DOES AN INCREASE IN SUBSIDIES LEAD TO CHANGES IN AIR FARES? EMPIRICAL EVIDENCE FROM SPAIN[a]

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Abstract

This paper examines the impact on prices of various regulatory changes in residents' flight subsidies implemented in Spain in recent years. It draws on a large sample of domestic routes for the period 2003-2013 to estimate a price equation that accounts for the panel data and the potential endogeneity of specific explanatory variables. Price differences were not found between the treated routes (routes affected by the discounts) and the control routes (routes not affected by the discounts). This is the case regardless of the discount percentage on prices that island residents enjoy.

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1. **Introduction**

Air transportation is key in supporting mobility around cities and regions that are located in peripheral or remote locations. However, as demand for routes serving peripheral locations may be low, airlines may provide less frequent and more expensive services there, or may not even offer any service at all (Bitzan and Junwook, 2006; Fageda, 2013). It is widely recognized in the literature that high-density economies in the airline industry (Caves *et al.*, 1984; Brueckner and Spiller, 1994) may help airlines save costs by operating on denser routes with larger planes at higher load factors.

The traditional way of dealing with this problem in the European Union has been to subsidize the population living in peripheral communities or to apply price discounts to specific routes. Furthermore, these subsidies may be accompanied by the imposition of public services obligations (PSO) that put limits on the frequency of service, the size of the aircraft, the schedule for the service, and, on occasions, the maximum permitted fare for some or all seats.

In this regard, several European national and regional governments have introduced sizeable air service discount schemes that benefit island residents on domestic routes that have islands as their endpoints. These discounts are financed by governments, which subsidize the price paid by island residents. As they are not embedded in PSO regulations (i.e. they are independent), they can also include additional price reductions. Examples of this type of policy can be found in France, Italy, Spain, Portugal and the United Kingdom.

In particular, populations from outlying regions[1] enjoy these kinds of subsidies because the government is seeking to promote territorial equity. Because these regions are geographically very distant from the European continent, they benefit from specific legislation like this, in order to be protected.[2] In particular, there are differences in the form of the grant, and even in the type of the subsidy (they are predominantly specific or *ad-valorem*).

Although these subsidies are economically significant, as far as is known the relevant literature has not focused on its corresponding importance. Moreover, the analysis of the policies to support air services in remote regions is generally made under the terms of the

[1] In the EU there are nine Outermost Regions: Guadeloupe, French Guiana, Martinique, La Réunion, Mayotte (French overseas departments); Saint-Martin (French overseas collectivity); Madeira and Azores (Portuguese autonomous regions) and the Canary Islands (Spanish autonomous community).

[2] In the words of the European Commission: "These specific measures are designed to address the challenges faced by the Outermost Regions because of their remoteness, insularity, small size, difficult topography and climate, and economic dependence on a few products" See: http://ec.europa.eu/regional_policy/en/policy/themes/outermost-regions/

public service obligation (PSO) declaration.[3] In this regard, several studies have analyzed the design and effects of the PSO applied in different European countries. Williams and Pagliari (2004) and Merkert and O'Fee (2013) identify vast diversity in the instruments and selection of protected routes across Europe. Lian (2010) and Lian and Ronnevik (2011) assess the weaknesses of the PSO regulation implemented in Norway, while Di Francesco and Pagliari (2012) analyze the potential negative impact on airfares of eliminating PSOs on the routes connecting the Italian mainland to the island of Sardinia. Calzada and Fageda (2014) find that PSOs reduce competition on the protected routes, while their effect on the number of flights differs depending on national regulations.

Furthermore, some studies have examined the effects of PSOs on the efficiency of operators. Santana (2009) finds that PSOs increase the operation costs of European carriers, but she does not observe a similar effect in the US system. Merkert and Williams (2013) show that European operators perform better in the early months of the PSO contracts than when the contract is approaching termination, suggesting that airlines have fewer incentives to increase efficiency before the tender finishes due to the absence of competition. Finally, some other papers have examined the design of PSOs in European air markets. Pita *et al.* (2013) propose an operational planning model to examine the design of subsidized air transportation, and apply this methodology to assess the Azores PSO system; while Pita *et al.* (2014) extended this model and apply it to an analysis of the PSO network in Norway.

Less attention has been paid to the analysis of price discounts established for residents on islands out of PSOs regulations. In Spain, Calzada and Fageda (2012) show that routes benefiting from price discounts are priced more highly than the remainder of the domestic routes. Fageda *et al.* (2012) draws on data of routes departing from Gran Canaria airport, including national and international destinations. They compare prices on subsidized routes (domestic flights from Gran Canaria) with those that are unsubsidized (international flights from Gran Canaria), and find that non-resident passengers pay higher prices than international passengers.

Valido *et al.* (2014) compare the different effects of *ad-valorem* and specific subsidies for resident passengers in air transport markets in a 'market power context'. They show that non-resident passengers may be spelled from the market if the proportion of resident passengers is high enough. They also analyze the most desirable situation between both types of subsidies, *ad-valorem* or specific, showing that their effects depend on the

[3] In a more general perspective, Nolan *et al.* (2005) examine the social welfare implications of different regulations: direct subsidies, protected route packages, and revenue guarantees.

passengers' willingness to pay. Finally, they apply the model to the Canary Island markets, concluding that the *ad-valorem* subsidy is not the best for the conditions of this market. Finally, Cabrera *et al.* (2011) carry out a comparative description of these kinds of subsidies in European outermost regions (they also analyzed PSO declarations in these regions)

This paper contributes to the literature on price discounts to island residents by examining the impact on prices of different regulatory changes implemented in Spain in recent years. We draw on a large sample of domestic routes (including routes both affected and unaffected by the discounts) for the period 2003-2013 to estimate a price equation that accounts for the panel data of our sample and potential endogeneity of some explanatory variables.

Previous papers about the impact on prices of discounts have simply distinguished between subsidized and unsubsidized routes. Here, the change in the amount of the discount offered in the period under study can be exploited. Specifically, the percentage of price discount that island residents can benefit from has increased gradually from 33% to 50% during the considered period. Hence, we can examine not just price differences between subsidized and unsubsidized routes but also the differential impact of the amount of the subsidy on prices (without discounts) by separately identifying the effect of three different regulatory changes.

In the following section, the price discount policy applied in Spain to protect island residents and its historical evolution is explained. Next, suggestions based on the data are put forward and descriptive statistics are provided. In the last section, the empirical strategy is developed and the results of the econometric analysis are shown. Finally, the paper concludes with some policy recommendations.

2. Subsidy scheme in Spain

In Spain, subsidies for resident passengers from specific territories have been common practice. The first application of legislation in this regard was in 1960 and the last modification in 2005.[4] The main objective has always been the same, which is territorial equity, and the type of subsidy has also been an invariant *ad-valorem* subsidy, i.e. a percentage of the discount on the final price paid by the resident passenger.

In particular, the *ad-valorem* subsidy is a common aspect of the successive legislation changes, but there have been some changes in the percentage of discount. Moreover, the

[4] In fact, there have been other changes in legislation (even after this one) that affects other aspects of the resident subsidy theme. However, we only take into account the legislation that modifies the percentage of the subsidy.

legislation has modified various aspects of the conditions that merit the subsidy, and detailed the maximum amount available, the way to gain accreditation, and so on.

Subsidies began in 1960, when pre-democratic legislation introduced an air transport subsidy for residents who lived in the Canary Islands because of "…rising ticket prices…", adding that "…it would not be fair that airlines suffer the reduction in ticket prices…". However this only lasted one year (1961), as in mid-1962 legislation changed the percentage to 33% and the residence of the passengers entitled to the subsidy (to Spanish Sahara and Ifni).

Following these first applications in air transport, many changes were introduced, such as the addition of other affected territories (Balearic Islands, Ceuta and Melilla) or the transport mode (maritime), among others, as has been mentioned above.[5]

The percentage of the subsidy, whose changes are analyzed in this paper, has been 50% since 2007, but it has focused on the airline industry and in the case of the Canary Islands, this percentage has experienced variations. In this regard, this paper distinguishes between inter-island trips and the connection of the Canary Islands with the rest of the Iberian mainland

On the one hand, the percentage for inter-island routes has increased from 10% (in application from January 1988 to August 1998), to 33% (in application from August 1998 to February 2005), 38% (in application from February to December 2005), to 45% (2006) and to 50% (in application from January 2007 to date).

On the other hand, regarding connections with the rest of the country, the percentage has been increased from 12% (1961), to 33% (from 1962 to February 2005), to 38% (in application from February to December 2005), to 45% (2006) and to 50% (in application from January 2007 to date).

Concerning the maximum amount of subsidy per passenger, the legislation states that: "in no case can the subsidy reach the greatest fare of the rates involving business class fares on air transport services". Furthermore, the subsidy cannot be applied to tickets that include trips outside national territory.

In order to be entitled to the subsidy, the passenger has to facilitate relevant data to the airline and immediately receives the discount on the price. Next, the airline directly obtains

[5] Other changes can be extracted from the legislation (for example, the maximum amount per passenger, the accreditation of residence, and so on) but the economic consequences of these changes are not relevant to this paper.

the money from the government. The amount of air transport subsidies in 2016 demonstrate its importance: it represents over €358 million of the Spanish budget.[6] Various pieces of legislation related to subsidies are summarized in table 1, taking into account only the differences in percentages, territory and transport mode.

[6] See "Presupuestos generales del Estado 2016. Programa 441O Subvenciones y apoyo al transporte aéreo". Available at: https://www.boe.es/boe/dias/2015/10/30/pdfs/BOE-A-2015-11644.pdf

Table 1. Evolution of resident subsidies in Spain[7]

Law	Application Area	Transport method	Destination	Percentage
Law 118/1960	Canary Islands	Air	Rest of national territory	12%
DL 22/1962	Canary Islands, Ifni and Spanish Sahara	Air	Rest of national territory	33%
Law 46/1981	Balearic Islands	Air and maritime	Rest of national territory	25%
		Air and maritime	Between islands	10%
Law 33/1987	Canary Islands, Ceuta and Melilla	Air and maritime	Rest of national territory	33%
		Air and maritime	Between islands	10%
Law 30/1998	Balearic Islands	Air and maritime	Rest of national territory	33%
			Between islands	Generally applicable to the archipelagos of the Spanish State
RD 1745/1998	Canary Islands	Air and maritime	Rest of national territory	33%
		Air	Between islands	33%
		Maritime	Between islands	10%
RD 1746/1998	Balearic Islands	Air	Rest of national territory	33%
		Air	Between islands	33%
		Maritime	Between islands	10%
RD 207/2005	Balearic Islands, Canary Islands, Ceuta and Melilla	Air	Rest of national territory	38%
		Air	Between islands	38%
		Maritime	Between islands	15%
Law 30/2005	Balearic Islands, Canary Islands, Ceuta and Melilla	Air	Rest of national territory	45%
		Air	Between islands	45%
		Maritime	Between islands	22%
Law 42/2006	Balearic Islands, Canary Islands, Ceuta and Melilla	Air	Rest of national territory	50%
		Air	Between islands	50%
		Maritime	Between islands	25%

Source: Own elaboration.

[7] There is an autonomic legislation additional to National legislation in maritime transport. Nowadays, with these complements, the percentage of discount for this transport mode is the same as for the air transport. We do not analyze this legislation because it is irrelevant for air transport and therefore irrelevant in our work.

3. Data

Our database contains more than 700 observations from 2003 to 2013 from 47 Spanish national routes. Two kinds of routes are identified: those where passengers may be entitled to the resident subsidy (inter-island and routes with origin or destination on an island) and those where passengers may not.

This data structure allows an empirical strategy to be employed that is based on how the treated routes (those that are subsidized) change in relation with the control group (those routes that are not affected by subsidies). Two seasons (winter and summer) are also distinguished, meaning that any particular observation is identified by year (*t*) route (*i*) and season (*s*).

Prices set by airlines at route level are generally modeled as a function of a set of route and carrier specific variables. Here, we exploit the variability across routes so that the focus is on route-specific variables. Taking this into account, prices can be understood as a mark-up over costs. The main determinants of the mark-up are intensity of competition and demand on the route. The main determinants of route costs are distance and demand given the relevance of distance and density economies. Hence, our control variables are capturing those determinants of mark-ups and costs. Similar control variables have been used in a number of previous studies about prices in air transport market (see for example Berry *et al.*, 1996; Borenstein, 1989; Brander and Zhang, 1990; Evans and Kessides, 1993; Dresner *et al.*, 1996; Fageda, 2006; Fischer and Kamerschen, 2003; Hofer *et al.*, 2008; Bilotkach and Lakew, 2014).

All continuous variables are expressed in logs. The use of logs in continuous variables is common in studies about air fares. Note also that the variables of main interest in the analysis (variables for the change in the percentage of discounts over prices that island residents enjoy) are dummy variables. In this regard, the use of logs for the dependent variable has the advantage that the interpretation of the dummy variable coefficients are clearer as they are interpreted as the percentage change in prices associated with being affected by the discounts.

Thus, the variables included in the database are:

1. $LnPrice_{its}$: is the natural logarithm of the price corresponding to the route *i* in the year *t* and season *s*. This is the dependent variable in our model. This variable is constructed as the lowest mean round trip price charged by airlines offering services weighted by their

corresponding market share. Information has been obtained manually from airlines websites for a sample week of the summer and winter season since 2003. Hence, this study draws on (at least for Europe) a unique database of historical prices (2003-2013).

These homogeneous rules are followed in the data collection of prices. Price data relating to the city pair link (route) that has the city with the largest airport as its origin. Additionally, the price data has been collected one month before travelling, and the price refers to the first trip of the week, with the return being on Sunday. With this procedure, variability of data across routes can be exploited because data is obtained under homogeneous conditions for all the routes in our sample. To explain the corresponding price for each route we take as explanatory variables the following:

2. *Ln passengers*$_{it}$: the logarithm of the number of air passenger carried in those operations on route *i* during year *t*. Source: Spanish airport operator (AENA). The expected sign of the coefficient of this variable is ambiguous. More route traffic density may imply a better exploitation of density economies but higher demand levels may also lead airlines to charge higher mark-ups over costs.

This variable may be showing an endogenous relationship with the dependent variable. So we implement an instrumental variables procedure in the estimation of equation [1] through the following variables:

2.a. *Population*$_{it}$: the logarithm of the average population at origin and destination on route *i* during year *t*. Source: Spanish Statistical Institute (INE).

2.b. *Unemployment*$_{it}$: the logarithm of the average rate of unemployment between origin and destination on route i_t in the year *t*. Source: Spanish Statistical Institute (INE)

2.c. *Barcelona / Madrid enlargement*: two binary variables that take value 1 following the enlargement of these two majors airports.

3. Ln competitors$_{it}$: logarithm of number of competitors on route *i* at year *t* . Source: AENA. This variable will allow us to measure the influence of the intensity of competition on prices charged by airlines. In the case that competition reduces prices charged by airlines, the sign of the coefficient associated to this variable should be negative. However, the variable for the number of competitors may also work as a proxy for the profitability of operating on the route as it may be correlated with levels of demand on the route or omitted factors that influence such profitability.

This variable may be showing an endogenous relationship with the dependent variable. So we have implemented an instrumental variables procedure in the estimation of equation [1] through the same variables as air passengers.

4. $D_{it}^{Ryanair}$: binary variable that takes value 1 if Ryanair operates route i during period t. A negative sign is expected for the coefficient associated with this variable. Ryanair usually fixes very low charges, thus inducing other route competitors to reduce prices. Note here that Ryanair is the leading low-cost airline in Europe and it is generally able to operate with lower costs than its rivals. Hence, we may expect that the presence of Ryanair on the route may have a significant impact on prices charged on the route beyond the number of airlines offering services there. Source: own elaboration from AENA.

5. $Ln\ distance_i$: logarithm of the number of kilometers between origin and destination of the route i. Route length is a major determinant of airline costs and its coefficient is expected to be positive and lower than one. This means that the increase in costs is less than proportional to the increase in the number of kilometers flown. Long-haul routes involve higher average speeds, less intense consumption of fuel, and lower airport charges per kilometer. Source: Webflyer website (http://www.webflyer.com/).

6. Difference-in-difference variables. Six variables are included in order to control the effect of the changes in the level of subsidies (33% to 38%, 38% to 45% and 45% to 50%) in the subsidized routes on the endogenous variable. Firstly, binary variables that take value 1 if the period is after the corresponding percentage of subsidy, for all routes ($D_{its}^{Period\ 38}$, $D_{its}^{Period\ 45}$, $D_{its}^{Period50}$). Secondly, the relevant variables, binary variables that takes value 1 if the route is subsidized and the period is after the corresponding percentage of subsidy (DiD_{its}^{38}, DiD_{its}^{45}, DiD_{its}^{50}). These variables show us the relative change of these *treated* routes regarding *control* group (routes without subsidies).

Discounts given to island residents may have different effects on prices (without discounts). On the one hand, the discount should increase the amount of traffic on the route (by residents), although in our price equation this effect is captured by the demand variable. Second, it may increase prices since these discounts make the demand of island residents less elastic and, as a consequence, airlines can establish higher mark-ups. On the other hand, airlines may be forced to incorporate the subsidy into the price (without discount) if they are operating in a competitive context. Indeed, the subsidy may increase the number of airlines offering flights on the route given the increased demand. This effect can in part be captured by the variable 'number of competitors'. Overall, the subsidy may have an effect both on demand and supply, so that the expected effect on airlines behavior is not clear *a priori*.

Regardless of the impact of discounts on demand and supply, prices could be lower with the discounts as they imply the existence of two different types of passengers with varying willingness to pay. As the discount only affects one of the two types of passengers (the islands residents) resident demand increases but at the expense of non-resident passengers, who can be expelled from the market. This may lead to lower demand and prices. Ideally, we should capture this latter effect through variables that distinguish between residents and non-residents but unfortunately this information is not available. However, the comparison between subsidized and non-subsidized routes may indirectly capture such effect.

In any case, we can also examine whether airlines react differently to different levels of subsidy, which is the main purpose of this analysis. In fact, this is the main added value of this study in contrast with previous papers that have examined the influence of discounts on prices.

Table 2 includes some descriptive statistics from the database. We split each data on both subsidized (treated) and non-subsidized routes (control group).

Table 2. Descriptive Statistics

Variable	Average		Standard deviation		Minimum		Maximum	
	U-S	**S**	**U-S**	**S**	**U-S**	**S**	**U-S**	**S**
Price	175.99	301.20	109.8	267.5	19.9	24.6	840.36	1,836
Passengers	558,173	570,172	695,433	473,048	49,287	66,169	4,842,969	1,775,715
Population	1,382,391	1,235,050	898,406	411,377	549,690	915,262	5,552,050	2,581,147
Unemployment	14.06	15.34	6.2	7.1	5.3	5.1	31.21	34.7
Competitors	1.97	2.80	0.8	1.1	1	1	5	7
Distance	549.11	926.61	195.9	704.9	284.6	119.2	893.52	2,193.3

Source: Own elaboration. Note: U-S represents Unsubsidized routes. S represents Subsidized routes.

Treated routes are on average more expensive, longer and have a higher number of competitors than those that are unsubsidized. In Table 3 we provide a preliminary analysis: what have been the changes in prices after each increase of the subsidy? We obtain the average prices for each period considering the differentiation between these two kinds of routes.

Table 3. Average prices by period

Route	Period under 33%	Period under 38%		Period under 45%		Period under 50%	
Subsidized	507.29 (360.52)	568.31 (347.62)	**+12.0**	378.53 (291.93)	**-33.4**	198.66 (108.72)	**-47.5**
Non-subsidized)	249.49 (125.45)	310.77 (163.75)	**+24.6**	194.04 (82.56)	**-37.6**	152.03 (77.15)	**-21.7**

Source: Own elaboration. Standard deviation among brackets. Bold numbers are the average rate change from previous period

The average changes in prices do not show a clear pattern: in the first change prices increase less in treated groups than in the control group, which is a good indicator for consumers. But in the following two modifications prices decrease less than in the control group. These results obviously require a causal analysis in order to estimate the real effect on prices.

4. Empirical strategy and results

Our empirical strategy is based on the structure of the panel database. As we have previously mentioned, this includes 47 routes for the whole period, but in an unbalanced panel. The latter is due to some new routes or others that have lost their scheduled air services in the period. Hence, we must employ an econometric technique in the context of the panel data framework.

The second question to address is that there may be a simultaneous determination of the variables of demand and number of competitors, as mentioned above. Hence, the estimation is made using an Instrumental Variables estimator with panel data.

This strategy requires the use of instruments that must be correlated with the instrumented variables and they should not be endogenous. In this regard, as noted above, we include the following variables as instruments of both variables: level of population, average rate of unemployment at origin and destination points and enlargement of Madrid and Barcelona´s airports.

The empirical analysis is based on the estimation of the following pricing equation for the route *i* in year *t* and season *s*:

$$\begin{aligned} Ln\text{Price}_{its} &= \beta_0 + \beta_1 Ln\text{Passengers}_{it} + \beta_2 LnCompetitors_{its} + \beta_3 D_{ts}^{Period\,38} \\ &+ \beta_4 D_{ts}^{Period\,45} + \beta_5 D_{ts}^{Period\,50} + \beta_6 DiD_{its}^{38} + \beta_7 DiD_{its}^{45} + \beta_8 DiD_{its}^{50} + \\ &+ \beta_9 Ln\text{Distance}_i + \beta_{10} \text{D}_{its}^{Ryanair} + \varepsilon_{its} \end{aligned} \qquad [1]$$

Table 4 shows the results of the estimation of the pricing equation. The estimation is performed using two different techniques that take advantage of the panel nature of our data: the fixed route and random effects models. The use of either model allows us to consider unobserved route heterogeneity.

An advantage of the fixed effects model is that it allows us to control for any omitted variables that correlate with the variables of interest and which do not change over time. As such, the fixed effects model is more reliable than other estimation techniques. However one shortcoming of the fixed effects model is that it may be less informative than other techniques because the effect of time-invariant variables cannot be identified. Indeed, the random effects model has the advantage that it may capture both the between and within variation of the data, while the fixed effect model only captures the within variation of the data. However, a disadvantage of the random effects model is related with the potential bias derived from the correlation between the explanatory variables and the random effects.

For this reason, the Hausman test is generally used to select the most appropriate estimation method. The Hausman test shows whether there are substantial differences between random and fixed effects. Given that the fixed effects model is always consistent but the random effects model is more efficient, if the test shows substantial differences between the random and fixed effects model then the fixed effects model is the most appropriate estimation method. In the case that substantial differences between the fixed and random effects model are not found, then the random effects model is the most appropriate choice. The Hausman test recommends using the random effects model, although we report the results of both methods for the sake of completeness. However, the discussion of results focuses on the random effects model.

The overall explanatory power of the model is reasonably good with an R^2 of 0.35. Results for the demand variable suggest that airlines may exploit density economics on denser routes. Indeed, the coefficient associated to the demand variable is negative and statistically significant. This result provides evidence in favor of one of the justifications for applying subsidies and other protection mechanisms in peripheral routes; the low demand that is typically found in peripheral routes implies that airlines must provide the service at high costs.

We also find a positive relationship between the number of competitors and prices charged on the route. This result is surprising as we might expect that the number of competitors captures the intensity of competition on the route. One possible explanation for this result is that the demand variable may be capturing the exploitation of density economics by airlines, while the variable of number of competitors may be capturing the ability of airlines to set high mark-ups over costs and hence it could work as a proxy of the profitability of the route.

In any case, another variable that may identify the intensity of competition on the route is that related with the presence of Ryanair. As mentioned above, Ryanair is the leading low-cost airline in Europe and usually offer flights with aggressive marketing at very low prices. Hence, the results of our analysis suggest that what it is relevant in terms of competition in the Spanish airline market is not the number of competitors but the identity of the competitors. Indeed, the coefficient associated to the variable of Ryanair is negative and statistically significant.

We also find evidence of distance economics as the coefficient of the distance variable is positive and statistically significant, but lower than one. It will be recalled that distance economies in the air transport market are related with the fact that longer routes involve higher average speeds, less intense consumption of fuel, and lower airport charges per kilometer.

The main variables of our analysis are the difference–in-difference variables that are constructed by the interaction between the dummy variable for subsidized routes and the period after the corresponding percentage of subsidy. In contrast to previous studies, here we can identify whether an increase in the percentage of the subsidy has led to changes in prices (without discount).

Results for this interaction variable shows that we do not find price differences between the treated routes (routes affected by the discounts) and the control routes (routes not affected by the discounts). This is the case regardless the percentage of discount on prices that island residents enjoy.

The different subsidy effects mentioned above (changes in demand and supply) seem to offset each other. Therefore, the effect of subsidies on the price without subsidy appears to be complex, which could explain our result. In any case, a clear implication of this result is that island residents have taken advantage of the discounts through lower prices (with the discount) while non-residents are not harm by the discount policy as prices without the discount are not higher.

Table 4. Price equation using panel data estimations with instrumental variables

Covariates	Fixed effects	Random effects
Ln passengers	-0.20 (0.47)	-0.61 (0.16)***
Ln competitors	1.98 (0.53)***	1.84 (0.51)***
Period under subsidy 38	-0.08 (0.17)	4e-4 (0.13)
Period under subsidy 45	-0.60 (0.19)***	-0.44 (0.13)***
Period under subsidy 50	-1.14 (0.19)***	-0.92 (0.08)***
DiD under 38	**0.11 (0.23)**	**0.06 (0.21)**
DiD under 45	**0.37 (0.25)**	**0.26 (0.20)**
DiD under 50	**-0.10 (0.13)**	**-0.19 (0.12)**
Ryanair	-0.98 (0.22)***	-1.02 (0.22)***
Ln distance		0.14 (0.07)**
Constant	7.17 (5.83)	11.53 (2.14)***
Observations	727	727
R^2 (overall)	0.26	0.35
Hausman test	Prob>chi2=0.9757	

Note 1: *** 1%, ** 5%, *10% significance test. Standard errors among brackets.
Note 2: Passengers and number of competitors have been estimated using the following instruments: average population between two cities, average rate of unemployment and enlargement of Madrid and Barcelona´s airports.

5. Conclusions

This paper has analyzed the impact on prices of different levels of discounts to island residents using data drawn from a large sample of Spanish airline market routes. The results suggest that prices on subsidized routes are no different to prices on unsubsidized routes after controlling for demand, distance and the intensity of competition on the route. Furthermore, our analysis does not find a differential reaction of airlines to different levels of subsidy. Indeed, the subsidized routes have been affected by several regulatory changes that increased the percentage of discounts for island residents from 33% to 50%. Despite the magnitude of the changes in the amount of the discount enjoyed by island residents, we have not found a significant difference in the level of prices (without the discount). Thus, our analysis shows that the discount policy seems to work as a subsidy to the island residents and not as a subsidy to the airlines, as the latter do not increase prices on subsidized routes. Furthermore, given that airlines do not increase prices on subsidized routes, non-residents are unaffected by the discount policy.

Overall, the discount policy may be effective in reducing the costs of insularity and the long distance travel to/from the mainland for residents. Indeed, the discount policy may promote the mobility at national level of residents in islands, as airlines do not pass the increased demand to passengers through higher prices (without the discount). Having said this, the increased subsidy implies an increase in the amount of public resources devoted to protecting island residents. As noted above, Spanish governments spend more than €300 million of the Spanish annual budget on air transport subsidies.

Regarding this point, alternative policies could be implemented to protect passenger residents on islands, with a lower impact on the governmental budget. Some of these policies might include providing a specific subsidy that does not depend on ticket price, applying a price-cap or favorable tax treatment for specific routes (although competition policy rules must work in this specific case), or subsidize the airline instead of subsidizing the passenger. Evaluation of these alternative policies could be the subject of further research.

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