The impact of intercontinental air accessibility on local economies: Evidence from the de-hubbing of Malpensa*

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Abstract

An increasing body of literature has found a positive and significant impact of airport activities on local economies. However, it is not clear whether this effect is driven by demand factors (passengers arriving and departing with their expenditure) or supply factors (accessibility provision for local firms). By considering the 2008 de-hubbing of Malpensa as a natural experiment, we estimate the impact of a reduction in connectivity on employment in Travel-To-Work Areas of Lombardy, Piedmont, Liguria and Emilia Romagna. De-hubbing decision, in fact, affected permanently the intercontinental accessibility of the airport, with only temporary effect in terms of passengers. We found that areas specialized into export-oriented sectors suffered from the contraction in the degree of connectivity and that this effect decreases with the distance from the airport. No effect was found in urban areas and in areas specialized into heavy industry sectors.

Keywords: Airports, de-hubbing, Malpensa, local development

1. Introduction

Airports are crucial for local development both because they influence dramatically the international accessibility of cities and regions and because, through demand-side effects of operations, they may be key players in local economies (Hakfoort et al. 2001; Brueckner, 2003; Percoco, 2010; Chi and Baek, 2013; Murakami et al. 2016). The air transport service is indeed recognised to play a crucial role by facilitating both the transfer of goods (Button and Yuan, 2013) and of people (Williams and Baláž, 2009; Bråthen and Halpern, 2012; Forsyth et al., 2014), as well as stimulating the attractiveness of more firms to specific regions (e.g., Sellner and Nagl, 2010).

Hubs in particular, provide higher levels of connectivity to local consumers through higher frequency of flights and, even more importantly, through long haul flights. In other words, hubs enlarge the network scope of consumers with respect to a simple origin-destination system (Burghouwt and Redondi, 2013). It is hence no surprise that economic activities benefit from locating close to a hub. Bel and Fageda (2010) find that a 10% increase in intercontinental routes increases the number of headquarters of multinationals in European metropolitan regions by 4%. Similarly, Vinciguerra et al. (2011) find also a positive effect on innovative activities of firms, while Hakfoort et al. (2001) estimate that the total multiplier of direct employment on the Amsterdam Schiphol airport is almost 2. The aim of this paper is to contribute to the literature on the economic impacts of international accessibility on local development by analyzing the natural experiment of the de-hubbing of Malpensa airport, hence we aim to estimate the effect of an exogenous contraction of international connectivity or areas surrounding the airport.

During the period going from 2005 to 2007, the Malpensa airport has experienced a continuous growth in terms of activities, reaching 490,000 tons of cargo handled and 24 million of passenger traffic in 2007. On March 31, 2008 Alitalia (AZ) cut 180 flights and 14 intercontinental routes a day (about 70% of its operations in the airport) from Malpensa as a result of a de-hubbing decision. Our aim is hence to estimate the effect of such sudden contraction in connectivity on

economic development as measured by total employment in Travel-To-Work Areas (TTWAs) in the regions of Lombardy, Piedmont, Liguria and Emilia Romagna.

A growing body of literature is currently analyzing the consequences of de-hubbing for airport operations and consumer welfare. Overall, de-hubbing suddenly leaves passengers with no more available links due to the drop in airports' connectivity (Rodríguez-Déniz et al. 2013), though the de-hubbing itself cannot be generally considered as fatal. In some circumstances it also creates opportunities, in terms of creation of a new optimal mix of alternative carriers (Wei and Grubesic 2015) or the increase of product quality as the reduction in travel times and on-time performance (Rupp and Tan 2016). So far, the literature has provided mixed results.

Redondi et al. (2012) present the results of a statistical analysis of 37 cases of de-hubbing and found a low degree of resilience of airports as in the vast majority of cases traffic did not recover after five years from the shock, unless low cost carriers replaced the hub carrier. Low cost carriers are also crucial in reducing airfares after de-hubbing (Tan and Samuel, 2016), although results in terms of variation in consumer welfare are not univocal.

Bilotkach et al. (2014) in fact found a reduction in consumer welfare in the case of Malév Hungarian Airlines bankruptcy. The benefits from airfares reduction were in fact outweighed by the deterioration in service quality. Luo (2013) presents an analysis of the de-hubbing of the Cincinnati airport following the merger between Delta and Northwest. In this case, the variation in consumer welfare was positive because of the reduction in airfares and an increase in the frequency of flights to other hubs.

In this paper, we are interested in the implications of de-hubbing for local development and consider the effect of such decision in areas surrounding the Malpensa airport. By using an event study methodology and addressing the spatial interdependence among TTAWs, we have found that de-hubbing reduced employment by 5.5% in TTWAs within 10 kilometers from the airport and that this effect is localized in areas specialized into export-oriented industries. Our results also point at a not-significant effect on urban areas and TTWAs specialized into heavy industry manufacturing.

The reminder of this paper is organised as follows. Section 2 depicts the de-hubbing of Malpensa. Section 3 describes the methodology and data. Section 4 reports the results of the empirical analyses. Section 5 concludes.

2. The de-hubbing of Malpensa

In 2008, the financial crisis of the traditional flag Italian carrier, Alitalia, was the main cause for the de-hubbing at the Malpensa airport. Before the financial collapse, the company developed its network based on a dual hub strategy at the Fiumicino (Rome) and Malpensa airports, where the latter offered up to 62 destinations both outside Europe and towards destinations more than 3,000 km far away. Specifically, one third of all these destinations were directly served by Alitalia.

Following the crisis, in 2008, the airline decided to focus on a unique hub, that of Fiumicino, by de-hubbing its network in Malpensa. After the crisis only 4 intercontinental routes (out of 28) were served by Alitalia departing from Malpensa (data are from OAG). As a result, the number of intercontinental flights dropped by 36% and the number of served-airports of 19%, from 58 to 47 (Figure 1). Accordingly, the total number of annual passengers decreased from 23.8 million in 2007 to 17.5 in 2009. When considering the European and medium haul connectivity, the decline was less pronounced with a cumulative decrease in the number of flights equal to 18%, which has afterwards quickly recovered thanks to the activity of low cost carriers (e.g., easyJet).

Figure 2 contributes to better illustrate how the scheduled offer of Alitalia (AZ) significantly dropped at Malpensa both at an intercontinental and European level. Several reasons were conductive to the decision of Alitalia to decrease significantly the number of flights operated in Malpensa. First, Alitalia has suffered significantly from the decision to run a network strategy involving operations in two hubs with a significant duplication of flights and routes served with respect to both Rome Fiumicino and Milan Linate. For instance Redondi (2013) estimates that about 70% of seats offered by Alitalia in Milan Linate were overlapping with the supply in Malpensa. This situation was

unsustainable from a financial point of view for Alitalia, whose net result was -712 million euros in 2008.

Furthermore, from a more local perspective, Malpensa suffered a strong competition by Milan Linate, which had a better accessibility to Milan city center, and by Bergamo Orio al Serio, specialized into low cost carriers. As a consequence, Malpensa was less attractive as a hub, even though traffic allocation rules were approved although never fully applied.

To be noted is the fact that passenger traffic partially recovered already one year after the de-hubbing, but easyJet traffic almost doubled between 2008 and 2009. Given the point-to-point and mostly European network structure of that carrier (as well as evidenced in figure 2), it is clear that de-hubbing produced more significantly a contraction in the intercontinental connectivity of the airport.

3. Methodology and data

To estimate the causal effect of the de-hubbing of Malpensa airport we adopt an event-study framework with heterogeneous effects depending on the distance from the airport. In particular, our baseline specification is as follows:

(1)

$$y_{it} = \alpha_i + \beta Post_{t-1} + \gamma Post_{t-1} \times distance_i + \delta trend_{i,t-1} + \varphi Movements_{i,t-1} + \varepsilon_{it}$$

Where y_{it} indicates employment in TTWA i in year t, $Post_t$ is an indicator variable taking the value of 1 after the de-hubbing (from 2008 on) and zero otherwise, $distance_i$ measures the distance between the core city of TTWA i and Malpensa airport, $trend_{it}$ indicates TTWA-specific temporal trends. The specification includes TTWA specific fixed effects (α_i). The effect of de-hubbing, according to equation (1), is then $\beta + \gamma distance_i$ and it is hence a function of the spatial distance between TTWA i and Malpensa airport. Ideally, we expect β to be negative (the effect in the immediate surroundings,

that is when distance is zero) and γ positive indicating an attenuation of the impact across the space. Importantly, to disentangle the effects associated to the change in the connectivity and those to operations, we control for the number of movements in airports in the regions of Lombardy, Piedmont, Liguria and Emilia Romagna. Fixed effects are of paramount importance in equation (1) since they take all time-invariant TTWA-specific variables which might affect estimates of parameters β and γ, that is they capture the accessibility to Malpensa airport from TTWA i, the location of other airports and, to a certain extent, given the short temporal window we consider, economic specialization of TTWAs. Similarly, variable $trend_{it}$ indicates local trends influencing employment, so that de-hubbing can be interpreted as departure from these trends. Equation (1) is estimated in logs and through OLS, so that parameters β, γ are correctly identified under the assumption of independence of $Post_t$ from variables eventually omitted.

Furthermore, to test the solidity of our findings we assess the impact of the Malpensa's de-hubbing by accounting for the spatial dependence that could exist when estimating the reduction of employment at the TTWA level. This has been achieved relying on two different types of spatial model, namely the spatial autoregressive model (SAR) and the spatial error model (SEM). The former includes a spatially lagged dependent variable, which, once ignored, would lead to biased and inconsistent estimates (Anselin et al. 1998). In formula:

$$(2)\ y_{it} = \rho W y_{it} + \beta X_{t-1} + \varepsilon_{it}$$

Where ρ is the spatial autoregressive parameter, W is the weighted distance matrix (*152 X 152*) of TTWAs, and $W y_{it}$ is the spatial lag of the level of employment in TTWA i in year t. X stands for the vector of independent variables at *(t-1)* included in the model, while ε_{it} is the vector of errors.

Instead, the second model (SAR) addresses the presence of spatial autocorrelation by defining a spatial autoregressive process for the error term, which would lead OLS estimates to be inefficient, although unbiased, if not considered (Anselin et al. 1998). Specifically:

(3) $y_{it} = \beta X_{t-1} + \varepsilon_{it}$ with $\varepsilon_{it} = \lambda W_i \varepsilon_{it} + \mu_{it}$

Where λ represents the spatial autoregressive coefficient, while μ stands for the vector of errors i.i.d. Employing these two approaches to introduce spatial autocorrelation would allow us to consider the case where the change in employability in one TTWA is affected by the change in employability in nearby TTWAs (SAR). Second, through the SEM model we would be able to account for the presence of omitted variables from the regression model that are spatially correlated and might have an effect on the dependent variable (e.g., in the case of random shocks spreading to neighbouring regions). Furthermore, we present the decomposed total effects into the direct and indirect effects when considering the SAR model (LeSage and Pace 2009). On one side, the direct effects refer to the impact of the change in an explanatory variable on a dependent variable in a spatial unit and that arising from the dependent variables of neighboring units. On the other, the indirect effects measure the impact of the change of the explanatory variable of one spatial unit on the dependent variable of all the other units considering their spatial dependence. Due to their specificities, we perform both a spatial panel autoregressive model and a spatial panel error model with fixed effects.

For the scope of our research, we constructed a unique panel dataset at TTWA level for the years from 2005 to 2010, using employment data from the Italian National Institute of Statistics (ISTAT). We restrict the temporal window to data three years before and three years after the de-hubbing in order to provide lower bound estimates of the effect and minimize the probability to capture the effect of eventual concurring factors (e.g. the international economic crisis). ISTAT classifies TTWAs according to their specialization into three categories: urban systems (mainly specialized into service sectors), areas specialized in export-oriented manufacturing, and areas specialized into heavy industry manufacturing.[1] Furthermore, we use data from TTWAs belonging

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[1] Unfortunately, data at sectorial level are not available for non-census years, so that we cannot exploit information on the sectorial composition of local economies in a panel model as in equation (1).

only to some regions in the North of Italy, Lombardy, Piedmont, Liguria and Emilia Romagna, in order to have a more precise identification of the effect of de-hubbing.

The distance between TTWAs and Malpensa airport was calculated as the road distance between the chief town of each TTWA and the Malpensa airport by using Via Michelin, while data related to the number of movements are from Assaereo.

Before proceeding with the presentation of our results, it is important to discuss several points regarding our identification strategy. First, the main assumption behind the estimation of equations (1), (2) and (3) is that variable *Post* is exogenous or, in other terms, that no contemporary changes can be observed in other unobserved variables. It should be noted that we also control for the number of passengers in the airports of the regions, so that we control for eventual structural breaks in variables possibly affected by the de-hubbing.

A potential threat to the identification of the effect is represented by the international crisis begun in 2008. However, as also reported in Baiardi and Percoco (2012), the crisis hit the North of Italy only in 2011, hence at the end of the period we are considering in this paper. It should be also noted that in some specifications we use the time period 2006-2009, so that we almost exclude any potential confounding factor from the recession (see also the section 4 for a robustness test considering a synthetic control method).

A final assumption behind equations (1)-(3) is that the heterogeneity in the impact of the de-hubbing is related to the distance decay from Malpensa. This implies that we think that firms using more intensely the airport tend to locate closer, so that an exogenous variation in the accessibility of Malpensa should be observed especially in economies closer to the hub. It should be noted that this assumption is consistent with previous findings regarding the location of firms (Sellner and Nagl, 2010).

Table 1 reports descriptive statistics. Columns (1) and (2) show the average number of employees per TTWA before and after de-hubbing respectively. Data point at a substantial stability of employment. By splitting the sample into TTWA located within 50 kilometers of road distance

from Malpensa and farer than 50 kilometers, it emerges a slightly different picture as it seems that TTWAs close to Malpensa suffered from a contraction in employment, whereas the rest of the areas were immune from the shock. These patterns in the data need to be tested more properly in an econometric framework to verify both the robustness to the inclusion of potential confounding factors and the statistical significance.

[TABLE 1]

4. Results

We start the empirical analysis with the estimation of equation (1) by means of OLS with TTWA-specific fixed effects and trends. Results are reported in model (1) in table 2 and indicate an effect of de-hubbing on employment not statistically different from zero. In models (2)-(4) we split the sample into urban TTWAs, TTWAs specialized into export-oriented activities and TTWAs specialized in heavy industries. Interestingly, it emerges that our coefficients of interest are significant only in model (3) where $\beta = -7.4\%$ and $\gamma = 1.0\%$, indicating that the de-hubbing produced a contraction in employment by 7.% in the TTWA where Malpensa is located and that this effect declines with a gradient of 1% in (log) road distance.

[TABLE 2]

The rationale behind our analysis is that de-hubbing has decreased the international connectivity of the surroundings of Malpensa airport and this, in its turn, has resulted in a contraction in economic activities. However, airport operations may drive demand-side effects not necessarily related to variations in connectivity. In this regard, our control for airport operations, namely the number of movements, suggests that for TTWA specialized in export-oriented areas, an increase of

1% in the amount of movements marginally led to a 0.7% increase in employment, whereas no significant effects were found in other areas.[2]

After computing the Moran'I test on the dependent variable, which suggests the presence of positive spatial autocorrelation in level of employment among TTAWs at 1% significant level (z-statistic 3.975), it was advisable to extend our analysis to spatial panel models to account for the interdependence in employment across areas. The estimates of the SEM model in Table 3 are in line with estimates in Table 2 with a contraction at $distance_i = 0$ of 6.4% and a spatial decay parameter of 1% for TTWA specialized in export-oriented industries.

[TABLE 3]

Although the SEM model appears to be more appropriate following the Akaike's information criterion (Spatial panel error model: -4,631.761; Spatial autoregressive model: -4,634.91), we also report the estimates for the SAR model as it allows to disentangle the whole effect into its direct and indirect components.

Overall, the SAR estimates in Table 4 corroborate our findings, highlighting that, on average, the direct effect of de-hubbing of Malpensa accounts for a contraction in employment by 5.9% in the TTWAs specialized into export-oriented activities with a spatial decay parameter of 1.1%. Regarding the spillover effect (indirect effect) arising from neighbors, de-hubbing led to a contraction of employment by 14.6% in the same areas with a spatial decay parameter of 2.6%.

[TABLE 4]

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[2] It should be mentioned that also specifications with the interaction between movements with distance was estimated with no changes in the parameters of interest.

In Table 5 we report robustness checks on restricted samples, including fixed effects, local trends and controls as for previous regression models across all specifications. Employing a SEM model, in Panel A, we restrict the sample to two years before and two years after the de-hubbing (i.e. 2006-2009) and find an increase in the significance of parameters and an increase to $\beta = -8.0\%$ and $\gamma = 1.30\%$ only for export-oriented TTWAs. By restricting also the spatial extent of the sample to TTWAs within 150 road distance to Malpensa (Panel B), the OLS estimates decreases to $\beta = -6.8\%$ and $\gamma = 1.3\%$, implying a contraction by about 14,000 jobs in the whole area.[3]

[TABLE 5]

In our macroeconomic analysis, we have not ruled out possible channels of transmission of the shock because of the lack of data, although we have argued that the de-hubbing has had a significant and permanent effect on the connectivity of the airport. However, as reported in section 2, the recovery of passenger traffic in Malpensa was possible because of doubling of passengers of easyJet. Those are low cost carrier passengers and hence significantly different in terms of expenditure and relative multiplier effect with respect to intercontinental and business class passengers.

A further point to be discussed is whether our treatment variable is plausibly exogenous. In section 2, we have argued that the de-hubbing decision was not driven by local economic conditions and that the Great Recession has had an impact in Northern Italy only in 2011. However, we cannot exclude that an indicator variable such as *Post_{t-1}* may also capture the impact of the crisis in destination countries. To this end, we need to establish the causal impact of de-hubbing on passenger traffic and compare the results obtained for Malpensa to other benchmark airports.

In order to address this issue, we make use of the synthetic control method in which a synthetic counterfactual (i.e. a theoretical Malpensa without de-hubbing) is compared to the observed pattern.

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[3] It should be noted that SEA estimates a loss by about 8,000 jobs in the sole province of Varese between 2007 and 2009: http://sea2013csr.rep.message-asp.com/it/sostenibilita-socio-economica/societa-territorio/evoluzione-delleconomic-footprint-malpensa#start

The approach consists in using information on 26 European international airports between 2003 and 2015 (Table 6) to construct an artificial time series mimicking passenger traffic in Malpensa before 2008 and then used to extrapolated passenger traffic in Malpensa after 2008 without de-hubbing (Abadie et al., 2010; Percoco, 2014; Percoco, 2015). We use information on the number of passengers, market share of low cost carriers, market share of the dominant carrier, the share of international routes and per capita GDP in the NUTS3 region where the airport is located. Table 7 reports descriptive statistics for those variables, whereas the synthetic control method is described in depth in Appendix 1.

[TABLE 6 and 7]

Figure 3 reports the pattern of passengers for Malpensa and for the synthetic Malpensa, using information from Geneva Cointrin (Unit weight: 0.298), Munich Strauss (0.441) and Oslo Gardemoen (0.262). The divergence between the two series beginning in 2008 is considerable and clearly documents a structural change occurring in air traffic after de-hubbing. Specifically, in 2015 Malpensa accounted for 18.5 Mln of passengers, 37% less than that of its synthetic control (29.41 Mln). As a sort of placebo test, figure 4 reports the same analysis for Amsterdam-Schiphol and, interestingly enough, there is no sign of structural contraction into the number of passengers neither in the actual Amsterdam-Schiphol, nor in the synthetic control.[4] By combining evidence from figure 3 and figure 4, it is clear that our variable $Post_{t-1}$ measures a structural change occurring in Malpensa airport and this is related to de-hubbing.

5. **Conclusions**

The impact of airports on local development has regained considerable attention of scholars in recent years. In this paper, we have considered the natural experiment of the de-hubbing of

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[4] In this case, synthetic Amsterdam Schiphol is composed by Barcelona El Prat (Unit weights: 0.062), Paris Charles De Gaulle (0.401), Dusseldorf (0.074), London Heathrow (0.237), Oslo (0.153), London Stansted (0.021) and Vienna (0.052).

Malpensa to identify the impact of connectivity on local employment. By using an event study econometric approach, in the stricter specification, we have found a contraction in the number of employees by 7-8% in the TTWA where Malpensa is located with a spatial decay parameter of 1.3% of log distance. The estimates imply an overall decrease in employment by 5.9% at 5 kilometers from the airport, 5.5% and 4.5% at 10 and 50 kilometers distance respectively. These results are crucial for the development of one of the richest areas in Europe. While regional and national policymakers have contributed to continuously provide economic subsidies to Alitalia over time and sustain the development of Malpensa by financing airport and accessibility infrastructures, at the end, the Alitalia's choice to de-hub from Milan has had dramatic consequences for the local economic development.

It is interesting to note that results presented in this paper differ substantially from previous literature in that Brueckner (2003) and Percoco (2010) have found a substantial effect in the service sector. The effects of the de-hubbing of Malpensa was instead significant only in export-oriented TTWAs, whereas no effect was found for urban TTWAs, traditionally specialized in service provision. Besides the fact that in our analysis we have not considered the direct effect on sectorial employment because of the lack of data, the difference in empirical results highlights that direct international connectivity promotes export.

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Appendix 1[5]

Let us consider $K + 1$ airports and, K of them called the "donor pool" and the last one is Malpensa, treated with de-hubbing after 2008. Let Y_{it}^H be the potential traffic of airport i in time t in absence of de-hubbing, where H stands for hubbing. Let Y_{it}^D be the potential outcome in the period following de-hubbing. In $T_0 + 1$ de-hubbing is implemented, hence we have T_0 $(1 \leq T_0 < T)$ pre-de-hubbing periods. Malpensa will be exposed to the policy intervention from $T_0 + 1$ on (in our case, we assume 2008), until T (in our case 2015).

Let us D_{it} the de-hubbing indicator, i.e. the dummy variable that equals one only after de-hubbing in Malpensa:

$$D_{it} = \{ \ 1 \ if \ i = 1 \ and \ T > T_0 \quad 0 \ otherwise$$

This means that the observed traffic can be written as $Y_{it} = Y_{it}^H + \alpha_{it} D_{it}$. We are interested in is the effect of de-hubbing $\alpha_{it} = Y_{it}^D - Y_{it}^H$. In particular, we are interested in the time series $(\alpha_{1T0+1}, \alpha_{1T0+2}, ..., \alpha_{1T})$, where for $t > T_0$

$$\alpha_{1t} = Y_{1t}^D - Y_{1t}^H = Y_{1t} - Y_{1t}^H$$

where Y_{1t}^D is observed, whereas Y_{1t}^H needs to be estimated. To this end, let us assume that Y_{it}^D is given by a factor model

$$\textbf{(1)} \ Y_{1t}^D = \delta_t + \lambda_t \mu_i + \epsilon_{it}$$

where δ_t is an unknown common variable across airports, λ_t is a $(1 \times F)$ vector of unobserved common factors, μ_i is an $(F \times 1)$ vector of unknown factor loadings, and ϵ_{it} is the error terms comprising unobserved transitory shocks at the district level with zero mean.

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[5] This Appendix mostly follows PERCOCO (2014; 2015).

Let us now consider a $(K \times 1)$ vector of weights $\mathbf{W} = (w_2, w_3, ..., w_{K+1})'$ used to construct the outcome variable for each synthetic control:

$$\sum_{k=2}^{K+1} w_k Y_{kt} = \delta_t + \lambda_t \sum_{k=2}^{K+1} w_k \mu_k + \sum_{k=2}^{K+1} w_k \epsilon_{kt}$$

The optimal weights $(w_2^*, w_3^*, ..., w_{K+1}^*)$ will be such that

$$\sum_{k=2}^{K+1} w_k^* Y_{k1} = Y_{11}$$

$$\sum_{k=2}^{K+1} w_k^* Y_{k2} = Y_{12}$$

$$...$$

$$\sum_{k=2}^{K+1} w_k^* Y_{kT0} = Y_{1T0}$$

Abadie et al. (2010) show that, if $(\sum_{n=1}^{T_0} \lambda_t' \lambda_t)$ is non-singular, then

(2) $Y_{it}^H - \sum_{k=2}^{K+1} w_k^* Y_{kt} = \sum_{k=2}^{K+1} w_k^* \sum_{s=1}^{T_0} \lambda_t (\sum_{n=1}^{T_0} \lambda_t' \lambda_t)^{-1} \lambda_s' (\epsilon_{js} - \epsilon_{1s}) - \sum_{k=2}^{K+1} w_k^* (\epsilon_{jt} - \epsilon_{1t})$

and under standard assumptions the mean of the right hand side is equal to zero. From this, the synthetic control estimator of α_{1t} is equal to

(3) $\hat{\alpha}_{1t} = Y_{1t} - \sum_{k=2}^{K+1} w_k^* Y_{kt}$

for $t \in \{T_0 + 1, ..., T\}$. Estimator (3) therefore provides a measure of the impact of the policy on unit 1 as a function of the observed time series, Y_{1t}, and of a synthetic control series, $\sum_{k=2}^{K+1} w_k^* Y_{kt}$. Abadie et al. (2010) provide details on the numerical estimator in (3).

Table 1: Descriptive statistics

	Whole sample		Distance <50 km		Distance > 50km	
	(1)	(2)	(3)	(4)	(5)	(6)
	Before	After	Before	After	Before	After
Employees	57,021	57,807	101,107	99,060	55,209	56,112
	(138,249)	(138,382)	(83,497)	(81,103)	(139,805)	(140,034)
Observations	456	456	18	18	438	438

Notes: The table reports mean and standard errors (in parentheses) of the number of employment in Travel to Work Areas in the sample. "Before" refers to years prior to 2008 (excluded); "After" to years after 2008 (included.

Table 2: Baseline regressions (OLS estimates, Dep. Variable: total employment)

All independent variables are lagged by one period

	Whole sample	Urban	Export-oriented	Heavy industry
	(1)	(2)	(3)	(4)
Post*Distance	0.004	-0.013	0.010**	0.001
	(0.004)	(0.009)	(0.004)	(0.009)
Post	-0.043**	0.037	-0.074***	-0.022
	(0.018)	(0.049)	(0.020)	(0.043)
Movements	0.001	0.000	0.007*	0.001
	(0.001)	(0.001)	(0.004)	(0.005)
Observations	912	294	456	150
R-squared	0.213	0.283	0.265	0.093
Regional trends	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes

Table 3. Spatial panel error model (Dep. Variable: total employment)

All independent variables are lagged by one period

Variables	Whole sample	Urban	Export-oriented	Heavy industry
	(1)	(2)	(3)	(4)
Post*Distance	0.003	-0.013	0.010***	0.001
	(0.003)	(0.009)	(0.004)	(0.008)
Post	0.050	0.036	-0.064***	-0.020
	(0.079)	(0.052)	(0.022)	(0.044)
Movements	0.001	0.000	0.006	0.000
	(0.001)	(0.001)	(0.004)	(0.005)
Lambda	0.949***	0.597***	0.703***	0.389***
	(0.039)	(0.080)	(0.067)	(0.140)
Sigma-square	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	912	294	456	150
Log-pseudolikelihood	2321.1254	720.1669	1197.3979	390.5461
Regional trends	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes

Table 4. Spatial autoregressive model (Dep. Variable: total employment)

All independent variables are lagged by one period

Variables	Whole sample			Urban			Export-oriented			Heavy industry		
	Main	Direct	Indirect	Main	Direct	Indirect	Main	Direct	Indirect	Main	Direct	Indirect
Post*Distance	0.003	0.004	0.014	-0.013	-0.014*	-0.023	0.010***	0.011***	0.026**	0.001	0.001	-0.000
	(0.003)	(0.003)	(0.012)	(0.009)	(0.008)	(0.016)	(0.004)	(0.003)	(0.011)	(0.009)	(0.007)	(0.006)
Post	-0.022	-0.023	-0.090	0.057	0.059	0.100	-0.058***	-0.059***	-0.146**	-0.015	-0.015	-0.007
	(0.018)	(0.015)	(0.064)	(0.049)	(0.042)	(0.079)	(0.020)	(0.017)	(0.058)	(0.044)	(0.038)	(0.029)
Movements	0.001	0.001	0.003	0.000	0.000	0.000	0.006*	0.006*	0.016	0.001	0.001	0.001
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.002)	(0.004)	(0.004)	(0.012)	(0.005)	(0.005)	(0.005)
Rho	0.788***			0.610***			0.696***			0.404***		
	(0.041)			(0.080)			(0.060)			(0.131)		
Sigma-square	0.000***			0.000***			0.000***			0.000***		
	(0.000)			(0.000)			(0.000)			(0.000)		
Observations	912	912	912	294	294	294	456	456	456	150	150	150
Log-pseudolikelihood	2323.04			720.8628			1199.183			390.8985		
Regional trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Robustness checks

All independent variables are lagged by one period. Panel A reports the estimate of the SEM model reducing the time period (2006-2009), while Panel B shows the results of the OLS regression when both reducing the time period to 2006-2009 and restricting the spatial extent of the sample to TTWAs within 150 road distance to Malpensa.

Variables	Whole sample	Urban	Export-oriented	Heavy industry
	(1)	*(2)*	*(3)*	*(4)*
	Panel A: Only years 2006-2009			
Post*Distance	0.003	-0.018*	0.013***	0.003
	(0.004)	(0.010)	(0.004)	(0.009)
Post	-0.033	0.075	-0.080***	-0.023
	(0.021)	(0.055)	(0.020)	(0.044)
Movements	-0.000	-0.001*	0.008**	0.003
	(0.001)	(0.001)	(0.004)	(0.005)
Lambda	-0.150	0.214	-0.695**	-1.489***
	(0.188)	(0.145)	(0.298)	(0.346)
Sigma-square	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	608	196	304	100
Log-pseudolikelihood	1646.0356	512.7498	861.1926	291.3164
Regional trends	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes
	Panel B: Only years 2006-2009 and distance < 150 km			
Post*Distance	0.012***	0.009	0.013***	-0.007
	(0.004)	(0.035)	(0.004)	(0.011)
Post	-0.059***	-0.042	-0.068***	0.025
	(0.019)	(0.164)	(0.020)	(0.049)
Movements	0.006	0.158	0.009*	0.004
	(0.004)	(0.101)	(0.005)	(0.008)
Constant	-16.693	-88.926**	-3.958	23.918
	(19.557)	(32.525)	(25.642)	(48.327)
Observations	232	48	128	56
R-squared	0.070	0.165	0.190	0.070
Regional trends	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes

Table 6: List of donor airports

List of donor airports	
AMS	LGW
ARN	LHR
ATH	LIS
BCN	MAD
BRU	MAN
CDG	MUC
CPH	MXP
DUB	ORY
DUS	OSL
FCO	STN
FRA	TXL
GVA	VIE
HEL	ZRH

Table 7: Descriptive statistics

Variables	Mean	SD	Min	Max
Passengers (Mln)	26.49	14.99	8.02	69.43
% LCC	22%	21%	0%	97%
Nr. of runways	2.46	1.08	1	6
% market share (Dominant airline)	45%	13%	10%	71%
% International routes	15%	12%	0%	52%
€ per inhabitants (NUTS3)	38386	14471	18600	81500
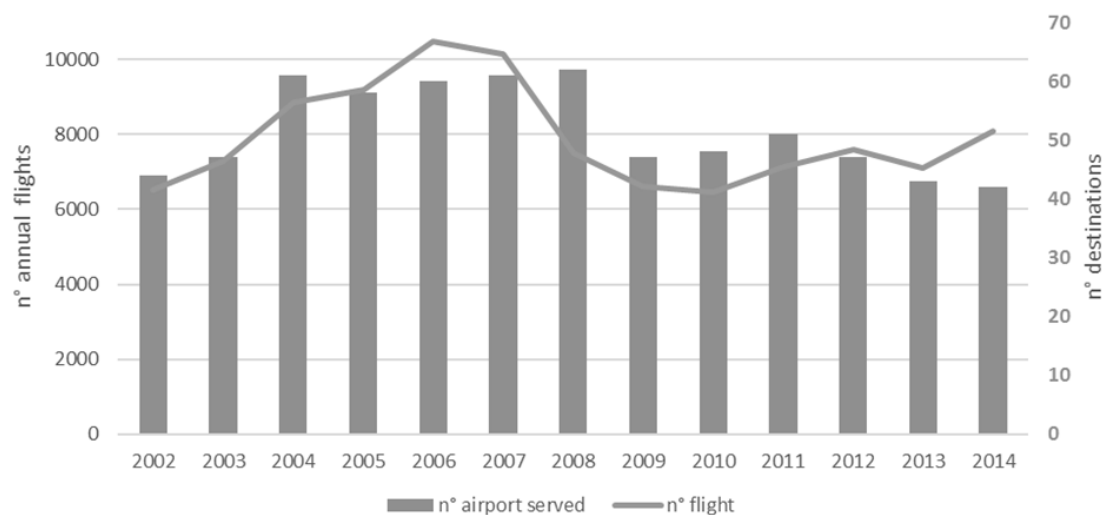
Figure 1. The yearly offer from the MXP airport toward non-EU destinations that are 3,000 km far away
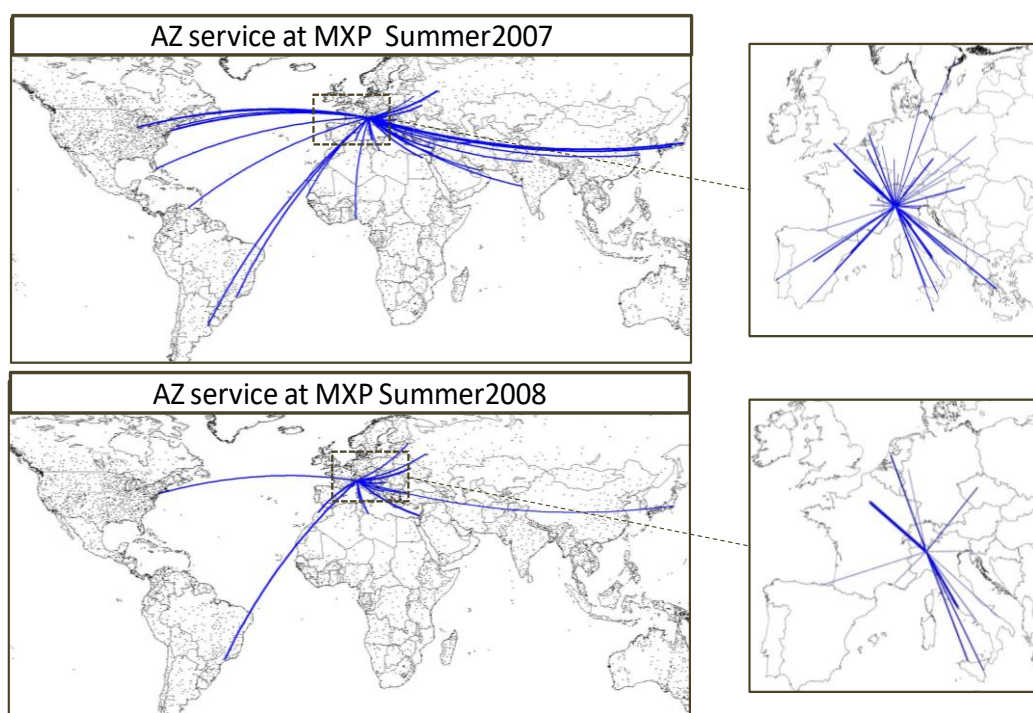

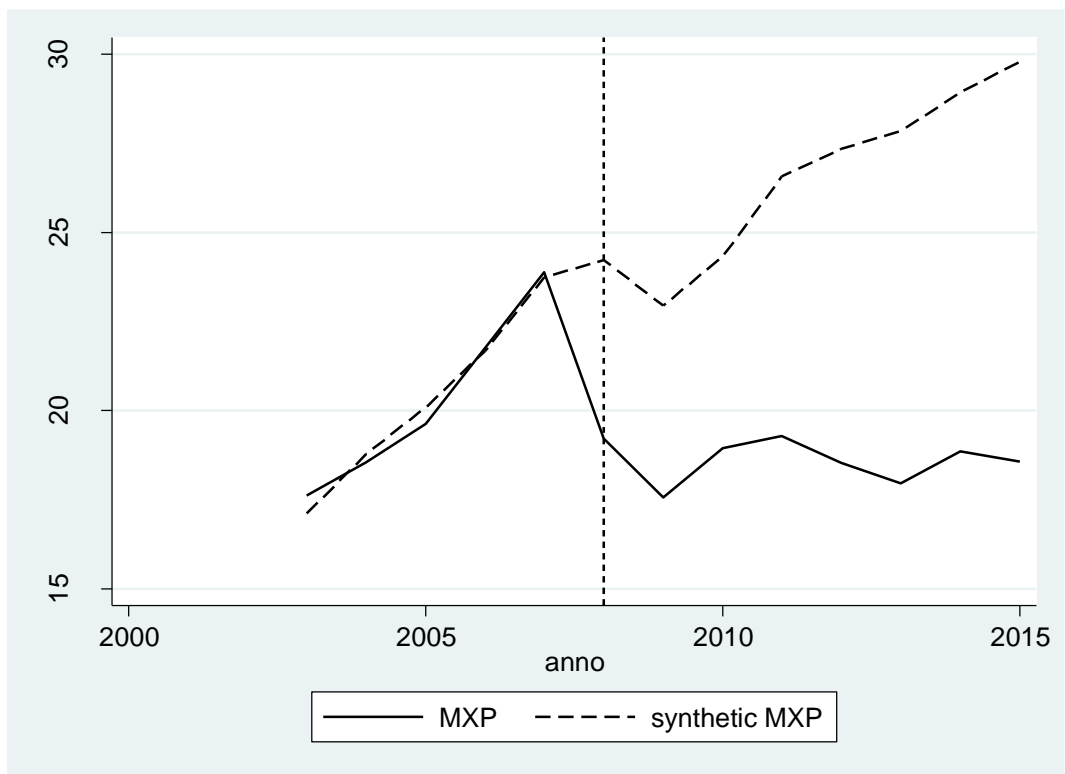**Figure 2. The scheduled offer of Alitalia at MXP airport before and after the de-hubbing**
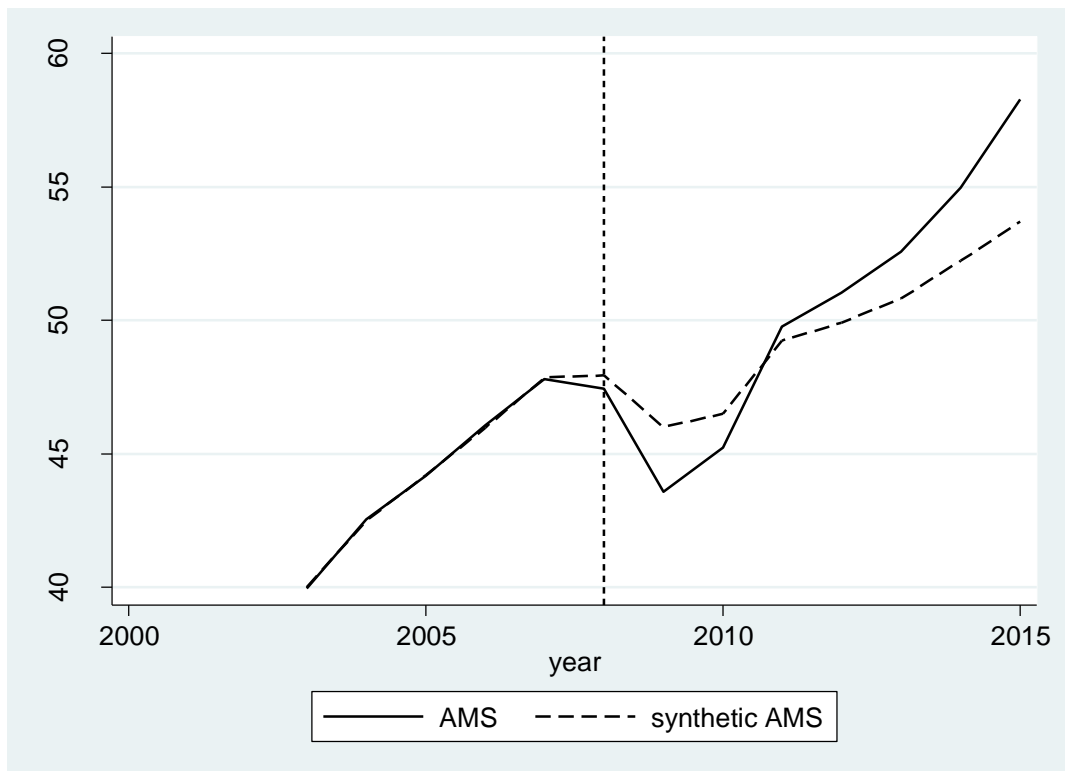
Figure 3: The effect of de-hubbing in Malpensa

Figure 4: A placebo test with Amsterdam Schiphol

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