The Remains of Regulation: Airlines' Profits after Liberalization*

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Abstract

This paper develops an empirical model of entry to analyse the effect of previous regulation on European airlines' post-liberalization profits. I distinguish between European flag carriers which are highly regulated at the beginning of the eighties, and independent airlines. I find that the latter enjoy sunk-cost advantages but get lower variable profits than the former. This means that possible efficiency disadvantages suffered by the flag carriers are more than offset by their higher perceived quality, leading to a situation in which they are less likely to enter a route, but also less likely to exit.

Keywords: airlines, profits, entry, deregulation.

JEL Nos.: L19, L59, L93.

I. INTRODUCTION

This paper analyzes the impact of liberalization on the market structure of the European airline industry and studies the effect of previous regulation on firms' post-liberalization profits and probability of entry.

During the eighties, the European airline industry started a process of liberalization that finished on January 1993 with the Third Package of measures introduced by the European Union. This package of deregulatory measures allows all EU carriers to operate any route within the EU, with no restrictions on fares, capacities or frequencies.[1] According to the Memorandum No. 2 published by the European Economic Commission [see European Economic Commission (1984)] the aim of these reforms is to create a more competitive and efficient airline market in Europe, compatible with the viability of the European carriers.

The liberalization of the European airline industry is intended to increase competition and so to move fares close to costs and to increase the incentives to improve efficiency. However, most European flag carriers need to implement

[1] The only exception is domestic cabotage, that is to be liberalized in April 1997.

drastic restructuring plans before becoming viable in a competitive framework. Accordingly, during the last few years they have been requesting subsidies and state aid to finance their restructuring plans. However, giving aid to European flag carriers may imply that more efficient unsubsidised competitors have limited access to many European routes and cannot reach relevant market shares.

In this paper, I distinguish between European flag carriers and independent airlines. European flag carriers were subject to tight regulation until the mid-eighties. In particular, firms were not able to compete either on prices or capacities and entry to and exit from a route were regulated by bilateral agreements. On the other hand, independent carriers such as brand new firms, charter companies and American carriers were operating under more liberal legislation in the same period. These two sets of firms differ in two respects, efficiency and perceived quality differences. For instance, we could expect flag carriers to be less efficient if regulation had introduced distortions in their organizational structure which are difficult to correct in the short run. We could also expect them to have higher perceived quality standards than independents due to their strong reputation and presence in the market. It is clear that efficiency and perceived quality standards are among the main determinants of profits. By distinguishing between these two sets of firms we can identify the main effects of previous regulation on firms' profits and their probability of entry in individual routes after the liberalization. With this information, we can evaluate if further subsidies to finance flag carriers' restructuring plans can be warranted by their relative position in the market.

Given the recent introduction of the EU Third Package of deregulatory measures, it is still too early to analyze its impact on the European airline market structure. However, in 1984 and subsequent years various European countries (e.g. United Kingdom, Ireland and the Netherlands among others) signed liberal bilateral agreements allowing entry and price competition in their international routes. Previous studies [Abbot and Thompson (1991) and Marín (1995), among others] have shown that the introduction of these agreements has given rise to more competition, affecting prices, costs and the strategic behaviour of the firms. Given that these agreements have almost the same characteristics that the EU Third Package of measures, I use the set of routes affected by the agreements to analyze the differences in profitability between European flag carriers and independent airlines.

Given that airlines' profits in individual routes are not directly observable and entry only takes place when profits are expected to be positive, I construct an empirical model of entry in which entry decisions depend on the determinants of profits. I assume that the heterogeneity of potential entrants leads to strategic asymmetries which can be captured by modelling entry as a sequential move game. The sequential move model in this paper has a unique pure-strategy equilibrium. Moreover, I assume that the order of moves is determined by the expected post-entry profits of the firms in the market. So that the determinants of the order of moves coincide with the determinants of profits. Given these two circumstances, the use of standard qualitative choice model estimation techniques is appropriate.

In order to identify the effects of previous regulation on firms' profits, the model of entry includes a dummy variable with different values for European flag carriers and independent airlines. I apply this model to a panel of data on a set of European air routes affected by the introduction of liberal bilateral agreements. I find that European flag carriers have both a lower probability of entry and a lower probability of exit since both their sunk costs and variable profits are higher than those of the independent carriers. This arises because flag carriers enjoy higher perceived quality standards achieved through higher advertising intensities and other brand image sunk costs which enhance consumers' willingness to pay for their products. The positive effect of this perceived quality on variable profits more than offsets any negative effect derived from their possible lower efficiency. Additionally, some other market devices related to the control of airport facilities increase the probability of entry to and reduce the probability of exit from a route. It is obvious that European flag carriers benefit more from these market devices than independent airlines. This paper shows that both the higher perceived quality and the control of airport facilities allow European flag carriers to keep a privileged position in the European market, which and so questions their need for additional state aid.

II. AN EMPIRICAL MODEL OF ENTRY

II(i). *Firms' decision process*

Airline companies can be regarded as multimarket firms, each route being a different market. Both physical and human capital are non-market specific. That is [according to Teece (1982)], most inputs employed by the firm are not specialized to the particular products and services which the enterprise is currently producing. Therefore, we can represent the decision process of the firms as a sequence of decisions as follows. First, firms make a long run choice about technology and quality standards. Second, they decide the set of markets in which to operate given this organizational technology. Finally, they compete in each market and earn post-entry profits. Accordingly, both incumbents and other potential entrants[2] make a choice to stay in or out of each market in every period.[3]

Following Berry (1992), I do not model equilibrium choices over entire networks, but follow a partial equilibrium approach and analyze single routes. This does not imply that firms do not consider some aspects of their network structure when making their entry decisions. However, I assume that at the beginning of each period a firm takes its previous overall network structure and customers' goodwill as given and decides whether to serve a given route. Accordingly, I define the entry decision as the decision of serving one route in a particular

[2] For a definition of the set of potential entrants, see the Appendix.

[3] Note that the entry-no entry decision for the incumbent firms is equivalent to a no exit-exit decision.

period. It is clear that this decision affects both incumbents in the previous year and other potential entrants. I further assume that firms follow a profit maximization criterion.

II(ii). *Equilibrium configuration in a sequential-move entry model*

We model entry into a particular route as a multiple-person game in which each players' action depends not just on their own preferences, but also on the actions of the other players.[4] The most widely used equilibrium concept is the Nash equilibrium. The strategies are assumed to form a pure-strategy Nash equilibrium for each player when no player i can unilaterally increase its pay-off, π_i. The set of strategies E^*_i form a Nash pure-strategy equilibrium if

(1) $\pi_i(E^*_1, \ldots, E^*_i, \ldots, E^*_N) \geq \pi_i(E^*_1, \ldots, E_i, \ldots, E^*_N)$, for all i.

Consider the entry choice in a single air route. Potential entrants are airlines that have been operating for some time in the industry with specific network structure, efficiency and customers' goodwill. Given these circumstances, I assume that

[4] See Bresnahan and Reiss (1991) for a more detail explanation of the difference between single-person and multiple-person games.

before the entry game starts firms have complete information about their characteristics and the characteristics of their potential rivals. Then, we can order all potential entrants according to the profits they expect to earn should they enter that market, so that $i=1$ is the most profitable and $i=N$ the least. Following Berry (1992), I assume that this ordering does not change as the set of entering firms changes. I also assume that, first, profits are decreasing in the number of entering firms, which is consistent with the standard models of oligopolistic competition, and second, potential entrants choose whether or not to enter sequentially, with the most profitable choosing first.[5] These assumptions ensure that the entry game has a unique pure-strategy equilibrium. Thus, if we write $E_i=1$ if firm i enters, and $E_i=0$ otherwise, and denote by π_i^j the expected profits earned by firm i should j firms enter in total. Then the Nash equilibrium entry strategies are given by

(2) $E^*_i = 1 \Leftrightarrow \pi_i^i \geq 0$, for all i.

It is important to notice that the relevant entry condition is $\pi_i^i \geq 0$ and not $\pi_i^n \geq 0$, where n is the equilibrium number of firms in the market. It is clear that for $i \leq n$ these two conditions are equivalent. Given that profits are decreasing

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[5] See Koopmans and Lamo (1994) for examples of entry games in which most profitable firms enter first.

with the number of firms operating in the market, $\pi_i^n \geq 0$ implies $\pi_i^i \geq 0$, and, given the order of moves, i is more profitable than n and $\pi_n^n \geq 0$ implies $\pi_i^n \geq 0$. However for $i > n$, the two conditions are not equivalent. In fact, $\pi_i^n \geq 0$ does not imply $E_i = 1$. It is obvious that when $\pi_i^n \geq 0$ but $\pi_i^i < 0$, firm i will not enter the market, given the current order of moves. Provided that n is the equilibrium number of firms in the market, entry for any firm $i > n$, would imply $\pi_i^{n+1} < 0$ and therefore $E^*_i = 0$.[6]

This equilibrium condition characterises a distinctive and unique pure-strategy Nash equilibrium, in which the entry decision depends on the order of moves. This equilibrium condition has two important features. First, it does not depend on the equilibrium number of entries, n. Second, even when the econometrician does not know the order of moves, he observes its main determinants, and these are the same as those which determine the firm specific component in the profit function. It is clear that the assumption about the determinants

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[6] One intuitive reason explaining why firms make their entry decisions conditional on what more profitable firms do, not taking into account less profitable firms' actions is that when too many competitors enter the market, firms get negative profits, entry is followed by an intensive competition and the less profitable firms exit the market.

of the order of moves is crucial and any alternative order of moves based on a different criterion would imply a more complicated estimation procedure.

Recall that given the firms' decision process specified above, the incumbent firms in the previous period are included in the set of potential entrants together with other potential entrants. This also means that an incumbent firm in the previous period which makes a no-entry decision is actually making an exit decision.

Finally, note that are the special characteristics of this game those that preclude nonunique and nonexistent equilibria common to other types of games. For instance, in entry games in which potential entrants decide to enter for the first time in an industry, it is common to assume that before the game starts all the players are the same and, therefore, they play simultaneously. However, simultaneous move entry games generate non-unique equilibria. One way to restrict the number of possible equilibria is to assume that profits are non increasing in the number of entering firms. Bresnahan and Reiss (1990) show that this assumption insures that a pure-strategy equilibrium exists and precludes several non-unique equilibria from occurring, but one region of non-unique equilibrium remains. Multiple equilibria take place when the equilibrium number of entries is n, for any $0<n<N$, where N is the number of potential entrants. In this case, it is not possible to identify the firms that decide to enter in the market, but only the number of entries [see Bresnahan and Reiss (1987 and 1990) and Reiss and Spiller (1989)].

II(iii). *Determinants of profits*

Equilibrium condition (2) defines the optimal action for each potential entrant in any market. This equation defines the entry condition based on firm i's maximum expected post-entry profits. The action taken by other potential entrants is represented by the superindex, which determines the minimum number of rivals that firm i expects to face if it decides to enter the market.

Let us express firm i's total expected post-entry profits when there are j firms operating in the market, π_i^j, as

(3) $\pi_i^j = \nu_i^j(\epsilon_i, S) - (1-\phi_i)\ \sigma_i(\epsilon_i, S)$

where ν_i^j are firm i variable profits when there are j firms operating in the market, σ_i represents firm i's sunk costs of entry, which are independent of the number of firms operating in the market, and ϕ_i is a dummy variable equal to one for incumbent firms in the previous period and zero for other potential entrants, i.e., sunk costs are to be paid only by non-incumbent firms in the previous period. Both ν_i^i and σ_i are determined by firm *i*'s specific characteristics, ϵ_i, and market size, *S*.

In terms of an empirical model, the expected profit function can be parameterized as functions of observable variables and a structural error. In particular, the reduced form expected variable profit and sunk costs functions are derived from the actual and expected values of a set of variables that represent firms' specific characteristics, ϵ, and market size, *S*. The variable profits and the sunk costs reduced forms for firm *i* when there are *i* firms operating in market *k* and period *t* can be expressed as

(4) $\nu_{ikt}^{\,i} = \nu(\epsilon_{ikt}, S_{kt}, i(\epsilon_{ikt}); \alpha) + \mu_{1ikt}$

(5) $\sigma_{ikt} = \sigma(\epsilon_{ikt}, S_{kt}; \beta) + \mu_{2ikt}$

where *i* represents the order of moves which is determined by firms' specific characteristics, α and β are parameters to be estimated and μ_{1ikt} and μ_{2ikt} are error terms that I assume are standard normal distributed and independent of each other.

Accordingly, given equilibrium condition (2) and expression (3), firm *i*'s probability of entry in market *k* and period *t* can be written as

(6) $\text{Prob}\{E_{ikt}=1\} = \text{Prob}\{\pi_{ikt}^{\,i} \geq 0\} = \text{Prob}\{\nu_{ikt}^{\,i}-(1-\phi)\sigma_{ikt} \geq 0\}$

The observable variables included in the regression measure firm specific characteristics and market size and are the following. Among the firm specific characteristics, ϵ_i, I include airport presence at the two endpoints of the route, *AP*,[7] to measure economies of scope. This variable gives weights to the routes that the firm is currently operating according to their proximity or relatedness to the new market. Since *AP* is affected by entry decisions taken in the same period I include one period lagged values in the regressions. A higher *AP* is expected to increase the efficiency of the firm, reducing variable and sunk costs and thus having a positive effect on entry. *AP* can also measure perceived quality since a higher airport presence may enhance customers' willingness to pay. Most of the recent American literature [see Berry (1990) and Evans and Kessides (1993), among others] stresses the fact that this variable, on the one hand reduces costs and prices, while on the other hand increases the perceived quality of the product, and so the prices. Nevertheless, the two interpretations of *AP* have an unambiguous positive effect on profits. According to the empirical evidence on entry for the airlines industry [see Berry (1992)], airport presence is the

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[7] See the Appendix for a detailed definition of all the variables.

main determinant of entry in one route. The target of the present paper is to identify the effects of previous regulation on profits and the probability of entry. It is obvious that flag carriers have been operating in the European market for a long period and they all enjoy a high airport presence. By including the variable *AP* in the regression we can distinguish this effect from other less evident differences between European flag carriers and independent firms. In the regressions I include one period lagged values of this variable in order to avoid endogeneity problems.

To measure other effects of regulation on firms' profits, I include among the firm specific characteristics, ϵ_i, a dummy variable, *Y*, equal to one for independent airlines and zero for flag carriers. This variable can affect both variable profits and sunk costs. On the one hand, *Y* measures efficiency differences. For instance, regulated firms could be either more efficient, if their better knowledge of the market improves their performance, or less efficient, if the tight regulation has had a negative effect on their organizational structure. The set of more efficient firms are expected to have higher variable profits. On the other hand, *Y* also represents differences in perceived quality. For instance, European flag carriers, could have a better image than some of the independent firms, such as charter companies and brand new firms, because of their strong reputation and presence in the European market, their higher advertising intensities, etc. A better perceived quality implies higher variable profits and sunk costs of entry, as it involves larger advertising expenditures, higher image costs in opening a new desk in the airport, etc. Therefore, the sign and significance of the coefficients of *Y* on the variable profits and the sunk costs functions will indicate the total effect of previous regulation on total profits and can be informative about the differences in efficiency and perceived quality between flag carriers and independent firms.

Finally, we need to consider a variable measuring market size, *S*. This variable is traffic volume, *TV*, and is included in the regression in log form. Given that entry decisions can affect the current value of this variable which could lead to endogeneity problems, I include one period lagged values in the regressions. I allow this variable to affect both variable profits and sunk costs of entry.

Accordingly, firm *i*'s variable profits and extra sunk costs derived from entry in market *k* in period *t* can be specified as follows

(7) $\nu_{ikt}^{i} = \alpha_0 + \alpha_1 AP_{ikt-1} + \alpha_2 Y_i + \alpha_3 lnTV_{kt-1} + \mu_{1ikt}$

(8) $\sigma_{ikt} = \beta_0 + \beta_1 AP_{ikt-1} + \beta_2 Y_i + \beta_3 lnTV_{kt-1} + \mu_{2ikt}$

Thus, total profits can be written as

(9) $$\pi_{ikt}^{\ i} = \alpha_0 - (1 - \phi_{ikt-1})\,\beta_0 + [\alpha_1 - (1 - \phi_{ikt})\,\beta_1]\,AP_{ikt-1} + [\alpha_2 - (1 - \phi_{ikt})\,\beta_2]\,Y_i + [\alpha_3 - (1 - \phi_{ikt})\,\beta_3]\,lnTV_{kt-1} + u_{ikt}$$

where $u_{ikt}=\mu_{1ikt}-(1 - \phi_{ikt})\mu_{2ikt}$.

The probability of entry, Prob$\{E_{ikt}\}$, can be estimated according to a binomial probit model. In order to identify all the parameters in the variable profit and sunk cost functions recall that the dummy variable, ϕ_{ikt}, is equal to one for incumbent firms in the previous period and zero for other potential entrants and I include it in the regressions interacting with *AP*, *Y* and *lnTV*.

III. RESULTS AND INTERPRETATION

Tables I to III provide evidence about the significant changes in market structure that are taking place between 1984 and 1990 in the routes affected by the introduction of the liberal bilateral agreements. In particular, table I shows a great deal of simultaneous gross new entry and exit after the introduction of the agreements.[8] Net new entry for the whole period is positive even if in one specific year it is negative. As

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[8] Figures on new entry only include entry decisions by firms other than incumbents in the previous period.

Table I. New Entry and Exit after the introduction of the Liberal Bilateral Agreements. 1985-90.

	1985	1986	1987	1988	1989	1990
Gross New Entry	7	6	3	10	12	5
Exit	5	5	5	3	5	5
Net New Entry	2	1	-2	7	7	0
Avg. No. of Firms	3.3	3.4	3.3	3.7	4.1	4.1

Table II. Survival rates of firms established in 1984 (1) and new competitors that entered after 1984 (2).

	1984	1985	1986	1987	1988	1989	1990
(1)	100%	83.5%	75.2%	64.9%	61.8%	57.7%	52.6%

	1st year	2nd year	3rd year	4th year	5th year	6th year
(2)	100%	88.1%	58.1%	52.9%	42.9%	37.5%

Table III. Average market success and penetration by successful new entrants[1].

	1985	1986	1987	1988	1989	1990
Market success[2]	5.3%	10.0%	16.0%	19.8%	20.5%	23.9%
Market penetration[3]	6.2%	5.3%	5.4%	7.0%	8.5%	8.0%

Notes:

[1] The set of successful new entrants includes all those firms that were not operating on the route in 1984, entered during the period 1985-88 and were still operating in 1990, i.e. at least 3 years.

[2] Market success figures show the average percentage of successful new entrants operating on all the routes.

[3] Market penetration figures show the average percentage of the market supplied by successful new entrants.

a result the average number of firms operating on these routes has been increasing during the period under study. Moreover, the figures of gross new entry and exit are much larger than those of net new entry and cannot be warranted by the growth of the market. On the contrary, firms characteristics must be among the main determinants of gross new entry and exit, and the turnover of firms that they imply.

Table II provides the survival rates of firms that were incumbent in 1984, and new competitors that entered after 1984. Only about one half of the firms operating in 1984 were still serving the same market six years later and almost one half of the new competitors do not stay in the market more than three years. These results point out the speed of the changes in the composition of firms serving each route and the importance of exit and unsuccessful entry in the industry. Table III provides further evidence about entry characteristics. Market success figures are larger than market penetration figures because the new competitors still keep lower market shares than incumbents. This means that while entry is very common, many new competitors have problems in consolidating their position in the market. Nevertheless, both variables seem to follow a positive trend.

Table IV presents the results of estimating the probability that a firm enters a route according to the sequential-move model specified above. According to equation (9), this probability depends on the airport presence of the firm in the two route endpoints, on other effects of previous regulation on profits and on the size of the market. Moreover, these three variables can have different effects on variable profits and sunk costs of entry. The first column presents the estimated coefficients and the second column the marginal effects.[9]

The coefficient of *AP* in the variable profits equation is positive and significant, while in the sunk costs equation it is negative but not very significant. This means that the effect of this variable on entry is positive, and that this positive effect can be ascribed to firms with a higher airport presence earning higher variable profits, rather than to any effect on sunk costs. This finding is consistent with previous studies that show that airport presence has an important effect on variable profits. The effect of this variable is mainly going to benefit the local

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[9] Note that the marginal effects, δ, in the binomial probit model are distinct from the parameters, β. In fact, the marginal effects or derivatives of

$$E[y_i|x_i] = \Lambda(\beta' x_i)$$

are

$$\delta = \partial\Lambda(\beta' x_i)/\partial x_i$$

Table IV. Maximum Likelihood Estimates for Prob{E_{ikt}}. Binomial Probit Model.

	Estimates	Marginal Effects
α_0	-1.89	-5.94
	(-1.30)	(-1.26)
α_1	2.07	6.51
	(2.21)	(1.99)
α_2	-0.77	-2.41
	(-2.15)	(-2.05)
α_3	0.27	0.84
	(2.24)	(2.09)
β_0	1.94	6.10
	(1.14)	(1.17)
β_1	-0.95	-2.99
	(-0.86)	(-0.90)
β_2	-1.40	-4.41
	(-3.49)	(-3.42)
β_3	0.18	0.55
	(1.28)	(1.23)
$\chi^2(7)$	1541.29	
Pseudo R^2	0.74	
Prop. succ. pred.	97.12%	
Success index	76.52%	
N	2116	

Notes: *t*-test in parenthesis.

χ^2 is the Maximum Likelihood Ratio testing H_0: $\beta=0$.

flag carrier that has high airport presence in the domestic airports and controls access to domestic airport facilities.

The dummy variable *Y*, equal to one for independent firms not subject to regulation at the beginning of the eighties, and zero for European flag carriers, has negative and significant coefficients on both the variable profit equation and the sunk costs equation. This means that after controlling for differences in airport presence, some other differences between these two types of firms remain very significant. The most plausible interpretation for these results suggests that European flag carriers have higher perceived quality standards than independent carriers. Table V presents the average values for the main firm specific variables for these two sets of firms. The figures show that the average flag carrier has higher advertising goodwill, advertising intensity and wages than the average independent airline. The last column in table V shows the *t*-test for the difference in the sample means. Differences in advertising goodwill and intensity are significant at the 10 per cent level, implying higher perceived quality standards and, in turn, higher sunk costs for the flag carriers. According to Shaked and Sutton's (1982) model of oligopolistic competition with vertical product differentiation this also implies that they have greater market shares and mark-ups on marginal costs

Table V. Average values of the main specific firm characteristics for flag carriers and independent firms.[1]

Variable	Flag Carriers	Independent Carriers	*t*-test[2]
Wages[3]	34,550	28,114	1.047
AG	0.925	0,751	1.385
A/S	0,178	0,141	1.471

Notes:

[1] Values for 1985.

[2] *t*-test for the difference between flag carriers and independent firms sample means.

[3] See Appendix for variable definitions.

and, in turn, higher variable profits.[10] Notice that this result is consistent with either flag carriers or independent firms being the most efficient producer. All that is needed is that independent firms are not so much more efficient than flag carriers that the beneficial effects of efficiency on their variable profits outweigh the negative effects that come from being the low quality producer. Differences in wages reported in table V are not significant, but the figures could suggest that flag carriers have higher costs and are less efficient than independents.

The effects of these variables on the probability of new entry and exit can be easily calculated, substituting the estimated coefficients in equation (9). The results in table IV imply that independent firms have a higher probability of new entry, since the effect of Y on sunk costs dominates the effect on variable profits, but they also have a higher probability of exit, i.e., a lower probability of staying in the market. In particular, the second column in table IV presents the marginal effects for Prob$\{E_{ikt}\}$ with respect to changes in the explanatory

[10] This is also consistent with Marín (1995) who shows that after the introduction of the liberal bilateral agreements advertising goodwill has a positive and significant effect on both market share and the price-cost margin.

variables. For instance, independent airlines have double the probability of new entry than flag carriers, but this advantage can be offset by those flag carriers that have at least 10.5% more airport presence in the route than the independent carrier.[11] However, an independent airline also has 2.41 times more probability of exit than a flag carrier, and it would need to have at least 18.5% more airport presence than the flag carrier to offset this negative effect. These results are consistent with the high figures of gross new entry and exit and the low survival rates of new competitors, shown in tables I and II. In particular, they suggest that among the new competitors in a specific market, we are going to find both flag carriers and independent firms, but many independent firms are very likely to exit the market after a few years.

Finally, the variable *ln(TV)* has a positive and significant coefficient in the variable profits equation and a smaller, positive and not significant coefficient in the sunk costs equation. As a result, the overall effect of this variable on the probability of entry is positive, i.e., larger markets attract more entry, as expected. Additionally, the goodness of fit is very satisfactory. The maximum likelihood ratio is significant at less

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[11] Note that *Airport Presence* goes from 0 to 2.

than the one per cent level, the pseudo R^2 is 0.74,[12] the proportion of events successfully predicted is 97.12 per cent and the success index, that measures the proportion successfully predicted by the model when the two possible outcomes are uniformly distributed, is equal to 76.52 per cent.

This model was also estimated separately for each year. The main results were consistent with those reported for the pooled model, but the significance of some variables was lower. No trend in the estimates was noted.

IV. CONCLUSIONS

In this paper I compare European flag carriers, which were highly regulated at the beginning of the eighties, with independent firms, such as brand new firms, charter companies and American carriers, which were competing in less regulated environments during the same period. I find that European flag carriers have higher variable profits and higher sunk costs than independent airlines. This happens because they have more customers' goodwill, due to their reputation, their strong presence in the market for a long time and their higher

[12] The pseudo R^2 for a probit model is based on the formula given by Zavoina and McElvey (1975).

advertising goodwill. This implies that they have higher market shares and price-marginal cost margins and, in turn, higher variable profits. This also induces them to keep higher advertising intensities and image costs of opening a new desk in the airport. As long as the sunk costs effect is larger than the variable profits effect, flag carriers have a lower probability of entry in a new route. However, they also have a lower probability of exit due to their higher variable profits.

It is clear that a tight regulation could have had some negative effects on European flag carriers, introducing distortions on their organizational structure. However, it also had positive effects on these firms, since now they can use their larger network economies, derived from their higher airport presence in Europe, and their higher perceived quality standards to improve their performance. This paper shows that new, charter and non-European carriers are more likely to enter in a route, but they are unlikely to be able to consolidate their position. Therefore, the liberalization of the market has not provoked a drastic alteration in the identity of the companies operating in the market, but rather a reorganization of the European flag carriers network structure. Moreover, this means that even if the belief that flag carriers are less efficient than independent airlines is true, differences in efficiency are not large enough to offset the positive effect of other advantages enjoyed by the flag carriers. We can conclude that it is difficult to justify the protection and subsidies that many European flag carriers request from their governments.

APPENDIX. DATA AND VARIABLE DEFINITIONS

I analyze a panel of annual data on the largest 18 routes affected by the introduction of European liberal bilateral agreements, where a large number of entries and exits took place during the period 1985-90. Given the nature of these agreements, all these routes are international intra-European routes between United Kingdom, the Netherlands, Ireland, Germany and Belgium. In particular, the routes analyzed are London-Amsterdam, London-Brussels, London-Frankfurt, London-Hamburg, London-Dusseldorf, London-Dublin, Manchester-Amsterdam, Manchester-Frankfurt, Manchester-Brussels, Manchester-Dublin, Birmingham-Dublin, Amsterdam-Brussels, Amsterdam-Frankfurt, Amsterdam-Hamburg, Amsterdam-Dusseldorf, Brussels-Frankfurt, Brussels-Hamburg and Brussels-Dusseldorf.

The data are taken from the *Digest of Statistics (International Civil Aviation Organization)* and the variables involved in the study have been computed from annual data on: revenue passengers carried, wages, promotion outlays, total operating revenues and name and number of firms serving each route.

The sample includes firms operating in any of these routes between 1984 and 1990 and an additional set of potential entrants defined according to their airport presence on the route terminal airports. The selection criterion for the potential entrants is based on the variable *Airport Presence* (see definition below).[13] The set of potential entrants in a route includes the incumbent firms in the previous period and the firms having an airport presence greater or equal to two per cent.[14]

I do not regard as effective entrants, those firms that did not reach a one per cent market share during the first two years operating on the route and had exited the route by the third year.[15] The reason for introducing this minimum threshold to

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[13] This choice is consistent with the previous literature, see for instance Berry (1992).

[14] Several cut-off points have been tried, any positive AP_{ik}, AP_{ik} above five per cent, etc., and the results of the regressions are robust to this changes in the sample.

[15] I allow for a second year because I use annual data and there is not further information about the date when the entries take place. This means that, on the one hand, some firms do not reach a one per cent market share in the first year because they enter late in the year but they offer high frequencies and capacities and have to be regarded as effective entrants. On the other hand, some firms are operating in the market during two different years but actually they stay in the market only for a few weeks, some at the end of the first year, some at the

define entry is that we are interested in equilibrium strategies, but sometimes firms could have made wrong entry decisions, so that their current choice did not coincide with their equilibrium strategy. In these few cases, entry will be followed by strong competition and the exit of the less profitable firms.

The variables are defined as follows:

Airport Presence $(AP)_{ik}$.- Sum of the proportion of route served by company i at the two terminal airports of route k.

Advertising Goodwill $(AG)_i$.-

$$AG_{it} = (1 - d)\ AG_{it-1} + (A/S)_{it} = \sum_{j=0}^{\infty} (1 - d)^j\ (A/S)_{it-j}, \qquad 0 \leq d \leq 1.$$

where $(A/S)_{it}$ is firm i's promotional outlays on total sales revenue ratio in period t, and d is the decay rate at which the value of the previous advertising goodwill depreciates, that I assume equal to 0.1.

Advertising Intensity $(A/S)_i$.- Promotion outlays-total operating revenues ratio.

Traffic Volume $(TV)_k$.- Total passengers revenue carried.

$Wages_i$.- Weighted average wage of pilots, co-pilots, other cockpit personnel and cabin attendants, in dollars.

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beginning of the second year, and these firms cannot be regarded as effective entrants.

Y_i.- Dummy variable equal to one for independent carriers and zero for flag carriers.

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