"Car ownership and access to jobs in Spain"
(Abril 2008)

XREAP2008-04
Bel, G. (PPRE-IREA) **; Fageda, X.** (PPRE-IREA)
"Privatization and competition in the delivery of local services: An empirical examination of the dual market hypothesis"
(Abril 2008)

XREAP2008-05
Matas, A. (GEAP); **Raymond, J. L.** (GEAP); **Roig, J. L.** (GEAP)
"**Job accessibility and employment probability**"
(Maig 2008)

XREAP2008-06
Basher, S. A.; Carrión, J. Ll. (AQR-IREA)
Deconstructing Shocks and Persistence in OECD Real Exchange Rates
(Juny 2008)

XREAP2008-07
Sanromá, E. (IEB)**; Ramos, R.** (AQR-IREA); Simón, H.
Portabilidad del capital humano y asimilación de los inmigrantes. Evidencia para España
(Juliol 2008)

XREAP2008-08
Basher, S. A.; Carrión, J. Ll. (AQR-IREA)
Price level convergence, purchasing power parity and multiple structural breaks: An application to US cities
(Juliol 2008)

XREAP2008-09
Bermúdez, Ll. (RFA-IREA)
A priori ratemaking using bivariate poisson regression models
(Juliol 2008)

XREAP2008-10
Solé-Ollé, A. (IEB), **Hortas Rico, M.** (IEB)
Does urban sprawl increase the costs of providing local public services? Evidence from Spanish municipalities
(Novembre 2008)

XREAP2008-11
Teruel-Carrizosa, M. (GRIT), **Segarra-Blasco, A.** (GRIT)
Immigration and Firm Growth: Evidence from Spanish cities
(Novembre 2008)

XREAP2008-12
Duch-Brown, N. (IEB), **García-Quevedo, J.** (IEB), **Montolio, D.** (IEB)
Assessing the assignation of public subsidies: Do the experts choose the most efficient R&D projects?
(Novembre 2008)

XREAP2008-13
Bilotkach, V., **Fageda, X.** (PPRE-IREA), **Flores-Fillol, R.**
Scheduled service versus personal transportation: the role of distance
(Desembre 2008)

XREAP2008-14
Albalate, D. (PPRE-IREA), **Gel, G.** (PPRE-IREA)
Tourism and urban transport: Holding demand pressure under supply constraints
(Desembre 2008)

2009

XREAP2009-01
Calonge, S. (CREB)**; Tejada, O.**
"A theoretical and practical study on linear reforms of dual taxes"
(Febrer 2009)

XREAP2009-02
Albalate, D. (PPRE-IREA)**; Fernández-Villadangos, L.** (PPRE-IREA)
"Exploring Determinants of Urban Motorcycle Accident Severity: The Case of Barcelona"
(Març 2009)

XREAP2009-03
Borrell, J. R. (PPRE-IREA)**; Fernández-Villadangos, L.** (PPRE-IREA)
"Assessing excess profits from different entry regulations"
(Abril 2009)

XREAP2009-04
Sanromá, E. (IEB)**; Ramos, R.** (AQR-IREA), **Simon, H.**
"Los salarios de los inmigrantes en el mercado de trabajo español. ¿Importa el origen del capital humano?"
(Abril 2009)

XREAP2009-05
Jiménez, J. L.; Perdiguero, J. (PPRE-IREA)
"(No)competition in the Spanish retailing gasoline market: a variance filter approach"
(Maig 2009)

XREAP2009-06
Álvarez-Albelo,C. D. (CREB)**, Manresa, A.** (CREB)**, Pigem-Vigo, M.** (CREB)
"International trade as the sole engine of growth for an economy"
(Juny 2009)

XREAP2009-07
Callejón, M. (PPRE-IREA)**, Ortún V, M.**
"The Black Box of Business Dynamics"
(Setembre 2009)

XREAP2009-08
Lucena, A. (CREB)
"The antecedents and innovation consequences of organizational search: empirical evidence for Spain"
(Octubre 2009)

XREAP2009-09
Domènech Campmajó, L. (PPRE-IREA)
"Competition between TV Platforms"
(Octubre 2009)

XREAP2009-10
Solé-Auró, A. (RFA-IREA)**,Guillén, M.** (RFA-IREA)**, Crimmins, E. M.**
"Health care utilization among immigrants and native-born populations in 11 European countries. Results from the Survey of Health, Ageing and Retirement in Europe"
(Octubre 2009)

XREAP2009-11
Segarra, A. (GRIT)**, Teruel, M.** (GRIT)
"Small firms, growth and financial constraints"
(Octubre 2009)

XREAP2009-12
Matas, A. (GEAP)**, Raymond, J.Ll.** (GEAP), **Ruiz, A.** (GEAP)
"Traffic forecasts under uncertainty and capacity constraints"
(Novembre 2009)

XREAP2009-13
Sole-Ollé, A. (IEB)
"Inter-regional redistribution through infrastructure investment: tactical or programmatic?"
(Novembre 2009)

XREAP2009-14
Del Barrio-Castro, T., **García-Quevedo, J.** (IEB)
"The determinants of university patenting: Do incentives matter?"
(Novembre 2009)

XREAP2009-15
Ramos, R. (AQR-IREA), **Suriñach, J.** (AQR-IREA)**, Artís, M.** (AQR-IREA)
"Human capital spillovers, productivity and regional convergence in Spain"
(Novembre 2009)

XREAP2009-16
Álvarez-Albelo, C. D. (CREB), **Hernández-Martín, R.**
"The commons and anti-commons problems in the tourism economy"
(Desembre 2009)

2010

XREAP2010-01
García-López, M. A. (GEAP)
"The Accessibility City. When Transport Infrastructure Matters in Urban Spatial Structure"
(Febrer 2010)

XREAP2010-02
García-Quevedo, J. (IEB), **Mas-Verdú, F.** (IEB), **Polo-Otero, J.** (IEB)
"Which firms want PhDs? The effect of the university-industry relationship on the PhD labour market"
(Març 2010)

XREAP2010-03
Pitt, D., **Guillén, M.** (RFA-IREA)
"An introduction to parametric and non-parametric models for bivariate positive insurance claim severity distributions"
(Març 2010)

XREAP2010-04
Bermúdez, Ll. (RFA-IREA), **Karlis, D.**
"Modelling dependence in a ratemaking procedure with multivariate Poisson regression models"
(Abril 2010)

XREAP2010-05
Di Paolo, A. (IEB)
"Parental education and family characteristics: educational opportunities across cohorts in Italy and Spain"
(Maig 2010)

XREAP2010-06
Simón, H. (IEB), **Ramos, R.** (AQR-IREA), **Sanromá, E.** (IEB)

"Movilidad ocupacional de los inmigrantes en una economía de bajas cualificaciones. El caso de España"
(Juny 2010)

XREAP2010-07
Di Paolo, A. (GEAP & IEB), **Raymond, J. Ll.** (GEAP & IEB)
"Language knowledge and earnings in Catalonia"
(Juliol 2010)

XREAP2010-08
Bolancé, C. (RFA-IREA), **Alemany, R.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"Prediction of the economic cost of individual long-term care in the Spanish population"
(Setembre 2010)

XREAP2010-09
Di Paolo, A. (GEAP & IEB)
"Knowledge of catalan, public/private sector choice and earnings: Evidence from a double sample selection model"
(Setembre 2010)

XREAP2010-10
Coad, A., **Segarra, A.** (GRIT), **Teruel, M.** (GRIT)
"Like milk or wine: Does firm performance improve with age?"
(Setembre 2010)

XREAP2010-11
Di Paolo, A. (GEAP & IEB), **Raymond, J. Ll.** (GEAP & IEB), **Calero, J.** (IEB)
"Exploring educational mobility in Europe"
(Octubre 2010)

XREAP2010-12
Borrell, A. (GiM-IREA), **Fernández-Villadangos, L.** (GiM-IREA)
"Clustering or scattering: the underlying reason for regulating distance among retail outlets"
(Desembre 2010)

XREAP2010-13
Di Paolo, A. (GEAP & IEB)
"School composition effects in Spain"
(Desembre 2010)

XREAP2010-14
Fageda, X. (GiM-IREA), **Flores-Fillol, R.**
"Technology, Business Models and Network Structure in the Airline Industry"
(Desembre 2010)

XREAP2010-15
Albalate, D. (GiM-IREA), **Bel, G.** (GiM-IREA), **Fageda, X.** (GiM-IREA)
"Is it Redistribution or Centralization? On the Determinants of Government Investment in Infrastructure"
(Desembre 2010)

XREAP2010-16
Oppedisano, V., **Turati, G.**
"What are the causes of educational inequalities and of their evolution over time in Europe? Evidence from PISA"
(Desembre 2010)

XREAP2010-17
Canova, L., **Vaglio, A.**
"Why do educated mothers matter? A model of parental help"
(Desembre 2010)

2011

XREAP2011-01
Fageda, X. (GiM-IREA), **Perdiguero, J.** (GiM-IREA)
"An empirical analysis of a merger between a network and low-cost airlines"
(Maig 2011)

XREAP2011-02
Moreno-Torres, I. (ACCO, CRES & GiM-IREA)
"What if there was a stronger pharmaceutical price competition in Spain? When regulation has a similar effect to collusion"
(Maig 2011)

XREAP2011-03
Miguélez, E. (AQR-IREA); **Gómez-Miguélez, I.**
"Singling out individual inventors from patent data"
(Maig 2011)

XREAP2011-04
Moreno-Torres, I. (ACCO, CRES & GiM-IREA)
"Generic drugs in Spain: price competition vs. moral hazard"
(Maig 2011)

XREAP2011-05
Nieto, S. (AQR-IREA)**, Ramos, R.** (AQR-IREA)
"¿Afecta la sobreeducación de los padres al rendimiento académico de sus hijos?"
(Maig 2011)

XREAP2011-06
Pitt, D., **Guillén, M.** (RFA-IREA), **Bolancé, C.** (RFA-IREA)
"Estimation of Parametric and Nonparametric Models for Univariate Claim Severity Distributions - an approach using R"
(Juny 2011)

XREAP2011-07
Guillén, M. (RFA-IREA), **Comas-Herrera, A.**
"How much risk is mitigated by LTC Insurance? A case study of the public system in Spain"
(Juny 2011)

XREAP2011-08
Ayuso, M. (RFA-IREA), **Guillén, M.** (RFA-IREA), **Bolancé, C.** (RFA-IREA)
"Loss risk through fraud in car insurance"
(Juny 2011)

XREAP2011-09
Duch-Brown, N. (IEB), **García-Quevedo, J.** (IEB), **Montolio, D.** (IEB)
"The link between public support and private R&D effort: What is the optimal subsidy?"
(Juny 2011)

XREAP2011-10
Bermúdez, Ll. (RFA-IREA), **Karlis, D.**
"Mixture of bivariate Poisson regression models with an application to insurance"
(Juliol 2011)

XREAP2011-11
Varela-Irimia, X-L. (GRIT)
"Age effects, unobserved characteristics and hedonic price indexes: The Spanish car market in the 1990s"
(Agost 2011)

XREAP2011-12
Bermúdez, Ll. (RFA-IREA), **Ferri, A.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"A correlation sensitivity analysis of non-life underwriting risk in solvency capital requirement estimation"
(Setembre 2011)

XREAP2011-13
Guillén, M. (RFA-IREA), **Pérez-Marín, A.** (RFA-IREA), **Alcañiz, M.** (RFA-IREA)
"A logistic regression approach to estimating customer profit loss due to lapses in insurance"
(Octubre 2011)

XREAP2011-14
Jiménez, J. L., **Perdiguero, J.** (GiM-IREA), **García, C.**
"Evaluation of subsidies programs to sell green cars: Impact on prices, quantities and efficiency"
(Octubre 2011)

XREAP2011-15
Arespa, M. (CREB)
"A New Open Economy Macroeconomic Model with Endogenous Portfolio Diversification and Firms Entry"
(Octubre 2011)

XREAP2011-16
Matas, A. (GEAP), **Raymond, J. L.** (GEAP), **Roig, J.L.** (GEAP)
"The impact of agglomeration effects and accessibility on wages"
(Novembre 2011)

XREAP2011-17
Segarra, A. (GRIT)
"R&D cooperation between Spanish firms and scientific partners: what is the role of tertiary education?"
(Novembre 2011)

XREAP2011-18
García-Pérez, J. I.; **Hidalgo-Hidalgo, M.**; **Robles-Zurita, J. A.**
"Does grade retention affect achievement? Some evidence from PISA"
(Novembre 2011)

XREAP2011-19
Arespa, M. (CREB)
"Macroeconomics of extensive margins: a simple model"
(Novembre 2011)

XREAP2011-20
García-Quevedo, J. (IEB), **Pellegrino, G.** (IEB), **Vivarelli, M.**
"The determinants of YICs' R&D activity"
(Desembre 2011)

XREAP2011-21
González-Val, R. (IEB), **Olmo, J.**
"Growth in a Cross-Section of Cities: Location, Increasing Returns or Random Growth?"
(Desembre 2011)

XREAP2011-22
Gombau, V. (GRIT), **Segarra, A.** (GRIT)
"The Innovation and Imitation Dichotomy in Spanish firms: do absorptive capacity and the technological frontier matter?"
(Desembre 2011)

2012

XREAP2012-01
Borrell, J. R. (GiM-IREA), **Jiménez, J. L.**, **García, C.**
"Evaluating Antitrust Leniency Programs"
(Gener 2012)

XREAP2012-02
Ferri, A. (RFA-IREA), **Guillén, M.** (RFA-IREA), **Bermúdez, Ll.** (RFA-IREA)
"Solvency capital estimation and risk measures"
(Gener 2012)

XREAP2012-03
Ferri, A. (RFA-IREA), **Bermúdez, Ll.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"How to use the standard model with own data"
(Febrer 2012)

XREAP2012-04
Perdiguero, J. (GiM-IREA), **Borrell, J.R.** (GiM-IREA)
"Driving competition in local gasoline markets"
(Març 2012)

XREAP2012-05
D'Amico, G., **Guillen, M.** (RFA-IREA), Manca, R.
"Discrete time Non-homogeneous Semi-Markov Processes applied to Models for Disability Insurance"
(Març 2012)

XREAP2012-06
Bové-Sans, M. A. (GRIT), Laguado-Ramírez, R.
"Quantitative analysis of image factors in a cultural heritage tourist destination"
(Abril 2012)

XREAP2012-07
Tello, C. (AQR-IREA), **Ramos, R.** (AQR-IREA), **Artís, M.** (AQR-IREA)
"Changes in wage structure in Mexico going beyond the mean: An analysis of differences in distribution, 1987-2008"
(Maig 2012)

XREAP2012-08
Jofre-Monseny, J. (IEB), **Marín-López, R.** (IEB), **Viladecans-Marsal, E.** (IEB)
"What underlies localization and urbanization economies? Evidence from the location of new firms"
(Maig 2012)

XREAP2012-09
Muñiz, I. (GEAP), **Calatayud, D.**, **Dobaño, R.**
"Los límites de la compacidad urbana como instrumento a favor de la sostenibilidad. La hipótesis de la compensación en Barcelona medida a través de la huella ecológica de la movilidad y la vivienda"
(Maig 2012)

XREAP2012-10
Arqué-Castells, P. (GEAP), **Mohnen, P.**
"Sunk costs, extensive R&D subsidies and permanent inducement effects"
(Maig 2012)

XREAP2012-11
Boj, E. (CREB), **Delicado, P.**, **Fortiana, J**., **Esteve, A.**, **Caballé, A.**
"Local Distance-Based Generalized Linear Models using the dbstats package for R"
(Maig 2012)

XREAP2012-12
Royuela, V. (AQR-IREA)
"What about people in European Regional Science?"
(Maig 2012)

XREAP2012-13
Osorio A. M. (RFA-IREA)**, Bolancé, C.** (RFA-IREA), **Madise, N.**
"Intermediary and structural determinants of early childhood health in Colombia: exploring the role of communities"
(Juny 2012)

XREAP2012-14
Miguelez. E. (AQR-IREA)**, Moreno, R.** (AQR-IREA)
"Do labour mobility and networks foster geographical knowledge diffusion? The case of European regions"
(Juliol 2012)

XREAP2012-15
Teixidó-Figueras, J. (GRIT)**, Duró, J. A.** (GRIT)
"Ecological Footprint Inequality: A methodological review and some results"
(Setembre 2012)

XREAP2012-16
Varela-Irimia, X-L. (GRIT)
"Profitability, uncertainty and multi-product firm product proliferation: The Spanish car industry"
(Setembre 2012)

XREAP2012-17
Duró, J. A. (GRIT), **Teixidó-Figueras, J.** (GRIT)
"Ecological Footprint Inequality across countries: the role of environment intensity, income and interaction effects"
(Octubre 2012)

XREAP2012-18
Manresa, A. (CREB), **Sancho, F.**
"Leontief versus Ghosh: two faces of the same coin"
(Octubre 2012)

XREAP2012-19
Alemany, R. (RFA-IREA), **Bolancé, C.** (RFA-IREA), **Guillén, M.** (RFA-IREA)
"Nonparametric estimation of Value-at-Risk"
(Octubre 2012)

XREAP2012-20
Herrera-Idárraga, P. (AQR-IREA), **López-Bazo, E.** (AQR-IREA), **Motellón, E.** (AQR-IREA)
"Informality and overeducation in the labor market of a developing country"
(Novembre 2012)

XREAP2012-21
Di Paolo, A. (AQR-IREA)
"(Endogenous) occupational choices and job satisfaction among recent PhD recipients: evidence from Catalonia"
(Desembre 2012)

2013

XREAP2013-01
Segarra, A. (GRIT), **García-Quevedo, J.** (IEB), **Teruel, M.** (GRIT)
"Financial constraints and the failure of innovation projects"
(Març 2013)

XREAP2013-02
Osorio, A. M. (RFA-IREA), **Bolancé, C.** (RFA-IREA), Madise, N., Rathmann, K.
"Social Determinants of Child Health in Colombia: Can Community Education Moderate the Effect of Family Characteristics?"
(Març 2013)

XREAP2013-03
Teixidó-Figueras, J. (GRIT), **Duró, J. A.** (GRIT)
"The building blocks of international ecological footprint inequality: a regression-based decomposition"
(Abril 2013)

XREAP2013-04
Salcedo-Sanz, S., **Carro-Calvo, L.**, **Claramunt, M.** (CREB), **Castañer, A.** (CREB), **Marmol, M.** (CREB)
"An Analysis of Black-box Optimization Problems in Reinsurance: Evolutionary-based Approaches"
(Maig 2013)

XREAP2013-05
Alcañiz, M. (RFA), **Guillén, M.** (RFA), **Sánchez-Moscona, D.** (RFA), **Santolino, M.** (RFA), **Llatje, O., Ramon, Ll.**
"Prevalence of alcohol-impaired drivers based on random breath tests in a roadside survey"
(Juliol 2013)

XREAP2013-06
Matas, A. (GEAP & IEB), **Raymond, J. Ll.** (GEAP & IEB), **Roig, J. L.** (GEAP)
"How market access shapes human capital investment in a peripheral country"
(Octubre 2013)

XREAP2013-07
Di Paolo, A. (AQR-IREA), **Tansel, A.**
"Returns to Foreign Language Skills in a Developing Country: The Case of Turkey"
(Novembre 2013)

XREAP2013-08
Fernández Gual, V. (GRIT), **Segarra, A.** (GRIT)
"The Impact of Cooperation on R&D, Innovation andProductivity: an Analysis of Spanish Manufacturing and Services Firms"
(Novembre 2013)

XREAP2013-09
Bahraoui, Z. (RFA); **Bolancé, C.** (RFA); **Pérez-Marín. A. M.** (RFA)
"Testing extreme value copulas to estimate the quantile"
(Novembre 2013)

2014

XREAP2014-01
Solé-Auró, A. (RFA), **Alcañiz, M.** (RFA)
"Are we living longer but less healthy? Trends in mortality and morbidity in Catalonia (Spain), 1994-2011"
(Gener 2014)

XREAP2014-02

Teixidó-Figueres, J. (GRIT), **Duro, J. A.** (GRIT)
"Spatial Polarization of the Ecological Footprint distribution"
(Febrer 2014)

XREAP2014-03
Cristobal-Cebolla, A.; Gil Lafuente, A. M. (RFA), **Merigó Lindhal, J. M.** (RFA)
"La importancia del control de los costes de la no-calidad en la empresa"
(Febrer 2014)

XREAP2014-04
Castañer, A. (CREB); **Claramunt, M.M.** (CREB)
"Optimal stop-loss reinsurance: a dependence analysis"
(Abril 2014)

XREAP2014-05
Di Paolo, A. (AQR-IREA); **Matas, A.** (GEAP); **Raymond, J. Ll.** (GEAP)
"Job accessibility, employment and job-education mismatch in the metropolitan area of Barcelona"
(Maig 2014)

XREAP2014-06
Di Paolo, A. (AQR-IREA); **Mañé, F.**
"Are we wasting our talent? Overqualification and overskilling among PhD graduates"
(Juny 2014)

XREAP2014-07
Segarra, A. (GRIT); **Teruel, M.** (GRIT); **Bové, M. A.** (GRIT)
"A territorial approach to R&D subsidies: Empirical evidence for Catalonian firms"
(Setembre 2014)

XREAP2014-08
Ramos, R. (AQR-IREA); **Sanromá, E.** (IEB); **Simón, H.**
"Public-private sector wage differentials by type of contract: evidence from Spain"
(Octubre 2014)

XREAP2014-09
Bel, G. (GiM-IREA); **Bolancé, C.** (Riskcenter-IREA); **Guillén, M.** (Riskcenter-IREA)**; Rosell, J.** (GiM-IREA)
"The environmental effects of changing speed limits: a quantile regression approach"
(Desembre 2014)

2015

XREAP2015-01
Bolance, C. (Riskcenter-IREA); **Bahraoui, Z.** (Riskcenter-IREA), **Alemany, R.** (Risckcenter-IREA)
"Estimating extreme value cumulative distribution functions using bias-corrected kernel approaches"
(Gener 2015)

XREAP2015-02
Ramos, R. (AQR-IREA); **Sanromá, E.** (IEB), **Simón, H.**
"An analysis of wage differentials between full- and part-time workers in Spain"
(Agost 2015)

XREAP2015-03
Cappellari, L.; **Di Paolo, A.** (AQR-IREA)
"Bilingual Schooling and Earnings: Evidence from a Language-in-Education Reform"
(Setembre 2015)

XREAP2015-04
Álvarez-Albelo, C. D., Manresa, A. (CREB)**, Pigem-Vigo, M.** (CREB)
"Growing through trade: The role of foreign growth and domestic tariffs"
(Novembre 2015)

XREAP2015-05
Caminal, R., Di Paolo, A. (AQR-IREA)
Your language or mine?
(Novembre 2015)

XREAP2015-06
Choi, H. (AQR-IREA)**, Choi, A.** (IEB)
When one door closes: the impact of the hagwon curfew on the consumption of private tutoring in the Republic of Korea

(Novembre 2015)

2016

XREAP2016-01
Castañer, A. (CREB, XREAP); **Claramunt, M M.** (CREB, XREAP), **Tadeo, A.**, **Varea, J.** (CREB, XREAP)
Modelización de la dependencia del número de siniestros. Aplicación a Solvencia II
(Setembre 2016)

XREAP2016-02
García-Quevedo, J. (IEB, XREAP); **Segarra-Blasco, A.** (GRIT, XREAP), **Teruel, M.** (GRIT, XREAP)
Financial constraints and the failure of innovation projects
(Setembre 2016)

XREAP2016-03
Jové-Llopis, E. (GRIT, XREAP); **Segarra-Blasco, A.** (GRIT, XREAP)
What is the role of innovation strategies? Evidence from Spanish firms
(Setembre 2016)

XREAP2016-04
Albalate, D. (GiM-IREA, XREAP); **Rosell, J.** (GiM-IREA, XREAP)
Persistent and transient efficiency on the stochastic production and cost frontiers – an application to the motorway sector
(Octubre 2016)

XREAP2016-05
Jofre-Monseny, J. (IEB, XREAP), **Silva, J. I.**, **Vázquez-Grenno, J.** (IEB, XREAP)
Local labor market effects of public employment
(Novembre 2016)

XREAP2016-06
Garcia-López, M. A. (IEB, XREAP), **Hemet, C.**, **Viladecans-Marsal, E.** (IEB, XREAP)
Next train to the polycentric city: The effect of railroads on subcenter formation
(Novembre 2016)

XREAP2016-07
Vayá, E. (AQR-IREA, XREAP)**, García, J. R.** (AQR-IREA, XREAP)**, Murillo, J.** (AQR-IREA, XREAP)**, Romaní, J.** (AQR-IREA, XREAP)**, Suriñach, J.** (AQR-IREA, XREAP)**,**
Economic impact of cruise activity: the port of Barcelona
(Desembre 2016)

XREAP2016-08
Ayuso, M. (Riskcenter, XREAP)**, Guillen, M.** (Riskcenter, XREAP)**, Nielsen, J. P.**
Improving automobile insurance ratemaking using telematics: incorporating mileage and driver behaviour data
(Desembre 2016)

XREAP2016-09
Ruíz, A. (GEAP, XREAP), **Matas, A.** (GEAP, XREAP), **Raymond, J. Ll.**
How do road infrastructure investments affect the regional economy? Evidence from Spain
(Desembre 2016)

2017

XREAP2017-01
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