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## Air accessibility and the export of Italian manufacture in Europe: Evidence at regional level

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Air accessibility and the export  
of Italian manufacture in Europe:  
Evidence at regional level\*

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**Abstract**

We study the link between air accessibility (measured by non-stop flights offer) and the manufacturing export of the Italian regions in Europe using a panel of 12,000 half-yearly observations ranging from 1998 to 2010. The analysis shows that the supply of non-stop flights

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provided by full-service carriers has a positive impact on the exports of Italian regions, whilst no significant evidence of this is found for low-cost carriers. This last result may be partially due to a lower flight frequency offered by low-cost carriers and to the intrinsic features of low-cost carrier business model (flying to secondary airports, imposing strict baggage restrictions, providing limited seat space, etc.).

**JEL Classification:** C23, F10, L20, L60, L93.

**Keywords:** airlines, export, full-service carriers, low-cost carriers, manufacturing.

# 1 Introduction

Recent literature has recognized the relevance of face-to-face contacts and consequently of business traveling for strengthening international trade relations (Rauch, 2001; Cristea, 2011). Face-to-face interactions allow complex business relationships to be managed more effectively than with media (Saxenian, 1999); favor the cultivation of trust among business partners (Storper and Venables, 2004); and make it easier the transfer of tacit knowledge (Poole, 2010). Given these premises, accessibility, and, in particular, air accessibility emerges as a key factor in building, maintaining and reinforcing commercial relations (Frankel, 1998; Rauch, 1999; Kulendran and Wilson, 2000; Frankel and Rose, 2002). In facts, air traveling is often preferred to car or train by businessmen for their journey abroad at least for mid- and long-haul distances. Within Europe, air accessibility is strongly affected by the existence of non-stop flights as it lets businessmen reach any destination within two or three hours and complete a business mission smoothly within a day or, alternatively, reduce the journey time component considerably in case of a short stay.<sup>1</sup>

In this work, we study empirically the role played by non-stop flights in expanding the exports of the Italian regions in Europe. In light of the mounting importance of the competition between Low-Cost Carriers (LCCs)

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<sup>1</sup>The availability of a non-stop flight can also drive the decision of a businessman to visit a place or, more generally, the site choice among a set of possible destinations (Grosche et al. 2007).

and Full-Service Carriers (FSCs), we investigate the differential impact on exports induced by these two types of airlines. As amply investigated, LCCs adopt a strictly cost-saving business model that implies a flight offer normally from secondary airports, no frills, no cabin class differentiation, and low flight frequencies (Mason, 2000). All these aspects make the use of LCCs less appealing for businessmen, suggesting that the supply of non-stop flights by FSCs should be more influential in boosting exports than the supply of non-stop flights by LCCs.<sup>2</sup>

As far as flight frequencies are concerned, we develop a simple model of air accessibility to show that the propensity of businessmen to travel is strongly influenced by the number of flight frequencies offered on a single route. In particular, we demonstrate that the expected differential impact of one type of carrier with respect to the other is given by the ratio of the frequencies of the two carriers. In case of  $v$  multiple visits, the differential impact is affected by the power  $v$  of the ratio of the frequencies. This means that LCCs, by offering fewer frequencies, are less likely to be chosen by business travelers. Therefore, the impact of an additional LCC flight on exports should be weaker if compared to an additional flight provided by

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<sup>2</sup>In many cases, secondary airports are located at a remote distance from the effective destination. For example, the main airport of Barcelona (El Prat), served by FSCs, is located at less than 15 km from the city center, while the secondary airport (Girona), served by most of the LCCs, is further 90 km away. Moreover, LCC point-to-point strategy combines a sparse flight frequency with a large set of destinations, thus it is not rare that for several routes LCCs do not provide a daily service. Other factors that may reduce the appeal of LCCs to businessmen by making the travel experience rather unpleasant and, more generally, hamper in-flight working are: strict baggage restrictions and limited seat space.

a FSC. Using the same environment, we also show that the likelihood of a businessman to select a flight with a stopover versus a non-stop flight is much lower, especially in case of poor connections. This result justifies our empirical strategy to focus only on non-stop flights.

In addition to the relevance of exports for manufacturer turnover, productivity and employment (Bernard et al., 2003; Baldwin and Gu, 2003), theoretical and empirical literature has pointed out the relevance of trade for economic development (Barro, 1991; Frankel and Rose, 2002; Dollar and Kraay, 2004; Castro, 2006; Awokuse, 2007; Lee, 2011) although the point is amply debated.<sup>3</sup> The recent case of several Asian and Sud American countries seems to give further credit to this causal relationship (Rodrik, 2006; Hausmann et al. 2007; Jarreau and Poncet, 2009; Feenstra and Kee, 2008; Lee, 2011; Özyurt and Daumal, 2013). Although we do not investigate the link between regional exports and regional development any further, our study provides some insights on how air transport policies may affect regional development.

Our work also contributes to the expanding applied literature on airline travel and international trade (Cristea, 2011; Poole 2010) by providing empirical evidence in favor of the positive effect of direct air connection on exports. Furthermore, to the best of our knowledge, we are the first to distinguish be-

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<sup>3</sup>For a controversial and mixed evidence on cross-country growth performance and trade, see, for example: Temple (1999), Frankel and Romer (1999), Chang et al. (2005), Santos-Paulino (2005), and Abbott et al. (2009).

tween FSCs and LCCs in the analysis. In addition, our variable measuring the impact of air accessibility on trade (i.e., non-stop flight frequency to a particular destination market) is novel relatively to previous studies in this field, which, instead, use information on the number of travelers between two locations as a way to capture the availability of air services.

To conduct our empirical investigation, we combine different sources of airline and trade variables. We collected data on non-stop flights and exports of the Italian regions to the main European countries observed half-yearly during the period 1998-2010, for a total of 12,000 observations.

The econometric analysis employs instrumental variable, panel data fixed-effect techniques to deal with potential endogeneity. Our findings confirm a positive effect of non-stop flights on exports. Interestingly, a differentiated impact of FSCs and LCCs emerges; namely the supply of direct air connection provided by FSCs has a positive and significant impact on exports, whilst no significant evidence is found for LCCs.<sup>4</sup>

The rest of the paper is organized as follows. Next, Section 2 reviews the literature, then Section 3 presents a theoretical model of accessibility. The data are described in Section 4, subsequently the econometric model is illustrated in Section 5. Sections 6 and 7 are devoted to the discussion of the results, whilst Section 8 provides further evidence on non-stop flights and per route frequencies. Finally, concluding remarks are presented in Section 9.

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<sup>4</sup>This result partially departs from Mason (2000, 2001), who finds that business people may also use LCCs, especially for short-haul journeys.

## 2 Literature review

The branch of literature closest to our work analyzes the role of air travel as a channel to favor international trade. Some contributions identify a positive effect. In particular, Frankel (1997) focuses on the exports of high-tech capital goods from the United States. He argues that international (i.e. air) travel can affect the success of exports, as it implies a more committed and accurate pre-sale activity by the firm in the foreign country.

Poole (2010) underlines the importance of business and social networks in generating trade. She investigates how face-to-face communication generated by traveling for business reasons can facilitate international trade between countries. Using information related to passengers traveling abroad from the US during the period 1993-2003, she finds that a higher share of business travelers in total passenger travel purposes has a positive impact on exports. Further, she points out that this effect is stronger in the case of high-skilled travelers (i.e. those people in professional and managerial occupations), and in the case of differentiated products.

A different conclusion is reached by Head and Ries (2010), who investigate whether regular trade missions conducted by Canadian officers generate new business deals. After controlling for country-pair fixed effects, they find that trade missions have small, negative, and mainly insignificant effects.

Another stream of literature investigates the demand for air travel generated by business activities. Cristea (2011), using US data at state level over



the period 1998-2003, finds that an increase in the volume of exports raises the demand for business class air travel. Moreover, her work highlights that export composition has a positive impact on air travel demand. Aguilera (2003) identifies that the need to coordinate the planning and production processes with international customers is one of the main explanations of firm location in the neighborhood of an airport. Bel and Fageda (2008) find that air connectivity is a relevant factor driving foreign firms' location choices. Similarly, Brueckner (2003) argues that frequent service to a variety of destinations favors the location of new firms in the US metropolitan areas. In addition, Strauss-Khan and Vives (2009) show that headquarters tend to be located in US metropolitan areas with adequate airport facilities, and Williams and Balaz (2009) provide some evidence in favor of a positive impact of LCCs on the flows of knowledge and investments.

Other works that do not directly analyze the link between air travel and export volumes underline the role of infrastructure in the development, internationalization, and innovation of a country. Ashauer (1989) and Morrison and Schwartz (1996) find that investment in infrastructure provides a significant return to manufacturers, and augments productivity growth. With respect to the airline industry, Rosenthal and Strange (2001), Brueckner (2003), Graham (2003), and Green (2007) reach the conclusion that a better airline accessibility of the site, measured by the supply of airline routes, increases firms' productivity and employment. Furthermore Ahn et al. (2001) and Bernard et al. (2011) show that improved access to airports contributes

to reduce the costs of small and medium-sized enterprises by facilitating a direct connection to the export market.

With our paper we complement the related literature on air service and trade in a number of ways. First, our measure of the ease with which trade partners can establish face-to-face meetings (i.e., non-stop flight frequency to a particular destination market) is novel, since previous trade literature uses information on the number of travelers between two locations as a way to capture the availability of air services. Second, as we estimate the effect of non-stop flights on exports we distinguish between FSCs and LCCs: we are unaware of this being done in current related studies. Third, our empirical results are based on a data sample covering a set of European countries not examined by previous literature; for that reason, it is interesting to see how the findings of our paper compare with similar studies done using U.S. data.

### **3 A simple model of accessibility**

We aim to establish the link between business traveling and air service. As people traveling for work are usually not so price elastic but rather more keen to minimize their journey time, our model does not consider air fares and focuses on accessibility or, more specifically, on the temporal component evaluated by passengers when they decide to purchase the ticket.<sup>5</sup>

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<sup>5</sup>Note also that in principle it could be argued that our model intrinsically comprises some monetary elements, as time can be considered a key component of the generalized cost of travel (Recker et al 2001).

Consider a potential passenger  $p$ , willing to visit a place by plane, i.e. flying on route  $r$ . The potential traveler has an ideal round-trip plan, which is summarized by a preferred time for the outward flight  $\tau_o$  and for the inward flight  $\tau_i$ . The preferred plan  $(\tau_o, \tau_i)$  is represented by two points on two circumferences of unitary length, the first for the outward and the second for the inward flight, each recalling the 24-hour face of a pilot watch (Salop, 1979). Preferred plan  $(\tau_o, \tau_i)$  is randomly drawn from a bi-dimensional uniform distribution on the support  $[0, 1] \times [0, 1]$ . Moreover, the passenger has a time window of span  $\delta_p \in [0, \frac{1}{2}]$ , symmetrically positioned around the preferred time for outward and inward voyages. If the passenger finds an outward flight in the window  $(\tau_o - \delta_p, \tau_o + \delta_p)$  and an inward flight in the window  $(\tau_i - \delta_p, \tau_i + \delta_p)$ , he will choose to fly, otherwise, he will not.

A carrier  $c$  offers flight services on the route. There are  $n_c$  outward flights and  $n_c$  inward flights equidistantly positioned on the two circumferences.

The probability that a passenger  $p$  will find a flight  $f$  for a given  $\delta_p$  and  $n_c$  is:

$$\Lambda(\delta_p, n_c) = \min\{1, \delta_p n_c\}, \quad (1)$$

and for the round-trip flight is:

$$\Lambda_R(\delta_p, n_c) = \min\{1, (\delta_p n_c)^2\} \quad (2)$$

Therefore, the probability of satisfying a passenger request, until probability reaches the 100 per cent level, increases at a quadratic pace with  $n_c$

(and  $\delta_p$ ). This means that carrier's frequency choice may strongly affect the probability of traveling of different passenger categories.

To clarify this point, assume that passengers can be leisure or business travelers, i.e.  $p = l, b$ ; and that carriers can be low-cost and full service, i.e.  $c = F, L$ . Usually, business travelers have a shorter time windows than leisure travelers, i.e.  $\delta_b < \delta_l$ . If leisure travelers are the target of LCCs, and business travelers of FSC, we expect that  $n_L < n_B$ . Using (2), the probability that a businessman finds an acceptable schedule offered by a FSC (or LCC) is  $\Lambda_R(\delta_b, n_F)$  (or  $\Lambda_R(\delta_b, n_L)$ ), and the ratio between the two probabilities is:  $(n_F/n_L)^2$ . In other words, if the frequencies offered by a FSC on a route are double than that of a LCC, the probability of being chosen is four times more. If the total number of flights that FSCs and LCCs offer on their network is the same, i.e.  $N_F = N_L = N$ , the LCCs will serve  $n_L/n_F$  times the number of routes served by FSCs, and the ratio between the passengers served by LCCs and FSCs is  $n_F/n_L$ . That is the proportion of the frequencies determines the likelihood of patronizing one type of carrier with respect to the other.

Moreover, consider a case, in which, in order to develop a commercial channel,  $v$  visits are required, and assume that the preferred plan of the first visit is independent from the others.<sup>6</sup> In this case, the ratio between the passenger served by LCCs and FSCs having the same total number of frequencies becomes  $(n_F/n_L)^v$ .

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<sup>6</sup>As noted by Aguilera (2003), businessmen are used to preform multiple visits to coordinate the production processes with international customers.

Similar line of reasoning applies to non-stop flights vs flights with stopover. Let  $\rho_0$  be the additional time spent on air due to a longer distance flight and an additional take-off and landing, and  $\rho_1$  be the connection time. Connection time depends on the minimal connection time at the airport  $\rho_m$  and the number of connections offered at the airport  $\tilde{n}_c$ .<sup>7</sup> The additional time due to a flight with a stopover is  $\rho = \rho_0 + \rho_1(\rho_m, \tilde{n}_c)$ . We assume that a carrier offers the same frequencies on the two connected routes, i.e.  $\tilde{n}_c = n_c$ , and that the departure time at the intermediate airport is set randomly. Under these circumstances, the connection time is uniformly distributed on the interval  $[\rho_m, \rho_m + \frac{1}{n_c}]$ .<sup>8</sup> Therefore, the additional time due to a flight with a stopover  $\rho$  is uniformly distributed on the interval  $[\rho_0 + \rho_m, \rho_0 + \rho_m + \frac{1}{n_c}]$  and the time window at the initial airport is therefore reduced to  $\delta_p - \rho$ . The probability that a passenger with a time window  $\delta_p$  will find a flight with a stopover is therefore:<sup>9</sup>

$$\Lambda^S(\delta_p, n_c) = \begin{cases} 0 & \text{if } \rho_0 + \rho_m > \delta_p \\ \min \left\{ 1, \frac{1}{2} (\delta_p - \rho_0 - \rho_m)^2 n_c^2 \right\} & \text{if } 0 \leq \rho_0 + \rho_m \leq \delta_p \end{cases} \quad (3)$$

<sup>7</sup>The minimum connection time is the time needed to reach the next gate after the arrival in the hub.

<sup>8</sup>For intercontinental flight, FSCs organize their flights using a wave system that allows them to offer good connections without a reasonable loss of time, while for continental flights the schedule is less precise since it is more influenced by slot availability. In case of a wave system, the connection time  $\rho_1$  is fixed. Let  $\rho = \rho_0 + \rho_1$ . Total additional time  $\rho$  enters previous formula by reducing the time window of a traveler, i.e.  $\bar{\delta}_p = \delta_p - \rho$ . Using (2), the ratio of passengers flying with a connected flight and that on a non-stop flight is therefore:  $(\bar{\delta}_p/\delta_p)^2$ .

<sup>9</sup>It stems from the integral:  $n_c \int_{\rho_m + \rho_1}^{\delta_p} ((\delta_p - x) n_c) dx + n_c \int_{\delta_p}^{\rho_m + \frac{1}{n_c} + \rho_1} (0 \cdot n_c) dx$ .

and for the round-trip flight is:

$$\Lambda_R^S(\delta_p, n_c) = \begin{cases} 0 & \text{if } \rho_0 + \rho_m > \delta_p \\ \min \left\{ 1, \frac{1}{4} (\delta_p - \rho_0 - \rho_m)^4 n_c^4 \right\} & \text{if } 0 \leq \rho_0 + \rho_m \leq \delta_p \end{cases} \quad (4)$$

For each route, if  $0 \leq \rho_0 + \rho_m \leq \delta_p \leq \frac{1}{n_c}$ , the ratio between the passenger served by a flight with one stop over and another without stops becomes  $\frac{1}{4} (\delta_p - \rho_0 - \rho_m)^4 (n_c/\delta_p)^2$ .

For example, assume that the circumference represents a time span of one week. Suppose that three flights per day or twenty-one frequencies,  $n = 21$ , are often considered reasonable for businessmen (see the analysis in Section 8). Thus, we can assume that most of them, say about ninety per cent,  $\Lambda = (\delta_p n_c)^2$ , can satisfy their plan, i.e. their time window is:  $\delta_b = n^{-1} \sqrt{\Lambda} = \frac{1}{70} \sqrt{10} \simeq 0.045$ .

Now, if a FSC offers fourteen frequencies per week,  $n_F = 14$ , and a LCC only six per week,  $n_L = 6$  (see: Table 1), the probability that a businessman can satisfy its needs with a FSC is  $(\delta_b n_F)^2 = (\frac{1}{5} \sqrt{10})^2 = 0.4$  and with a LCC is  $(\delta_b n_L)^2 = (\frac{3}{35} \sqrt{10})^2 \simeq 0.073$ . Considering the same number of flights, the ratio between the passengers served by LCCs and FSCs is  $n_L/n_F = 3/7 \simeq 0.428$  if one visit is required; and  $(n_F/n_L)^2 = (6/14)^2 \simeq 0.183$  if two visits are required. Therefore, we expect LCCs to have a weaker impact than FSC for the same offer.

As far as the difference between non-stop flights and flights with a stopover are concerned, consider for instance  $\rho_0 + \rho_m = 1/56$  (about three additional

hours). The ratio between a business passenger choosing a flight with a stopover and a non-stop flight when there is an identical number of frequencies on each route is:  $\frac{1}{4}(\delta_p - \rho_0 - \rho_m)^4 (n_F/\delta_p)^2 = \frac{1}{4} \left(\frac{1}{70}\sqrt{10} - \frac{1}{56}\right)^4 (98\sqrt{10})^2 \simeq 0.0134$  if one visit is required, and 0.0002 if two visits are required. Therefore, we expect that flights with stopover have a weaker impact than non-stop flights.

## 4 The data

The data set used in this work combines three main statistical sources: the Official Airline Guide (OAG), the Italian National Institute of Statistics (Istat), and the European Institute of Statistics (Eurostat).

The OAG provides the bi-directional weekly frequency of non-stop flights by carriers operating on each route, thus making it possible to distinguish the flights supplied by FSCs from those supplied by LCCs. We define an airline as *low-cost* if it is a member of the European Low Fares Airline Association, and as *full-service* otherwise.<sup>10</sup> The OAG provides the statistics of flight frequency on a half-yearly basis in accordance with the winter schedule (November-March) and the summer schedule (April-October). We cover 24 European countries of export destination.<sup>11</sup>

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<sup>10</sup>The LCCs of our sample are Blue Air, EasyJet, Flybe, Jet2, Norwegian Air Shuttle, Ryanair, Sverigeflyg, Transavia.com, Vueling and Wizz Air. FSCs are those airlines not classified as LCCs; they comprise European national carriers (e.g. Alitalia, Lufthansa, British Airways) and regional carriers (e.g. Meridiana, Air Dolomiti, Brit Air, CityJet). Note that OAG data do not include charter airlines.

<sup>11</sup>These countries are: Albania, Austria, Belgium, Bulgaria, Czech Republic, Denmark,

The exclusion of non-European destinations is motivated by two main reasons. First, in relative terms, the overall journey time of an intercontinental non-stop flight is not much shorter than it is with stop-over(s). Therefore, the additional contribution to exports given by the presence of non-stop intercontinental flights is difficult to detect (see: Section 3). Second, European flights are spread over the entire Italian territory, while intercontinental flights gravitate around the two regions which host the intercontinental airports of Rome-Fiumicino in Lazio and Milan-Malpensa in Lombardy (see: Appendix). Clearly, this feature only allows a relationship to be identified between intercontinental trade and intercontinental flights for two regions, and hence it would not fit well with our panel data structure comprising 20 regions.

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Finland, France, Germany, Greece, Hungary, Ireland, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



...	Year 2004				Year 2005				...
...	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	...
Winter 2003		Summer 2004		Winter 2004		Summer 2005		Winter 2005	

Figure 1 : Winter and Summer semester spells

Trade data originate from Istat. For each Italian region the real value of its exports by country of destination is collected on a quarterly basis. The quarterly feature of these data allows a close relationship with the time framework of the OAG data, when we aggregate quarterly values to half-yearly ones. More precisely, the last quarter (Q4) of one year and the first quarter (Q1) of the following year of the Istat data are matched with the same winter semester of the OAG data, whilst the second and third quarters (Q2 and Q3) of the Istat data are associated with the summer semester of the OAG data (see Figure 1).

From Eurostat, we collect quarterly data on the national GDP of Euro-

pean trading countries and on bilateral real exchange rates, which are aggregated to achieve the same time structure as the airline data.<sup>12</sup>

The series on the GDP of the Italian regions are provided by Associazione per lo sviluppo dell'industria nel Mezzogiorno (Svimez) on a yearly basis, and converted to the half-year framework.<sup>13</sup> More precisely, the regional GDP of each region has been evenly split among the four quarters and then aggregated in a similar fashion to the previous variables. A similar procedure was established for data on foreign residents provided by Istat on yearly basis. Daily prices on Brent Oil are collected from Datastream, and then aggregated. From Googlemaps we retrieve the region-trading country distance defined as the shortest travel path by car between the capitals of each pair.

All the economic variables are in constant prices with the reference year set in 2005, which represents the middle of the sample period.<sup>14</sup>

By combining all the information from the above data sources, we obtain a balanced panel which comprises 20 Italian regions and 24 European countries observed half-yearly during the period 1998-2010, with a total of 12,000 observations. Table 1 reports the main descriptive statistics of the variables

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<sup>12</sup>For a couple of countries (Turkey and Albania) time series stored in the Eurostat database do not cover the whole period of analysis. Missing information is collected from the Datastream database to complete the series.

<sup>13</sup>Similar results are obtained using official data from Istat, but we rely on Svimez source because of the unavailability of data on regional GDP from Istat for the last year of the sample period.

<sup>14</sup>Exports and Oil prices have been deflated using the Italian import-export deflator provided by Istat. Country and regional GDP series have been directly retrieved in constant prices.

Table 1: Descriptive statistics.

Variable	Mean	St. Dev.	Min	Max
Exports (mil. €)	96.2	253.7	0.0	3476.4
Country GDP (mil. €)	106321.2	141677.1	0.416	579501.1
Region GDP (mil. €)	61231.8	58800.1	3184.0	268570.7
Real exchange rate	118.9	54.8	72.7	413.5
Foreign residents ('000)	954.6	4512.0	0.0	98205.0
Oil price (€/barrel)	40.3	17.4	9.3	78.2
Distance (Km)	1666.2	634.1	205.0	3375.0
FSC frequency on <i>rc</i> (weekly)	18.0	62.6	0.0	1768.0
LCC frequency on <i>rc</i> (weekly)	2.1	13.3	0.0	394.0
FSC freq. for operated routes	14.45	10.96	1.0	69.0
LCC freq. for operated routes	6.23	4.91	1.0	37.0

included in the database.

As indicated in the table, LCCs tend to limit their weekly frequency in each route in order to spread their fleet capacity over a larger set of routes. For this reason several destinations are not served on a daily basis, but just three or four times a week. FSCs, on the contrary, offer a more frequent flight service on each route. Normally they do not only provide a daily flight, but they often schedule more than one departure within the day (typically one in the morning and one in the evening). These differences should make FSCs more likely to meet the needs of business travelers, who value departure time and flight accessibility when they plan their business trip.

## 5 Empirical model

The empirical strategy used to study the impact of direct flights on exports draws upon the literature on trade, and hinges on an export equation that links exports to the GDPs of the areas of origin and destination and to the exchange rate (Poza, 1992; Obstfeld and Rogoff, 1996; Sauer and Bohara, 2001; Rose, 2000; Klaassen, 2004).

We augment the original model by adding foreign residents, travel costs, flight frequencies, origin-destination fixed effects, and time fixed effects. The baseline equation takes the following form:

$$\begin{aligned}
 \log(Exp_{rct}) = & \alpha_1 \log(Cntry\ GDP_{ct}) + \alpha_2 \log(Reg\ GDP_{rt}) + & (5) \\
 & + \alpha_3 \log(Exch\ rate_{ct}) + \alpha_4 \log(Foreign_{rct}) + \\
 & + \alpha_5 Dist_{rc} * \log(Oil\ price_t) + \alpha_6 \log(FSC\ freq_{rct}) + \\
 & + \alpha_7 \log(LCC\ freq_{rct}) + \rho_{rc} + \tau_t + \varepsilon_{rct},
 \end{aligned}$$

where:

- $\log(Exp_{rct})$  denotes the natural logarithm of exports from region  $r$  to country  $c$ , in semester  $t$  of a given year.
- $\log(Cntry\ GDP_{ct})$  is the GDP of the country of export destination, in logarithms. The higher the GDP of the foreign country, the larger the demand for *all* imported products, and therefore also for Italian goods, all else being equal.

- $\log(\text{Reg GDP}_{rt})$  is the natural logarithm of region  $r$ 's gross domestic product. This variable relates to the exporting capacity of  $r$ , as larger regions are expected to have larger exporting capacity.
- $\log(\text{Exch rate}_{ct})$  represents the natural logarithm of the real exchange rate between Italy and the trading partner. If foreign prices are higher relative to Italian prices, Italian goods become cheaper in the foreign country which, as a consequence, will import more from Italy, all else being equal.
- $\log(\text{Foreign}_{rct})$  is the natural logarithm of foreign residents in region  $r$  originating from country  $c$ . The presence of foreigners is expected to affect positively both the flows of exports and the demand for international air travel services (Rauch and Trindade, 2002).
- $\text{Dist}_{rc}$  is the distance in thousand kilometers between the capital of region  $r$  and the capital of country  $c$ , and  $\log(\text{Oil price}_t)$  is the logarithm of oil price. The product of these two variables takes into account the effect of transportation costs, as fluctuations in oil prices over the sample period affect both air travel and export volumes differentially over short versus long distances.
- $\log(\text{FSC freq}_{rct})$  and  $\log(\text{LCC freq}_{rct})$  are, respectively, the natural logarithm of FSC and LCC bi-directional non-stop flight frequencies between region  $r$  and country  $c$ . As previously argued, non-stop flights

help to establish contacts with foreign markets and therefore are expected to boost exports. The sign and the magnitude of  $\alpha_6$  and  $\alpha_7$  are useful to investigate which carrier type is more relevant as an export driver. We expect FSCs to be preferred by business travelers to a greater extent, and thus to play a more influential role in spurring exports compared with LCCs ( $\alpha_6 > \alpha_7 \geq 0$ ).

- The parameter  $\rho_{rc}$  is the region-country fixed effects. It comprises all the time-invariant components that are region- and/or country-specific, such as the distance between the Italian region and the importing country, a common language or common border, landlocked or coastal status, etc.
- The parameter  $\tau_t$  is the half-yearly period fixed effects.
- Finally,  $\varepsilon_{rct}$  is the error term of the regression, assumed random with zero mean.

Before presenting the results there are some critical points that need to be considered. First, equation (5) describes a log-log specification, which has the desirable property that the estimated coefficients can be roughly interpreted as an approximation of elasticities. This transformation relies on the assumption that variables are strictly positive. However, exports and flight frequencies can assume zero value if, for a specific origin-destination in a given semester, no trade flow or flight offer are observed. As explained in

Santos Silva and Tenreiro (2006), the use of logarithms can produce inconsistent estimates, especially when the frequency of zeros on the dependent variable is relatively high. In our analysis such concern is negligible since exports are null in only 12 out of 12,000 observations.<sup>15</sup>

As far as FSC and LCC frequencies are concerned, zero values appear more often, involving about two-thirds of the sample, so that a simple deletion of the null observations is not recommended. We tackle this issue by using a monotonic transformation, which adds 1 to these variables before taking the logarithm. Thus, the estimated coefficients should be interpreted more cautiously, since they only *approximately* represent elasticities.<sup>16</sup>

Second, as broadly pointed out in many related works, there is a severe risk of endogeneity bias. That is, even if controlling for unknown heterogeneity with fixed effect component, the flight frequency measures,  $\log(FSC\ freq)$  and  $\log(LCC\ freq)$ , could still be correlated with the error term of the regression. After presenting the baseline results in Section 6,

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<sup>15</sup>Our results are robust to different specifications and, above all, to the exclusion of those 12 observations.

<sup>16</sup>As a robustness check, we have considered different shifting parameters, e.g. 0.1, 0.01, 0.001. In all the cases, the magnitude of the estimated coefficients and their standard errors have not been affected significantly, so that we rely on the initial transformation. This choice is also motivated by the following argument. The log-log specification implies that regressors enter multiplicative in the underlying equation, and their coefficients are the exponents.

By adding 1 to the initial flight variable, we set the air connection with stop-over(s) to be the reference case, and we measure the ‘boosting’ effect of non-stop flights on export flow by their multiplicative impact. First, when the shifted variable equals 1 (the air connection with stop-overs), exports are not affected by the flight variables. Second, when the shifted variable equals 2 or more (i.e. there are non-stop connections), we capture the multiplicative (boosting) effect generated by non-stop flights on exports.

we will use an instrumental variable approach to account for heterogeneity. Finally, the Dickey-Fuller Test for unit root in panel data is conducted using the methodology suggested by Levin et al. (2002). The null hypothesis that the dependent variable is not stationary is rejected at a high level of significance.

## 6 Baseline results

The Generalized Least Squares (GLS) fixed-effect estimates of equation (5) in the base version are reported in Table 2. We cluster standard errors by four European macro-areas<sup>17</sup> and twelve years, for total of 48, which is above of 42 clusters, recommended by Angrist and Pischke (2009). This two-way clustering strategy accounts for the fact that neighboring or nearby countries have more similar business cycles than farther ones, and, hence, that they could possibly share a parallel trade pattern (Cameron et al. 2011).

Column (1) represents a basic gravity estimation, which is augmented with the number of foreign residents in each region,  $\log(\textit{Foreign})$  and with transportation cost barriers,  $\textit{Dist} * \log(\textit{Oil price})$ , in column (2). The coefficient on the GDP of the country of export destination,  $\log(\textit{Cntry GDP})$ , is statistically significant and positively signed, in line with the prediction

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<sup>17</sup>We adopt the categorization used by the United Nation, which defines the European macro-areas as follows. North-Europe: Finland, Ireland, Norway Sweden and United Kingdom; West-Europe: Austria, Belgium, France, Germany, Luxembourg, Netherlands and Switzerland; East-Europe: Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia; South-Europe: Albania, Greece, Portugal, Spain and Turkey.



Table 2: Baseline results.

Regressand log(Export)	(1)	(2)	(3)	(4)	(5)
log(Country GDP)	1.031*** (0.151)	0.895*** (0.152)	0.885*** (0.150)	0.886*** (0.153)	0.876*** (0.150)
log(Region GDP)	0.361 (0.255)	0.175 (0.237)	0.147 (0.235)	0.232 (0.245)	0.205 (0.242)
log(Exchange rate)	0.508*** (0.085)	0.389*** (0.068)	0.385*** (0.068)	0.386*** (0.068)	0.382*** (0.068)
log(Foreign residents)		0.026*** (0.007)	0.025*** (0.007)	0.026*** (0.007)	0.025*** (0.007)
Distance*log(Oil price)		-0.102*** (0.019)	-0.104*** (0.019)	-0.102*** (0.019)	-0.104*** (0.020)
log(FSC frequency)			0.019*** (0.005)		0.020*** (0.005)
log(LCC frequency)				-0.008 (0.006)	-0.008 (0.006)
R <sup>2</sup>	0.185	0.195	0.196	0.195	0.196
Observations	12,000	12,000	12,000	12,000	12,000

(a) Robust standard errors to heteroscedasticity and serial correlation in parenthesis, clustered by Year and European macro area of export destination.

(b) Statistically significance at the 1%, 5% and 10% level, respectively, denoted by \*\*\*, \*\* and \*.

(c) The regressions include country-region and time (i.e. season) fixed effects.

of the gravity model. A rise in trading partner's GDP positively affects the internal demand of the country and consequently also the demand for Italian goods, all else being equal.

Column (1) shows that this effect is almost proportional. In all the remaining columns of the table, when controls are added, the estimated coefficient ranges from 0.87 to 0.89; these numbers are similar to the findings

in the empirical trade literature. For example, in Frankel and Rose (2002), Rose and Engel (2002), the estimated coefficients ranges from 0.74 to 0.95.

The GDP of the Italian region,  $\log(\text{Reg GDP})$ , is found to be positive, albeit not statistically significant at conventional levels. One possible explanation for this result is that, once we control for region-country fixed effects, the average rate of GDP growth for region  $r$  is well captured by time fixed effects.<sup>18</sup>

The estimated coefficient on the real exchange rate, which proxies the relative price competitiveness of Italian regions, lies in the range 0.38-0.51, and is in line with the figures presented in previous works (e.g. Carlin et al., 2001; Chinn, 2006).

Foreign residents at regional levels have the expected positive effects on exports, as a larger presence in region  $r$  of foreign residents originating from country  $c$  may increase the exports from  $r$  to  $c$ .<sup>19</sup>

The transport cost component, given by the product of distance with the logarithm of oil price, is correctly negatively signed and highly statistically significant. The higher the transport costs, the lower the export flows.

When we include in the model the flight frequency variables, columns (3)-(5), the magnitude and significance of the remaining regressors are not considerably affected. First  $\log(\text{FSC freq})$  and  $\log(\text{LCC freq})$  are included

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<sup>18</sup>Indeed the correlation of regional GDP between regions is found to be quite high in our sample.

<sup>19</sup>Intuitively, foreign residents of country  $c$  can use their domestic networks to export region  $r$ 's goods to  $c$ .

separately, and then jointly. In all the cases, the coefficient on FSC frequency is positive and statistically significant, whilst the coefficient on LCC frequency is of small magnitude and statistically insignificant. Although we have not controlled for endogeneity yet, this result provides preliminary evidence of the main finding in the present work: namely, that the presence of FSCs has a positive effect on exports, while the presence of LCCs does not seem to play a relevant role.

## 7 Instrumental variable estimation

As the estimates of Table 2 could suffer from endogeneity bias, we instrument for both  $\log(FSC\ freq)$  and  $\log(LCC\ freq)$ . We rest on the use of different instruments and presents the results of various combinations. A first set of instruments stems from the persistency of air service in the region-country pair: it includes past semester values of FSCs and LCCs frequencies,  $\log(FSC\ freq_{t-1})$  and  $\log(LCC\ freq_{t-1})$  and two dummy variables, also lagged by one semester, equal to one in case of the presence of FSCs ( $FSC_{t-1}$ ) or LCCs ( $LCC_{t-1}$ ) on the region-country pair. These instruments are deemed valid as they measure the importance/presence of FSC and/or LCC (i.e. they are correlated with endogenous variables), and, at the same time, their lagged values guarantee that the instruments are uncorrelated with the error term. The first four columns of Table 3 reports the two-stage estimates when we use as instruments  $\log(FSC\ freq_{t-1})$  and  $\log(LCC\ freq_{t-1})$  in the first

column,  $FSC_{t-1}$  and  $LCC_{t-1}$  in the second column,  $FSC_{t-1}$  and  $\log(LCC\ freq)_{t-1}$  in the third column,  $\log(FSC\ freq)_{t-1}$  and  $LCC_{t-1}$  in the fourth column.

Afterwards, grounded on the negligible impact of LCCs on exports found in this analysis, we focus our attention on FSCs and discard LCCs from the regression. We develop a specific instrument for  $\log(FSC\ freq)$  built on the importance of FSCs belonging to an airline alliance, which notably represents a key aspect in the business strategy of FSCs (Gaggero and Bartolini, 2012). In each region-country pair the instrument is constructed taking the ratio of the flight frequencies of the FSCs belonging to an airline alliance over the total FSCs flight offer; for similar line of reasoning applied to the previous instruments, we use past semester values ( $Alliance\ share_{t-1}$ ). The validity of this instrument rests on the idea that alliance members take partners' schedule into account when they set their time table and thus airline alliances represent a key driver of the flight supply decision. More specifically, the existence of an alliance weakens the competitive pressure and spurs carriers to expand their flight offer. A further expansion of flight supply may arise since the quality of air service increases with the size of the alliance, i.e., higher number shared frequencies within the alliance available to travelers. The two-stage estimate with  $Alliance\ share_{t-1}$  as instrument is reported in column (5).

Finally, we include an additional instrument for  $\log(FSC\ freq)$  based on

the negative relationship between the LCCs and FSCs.<sup>20</sup> To construct the instrument we rely on a quasi-market share for LCCs (*LCC share*) given by the ratio of the total frequencies in  $rc$  provided by LCCs over the total number of flights offered by all types of carriers from region  $r$ , excluding FSC and LCC frequencies on  $rc$  from the denominator.<sup>21</sup> Note that because *LCC share* does not comprise the FSC flight frequencies on  $rc$ , it is purged from any correlation with the error term and thus any variable based *LCC share* on should stand for instrument. The instrument employed in the analysis, *LCC share dummy* $_{t-1}$ , is a dummy variable equal one if the lagged value of *LCC share* is above 5 percent, i.e., if the presence of LCCs in  $rc$  is deemed relevant.<sup>22</sup> The results stemming from employing *Alliance share* $_{t-1}$  and *LCC share dummy* $_{t-1}$  are reported in column (6).

To investigate for the presence of endogeneity we apply the Hausman (1978) test between the OLS (column (5), Table 2) and IV estimates (column (1), Table 3). The test produces a  $\chi^2$  value equal to 31.86, which is statistically significant at a critical value below 1 percent. We, hence, do not

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<sup>20</sup>This statement is intuitive from a competition point of view (the higher the market share of LCCs, the lower the importance of FSCs) and also observable in this sample (first-stage estimates of  $\log(\text{FSC freq})$ , columns (2) and (4) of Table 4).

<sup>21</sup>In formula:

$$(\text{LCC share})_{rc} = \frac{(\text{LCC freq})_{rc}}{\sum_{i \in H} (\text{FSC freq})_{ri} + (\text{LCC freq})_{ri}},$$

with  $r$  being the observed region and  $c$  the observed country;  $n$  representing the total number countries in the sample; and  $H = \{1, \dots, c-1, c+1, \dots, n\}$ . Note that because *LCC share* does not comprise the total (i.e., FSC plus LCC) flight frequency on  $rc$  it can be considered a *quasi*-share.

<sup>22</sup>As robustness checks we have tried different thresholds. The results, not reported but available upon request, are quite stable within the interval 3-7 percent.

accept the null hypothesis of exogeneity.

To check for the weak instruments problem, in Table 3 we report the  $F$ -statistic of the Cragg and Donald (1993) test. This test has been suggested by Stock and Yogo (2005) as a test for the presence of weak instruments (i.e. the equation is only weakly identified). In all the cases, the values of the  $F$ -statistic are significant at conventional levels and are greater than the threshold of ten, proposed by Staiger and Stock (1997) as the rule-of-thumb to consider weak identification as a real concern. Thus, we can confidently reject the null hypothesis that instruments are weak. Finally, to examine instruments' relevance, Tables 4 and 5 report the first-stage estimates of respectively  $\log(FSC\ freq)$  and  $\log(LCC\ freq)$  together with the  $F$ -test for joint significance of excluded instruments. The diagnostic, statistically significant, presents further evidence in favor of instruments' relevance in all columns.

A closer look at the first-stage estimates reveals that in practically all cases the sign of the instruments is in line with the expectations. As far as FSC frequency is concerned, there is a positive effect on  $\log(FSC\ freq)$  by those variables capturing the presence of FSCs (i.e.,  $\log(FSC\ freq)_{t-1}$  and  $FSC_{t-1}$ ) or the presence of airline alliances ( $Alliance\ share_{t-1}$ ), whilst a negative effect is found on those variables measuring the influence of LCCs (i.e.,  $\log(LCC\ freq)_{t-1}$ ,  $LCC_{t-1}$  and  $LCC\ share\ dummy_{t-1}$ ). Symmetrically, for the first stage estimates on  $\log(LCC\ freq)$ , we observe a negative and statistically significant coefficient on LCC variables, whilst a negative

effect is found for FSC and alliance variables.

Foreign residents have a positive effect on flight frequency (significant for FSCs and insignificant for LCC), as migrants have a clear influence on international travel demand. As expected, the Real exchange rate variable does not significantly contribute to explain carrier behavior because of the bi-directional nature of flight flows.

Table 3: Instrumental variable approach.

Regressand log(Export)	(1)	(2)	(3)	(4)	(5)	(6)
log(FSC freq.)	0.037*** (0.008)	0.056*** (0.010)	0.056*** (0.010)	0.037*** (0.008)	0.035* (0.018)	0.044*** (0.015)
log(LCC freq.)	-0.005 (0.009)	-0.008 (0.010)	-0.005 (0.009)	-0.008 (0.010)		
log(Country GDP)	0.918*** (0.291)	0.906*** (0.286)	0.910*** (0.287)	0.915*** (0.290)	0.926*** (0.286)	0.922*** (0.283)
log(Region GDP)	0.043 (0.392)	0.037 (0.366)	0.014 (0.380)	0.063 (0.377)	0.006 (0.378)	-0.006 (0.371)
log(Exchange rate)	0.377*** (0.116)	0.371*** (0.115)	0.372*** (0.115)	0.376*** (0.117)	0.379*** (0.115)	0.377*** (0.115)
log(Foreign residents)	0.018** (0.007)	0.017** (0.007)	0.017** (0.007)	0.018** (0.007)	0.018** (0.007)	0.017** (0.007)
Distance* log(Oil price)	-0.115*** (0.039)	-0.118*** (0.040)	-0.118*** (0.040)	-0.115*** (0.039)	-0.115*** (0.040)	-0.116*** (0.040)
Hansen $\chi^2$						1.593
Hansen pvalue						0.21
Cragg-Donald Wald $F$ stat	1450.69***	675.47***	674.29***	1452.19***	260.06***	138.89***
$R^2$	.0843	.0810	.0810	.0843	.0844	.0832
Observations	11,520	11,520	11,520	11,520	11,520	11,520

(a) Robust standard errors to heteroscedasticity and serial correlation in parenthesis, clustered by Year and European macro area of export destination.

(b) Statistically significance at 1%, at 5% and at 10%, respectively denoted by \*\*\*, \*\* and \*.

(c) The regressions include country-region and time (i.e., season) fixed effects.

(d) Instruments for log(FSC frequency) and log(LCC frequency): log( $FSC\ freq$ ) $_{t-1}$  and log( $LCC\ freq$ ) $_{t-1}$  in (1);  $FSC$  $_{t-1}$  and  $LCC$  $_{t-1}$  in (2);  $FSC$  $_{t-1}$  and log( $LCC\ freq$ ) $_{t-1}$  in (3); log( $FSC\ freq$ ) $_{t-1}$  and  $LCC$  $_{t-1}$  in (4);  $Alliance\ share$  $_{t-1}$  in (5);  $Alliance\ share$  $_{t-1}$  and  $LCC\ share\ dummy$  $_{t-1}$  in (6).



Table 4: First stage estimates of log(FSC frequency) in Table 3.

Regressand log(FSC freq.)	(1)	(2)	(3)	(4)	(5)	(6)
log(Country GDP)	0.129 (0.292)	0.222 (0.305)	0.210 (0.301)	0.135 (0.296)	0.516 (0.466)	0.513 (0.454)
log(Region GDP)	0.738 (0.706)	1.468 (1.286)	1.595 (1.273)	0.636 (0.723)	1.053 (1.471)	1.359 (1.518)
log(Exchange rate)	0.167 (0.108)	0.257 (0.135)	0.247 (0.138)	0.177 (0.106)	0.332 (0.187)	0.327 (0.179)
log(Foreign residents)	0.040** (0.011)	0.052** (0.012)	0.052** (0.012)	0.040** (0.011)	0.066** (0.014)	0.066** (0.013)
Distance* log(Oil price)	0.093 (0.063)	0.138 (0.081)	0.137 (0.082)	0.094 (0.063)	0.167 (0.102)	0.170 (0.103)
log(FSC freq.) <sub>t-1</sub>	0.457** (0.086)			0.457** (0.086)		
log(LCC freq.) <sub>t-1</sub>	-0.041* (0.016)		-0.037 (0.023)			
FSC <sub>t-1</sub>		0.815** (0.236)	0.815** (0.235)			
LCC <sub>t-1</sub>		-0.061 (0.066)		-0.088 (0.048)		
Alliance share <sub>t-1</sub>					0.586** (0.119)	0.581** (0.118)
LCC share dummy <sub>t-1</sub>						-0.161* (0.051)
F test of excluded instruments	15.06**	6.04*	6.95*	14.22**	24.11**	12.10**
R <sup>2</sup>	0.234	0.136	0.137	0.233	0.052	0.053
Observations	11,520	11,520	11,520	11,520	11,520	11,520

(a) Robust standard errors to heteroscedasticity and serial correlation in parenthesis, clustered by Year and European macro area of export destination.

(b) Statistically significance at 1%, at 5% and at 10%, respectively denoted by \*\*\*, \*\* and \*.

(c) The regressions include country-region and time (i.e., season) fixed effects.

Table 5: First stage estimates of log(LCC frequency) in Table 3.

Regressand log(LCC freq.)	(1)	(2)	(3)	(4)
log(Country GDP)	-0.554* (0.234)	-0.571 (0.333)	-0.553 (0.240)	-0.568 (0.328)
log(Region GDP)	2.339** (0.518)	3.584** (0.731)	2.320** (0.503)	3.628** (0.727)
log(Exchange rate)	-0.023 (0.177)	-0.177 (0.211)	-0.024 (0.179)	-0.173 (0.209)
log(Foreign residents)	0.014 (0.008)	0.015 (0.008)	0.014 (0.007)	0.015 (0.009)
Distance* log(Oil price)	-0.022 (0.031)	-0.044 (0.050)	-0.023 (0.032)	-0.042 (0.049)
log(FSC freq.) <sub>t-1</sub>	-0.010 (0.018)			-0.023 (0.020)
log(LCC freq.) <sub>t-1</sub>	0.761*** (0.059)		0.761*** (0.059)	
FSC <sub>t-1</sub>		-0.046 (0.031)	-0.025 (0.027)	
LCC <sub>t-1</sub>		1.935*** (0.162)		1.936*** (0.161)
F test of excluded instruments	170.07***	84.94**	167.17***	109.70***
R <sup>2</sup>	0.564	0.461	0.564	0.461
Observations	11,520	11,520	11,520	11,520

(a) Robust standard errors to heteroscedasticity and serial correlation in parenthesis, clustered by Year and European macro area of export destination.

(b) Statistically significance at 1%, at 5% and at 10%, respectively denoted by \*\*\*, \*\* and \*.

(c) The regressions include country-region and time (i.e., season) fixed effects.

As far as the two-stage estimates are concerned, no major differences appear on the gravity regressors with respect to Table 2. Shifting the discussion to the variables of interest, we observe that the coefficient on log(*FSC freq*)

is positive and statistically significant across all the specifications, whilst  $\log(LCC\ freq)$  remains statistically insignificant from zero. This result confirms the main message of the paper, namely that FSCs have a positive effect on exports, while no significant influence is found for LCCs. This finding is consistent with the argument anticipated in the introduction and in the theoretical model of Section 3. The estimated coefficient on  $\log(FSC\ freq)$  reported in Table 3 ranges from 0.035 to 0.056 and is larger than in the baseline, non-instrumented estimate of Table 2.

These numbers contrast with the possible expectation of an upward bias in the estimated elasticity, however there exist also reasons pointing towards a downward bias.<sup>23</sup> If on one hand changes in business opportunities, for instance BMW builds a new plant in Campania, will increase both the number of non-stop flights and the volumes of exports from Campania to Munich (upward bias), on the other hand, by symmetry, the construction of a hypothetical Barilla factory in Spain will imply a greater number of flights and a potential reduction of exports to Spain caused by larger production abroad (downward bias). Furthermore, there is other argument in favor of a downward bias in the GLS estimates. Assume, for instance, that Pirelli opens a sale office in France. This event is likely to produce an increase in sales of

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<sup>23</sup>Consider the following equation:  $Exp = \alpha \cdot freq + \dots + \varepsilon$ , with  $\varepsilon = (u + \theta)$ , where  $u$  is random and  $\theta$  represents an external factor. If both the error term  $\varepsilon$  and the flight frequency  $freq$  are correlated by  $\theta$ , then  $Cov(freq, \theta) \neq 0$ . The impact of flight frequencies on exports is  $d(Exp)/d(freq) = \alpha$ , whilst estimated with GLS becomes  $\hat{\alpha}_{GLS} = \alpha + Cov(freq, \theta) \neq \alpha$ . If  $\varepsilon$  and  $freq$  are positively correlated,  $Cov(freq, \theta) > 0$ , the GLS estimate is an upward biased, whilst a downward bias is observed in case of negative correlation,  $Cov(freq, \theta) < 0$ .

the Pirelli tires and simultaneously a reduction in the demand of flights to France, since the local staff substitutes the Pirelli managers' trip from Italy.

## 8 Complementary evidence

Sections 5 and 6 show that presence of non-stop flights and, in particular, of those supplied by FSC has a positive impact on exports. This section provides additional empirical evidence on the role played by non-stop flights with different frequency on the route. In order to conduct this analysis, we measure the presence/absence of a non-stop flight, as well as the number of non-stop frequencies offered in each route. First we make no distinction between FSCs and LCCs, then we investigate the differential effect of FSCs and LCCs.

The presence/absence of non-stop flights is identified with dummy variables, namely *ALL* if there is one carrier (irrespective from the type) providing at least one non-stop route on *rc*; whilst, if the distinction between FSCs and LCCs is made, *FSC* (*LCC*) to indicate the existence of a non-stop FSC (*LCC*) route on the region-country pair.

To gauge the different role played by flight frequencies, we assign each route frequency one category: *low* (1-13 frequencies in a week), *medium* (14-20 frequencies in a week) and *high* (21 frequencies or more per week);<sup>24</sup> then we follow the same procedure used to create  $\log(FSC\ freq)$  and  $\log(LCC$

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<sup>24</sup>This categorization rests on the idea that low frequency means at most one daily flight on the route, medium frequency at most two, and high frequency more than three.

*freq*) variables. As in the case of the aforementioned dummy variables, we both consider FSCs and LCCs jointly and separately. In this way we construct nine new variables of the form:  $\log([\textit{carrier}] [\textit{type}] \textit{freq})$ , where *carrier* = *ALL*, *FSC* or *LCC* indicates whether we are considering all carriers, FSCs only or LCCs only; *type* = *low*, *medium* or *high* categorizes the frequency on the route for the observed region-country pair.

The results are reported in Table 6. Contrary to the previous tables, here we do not control for endogeneity, therefore the coefficients are subject to the risk of bias. Previous analysis suggests that GLS estimates are downward biased.

Column (1) in Table 6 shows that the presence of at least one direct connection between *r* and *c* has a positively and statistically significant effect on exports from *r* to *c*. Furthermore, it emerges that the additional boost of non-stop flights to exports is only given if the frequency on the route is deemed high. Indeed, our definition of high frequencies, based on 21 flights or more per week, means that the air frequency on the observed route is at least of three flights per day. Such flight offer appears particularly suitable to business people, as it gives them multiple opportunities to conclude their trip within the same day. This finding may stem from the importance of air scheduling (i.e., departure time) to the eyes of a business traveler.

Column (2) shows that  $\log(\textit{ALL high freq})$  remains statistically significant when the low and medium frequency variables are removed. In columns (3) and (4) we focus on the differential effect of LCCs and FSCs. In line with

Table 6: Differential impact of non-stop flights with low, medium and high frequencies.

Regressand log(Export)	(1)	(2)	(3)	(4)
ALL	0.032** (0.016)	0.042*** (0.013)		
FSC			0.030** (0.012)	0.045*** (0.013)
LCC			-0.008 (0.031)	-0.024 (0.019)
log(ALL low freq)	0.007 (0.006)			
log(ALL med freq)	-0.000 (0.005)			
log(ALL high freq)	0.034* (0.019)	0.032** (0.016)		
log(FSC low freq)			0.010* (0.005)	
log(FSC med freq)			0.000 (0.004)	
log(FSC high freq)			0.035* (0.019)	0.033** (0.016)
log(LCC low freq)			-0.010 (0.010)	
log(LCC med freq)			0.007 (0.008)	
log(LCC high freq)			-0.003 (0.031)	-0.008 (0.032)
R <sup>2</sup>	0.196	0.196	0.196	0.196
Observations	12,000	12,000	12,000	12,000

(a) Robust standard errors to heteroscedasticity and serial correlation in parenthesis, clustered by Year and European macro area of export destination.

(b) Statistically significance at 1%, at 5% and at 10%, respectively denoted by \*\*\*, \*\* and \*.

(c) The regressions include log(Country GDP), log(Region GDP), log(Exch. rate), log(Foreign residents), Distance\*log(Oil price), country-region and time (i.e., season) fixed effects.

the mainstream results of this paper, no statistically effect is found on LCC variables, whilst the similar findings to columns (1) and (2) apply to FSCs.

To summarize, Table 6 contains two important results. First it suggests that business travelers strongly prefer non-stop flights to flights with stop-overs (which are the reference case). Second it shows that a direct connection between  $r$  and  $c$  can provide an additional boost to exports if the destination is served three times a day or more, preferably by a FSC rather than by a LCC. As argued in Section 4, LCCs normally offer low flight frequencies; however, even on those routes characterized by a repeated air service by LCCs, it is likely that the intrinsic features of LCC business model (flying to secondary airports, imposing strict baggage restrictions, providing limited seat space, etc.) make this type of carrier rather unsuitable to business traveling.

## 9 Conclusion

In the view of the role of face-to-face contacts in facilitating trade, this paper has studied empirically the effect of non-stop flights on exports. The underlying idea is that a non-stop flight connection to the country of export destination favors in-person visits, consolidates the relation with the existing trading partners, brings potential buyers and sellers closer together, augments their reciprocal trust, and, hence, increases the likelihood of trading. In other words, non-stop flights reduce the ‘distance’ between trading

partners and thereby constitute an important channel to boost exports.

We have tested this hypothesis for the Italian manufacturing sector using a panel of 480 pairs of Italian regions and the main European countries of export destination, sampled half-yearly during the period 1998-2010. We have matched the exports of each Italian region to each of the 24 European countries of the sample with the non-stop flight frequency, distinguishing between Full Service Carriers (FSCs) and Low-Cost Carriers (LCCs). Applying instrumental variable, panel data fixed-effect techniques, we found that the supply of non-stop flights provided by FSCs has a positive impact on exports, whilst no significant evidence is found in favor of LCC non-stop flights.

The present analysis provides some insights on the regional policies concerning air transport. In particular, it suggests that, in those regions where manufacturing represents a key driver of the local economy, a policy intervention aiming at favoring the entry of FSCs could be implemented with more emphases. Although state aid legislation may limit the policy intervention (i.e. it is not possible to discriminate among carriers types, for instance, by fixing different airport charges), airports designed to meet the specific needs of FSCs can be useful, for instance, to reach this objective. In countries, such as Italy, where regional governments control and manage most of airport infrastructure, this policy might be more easy to implement.

Regarding data availability, it would be interesting to separate exports by sub-sectors within the manufacturing industry, and then test whether non-stop flights have the same impact in every sub-sector, or whether there



are some sub-sectors which are more sensitive to the presence of non-stop flights. A deeper analysis could also be carried at product level (or for macro-categories of products) to test whether non-stop flights are more relevant in generating trade for differentiated goods than for homogeneous goods (Poole, 2010): we expect the former to be more dependent on communication than the latter (Rauch, 1999) and therefore more affected by the presence/absence of non-stop flights.

Finally, a similar approach to the present work to study the effect of non-stop flights on tourism flows would complete the picture. Symmetrically to the findings of this paper, LCCs are expected to be more relevant in boosting tourism than FSCs, as suggested by the recent literature (Williams and Balaz, 2009). If this expectation is confirmed, a national airport system could be designed to implement a regional development strategy, i.e. the specialization of some regions in manufacturing, and other regions in the tertiary sector (e.g. tourism).

The results of such lines of future research could give even more precise policy guidance on the topic that this work has just initiated.

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## **Appendix. The air transport system and the manufacturing sector in Italy**

The peculiarities of Italy in terms of its air transport system, manufacturing activities, geographical morphology, and peripheral location relative to the European barycenter make this country a valid case to investigate the effects of non-stop flights on exports, for the following reasons.

**1) Imperfect substitution with other means of transport:** the Italian peninsula is located in the Southern periphery of Europe. The Alps in the North and the surrounding Mediterranean Sea elsewhere create a barrier which may hamper the movement of people towards other countries. In Italy the high-speed train is only partially developed: it links a few of the main cities within the country, but is not well connected to the European network of high-speed trains. The highway infrastructure is more capillary, but access to neighboring countries is convenient only for those border areas located in the North.

**2) Airports spread around the country:** Italy comprises 20 administrative regions, and as Table 7 above shows, in 2010 there were 41 Italian airports carrying international operations. So, on average, the country has about two international airports per region. The distribution of airports is evenly spread throughout the country: eight airports are located in North-West part of Italy, nine in the North-East, eight in the Center, eight in the South and seven in the Isles.

Table 7: Italian airports ranked by Aircraft Movement (AM) in 2010.

Airport name	Macro area	AM (intl.)	% of total	Airport name	Macro area	AM (intl.)	% of total
Rome Fiumicino	C	192,942	24.90	Trieste	NE	5,190	0.67
Milan Malpensa	NW	153,939	19.86	Trapani	I	4,994	0.64
Venice	NE	51,662	6.67	Alghero	I	3,768	0.49
Bergamo	NW	47,957	6.19	Forlì	NE	3,698	0.48
Bologna	NE	45,705	5.90	Brindisi	S	2,504	0.32
Milan Linate	NW	33,087	4.27	Pescara	S	2,373	0.31
Rome Ciampino	C	32,995	4.26	Lamezia Terme	S	2,352	0.30
Pisa	C	26,128	3.37	Perugia	C	1,394	0.18
Turin	NW	21,009	2.71	Cuneo	NW	1,331	0.17
Naples	S	20,856	2.69	Parma	NE	1,131	0.15
Florence	C	20,341	2.62	Brescia	NW	1,039	0.13
Verona	NE	19,835	2.56	Reggio Calabria	S	745	0.10
Treviso	NE	14,342	1.85	Albenga	NW	590	0.08
Catania	I	11,736	1.51	Elba	C	334	0.04
Olbia	I	9,205	1.19	Siena	C	228	0.03
Bari	S	9,092	1.17	Foggia	S	213	0.03
Genoa	NW	7,208	0.93	Salerno	S	169	0.02
Cagliari	I	6,765	0.87	Taranto	S	120	0.02
Rimini	NE	6,087	0.79	Bolzano	NE	44	0.01
Palermo	I	5,914	0.76	Pantelleria	I	40	0.01
Ancona	C	5,888	0.76	Total		774,969	100.00

(a) Source Italian Civil Aviation Authority (ENAC).

(b) Only international traffic is considered.

(c) Macro-areas: North-West (NW), North-East (NE), Center (C), South (S), Isles (I).

The Italian airport system is characterized by: a lower average size of the major airports relative to other comparable European countries; a larger number of medium airports; and several small airports which do, however, offer international connections. These features lead to a quite homogeneous

distribution of flight offer.<sup>25</sup>

The proliferation of small and medium airports has been favored by local administrators who, seeking political consensus, have promoted the construction of new airports. Although, since the mid-1990s, some of the Italian airports have taken a step towards private ownership, most of them are still public.<sup>26</sup> The combined features of being diffused at the regional level and publicly owned mean that Italian airports can easily be influenced by regional policies.<sup>27</sup>

**3) Well-established manufacturing activities, scattered over the territory:** the secondary sector represents about 12 percent of the Gross Domestic Product (GDP); the most noteworthy manufactured products include machine tools, textiles and clothing, motorized road vehicles, domestic appliances, arms, fertilizers, and petrochemicals. Industry is mainly composed by

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<sup>25</sup>The statistics do not allow to separate intercontinental (i.e. non-European) flights to be separated from continental (i.e., European) flights; however, if the intercontinental traffic generated by the two main Italian airports of Rome-Fiumicino and Milan-Malpensa were not considered, the number of Italian airports with comparable continental market shares enlarges. Moreover, if those statistics were weighted by the different population size and economic strength of the Italian regions, an even more homogeneous distribution of flight offer among Italian airports would emerge.

<sup>26</sup>Currently, private investors are the major shareholders of the airport system in Rome (97 percent) and Naples (70 percent), while they are partial shareholders of the airports of Turin (49 percent) and Venice (33 percent). Contrary to its main opponent Rome, Milan's airport system is still publicly-owned.

<sup>27</sup>Recently, the national regulatory authority, ENAC has provided some objectives in terms of air transport system strategy to comply with the Single European Sky Performance Scheme Regulation (EC) No. 691/2010, which states that "The ENAC oversight philosophy is based on the principle of the minimum interference with the normal activity of Shareholders [...] ENAC is well aware that this is the first implementation of regulation 691/2010, and therefore the oversight policy and practices are to be considered as a 'first attempt', and could be changed during the period itself", ENAC (2011).

small and medium-sized enterprisers, which account for roughly 8 percent of GDP. Despite their modest size, many Italian firms are export-oriented, producing and commercializing their output worldwide, particularly in Europe. Additionally, a well-established feature of the Italian manufacturing sector is the presence of industrial districts, which are located mainly in the North, but also in the Center and the South of the country. Therefore, just as we note a scattered distribution of airports on the territory, we also observe a similar dispersion of economic activities and export flows, especially for the manufacturing sector.

The first point suggests that air transport most likely represents the preferred means of travel from Italy around Europe. The last two points indicate that the distribution of international airports and the distribution of exporting manufacturers are both evenly spread around the country, and therefore justify the analysis based on regional data, as we detail in the next section.