European Airlines' TFP and the 2001 Attack: Towards Safety in a Risk Society

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Abstract. The purpose of this paper is to analyze in terms of security the complexity of European Air Transport after the 2001 terrorist attack, taking into account Total Factor Productivity (T.F.P.) change. Our approach regards European Air Transport as a complex system of airplanes, airports and control. The investigation is based on recent data from the Amadeus database for the largest European (EU-27) air transportation companies (1997-2005). The paper employs the Cobb-Douglas specification of the production function and, in this context, tests the hypothesis that the 2001 terrorist attack had a significant influence on the performance of the EU-27 air transportation companies. An interesting finding is that except for some companies that were negatively influenced, several others were positively influenced by the 2001 terrorist attack. The technological level of the companies included in our dataset remained almost unchanged. The empirical findings are discussed and some suggestions are made regarding policy issues.

Keywords: European air transport, TFP, 2001 terrorist attack, production function, safety state.

1 Introduction

Undoubtedly, globalization has been one of the major characteristics of the 20th century. In line with other sectors, aviation has experienced a significant move toward globalization. After all, it is the stated objective of many airline carriers to become "global". In fact, in the twentieth century the demands of air transport users have expanded, technology has progressed and new markets have emerged [1]. Nowadays, international air transport is constantly growing a fact that promotes trade in related sectors. Meanwhile, the airline industry has been the subject of significant governmental interventions and one that was often based on great transatlantic industrial corporations that exchanged their *know-how* and undertook joint-ventures.

More precisely, air passenger traffic has grown worldwide at an average annual rate equal to about 9% since 1960 and has become a major industry, contributing to both domestic and international transport systems. Also, it constitutes a critical component in the growth of tourism, which is one of the world's major employment

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sectors [2]. In addition, it carries about 30% of world trade. Although aviation was forecasted to rise considerably by 2015 [3], the very recent financial crisis seems to worsen its performance.

The combination of institutional reforms with rising incomes and increased leisure time has led to the steady growth of air services. Additionally, technological changes have increased aircraft efficiency thus exerting a positive effect on cost. As a response to this situation, the airlines have adopted even more aggressive strategies with the introduction of frequent flier programs [4], [5]. However, the very recent financial crisis had a negative impact on these strategies and on the cost of flights. Meanwhile, it influenced negatively the prosperity, the leisure time and the availability of potential passengers to engage into (long-lasting) flights.

Of course, the past few years have been very difficult for air transportation given the tremendous shock of September 11, 2001. Since then, the air transport industry had to deal with a variety of problems. Overall, many airlines reported losses in 2002 and 2003. However, many airlines have made significant progress. Apparently, after the events of September 2001 considerable changes in air transportation have taken place. The low-cost carriers are continuing to take market share away from the other carriers as their route structure has grown large enough. In contrast, the traditional carriers, in order to effectively compete with low-cost carriers, have to find a way to reduce their costs. Some of them have introduced their own low-cost subsidiaries to compete with the low-cost airlines. Meanwhile, business travelers have relied more on other means of transportation such as ground travel, low-fare carriers, charters, corporate jets and regional carriers.

Conclusively, although the events of 2001 and the recent financial crisis have undoubtedly had a negative impact on the majority of air carriers, we have no serious reasons to believe that the industry will not remain a critical component in the global economy and the system of transportation in the future [6]. The intense competition in the industry is likely to intensify in the future. Thus, productivity gains will continue to be an important part of the industry's cost-reduction efforts. In this framework, it is apparent that reliable quantitative performance indicators are of paramount importance for policy matters and for monitoring internal operation [7].

This paper has three objectives: first to provide estimates of total factor productivity (T.F.P.) change accounting for technological change, as well as estimates of labor and capital productivity, for the largest European air carriers, over the time period 1997-2005 when data is available; second to assess the impact that the tremendous shock in 2001 had on the largest European air carriers; third to analyze the policy implications, taking into account the complexity of the air transport industry which is regarded as a *system* within the safety state.

The paper is structured as follows: Section 2 engages into a review of the literature; section 3 presents the methodology; section 4 sets out the data and the empirical framework, section 5 analyses the results; section 6 presents some policy insights; finally, section 7 concludes.

2 Review of the Literature

The institutional structure of air transport services has been through significant developments [8]. For instance, U.S. economic deregulation in 1977-78 changed the U.S.

policy in this area. This also affected other air transport markets [7], [1], [9]. More precisely, many European countries liberalized their markets, while the European Union (E.U.) moved to a position that has deregulated air transport since 1997 [10], [11], [12]. Besides Europe and North America, the majority of markets in South America have also been liberalized.

According to Siregar and Norsworthy [13] who measured productivity in the U.S. airline after the deregulations, productivity has increased considerably over time. Longer flights, higher aircraft utilization rates, along with more efficient aircraft and operational plans designed to economize fuel are major reasons for higher productivity performance in the industry. This achievement could not be realized unless technological changes in the aircraft manufacturing and in the management practices of airline companies take place.

In a very similar vein, Apostolides [14] examined labor productivity and TFP in U.S. air transportation during the 1990 - 2001 time span. He found that labor productivity and TFP in air transportation both increased over the analysis period, i.e. after the deregulations. Factors affecting increases in labor productivity include increases in capital intensity. Factors affecting TFP include improvements in the capital input, measures that increase the utilization of air carrier resources, measures that speed up maintenance work and the marketing of air services, and changes in industry structure.

The relevant literature dealing with the period prior to September 2001 expressed some concerns about the ability of airlines (and airports) to meet the constantly growing demand. For instance, the paper by Louis [15] proposed an assessment of technologies designed to enhance airspace safety. Meanwhile, the paper by Li et *al.* [16] provided a new approach to assessing the financial performance of air companies. The paper by Bhadra and Hechtman [17] examined the determinants of efficient airport operation. In other words, all papers mentioned above examined issues that occupied the attention right before September 2001, but will continue to draw interest in the future.

Despite the fact that the events of September 2001 have been the focus of policy attention, especially in the U.S. (see, for instance, [18], [19], [20]), it has received little attention, so far, in the empirical literature, particularly in Europe.

While there is little doubt that the events of September 11 and its after-effects resulted in an industry recession in the period following the attacks, there is some controversy regarding the possible longer term impact of September 11 on the airline industry. Ito and Lee [21] and Rupp et *al.* [22] analyze airline demand in the U.S. and airline schedule recoveries following September 11, respectively. They argue that September 11 resulted in a negative shock in US airline which was, to a great extent, transitory. Also, Inglada and Rey [23] studied the impact of the September 11 terrorist attacks and its after-effects on Spanish airline demand. Using data from 1980–2003, they found that September 11^{th} resulted in a negative demand shock, particularly in relation to international passengers.

Finally, Cunningham et al. [24] examined the impact of September 2001 on travelers' perceptions about the risk of air travel, service quality, and general satisfaction with air carriers. Their study suggested that the perceptions of travelers regarding the risk associated with flying and their perception of service quality have not changed significantly in the wake of September 11 and throughout the recession experienced.

3 Methodology

The empirical investigation is based on the *Growth Accounting* approach. Growth accounting was pioneered by Abramovitz [25] and Solow [26] and aimed at explaining the determinants of growth worldwide, after World War II. In growth accounting growth is decomposed over time, using a production function, into a part explained by growth in factor inputs and another part (i.e. the Solow residual), which is attributed to technological change, and is called Total Factor Productivity (T.F.P.). Growth accounting has been applied to numerous cases in the last two decades (see, for instance, [27]-[34]) with very satisfactory results. The most commonly used production function in empirical investigations using aggregate data is the Cobb-Douglas production function [35]. Specifications of the functional form of the production function such as the *translog* provide the opportunity to characterize the data in a more flexible way but with limited data it tends to be seriously over-parameterized. In other words, the *translog* estimates are likely to suffer from degrees of freedom and multicollinearity problems [36].

We, thus, assume a Cobb-Douglas production function with two inputs, capital and labor and Hicks-neutral technological progress. So production at time t is given by:

$$Y(t) = A(t) \bullet L(t)^{a} \bullet K(t)^{b} . \tag{1}$$

where Y(t)>0, L(t)>0, K(t)>0, A(t)>0, a>0, b>0

The notation is standard: Y is output, L labor, K capital, A the level of technology, while *a* and *b* are the labor and capital elasticities, respectively.

Technology constitutes a very crucial determinant of productivity and competitiveness however its direct quantification is difficult and it is usually estimated indirectly using a production function [9]. T.F.P. as a measure of technology can be affected by improvements in the quality of the inputs. This includes, for instance, improvements in computers and other equipment used in production and maintenance systems. At the industry level, T.F.P. can also be affected by changes in industry structure.

From equation (1) we get that:

$$\dot{A} / A = \frac{\partial A(t)}{\partial t} \bullet \frac{1}{A(t)} = \frac{\partial Y(t)}{\partial t} \bullet \frac{1}{Y(t)} - a \frac{\partial L(t)}{\partial t} \bullet \frac{1}{L(t)} - b \frac{\partial K(t)}{\partial t} \bullet \frac{1}{K(t)} . \tag{2}$$

Equation (2) allows us to estimate technological change, indirectly and implies that the rate of change in T.F.P. depends on the growth in output, labor and capital. Using mathematics, the rates of growth of labor productivity (Y/L) and capital productivity (Y/K) respectively, are given by [37]:

$$l = \frac{\partial Y(t)}{\partial t} \bullet \frac{1}{Y(t)} - \frac{\partial L(t)}{\partial t} \bullet \frac{1}{L(t)} . \tag{3}$$

$$k = \frac{\partial Y(t)}{\partial t} \bullet \frac{1}{Y(t)} - \frac{\partial K(t)}{\partial t} \bullet \frac{1}{K(t)} . \qquad (4)$$

4 Empirical Implementation

4.1 Data

The significance of the factors entering the production function is tested using the data collected from *Amadeus* international database for the largest European (E.U.-27) air transportation carriers. The choice of the companies was subject to data availability and all carriers of the dataset had to be oriented towards passengers' transportation. Also, they should serve as domestic and international carriers and they should be of large-scale. Based on the aforementioned criteria, the final dataset includes the top ten (10) companies, in terms of operating revenue, that fulfil these criteria, according to the *Amadeus* international database. Apparently, failure of certain airline companies to fulfil these criteria has led to the exclusion from the final dataset of well-known companies, such as e.g. Air France due to data (un)availability.

The data available is on a quarterly basis and covers the 1997-2005 time span. Any missing observations are interpolated. Output is measured as operating revenue, labour is measured as cost of employees and capital is measured as fixed assets. All variables are expressed in local currency in 1997 prices.

4.2 Results

The regressions are based on the log-linear form of the Cobb-Douglas production function with two inputs, i.e. capital and labor, Hicks-neutral technological progress and are estimated by Ordinary Least Squares (O.L.S.) which is the standard procedure for estimating the Cobb-Douglas production function. Also, a dummy variable (D01) that takes the value 1 after 2000 and 0 elsewhere is used to account for the impact of the 2001 terrorist attack and u_t is the disturbance term designed to capture the effects of all other factors that are not included in the model.[1] We estimate the following equation (see Appendix table 1 Regression Results, Cobb-Douglas Production Function for Air Carriers, 1997-2005):

$$\ln Y(t) = \ln A(t) + a\ln L(t) + b\ln K(t) + cD01 + u_t . \qquad (5)$$

The signs of the estimated coefficients are positive and thus consistent (except for one case which is not significant) with the implied hypotheses (a>0, b>0) and are statistically significant for the great majority of cases regarding input factors and the constant term. Also, the equations explain a very high part of the variability of output. The results should be assessed as satisfactory given the various imperfections in this

[1] It should be noted that the typical *Growth Accounting* model employed in this essay, which is constructed on the basis of specific theoretical assumptions, does not account for the impact of other variables on growth, such as the values of stocks, etc. Undoubtedly, other models would be needed for such an investigation.

sort of data as well as given the crisis period following the terrorist attack of 2001 and the subsequent violent shocks that the carriers have been through.

Also, there are no signs of serious violation of the basic assumptions concerning the residuals, as was easily confirmed with the aid of the relevant procedures. Specifically, the normality of the errors was assessed through the examination of the frequency distribution of the residuals as well as by reference to the Q-Q or P-P normality plot. As far as the assumption of homoscedasticity is concerned, compliance with this assumption was evaluated by examination of the scatter plot of the standardized residuals against the predicted values. Finally, as for the assumption that the residuals are independent of each other, the DW statistic was used that indicates the degree of autocorrelation of the residuals in our dataset. Given the value of this statistic for each carrier in our dataset, with only two exceptions, the hypothesis that the residuals are autocorrelated cannot be accepted.

Labor elasticities derived range between 0.45 and 1 and capital stock elasticities range between 0.1 and 0.5. These values are, in general terms, consistent with estimations traditionally produced by researches [38]-[39]. On these grounds, our estimates of labor and capital elasticity are regarded as credible. We also note that the dummy variable accounting for the impact of the 2001 terrorist attack in the U.S.A. is negative and statistically significant *only* for the British (British Airways), the Italian (Alitalia) and the Belgian (European Air Transport) carriers. Meanwhile, it is positive and statistically significant for Iberia, Easyjet, First Choice, Corsair and Delta Air Transport (currently Brussels Airlines) companies. Finally, Lufthansa and Ceske are not significantly influenced by the terrorist attack of 2001.

For example, the dummy variable for the case of Alitalia is statistically significant and equal to -0.139, implying that for every year after 2000 the company had been facing a decrease in operating revenue, due to the 2001 attack, equal to 0.139 millions Euros per year. On the other hand, Iberia had been enjoying an increase in operating revenue due to the 2001 events equal to 0.069 millions of Euros per year.

Next, the estimated parameters (a, b), the rates of growth in output ($\dot{Y} / Y$), labor ($\dot{L} / L$), capital ($\dot{K} / K$), labor productivity (l), capital productivity (k) and total factor productivity (T.F.P.) are calculated (see Appendix Table 2. Growth Rate in Output, Labour, Capital, Labour Productivity, Capital Productivity, Total Factor Productivity and Technology Participation for European Carriers, 1997-2005).

As can be seen, for the majority of carriers, T.F.P. remains practically unchanged over the time period 1997-2005 and hovers around 0%. Meanwhile, the great majority of air carriers experience a positive rate of growth in output as well as in input factors, implying a dynamic growth potential. Thus, it is obvious that technological change which hovered around 0% has not favoured economic growth; on the contrary it has acted as a serious burden to some of the companies in our dataset. Meanwhile, the annual growth rates in productivity of labor are negative due to the slower increase in output compared with labour input.

5 Result Analysis

A very intriguing finding of the aforementioned analysis is that except for some companies that where negatively influenced, many other European air transportation companies were positively influenced by the 2001 terrorist attack. A first and, apparently, technical explanation of this interesting finding is that positively affected (or not affected at all) were in principal those air carriers from our dataset that did not have a heavy flight load to the U.S.A., according to the carriers' official information. From a simple inspection of the carriers' operational plans, it is clear that North America has not been a primary destination for any of these companies.[2]

Also, the 2001 terrorist attack has certainly driven several potential U.S. passengers (and airline companies) to alternative solutions regarding the air carriers and the final destinations they have selected. In fact, some companies, e.g. Lufthansa [40], increased flights to other destinations, except U.S.A., as a response to the demand shock caused by the terrorist attacks. How much of the revenue is attributable to international operations with specific destination is hard to assess because of joint flights with domestic services.

Another explanation is that potential passengers made an attempt to avoid, besides the U.S., the countries that have been, according to the expectations formed, very dangerous for a possible attack, i.e. Britain, Italy and Belgium. After all, mass media not only visually, but also verbally reproduced the fear-for-flights scenario transplanted from the States worldwide, especially the popular western Europe destinations like London, Madrid, Rome, Paris etc that could be a next target choice of the Al Qaeda. This seems gradually to fade away since potential passengers seem to trust the intensified security measures at the airports enhanced by the fact that there are no recent hijack reports.

Finally, given the tremendous shock of September 2001, potential passengers have increased their use of communications technology such as high-tech videoconferencing and web-casting, as an alternative to flying and have avoided air traveling. This also facilitates cuts on company travel budgets; new high-technology apparatus proves handy for both psychological and financial purposes; it is safer and keeps staff available for more projects and tasks.

Meanwhile, the technological level of the companies included in our dataset, as expressed by T.F.P., remained almost unchanged. However, those companies the output of which was negatively influenced by the attack were not found to experience a positive change in their technological level, but rather a slightly negative T.F.P. change. This finding is probably the result of the prolonged crisis affecting their output - including the technological and organizational spheres -which they have not managed to overcome successfully, so far. As the British Airways Annual Report and Accounts [42] put it: "Some major airlines have gone out of business entirely, others are struggling to remain viable. […] The industry is in a state of disarray, if not despair".

However, airline companies are not alone; there are mutual benefits for both airports and airlines from entering into long term relationships. Airports can obtain

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[2] Actually, the positive effects of the events of September 11 on some companies such as Iberia are emphatically stressed by Iberia's Chairman [41]: "Yet if I had to highlight an event, that unquestionably ranks as one of the most outstanding achievement of this company, this is to have reported the second best operating income in its history in one of the worst years on record of commercial aviation. We have managed to confront the worst possible environment and come out of it even stronger."

financial support and secure business volume, which are important for daily operation as well as for long term expansion. Also, they have substantial market power due to the low price elasticity of their aeronautical services. On the other hand, airlines can secure key airport facilities on favourable terms, essential for making long term investments at an airport. However, such relationships are moderated by competition in both airline and airport markets [43].

Despite the serious lack of similar studies especially for Europe, our findings are, in general terms, consistent with those reported by a couple of other papers. For instance, Guzhva and Pagiavlas [44] concluded that that not all the U.S. major and regional airlines were affected by the 2001 attack. More precisely, some of the air carriers were able to significantly improve their performance immediately following the September 11th attack, a finding which is consistent with our results for the European case. Moreover, our results are consistent with Inglada and Rey [23] who found that September 11 resulted in a negative shock on Spanish airlines in relation to international passengers, flying to the U.S.A., etc. Finally, we should always keep in mind the postcolonial relations of Spain as a cultural and economic metropolis for the South American states.

Also, Cunningham's et *al.* [24] examination of the impact of September 2001 on traveler's perceptions reached conclusions which are compatible with our results. More precisely, their findings suggested that the perceptions of travelers regarding the risk associated with flying have not changed significantly in the wake of September 11 and throughout the crisis experienced by the industry. This finding reinforces the results of our study that some air carriers were not influenced negatively by the terrorist attack while others were positively influenced. Nevertheless, after the railway attacks in Madrid (March 11, 2004) and London (July 7, 2005), the risk was generalized rather than being merely spread in Europe. This risk is not associated with air services solely, and it has enhanced potential passengers to overcome their first negation to flights [46].

6 Policy Insights

The empirical results of our investigation seem relatively hard to explain due to the fact that the air transportation industry should be seen as a *system* consisting of airplanes, airports, passengers and control. The airline industry, that is so vital for lots of national economies, asks for holistic measures concerning the confrontation of the customers' risk.

The additional restrictions and security measures introduced are having a huge impact on airports, airlines and passengers. The result is that the facilitation processes at airports have been increasingly affected, with a worsening trend in efficiency and passenger service levels [45], [47], This is rather worrying, because *more* security does not necessarily mean *better* security. In this context, we need to critically review all the additional measures that have been introduced since the mid-1980s; it is a matter of managing the risk more intelligently. Then, we need to look at ways in which we can effectively provide these safeguards without harming the efficient operation of airports or the quality of services for which the industry is renowned [47].[3]

Safety seems to have been progressively elevated, over the past generation, to a desirable condition of numerous situations, institutions, and organizations. It motivates decision making in a wide range of domains. It relates closely to what is called the "risk society" [48], [49]. Safety simply represents the positive goal of policy in the risk society: to avert risk in the cause of increased safety. Thus, while well-being may still be defined, in some contexts, in economic (universal opportunities) or welfare (universal benefits for basic needs) terms, well-being is also increasingly defined as safety or security. As a result, the "safety state" may attempt both to ensure safety at various levels and to legitimate/rationalize other policies in the name of safety and security. Thus, various policies and even laws concerning matters such as privacy and confidentiality have been overridden by the concern with "national security".

The aforementioned measures seem to relief potential passengers from their anxiety or fear for an air flight when scheduling their travel. Hence, the rise of the surveillance society is one crucial background phenomenon to current airport screening and security regimes; the rise of the safety state is the other. Like the concept of the surveillance society, the term alerts us to certain key characteristics of some processes, events, and activities visible in contemporary modes of governing. The safety state is a heuristic device or *problematique*, a rudimentary means of organizing a field of study. It is equivalent to thinking of the "welfare state" and, indeed, one can argue that the "safety state" is steadily displacing, if not replacing, that way of conceiving state activity [50].

The safety state is no longer concerned with counteracting the effects of the unequal society; rather, its concern is to grapple with the *unsafe*. The question of who may be protected, and who may not, is one of the unequal *redistribution* of safety. This may be linked, in turn, with rising levels of public fear and anxiety. In this context, the airport of the future will look rather different: TSA and Aviation Industry must seek a partnered approach to Identifying the Requirements of the Airport of the Future; the airport of the future will employ new technologies and systems; systems and technologies will be dynamic and continually updated: different from pre 9/11 approach [51]. Technology will provide the tools for airports to maximize revenue generation opportunities and reduce costs and then keep these firmly under control.

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[3] In 2008 Häfner [45] claimed that "adjusted Quality Standards for facilitation and security are a prerequisite for best airport operations; inadequate capacity and availability of security controls are harming the passenger throughput and processes in terminals; all processes need harmonised capacities to ensure best services and a sense of wellbeing and feel secure for passengers…The use of new technologies to support the reduction of capacity constraints and costs could be beneficiary: the use of biometrics and other new technologies for processing passengers (or certain groups of passengers) need to be harmonised for All Aviation and Non-aviation processes (i.e. check-in, security, passport control, retailing, boarding, baggage claim)…All relevant parties in the aviation and travel segment should use new technologies e.g. use of 2d Barcode for aviation, non-aviation, airline and public processes within terminals; creation of additional capacities for passenger handling in existing infrastructure; cost and process optimization through automation; change of processes in compliance with security obligations for passengers and operational requirements, e.g. EU-Regulations…Non aviation should be centrally integrated in all terminal planning and design aspects; airports cannot finance infrastructure on aviation fees only; income from non-aviation becomes a crucial factor".

Through a series of industry case-studies this program identifies the major drivers of change for both passenger and cargo management systems and the new technologies that will deliver these economic improvements to airport operators [52].

In the rush to upgrade security by technological means, much is left to be desired in the upgrading and training of security personnel. In the Canadian case, for instance, new bodies such as CATSA (Canadian Air Transport Security Authority) have engaged in serious (re)training programs, but the overwhelming emphasis since the 2001 attack has been on technical rather than skilled human contributions to improved security [53]. Such skilled human contributions are vital to a workable and publicly acceptable security regime and may, in fact, help to produce the very specific results.

7 Conclusions

The present paper estimated T.F.P. change in the largest European (EU-27) air carriers over the 1997-2005 time span, taking into account the 2001 terrorist attack. The paper was based on very recent data from the Amadeus international database for air transportation. The paper employed the Cobb-Douglas specification of the production function and the hypothesis that the 2001 terrorist attack has had a systematic and significant influence on the performance of the European air transportation companies was investigated with the use of a dummy variable which captured its impact on output.

A very interesting finding of our investigation was that, except for some companies that where negatively influenced, many other European air transportation companies were positively influenced by the 2001 terrorist attack, mainly those which did not have a heavy flight load to the USA. Meanwhile, the technological level of the companies included in our dataset, as expressed through T.F.P., remained almost unchanged, whereas those companies the output of which was negatively influenced by the attack were not found to experience a positive change in their technological level, but rather a negative T.F.P. change, probably as the result of a prolonged crisis that they have not managed to overcome successfully. Our findings were, in general terms, consistent with the findings by other researchers.

Next, the paper argued that the air transportation industry should be seen as a *system* consisting of airplanes, airports, passengers and control, asking for holistic measures concerning the confrontation of the customers' risk and the political prestige of both the airline companies and the western governments to secure the life of their citizens. Over the years, in response to the terrorist attacks, these measures have increased. The additional security measures introduced are having a huge impact on airports, airlines and passengers. The paper concluded that all the additional security measures need to be critically reviewed in an attempt to manage the risk more intelligently.

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Appendix

Table 1. Regression Results, Cobb-Douglas Production Function for Air Carriers, 1997-2005

Company	lnA(t)	t-stat	a	t-stat	b	t-stat	c	t-stat	R^2	DW-stat
1.LUFTHANSA	3.2805	6.7721	0.601	9.008	0.260	4.127	-0.009*	-0.537	0.987	1.422
2.BRITISH AIRWAYS	5.7220	3.2942	0.484	3.043	0.200	3.289	-0.067	-7.403	0.918	1.524
3.ALITALIA	5.0250	3.0403	0.926	4.987	-0.170	-1.733	-0.139	-5.361	0.862	2.091
4. IBERIA	1.6338	1.5086	0.657	6.010	0.296	2.296	0.069*	2.855	0.952	0.866
5.CESKE AEROLINIE	3.8764	3.0325	0.449	3.564	0.404	2.249	-0.062	-1.024	0.978	0.988
6.EASYJET	0.3959	2.2848	0.991	24.886	0.136	3.530	0.063	2.531	0.999	1.401
7.FIRST CHOICE	4.8592	13.655	0.652	11.948	0.102	3.059	0.085*	4.141	0.987	1.754
8.CORSAIR	4.6005	3.1789	0.593	9.679	0.142	1.304	0.078	2.440	0.968	0.732
9.DELTA AIR TRANSPORT	-5.0774	-5.7433	1.054	18.497	0.493	6.028	0.165	2.407	0.996	1.665
10. EUROPEAN AIR TRANSPORT	4.6985	5.1970	0.702	4.390	0.124	1.185	-0.226	-2.712	0.940	0.761

* The dummy variable takes the value 1 after 2000 and ends in 2004

Table 2. Growth Rate in Output, Labor, Capital, Labor Productivity, Capital Productivity, Total Factor Productivity and Technology Participation for European Carriers, 1997-2005

Company	a	b	a + b	$\dot{Y}$ / Y	$\dot{L}$ / L	$\dot{K}$ / K	l	k	TFP
1.LUFTHANSA	0.601	0.260	0.861	0.0360	0.0451	0.0349	-0,0091	0,0011	-0.001
2.BRITISH AIRWAYS	0.484	0.200	0.684	-0.0037	0.0032	0.0008	-0,0069	-0,0045	-0.005
3.ALITALIA	0.926	-0.170	0.756	-0.0013	0.0209	0.0484	-0,0222	-0,0497	-0.012
4. IBERIA	0.657	0.296	0.953	0.0332	0.0349	0.0215	-0,0017	0,0117	0.004
5.CESKE AEROLINIE	0.449	0.404	0.853	0.0623	0.1055	0.0506	-0,0432	0,0117	-0.006
6.EASYJET	0.991	0.136	1.127	0.1965	0.1709	0.1575	0,0256	0,0390	0.006
7.FIRST CHOICE	0.652	0.102	0.754	0.0492	0.0522	0.1111	-0,0030	-0,0619	0.004
8.CORSAIR	0.593	0.142	0.735	0.0379	0.0532	-0.0032	-0,0153	0,0411	0.007
9.DELTA AIR TRANSPORT	1.054	0.493	1.547	0.1660	0.0999	0.0819	0,0661	0,0841	0.020
10.EUROPEAN AIR TRANSPORT	0.702	0.124	0.826	0.0617	0.0985	0.1122	-0,0368	-0,0505	-0.021