GERMAN AIRPORT PERFORMANCE

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Re-estimating Financial Performance of European Airports[1]

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Abstract: The focus of this paper is privatisation of the European airports and its impact on their financial performance. The study can be treated as an extension of the analysis carried out by H.-A. Vogel (2006). We use a dataset that is more extensive in terms of the number of airports and time span, and contains a somewhat different set of variables.

In the first part of the research financial ratio analysis is used. Specifically, static comparative analysis that discovers the differences between the performance of the airports is supplemented with dynamic analysis of the sample of the airports that experienced change in ownership which compares the performance before and after this event.

The second part of the research is an application of Data Envelopment Analysis (DEA) and some related developments (Brockett, Golany, 1996) to the available data. Several combinations of inputs and outputs are considered an adjustment procedure is applied to the resulting DEA scores in order to judge about pure "programmatic" efficiency of various ownership structures.

Generally, fully and partially privatised airports perform best in terms of profitability indicators, reinvestment rate and usage of non-aviation revenue sources. Other results are not equally consistent and considerable. After privatisation airports tend to increase profitability and earn more non-aviation revenue per passenger, the two facts being likely to be related to each other. On the aggregate level public airports turn out to be perform worst under a huge majority of specifications of DEA. Under most specifications fully privatised airports show best results.

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1. Introduction

The paper addresses the issue of financial performance of the airports and its connection to governance structures, mainly ownership matters. This question is crucial for both current and possible future investors. It is particularly important for the latter in the context of the privatisation in the airport sector which has been taking place since 1980s. Success of future privatisation projects will strongly depend on current privatisation programs which are in turn defined through privatised airports' performance.

Today's airports are complicated businesses that not only engage in purely aviation activities but also offer a number of services to passengers. Some of the airports prefer to offer all the services themselves, the other tend to outsource some of them (e.g. ground handling, retail and restaurants, parking etc)). Therefore, the task of comparing and benchmarking of the airports based on technical and operating data (as opposed to financial) becomes rather complex. Nevertheless, this problem is dealt with in a great deal of recent studies (Gillen, Lall, 1997, Parker, 1999, Murillo, Melchior, 1999, Pels, Nijkamp, Rietveld, 2001, Sarkis, 2000, Barros, Dieke, 2007 and many others) that used different approaches to what they call airport efficiency, i.e. they applied various specifications of the production function none of which can be claimed to be true or false. That is why many researchers applied several techniques to the same sample in order to confirm or reject their findings. But still it is hardly possible to consider all specifications would seem to be sensible.

When assessing financial performance, one can avoid many problems of comparison since most figures are expressed in the same units – in terms of currency units. In the end, monetary figures are what really matters for the investors. It is not always possible to assume that financial performance is highly correlated with technical performance since high technical performance is not of direct interest to the investors. But to take into account interests of investors is essential since they provide capital and let the airports develop and modernise their businesses which in effect must matter to their clients as well.

In this paper we follow the framework set by Vogel (2005) who was one of the first researchers to study the interrelation between privatisation aspects and financial performance of the airports. We apply some conventional methods of assessing financial performance (financial ratios) as well as data envelopment analysis (DEA) which is widely used in many benchmarking studies but still is rather uncommon in application to financial data. We also apply a relatively new, mathematically consistent methodology to explain DEA efficiency scores proposed by Simar and Wilson (2007).

This paper is organized as follows. Section 2 provides an overview of the literature on existing research on privatisation and performance issues. Section 3 introduces the sample of European airports in question. Section 4 focuses on methodological aspects. Section 5 presents the results. Section 6 concludes.

2. Literature Overview

2.1. Theoretical introduction

As noted by Morrison (2008), one has to distinguish among financial, operating and service quality performance. These three aspects of performance correspond to different interest groups. This paper concentrates on one of these aspects, namely on financial performance which matters to the investors, first of all to the owners of the company.

Some traditional theoretical relationships between ownership and performance are outlined in Backx et al. (2002) who in turn refer to a number of corporate finance theories. All of them agree that publicly owned entity has much less stimuli to run business efficiently that a privately owned one does.

However, Oum et al. (2006) referring to some more recent literature note that this "common-sense view" of private firms being more productive and efficient than public ones does not always find support not only in empirical literature but even in more recent theoretical work (e.g. De Fraja (1993) shows through principal-agent problem modelling that government ownership "is not only

not necessarily less productively efficient, but in some circumstances more productively efficient", Vickers and Yarrow (1991) claim that market structure is the primary determinant of the efficiency rather than ownership *per se*.)

In this regard, mixed (or hybrid) private-public ownership enterprises constitute an interesting case because they may merge both positive and negative qualities of each of "pure" types of ownership in a way that is not known *a priori*. Some authors argue that the mixed form of ownership would be beneficial. State ownership may provide more favourable debt conditions through guarantees which leads to lower cost of capital, higher tax shields, etc. The fact that the state sells a part of an enterprise to private investors but still retains a considerable stake may be regarded as a signal of commitment and interest in preserving and increasing the enterprise value. Moreover, unsuccessful performance of partially privatised enterprises would decrease interest of private investors in participating in partial privatisation projects in future.

At the same time, hybrid ownership may result in conflicts between private and public shareholders. Study by Ehrlich et al. (1994) who considered 25 international airlines over the period 1973-83 does not disprove this theory showing that at least in the short term partial privatisation does not yield considerable productivity benefits.

In our paper we stick to the traditional view of private ownership as of providing better performance. This will be reflected in our assumptions about the expected results.

2.2. Methods and empirical literature review

Popular methods for measuring various aspects of airports performance are listed in a number of papers, i.e. Vasigh, Haririan (2003) who mention the following: ratio analysis, regression analysis, partial and total factor productivity analysis and more statistically advanced frontier analysis techniques. The most well-known of the latter are a nonparametric approach called data envelopment analysis (DEA) which is a non-parametric technique and parametric stochastic frontier analysis (SFA).

A majority of the academic work on airport efficiency has so far concentrated only on the productivity aspect which meant using data on physical measures of airports inputs and outputs. Vogel (2005) was to the author's best knowledge the first who to consider solely the financial aspect and therefore to use financial data. However, as aforementioned methods were not designed for assessing financial performance not all of them may be appropriate in this case. Here we briefly discuss all the methods and their applicability.

We do not consider partial and total productivity analysis since these approaches usually require what in our case are irrelevant physical performance data.

2.2.1. Ratio and regression analysis

The first two methods are traditional for measuring financial performance of any business. Traditional financial ratio analysis includes calculating indicators of asset situation, efficiency, profitability and liquidity and comparing those of different companies with each other or with industry averages. (See e.g. Brealey, Meyers, 2003, Robinson et al., 2009). Statistical tests may be carried out in order to judge whether different particular groups of companies have significantly different ratios. The grouping is therefore defined by the research question.

A natural extension to simple comparison of ratios over different groups is estimating econometric models that explain differences in financial ratios taking into account several factors as explanatory variables. Usually a small number of regressors are considered to be relevant to the research while other variables are included to control for various environmental factors.

These two approaches have been often used together and here we mention basic findings of the studies that used either of them or both.

Boardman and Wining (1989, 1992) in two studies confirm the higher performance of the private companies as compared with state-owned and mixed-ownership firms.

Megginson et al. (1994) document significant post-privatisation increases in operating efficiency, profitability, capital investment spending and a significant decrease in leverage. They employ data on 36 companies that were (partially) privatised before 1990.

D'Souza and Megginson (1999) in a study of 85 companies from 28 countries and 21 industries that were privatised during the years 1990-1996 also find the evidence of increased profitability (as measured by ROA, ROE and ROS) following privatisation. Unexpectedly, capital investment spending measured by capital expenditure divided by total assets, and capital expenditure divided by total sales, was found not to change significantly. Leverage turned out to have declined significantly following the privatisation.

Dewenter and Malatesta (2001) employing the data on 85 companies that were privatised compare their pre- and post-privatisation financial and operating performance and find significant increases in output, operating efficiency, profitability as well as a significant decrease in leverage.

Backx et al. (2002) find that private airlines have higher profitability (as measured by ROE and ROA)

Vasigh and Haririan (2003) considering a sample of airports found however that publicly owned airports are more efficient in terms of profitability than the private ones.

Boubakri et al. (2005) examining a large sample of 230 firms from various industries based in 32 developing countries documented increased profitability and investment intensity as measured by investments per sales and investments by assets. They come to similar conclusions in a later study Boubakri et al. (2009) using multi-industry data on 189 companies headquartered in various regions of the world, both in developed and developing countries (no leverage decrease documented).

Gupta (2005) examined Indian state-owned enterprises during the period between 1990 and 2000 (considering firms that were partially privatised and those that remained state-owned over this period) and found a positive impact of partial privatisation on profitability, productivity and investment.

Comparing financial ratios of the airports, Vogel (2005), who used the data from 1990 to 1999 on 35 European airports, found that generally private and partially privatised airports outperform public ones in terms of most profitability indicators (e.g. return on equity, return on sales) and have lower leverage, whereas

public airports are better in terms of assets utilisation (total asset turnover, fixed asset turnover). Performing the same procedure on a smaller sample of the airports that were partially or fully privatised during the period in consideration, he came basically to the same conclusion but received less statistically significant results. In particular, the capital structure turned out to have changed insignificantly.

However, Mathur and Banchuenvijit (2007) used a sample of 103 companies from 36 countries (both developed and developing) and found no evidence of significant increase in profitability after privatisation in emerging markets, whereas this increase proves to be significant in developed countries. Capital expenditure intensity (measured by capital expenditure divided by total assets and by capital expenditure divided by sales) was found to decrease following the privatisation, but the decline was only significant for developing countries. Leverage is documented to decrease significantly for both samples.

These two approaches raise relatively few conceptual questions. Although financial ratios have a well-known drawback of biasedness, which stems from existing accounting practices, albeit in line with existing accounting standards, it may lead to a distorted representation of some aspects of the financial situation of the company. In particular it applies to the value of assets which can be affected and manipulated by depreciation and revaluation policies. These problems are often not taken into account, because correction of the bias is often either impossible or hardly feasible, especially as far as large databases are concerned. In particular one should be sceptical about balance sheet data because of mentioned problems. Nevertheless, the problem may become less severe if one relies on a number of indicators rather than on few. One of possible ways out seems to be the following: paying most attention to income statement data and trying to reasonably correct balance sheet data. In our paper we provide measures calculated from raw balance sheet data mostly for reference purposes.

A really serious question that is usually ignored is a question of causality: is it plausible to explain difference in performance through different ownership

structure when changes in ownership structure can be themselves caused by financial performance? More precisely, one has to understand if companies perform better because they are privatised or companies get privatised because they already showed good performance and seemed attractive for investors. We denote the former causality relation as “basic” and the latter one as “inverse”. One of the possible ways to check the “inverse” causality relation is to run the following analysis on the sample of publicly owned airports (that will or will not be privatised): select as a dependent variable a dummy indicating a future privatisation status and several performance indicators as regressors and run a binary choice model. We check for causality in Section 5.

2.2.2. Frontier approaches

The concept of production function is central for the frontier approaches. Production is understood as the process of transformation of the set of inputs into the set of outputs. The goal of stochastic frontier analysis is to parametrically estimate the production function (or the cost function, depending on the specification) and to calculate deviations from the estimated frontier for each decision-making unit (DMU) thereby estimating their relative (in)efficiency. DEA objective is somewhat similar in the sense that the efficiency frontier as well as deviations of each DMU from it are estimated with the exception that non-parametric methods are used for inefficiency evaluation. Advantages and disadvantages of each method are well known, see e.g. Morrison (2008) for the summary.

DEA is arguably the most popular benchmarking technique because it does not require any specification of a particular functional form in estimating the underlying production technology. Additionally, it does not impose almost any limitations on the data. Only certain properties of the production set are to be fulfilled (see section Methodology). But at the same time this constitutes a weakness of this method as the researcher does not have any clue how the production function has to be defined, i.e. which variables should be used as inputs

and outputs. Consequently researchers tend to use various combinations of inputs and outputs which they consider to be meaningful or interpretable.

Originally DEA was intended to use physical measures as inputs and outputs because a production function does not include prices of resources and products. DEA has been widely applied to examine technical and allocative efficiency in a variety of industries; see Gattoufi et al. (2004) for a comprehensive biography.

Barros and Dieke (2007) review recent papers that applied DEA to airport efficiency analysis. A large majority of the papers focuses on the operating performance aspect, hence physical measures are used both on the input (e.g. terminal size, number of check-in desks, airport surface area, number of runways, runway length etc. in different combinations) and on the output side (e.g. number of aircraft transport movements, number of carried passengers, total freight etc.). Some of the authors employ financial and physical measures in the same specification on both output and input sides (Sarkis, 2000, Sarkis and Talluri, 2004, Barros, Dieke, 2007 to name a few) which may seem arguable, but at the same time one lacks clear theoretical arguments against such specifications.

Vogel (2005) was one of the few researchers who used only financial data, namely total revenues as an output and total costs as an input.

It is natural for applied researchers to seek methods to explain the differences in efficiency of decision-making units expressed by DEA scores. Arguably the most popular method for explaining the DEA scores is a so-called second-stage regression that explains the scores by means of various environmental variables. Again, a great number of studies (e.g. Abbott, Wu, 2002, Chi-Lok, Zhang, 2008 etc.) used a tobit-regression approach or even estimated a linear model by ordinary least squares (OLS) both of which were shown to be inconsistent by Simar and Wilson (2007) who instead proposed using truncated regression for this purpose and showed consistency of inference using Monte-Carlo experiments.

3. Data

The dataset we use is based on the one used by Vogel (2005) but it was considerably extended by adding recent data (up to 2006, in some cases 2007) and data on a number of airports not represented in the original database. All in all 88 European airports and airport groups are represented in our database, but it does not constitute a balanced panel. For 41 of 88 airports the data cover the period of more than 10 years. All in all there are 914 observations. 192 of them represent fully privatised airports, 178 correspond to partially privatised and the rest 544 account for public ones.

We assume the following definition of the degree of privatisation. An airport is considered to be "fully privatised" or simply "privatised" if more than 75% of equity belong to private investors. "Partial privatisation" requires a minimum private share of 25% of equity capital. Otherwise the airport is thought of as publicly owned.

Later we distinguish between airports that experienced a change in their ownership structure and those that did not. There are 19 airports belonging to the first group.

The dataset contains various financial statements figures (from income statements, balance sheets, cash flow statements) and environmental variables: apart from ownership status, the data on regulatory regime are available. Monetary figures are converted into dollar values using PPP exchange rate. The newer data were extracted from the published annual reports; some information was requested directly from airports. The data on PPP were obtained from Eurostat.

The list of the airports is provided in the appendix.

4. Methodology

4.1. Financial ratios

We calculate financial ratios to assess asset situation, efficiency, profitability and investment performance. Traditionally profitability is assessed via ratios of

profit figures (EBIT, EBITDA, Net Income) to various groups of assets, equity and revenue. We use all these ratios (eight indicators all in all). Notably, we use a Historical value of Fixed Assets figure for constructing some ratios. The motivation behind that is that the standard book value figure of assets may be misleading in this case. If an airport is old enough and large investment programs have not been implemented for a long time, it is likely that the airport will report a low book value of the fixed assets because of a larger cumulated depreciation (hence – of the total assets since the former constitute a substantial proportion of the latter). The problem is especially pronounced if the accounting policies which the company follows do not require revaluation of the assets. In this case the book figures may not even reflect the fair value of the assets. Employing historical costs (which is simply a book value of a respective asset item as if it never were depreciated) is not a perfect solution since in essence it is a sum of undiscounted values that belong to different periods of time. Nevertheless, it gives us another perspective of the company's assets, but we still have to consider other measures for more reliable inference. Other ratios are given in Table 1. We note once again that we pay most attention to EBIT and EBITDA margins since they are calculated without using any balance sheet figures.

In order to compare the ratios across different groups that are discussed later, non-parametric Mann-Whitney test is used. We use this test because it does not require an assumption of normality of the data. The test hypothesis reads as follows: two samples belong to the same distribution. In contrast to many studies we distinguish between 3 groups: publicly owned, partially and fully privatised airports and conduct unpaired tests between all three pairs of groups.

Table 4.1. Definitions of Financial Ratios

Financial ratios	Definition
EBIT / Assets	EBIT divided by Total assets
EBIT / Equity	EBIT divided by Equity
EBIT / Fixed Assets	EBIT divided by Historical value of Fixed Assets
EBIT Margin	EBIT divided by Total Revenue

EBITDA / Assets	EBITDA divided by Total assets
EBITDA / Equity	EBITDA divided by Equity
EBITDA / Fixed Assets	EBITDA divided by Historical value of Fixed Assets
EBITDA Margin	EBITDA divided by Total Revenue
Leverage	Total Debt divided by Total Assets
Fixed Asset Turnover	Total Revenue divided by Historical value of Fixed Assets
Non-Aviation Share of Total Revenue	Commercial plus Other Revenue divided by Total Revenue
Reinvestment rate	Investment in fixed assets divided by Depreciation
Non-aviation revenue per passenger	Non-aviation revenue divided by the number of passengers

Accounting not only for ownership effects, but also for other factors one can obtain more statistically consistent results. We account (and hence introduce dummies) for the following effects:

- ownership effects
- year-specific effects;
- country-specific effects;
- form of regulation (no regulation, cost-based regulation, incentive regulation).

Running a regression model and including dummy variables for the mentioned effects into specification one can judge by the sign and significance of the coefficients corresponding to ownership variables if ownership structure really has explanatory power.

We will estimate linear regression model of the following general form:

Table 4.2. General regression specification

Dependent variable	**Independent variables (dummies)**
RATIO	• Y1991, ..., Y2007 that take value 1 if the observation was made in the corresponding year, 0 otherwise • GERMANY, UK, ITALY, FRANCE that take value 1 if the airport is located in the corresponding state, 0 otherwise

	• CB, IB that take value 1 in case of cost-based or incentive-based regulation, respectively, 0 otherwise. • PRIVATE, PART_PRIV that take value 1 if the airport is private or partially privatised, respectively, 0 otherwise.

4.2. Data envelopment analysis

This approach assumes that all the firms or decision-making units (DMU) have an access to the same production technology. Production is defined as transforming a set of inputs x into a set of outputs y. The production process is constrained by the production set Ψ, which is the set of physically attainable points (x,y):

$$\Psi = \{(x,y) \in \Re_+^{N+M} \,|\, x \text{ can produce } y\}, \text{ where}$$

$$x \in \Re_+^N \text{ is an input vector and } y \in \Re_+^M \text{ is an output vector.}$$

This set is assumed to follow a number of properties (see Simar and Wilson, 2007). One of the most important of them is an assumption of strong disposability of inputs and outputs which is equivalent to an assumption of monotonicity of the underlying technology.

Although all DMUs have an access to the same technology they may or may not achieve its frontier. The distance of the point corresponding to the particular DMU to the frontier which measures the inefficiency of each DMU can be influenced by endogenous factors such as ownership situation, institutional environment including regulation and competition between airports, macroeconomic conditions etc. and some statistical noise.

This distance can be measured in several ways. We will use Shephard input-oriented efficiency measure which is reciprocal to the Farell-Debreu input-oriented efficiency measure. The latter is defined for a given point as:

$$\theta(x,y) = \inf\{\theta \mid \theta x \in X(y)\} = \inf\{\theta \mid (\theta x, y) \in \Psi\}, \text{ where}$$

Ψ is not observable, hence one has to substitute it with its DEA estimate:

$$\hat{\Psi}_{CRS} = \{(x,y) \in \Re^{N+M} \mid y \le \sum_{i=1}^{n} \gamma_i y_i;\ x \ge \sum_{i=1}^{n} \gamma_i x_i \text{ for } (\gamma_1,\ldots,\gamma_n)$$

$$\text{such that } \sum_{i=1}^{n} \gamma_i = 1 \text{ and } \gamma_i \ge 0,\ i = 1,\ldots,n\}.$$

This estimator assumes variable returns to scale of the underlying technology. Assumptions that concern returns to scale are reflected in the constraint requiring the γs to sum to one. In particular dropping this constraint would assume constant returns to scale.

In this paper we will favour VRS estimator because of the existing evidence in the literature that scale effects can be substantial for the airports (e.g. Pels et al,. 2001). For reference purposes we also report results obtained under constant returns to scale assumption.

5. Results

First of all in order to check for "inverse" causality discussed in Section 2 we estimate a Probit model. We use performance ratios that are least likely to be correlated with each other to avoid multicollinearity problem but are assumed to affect private investors' choice and account for possible year- and country-specific effects. Estimation results are given in Table 5.1. The main result that less profitable companies are more likely to be privatised clearly shows that we can reject the "inverse" causality hypothesis. This implies that private investors are more likely to invest in poorly performing companies having in mind to improve their performance and supports our "basic" causality relation.

Table 5.1. Privatisation causality determination.

Const	1.442	0.009	**
EBITDA Margin	-1.543	0.011	*
Debt-To-Assets	0.152	0.746	
Non-av. rev. share	-1.252	0.135	
y1991	-0.007	0.987	
y1992	-0.211	0.642	
y1993	-0.018	0.969	
y1994	-0.206	0.653	

y1995	-0.240	0.606	
y1996	-0.219	0.638	
y1997	-0.636	0.144	
y1998	-0.968	0.031	*
y1999	-1.072	0.013	*
y2000	-1.341	0.005	**
y2001	-1.748	0.001	***
y2002	-1.760	0.001	***
y2003	-2.098	0.001	***
y2004	-2.244	0.001	***
y2005	-2.322	0.001	**
y2006	-2.323	0.001	***
y2007	-1.832	0.008	**
Germany	-0.074	0.756	
Italy	-4.268	0.977	
France	0.207	0.584	

Sample: publicly owned airports. Dependent variable is equal to 1if an airport will be privatised, 0 otherwise.
Significance codes: *** - 0.001, ** - 0.01, * - 0.05, ` - 0.1.

All the following analysis was performed on two samples of the airports separately: the whole available dataset and the sample of the airports that experienced the change in their ownership structure.

5.1 Financial ratio and regression analysis

As mentioned before we base our expectation of the results on the traditional view that private companies are more efficient than the public ones. Hence we assume that profitability measures should be higher for private companies. Non-aviation revenue share should also be higher for private companies which would imply that seeking profitable opportunities they develop additional, non-core businesses. For the same reason non-aviation revenue per passenger is also expected to be higher for private airports. We expect Capex-to-Depreciation ratio to be higher for private firms since they are assumed to be more interested in its future development than public ones. Debt-to-Assets ratio is expected to be higher for public companies because of their easier access to debt capital. But it is worthwhile to point out once again that we pay much less attention to the measure that are calculated from raw balance sheet data (Debt-to-Assets ratio, EBIT(DA)-to-Equity ratio, EBIT(DA)-to-Assets ratio).

We do not express any expectations about the airports with mixed ownership structure because we do not have unequivocal theoretical arguments for this.

5.1.1. Whole sample

In this section we compare mean group ratios carrying out the non-parametric Mann-Whitney test in order to define whether they are statistically different from each other. We use 5% significance level.

Table 5.2. Mann-Whitney test results. Whole sample.

Ratio	Private	Partially privatised	Public
EBITDA/Equity	0.183	**0.475**	*0.375*
EBITDA/Assets	0.098	**0.142**	*0.115*
EBITDA/Fixed assets (H)	0.104	0.097	0.064
EBITDA Margin	**0.344**	**0.340**	0.317
EBIT/Equity	0.129	**0.261**	0.149
EBIT/Assets	**0.07**	**0.082**	0.049
EBIT/Fixed assets (H)	**0.074**	**0.057**	0.024
EBIT Margin	**0.239**	*0.182*	0.118
Capex/Depreciation	**3.863**	**3.222**	1.246
Non-aviation revenue share	**0.424**	0.3	*0.388*
Debt/Assets	0.39	**0.593**	**0.583**
Fixed Assets Turnover	**0.455**	0.246	0.241
Non-Aviation Revenue per PAX	**8.234**	6.259	7.018

The given values are the average ratios for the corresponding ownership groups. Mean ratios that were found to differ insignificantly (at the 5% significance level) from each are shown in the same font.

As Table 1 and 2 show, if one does not distinguish between partially and fully privatised airports, they perform significantly better than the publicly owned ones in terms of profitability, which confirms our expectations and is confirmed by all 8 respective ratios. One has to note that coefficients for mixed ownership in regressions explaining our "favoured" profitability ratios EBITDA Margin and

EBIT Margin are slightly higher than those for private airports, but obviously this difference cannot be regarded as statistically significant.

Debt-to-Assets ratio is considerably higher for the airports with public (fully or partially) ownership which is also in line with our expectations. But we get almost the opposite result after accounting for other factors – private airports turn out to have a higher leverage than public and partially privatised ones. This inconsistency with our assumptions can be explained by differences in accounting techniques that may be of such importance here that the corresponding effects captured by country dummies explain a high proportion of the variation of the ratio in question.

Capex-to-Depreciation ratio is higher for the airports with (partially) private ownership structure which is shown by the Mann-Whitney test results. This result is confirmed both in Table 1 and 2.

Privatised airports have lower fixed assets turnover ratio. This phenomenon is similar to that described in many studies (e.g. Boubakri et al., 2005) with the exception that Total assets turnover is considered in most of them.

Ratios that concern non-aviation revenue show inconsistent results. Whereas the result of the tests is that private airports are "better" in terms of developing non-aviation businesses, regression results contradict each other and are insignificant in 3 out of 4 cases.

Table 5.3. Results of regression analysis. Whole sample.

Ratio (dependent variable)	**"Private" dummy coefficient**		**"Partially privatised" dummy coefficient**	
EBITDA/Equity	+0.031		+0.081	**
EBITDA/Assets	+0.000		+0.028	***
EBITDA/Fixed assets	+0.008		+0.022	***
EBITDA Margin	+0.045	***	+0.048	***
EBIT/Equity	+0.031	`	+0.032	`
EBIT/Assets	+0.014	*	+0.022	***
EBIT/Fixed assets (H)	+0.012	`	+0.01	*
EBIT Margin	+0.055	***	+0.058	***
Capex/Depreciation	+0.100	**	+0.088	

Non-aviation revenue share	+0.005		-0.047	***
Debt/Assets	+0.066	**	+0.016	
Fixed Assets Turnover	-0.033	`	-0.019	
Non-aviation revenue per PAX	-0.301		+0.008	

Significance codes: *** - 0.001, ** - 0.01, * - 0.05, ` - 0.1.

5.1.2. Airports that experienced ownership change

As here we deal with a much smaller sample of 19 airports we do not distinguish between partial and full privatisation.

Table 5.4. Mann-Whitney test results.
Sample of airports privatised during 1990-2007.

Ratio	Public	(Partially) privatised
EBITDA/Equity	**0.480**	0.373
EBITDA/Assets	**0.159**	0.133
EBITDA/Fixed assets (hist. cost)	0.088	0.096
EBITDA Margin	0.318	**0.379**
EBIT/Equity	0.223	0.216
EBIT/Assets	0.082	0.080
EBIT/Fixed assets (hist. cost)	0.039	0.059
EBIT Margin	0.153	**0.224**
Non-aviation revenue share	0.363	0.340
Debt/Assets	**0.603**	0.545
Fixed Assets Turnover	0.271	0.254
Non-aviation revenue per passenger	5.846	**6.751**

The given values are average ratios for the corresponding ownership groups. Ratios that were found to be significantly (at the 5% significance level) greater for a particular ownership group are given in boldface.

The results obtained in this subsection are disappointing because most of them are insignificant: Mann-Whitney test fails to find statistically significant difference between ratio distribution in two groups whereas regression coefficients are not significant. Most of the regression coefficients turn out to have “wrong” signs but this is not a problem since they are not significant. The main positive

result is that the only two coefficients that are significant (EBITDA Margin and Non-aviation revenue per passenger) have "correct" signs meaning that after privatisation airports tend to increase their profitability and non-aviation revenue per passenger (the latter might be closely related to the former). Additionally, mean comparison reveals that airports tend to decrease leverage following the privatisation which is also in line with the expectations.

Table 5.5. Results of regression analysis.
Sample of airports privatised during 1990-2007.

Ratio (dependent variable)	"Public" dummy coefficient
EBITDA/Equity	-0.016
EBITDA/Assets	+0.025
EBITDA/Fixed assets (hist. cost)	+0.007
EBITDA Margin	-0.035*
EBIT/Equity	+0.038
EBIT/Assets	+0.017
EBIT/Fixed assets (hist. cost)	+0.009
EBIT Margin	-0.024
Capex/Depreciation	+0.388
Non-aviation revenue share	+0.004
Debt/Assets	-0.009
Fixed Assets Turnover	-0.005
Non-aviation revenue per passenger	-1.222**

The signs "+" and "-" stand for the sign of the coefficient of the respective dummy variable.
Significance codes: *** - 0.001, ** - 0.01, * - 0.05.

Finally it is necessary to note that these findings agree with those of Vogel (2005) who also revealed expected and significant differences for the whole sample of the airports. His results for the limited sample of the airports before and after privatisation were still in line with expectations, but were considerably less significant.

5.2 Data envelopment analysis

5.2.1 Full sample analysis

Selecting inputs and outputs for DEA model we have to keep in mind that its key assumption is a production function. Hence our aim is choose inputs and outputs in such a way that they are to a certain extent analogous to those of the simplest classical production function (see e.g. Pindyck, Rubinfeld, 2005 who mention labour, capital and materials as basic input categories).

As a proxy for labour we choose total staff costs, as a proxy for materials the item "other operating costs" (operating costs less depreciation and staff costs) is chosen which includes among others actual material costs and the "other costs" item which in many cases constitutes a figure that is high in value and cannot be forgone. As a default proxy for capital we choose historical costs of fixed assets, we will call the specification using this variable as an input default specification. We also repeat all the analysis with two other indicators: depreciation and total assets. The output set remains unchanged: aviation and non-aviation revenues.

The "raw" results for the default specification under constant and variable returns to scale are reported in Figures 5.1 and 5.2 by means of boxplots. They are constructed as follows: the higher and lower box bars correspond to the first and the third quartile, the bold middle line reflects the median. The length of the "whiskers" cannot be more than 1.5 times the distance between higher and lower bars of the box Figures for other specifications are given in the Appendix.

The main message of both figures is that public airports have significantly lower scores that is confirmed by the Kruskal-Wallis test results (Table 5.5) under both scale assumptions. The corresponding p-values are close to zero which means that the hypothesis about the same distribution for all three groups is rejected even at very low significance levels.

Table 5.6. Kruskal-Wallis test results

Specification	Kruskal-Wallis test statistic	P-value
Hist. Costs of Fixed Assets (CRS)	43.87	0.000
Hist. Costs of Fixed Assets (VRS)	34.56	0.000
Total Assets (CRS)	23.57	0.000
Total Assets (VRS)	15.68	0.000
Depreciation(CRS)	123.10	0.000

Depreciation (VRS)	100.54	0.000

Figure 5.1

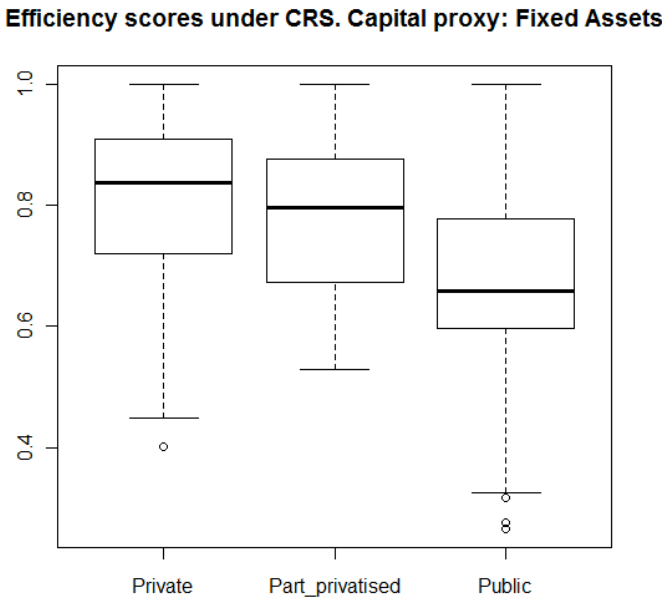
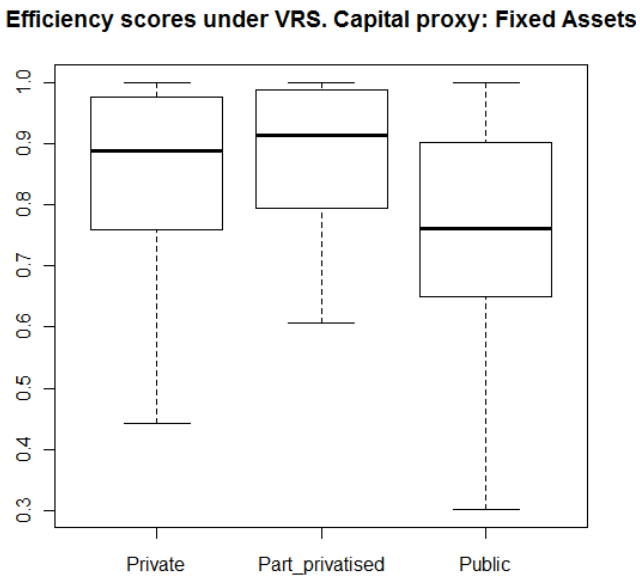


Figure 5.2



After obtaining these results we take a step further and apply a technique described by Brockett and Golany (1996). In their study they distinguished between what they called managerial and programmatic inefficiency, the latter being defined as inherent and natural inefficiency of a particular DMU group which is out of management control. Their approach was to account for managerial inefficiency within groups, i.e. for intragroup score variation by artificially correcting amount of inputs (or outputs, depending on the orientation of the model) so that every DMU becomes efficient within its group. After that, DEA with the corrected data is run. Finally, statistical tests are conducted in order to judge whether the scores of all the groups that were obtained at this stage belong to the same distribution. If no programmatic differences are assumed, all units are expected to be efficient according to the DEA results.

In our case we consider airports with different ownership structures to belong to different "programs". The results of the Brockett-Golany procedure are provided in Figures 5.3 and 5.4 and in Table 5.6. Again we report here the results for the default specification, other figures are given in the Appendix.

Figure 5.3

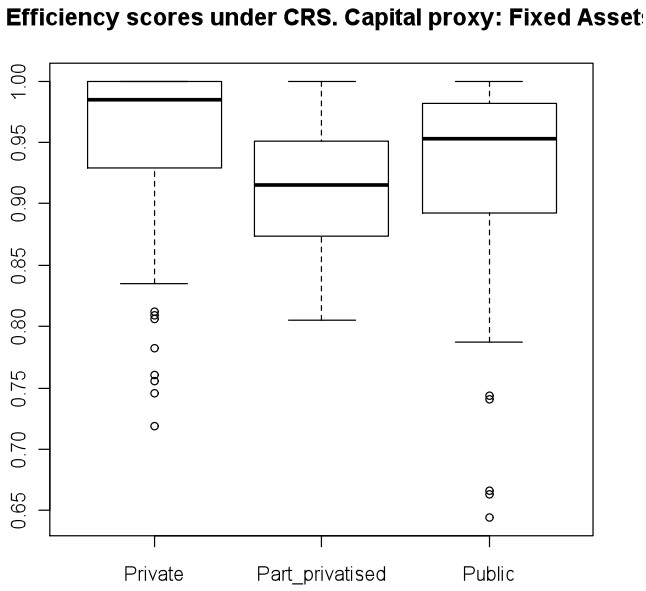


Figure 5.4

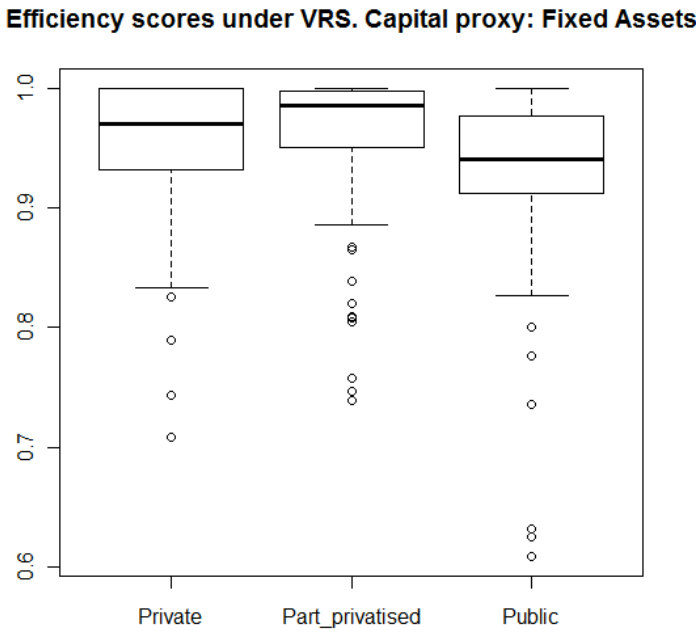


Table 5.7. Kruskal-Wallis test results (after Brockett-Golany procedure)

Specification	Kruskal-Wallis test statistic	P-value
Hist. Costs of Fixed Assets (CRS)	47.41	0.000
Hist. Costs of Fixed Assets (VRS)	38.33	0.000
Total Assets (CRS)	75.28	0.000
Total Assets (VRS)	11.58	0.003
Depreciation(CRS)	168.61	0.000
Depreciation (VRS)	63.62	0.000

All p-values in Table 5.6 are again negligible which indicates that the hypothesis of common distribution of scores for the three groups is rejected. But the picture is somewhat different now for the two scale assumptions. Under CRS partially privatised airports seem to be least efficient whereas under VRS public ones are worst in class. This can be explained by the fact that on the average partially privatised airports happen to operate at a considerably higher scale.

5.2.2 Reduced sample analysis

Again we repeat the above analysis using the reduced sample of the airports whose ownership structure changed. Figure 5.5 and Figure 5.6 show pooled DEA scores under the two scale assumptions. They clearly demonstrate a higher efficiency of private airports. It is also clear that the lowest scores belong to public airports, in other words private and partially privatised airports do not have such low scores as some public ones do.

Figure 5.5

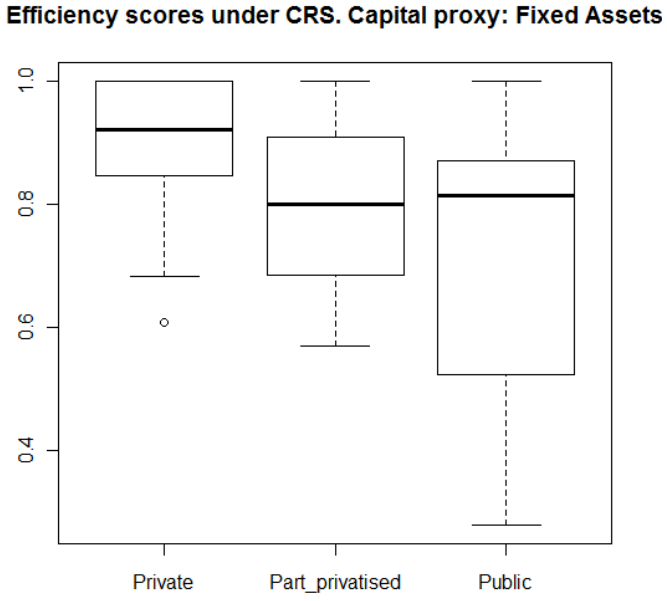


Figure 5.6

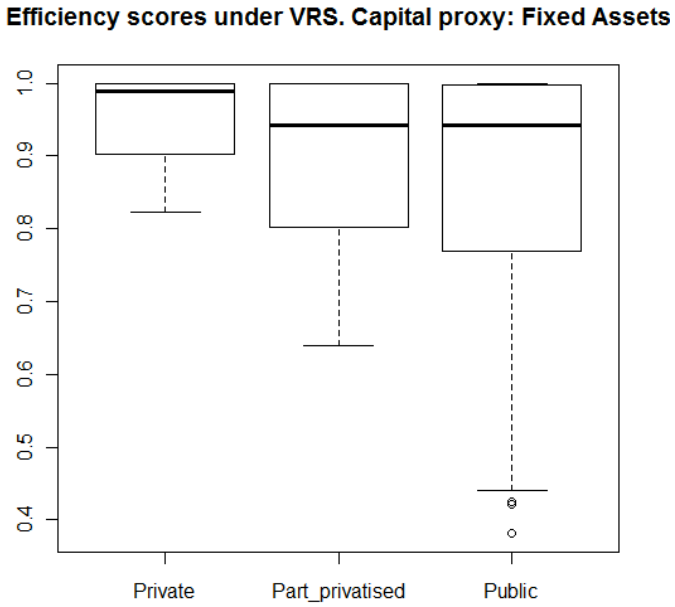
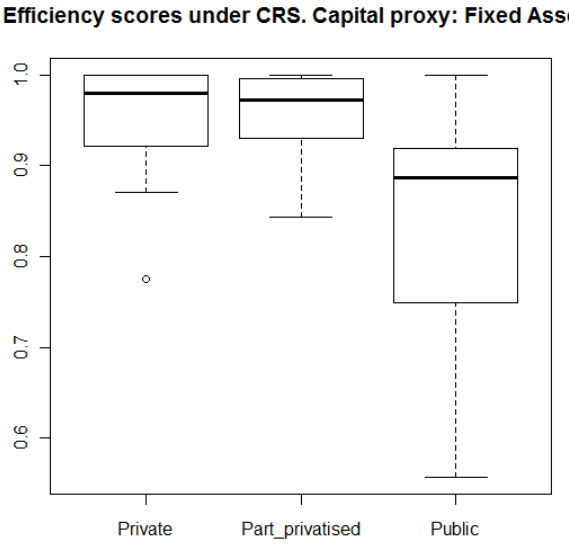


Table 5.7 reports that hypotheses about common distribution of scores of different groups is rejected for all but one specification which uses Total assets as an input.

Table 5.8. Kruskal-Wallis test results. Reduced sample.

Specification	Kruskal-Wallis test statistic	P-value
Hist. Costs of Fixed Assets (CRS)	13.27	0.001
Hist. Costs of Fixed Assets (VRS)	5.73	0.05
Depreciation(CRS)	11.46	0.003
Depreciation (VRS)	10.54	0.005
Total Assets (CRS)	2.664	0.264
Total Assets (VRS)	8.95	0.011

Figure 5.7



The results that we obtain from Brockett-Golany procedure are quite similar in the sense that public airports have a considerably lower efficiency under both scale assumptions. Kruskal-Wallis test shows again a rejection of hypotheses of common for all the three groups distribution (except for one specification.)

Figure 5.8

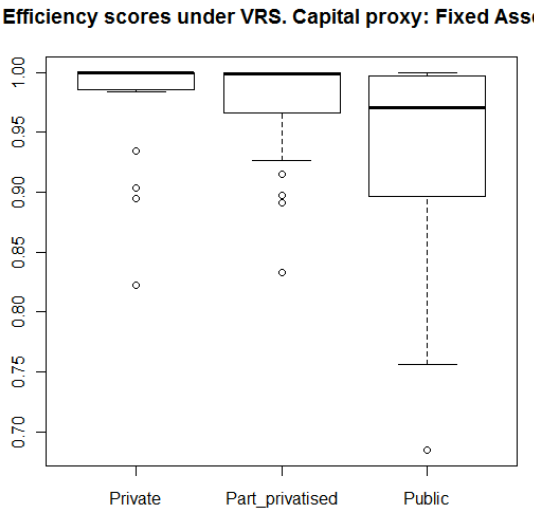


Table 5.9. Kruskal-Wallis test results (after Brockett-Golany procedure). Reduced sample.

Specification	Kruskal-Wallis test statistic	P-value
Hist. Costs of Fixed Assets (CRS)	26.49	0.000
Hist. Costs of Fixed Assets (VRS)	12.49	0.002
Total Assets (CRS)	23.04	0.000
Total Assets (VRS)	6.55	0.038

Depreciation(CRS)	41.13	0.000
Depreciation (VRS)	17.24	0.000

6. Conclusion

This paper was intended to address the issue of the financial performance of the airports and its links with the ownership structure. This topic being of great importance to current and potential investors surprisingly has not been actively addressed in recently. The relatively recent paper by Vogel (2005) basic framework of which we follow in our study is one notable exception.

The contribution of our paper to the existing literature is the following. Firstly, we examine a large database (in terms of both the number of airports covered and the time span). Secondly, we try to distinguish between partially and fully privatised airports though data do not allow us to draw unequivocal conclusions on that. Thirdly, in order to achieve reliability of our findings we try to use several specifications/tests for each method.

This research does not give clear answers to all the questions (due to insignificance of some results). At the same time it is possible to say that the obtained results do not contradict most of the existing empirical literature addressing the issues of privatisation and financial performance and that of the airports in particular.

Privatised airports are shown to generally outperform public ones in terms of profitability, investment intensity and usage of non-aviation activities. This finding can serve as a supporting argument for traditional corporate finance and strategic management theories that predict this result.

Concerning the difference in performance of partially and fully privatised airports one fact is clear – partially privatised airports do not perform significantly better than private ones (which means that they are either as efficient or perform worse). This is supported by financial ratio analysis and DEA.

Switching to the analysis of the reduced sample of the airports that have experienced a change in ownership structure during the time period in

consideration, we find that although privatisation affects most of the indicators in the expected way, in most cases these changes are not statistically significant. A similar result was obtained by Vogel (2005). At the same time, DEA results in general are in line with those obtained analysing the full sample: public airports perform worst, and partially privatised airports do not outperform private ones. This finding casts doubts on the theory about combining advantages of public and private ownership types.

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Appendix

Table A1. List of the airports

Country	Airport	Country	Airport
Austria	Salzburg	Italy	Genoa
Austria	Vienna	Italy	Naples
Belgium	Brussels	Italy	Olbia
Czech Republic	Prague	Italy	Palermo
Denmark	Copenhagen	Italy	Pisa
Estonia	Tallinn	Italy	Pescara
France	Aeroports de Paris	Italy	Rimini
France	Ajaccio	Italy	Lamezia
France	Biarritz	Italy	Trapani
France	Bordeaux	Italy	Turin
France	Lille	Italy	Trieste
France	Lyon	Latvia	Riga
France	Montpellier	Malta	Malta
France	Marseille	Netherlands	Amsterdam
France	Nice	Poland	Polish Airport Authority
France	Nantes	Slovenia	Ljubljana
France	Strasbourg	Switzerland	Geneva
Germany	Berlin	Switzerland	Zürich
Germany	Bremen	UK	Aberdeen
Germany	Cologne-Bonn	UK	Birmingham
Germany	Dresden	UK	Blackpool
Germany	Dortmund	UK	Bournemouth
Germany	Düsseldorf	UK	London Biggin Hill
Germany	Fraport	UK	Bristol
Germany	Hannover	UK	Cardiff
Germany	Hamburg	UK	Edinburgh
Germany	Leipzig	UK	Exeter
Germany	Munich	UK	Glasgow
Germany	Nuremberg	UK	Leeds
Germany	Saarbrücken	UK	London City
Germany	Stuttgart	UK	Gatwick
Greece	Athens	UK	Heathrow
Hungary	Budapest	UK	Liverpool
Italy	Alghero	UK	Manchester
Italy	Ancona	UK	Durham Tees Valley
Italy	Sistema del Garda	UK	Newcastle
Italy	Bergamo	UK	Norwich
Italy	Bologna	UK	Southend
Italy	Bolzano	UK	Southampton
Italy	Cagliari	UK	Stansted
Italy	Catania		
Italy	Florence		
Italy	Forio		

Table A2
Preliminary causal regressions:
Probit. Sample – public airports
Dependent variable is equal to 1if an airport will change its ownership structure, 0 otherwise.

const	1.442	0.009	**
EBITDA Margin	-1.543	0.011	*
Lev	0.152	0.746	
Non-av. rev share	-1.252	0.135	
y1991	-0.007	0.987	
y1992	-0.211	0.642	
y1993	-0.018	0.969	
y1994	-0.206	0.653	
y1995	-0.240	0.606	
y1996	-0.219	0.638	
y1997	-0.636	0.144	
y1998	-0.968	0.031	*
y1999	-1.072	0.013	*
y2000	-1.341	0.005	**
y2001	-1.748	0.001	***
y2002	-1.760	0.001	***
y2003	-2.098	0.001	***
y2004	-2.244	0.001	***
y2005	-2.322	0.001	**
y2006	-2.323	0.001	***
y2007	-1.832	0.008	**
Germany	-0.074	0.756	
Italy	-4.268	0.977	
France	0.207	0.584	

Table A3
Mann-Whitney tests results.

Ratio	Private-partially privatised	Partially privatised - public	Private-public
EBITDA/Equity	2329.5 0	15243 0.003	11653 0
EBITDA/Assets	3679.5 0	17202 0	18127.5 0.019
EBITDA/Fixed assets (H)	4210 0.523	10388.5 0	10234 0
EBITDA Margin	15291.5 0.08	43172.5 0.044	50029.5 0
EBIT/Equity	4160.5 0	17161 0	19857.5 0.357

EBIT/Assets	6822 0.372	18543 0	26662 0
EBIT/Fixed assets (H)	5159 0.043	10552.5 0	11492 0
EBIT Margin	18603.5 0	51852 0	63604.5 0
Capex/Depreciation	505.000 0.151	3579.500 0.000	1566.000 0.000
Non-aviation revenue share	21416.5 0	22018.5 0	47743.5 0.004
Debt/Assets	3393 0	12963.5 0.715	10051.5 0
Fixed Assets Turnover*	4256.5 0.607	7848.5 0.01	8553.5 0.029
Non-Aviation Revenue per PAX	17679 0	32353 0.527	45667 0

Given values are test statistics and corresponding p-values. Test hypothesis: ratios of the two ownership groups correspond to the same distribution.

Graphical representation of ratios. Full sample.

Figure A1

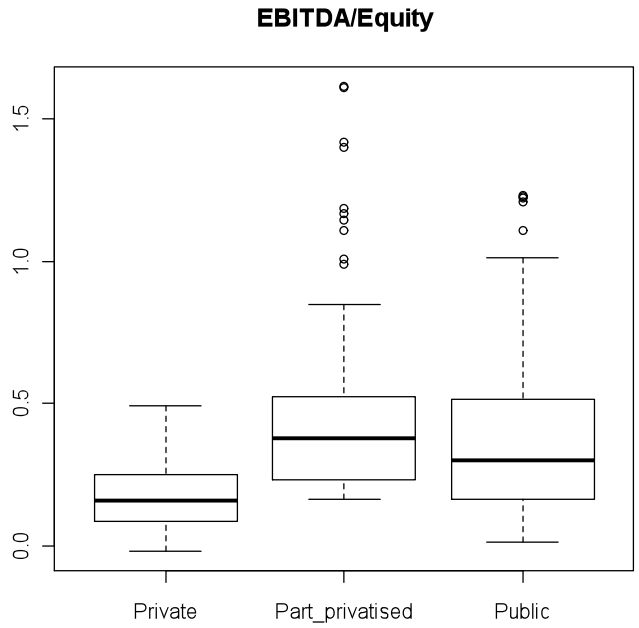


Figure A2

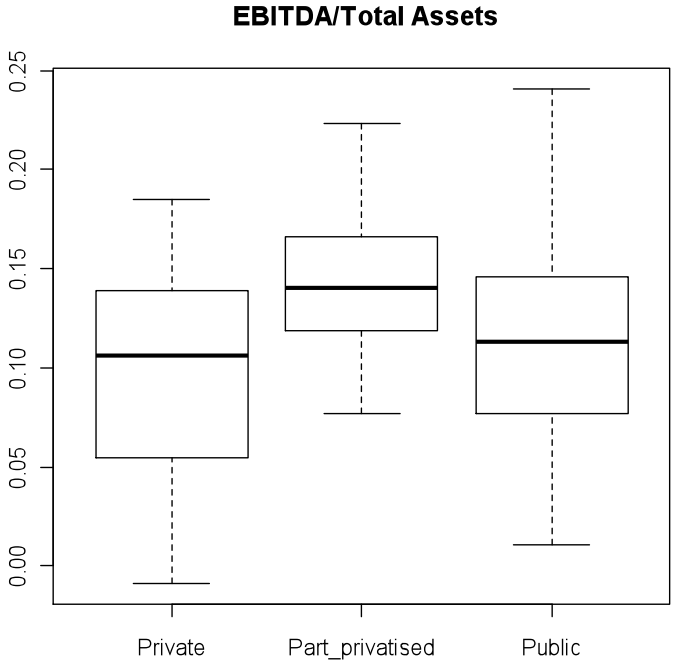


Figure A3

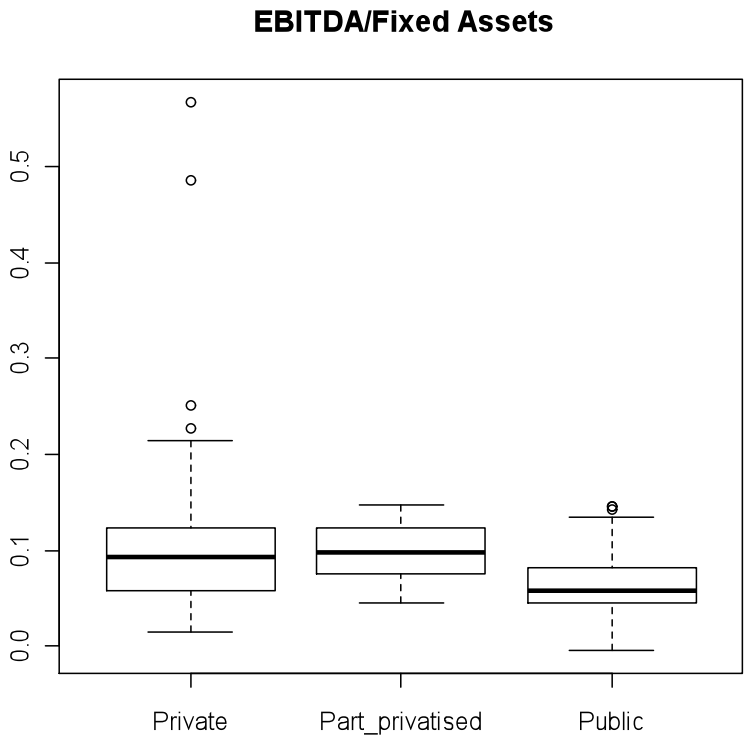


Figure A4

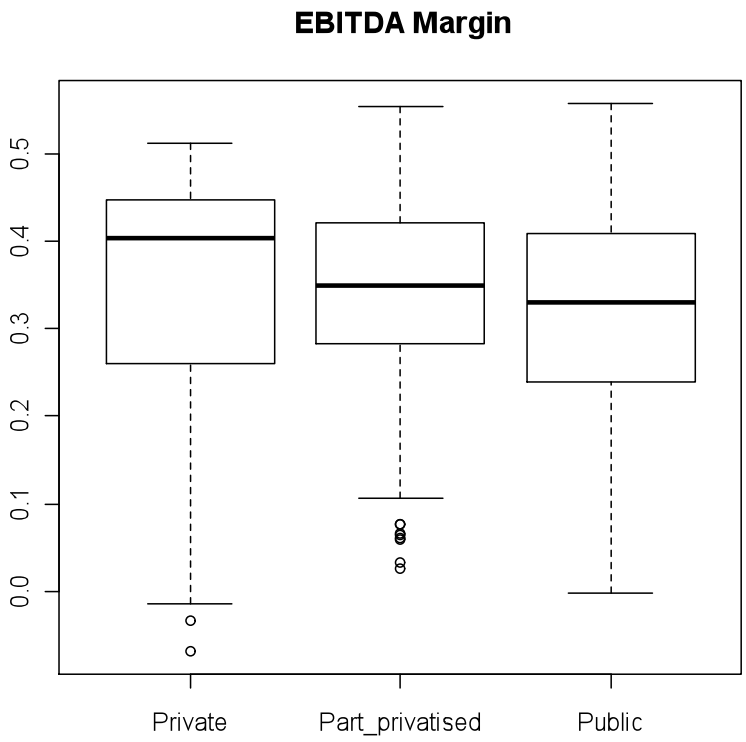


Figure A5

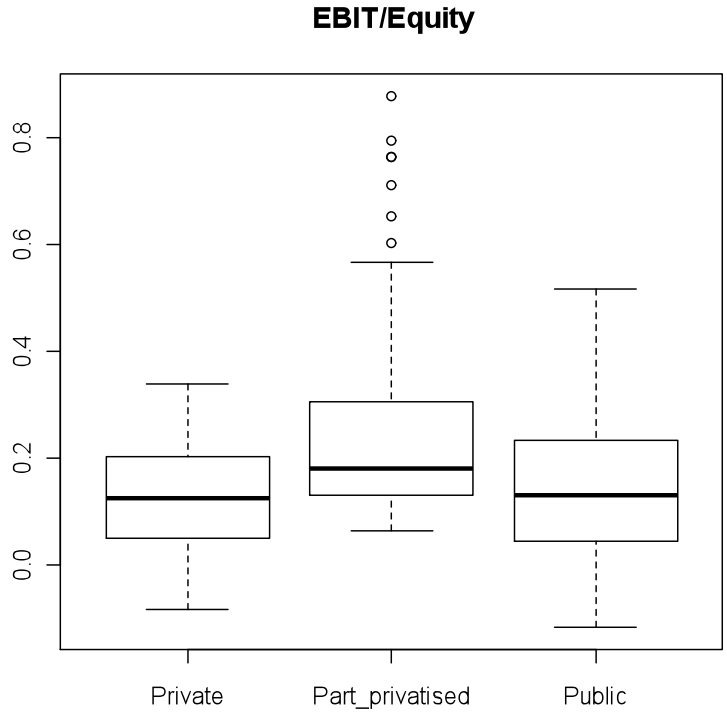


Figure A6

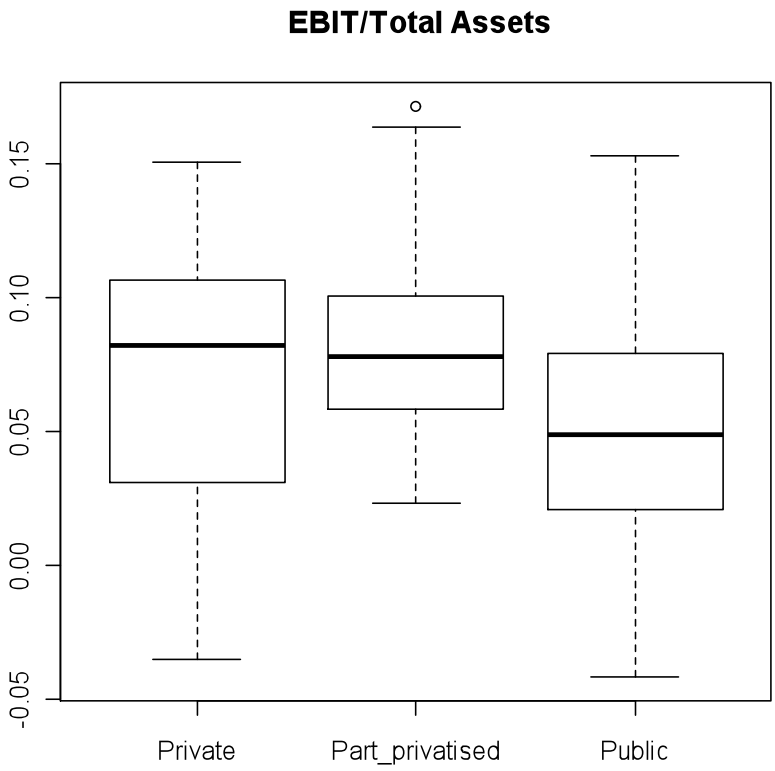


Figure A7

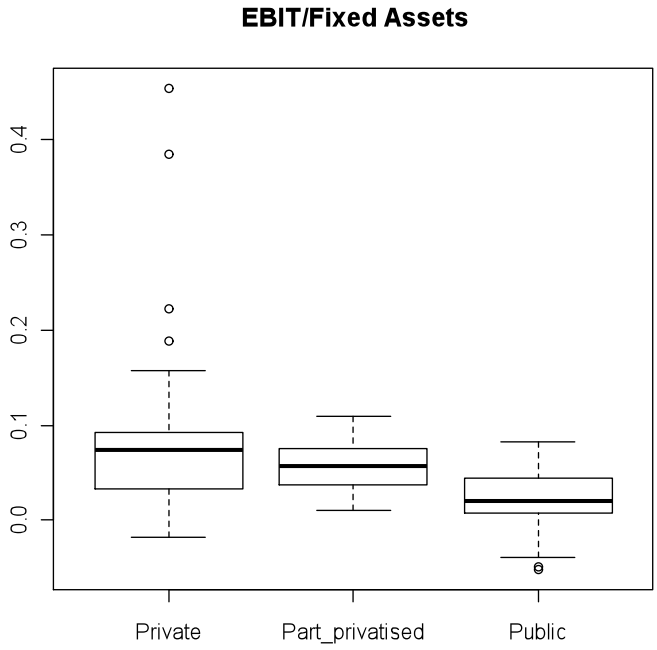


Figure A8

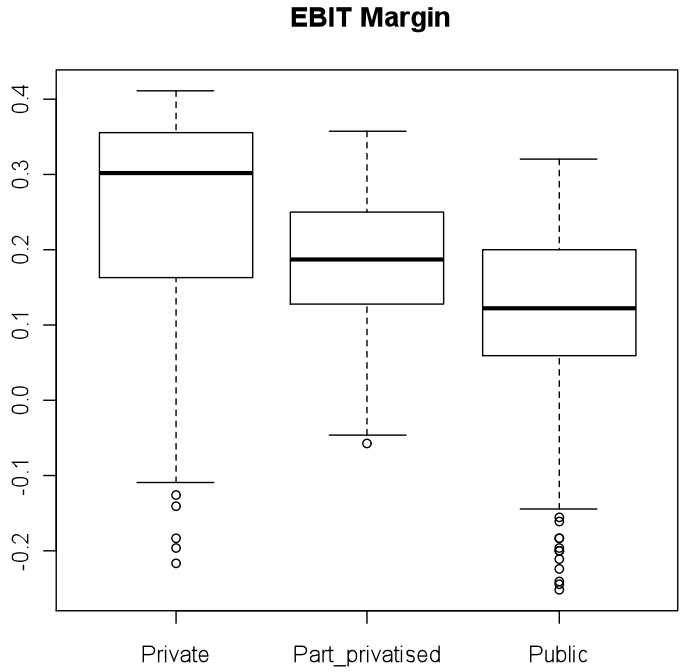


Figure A9

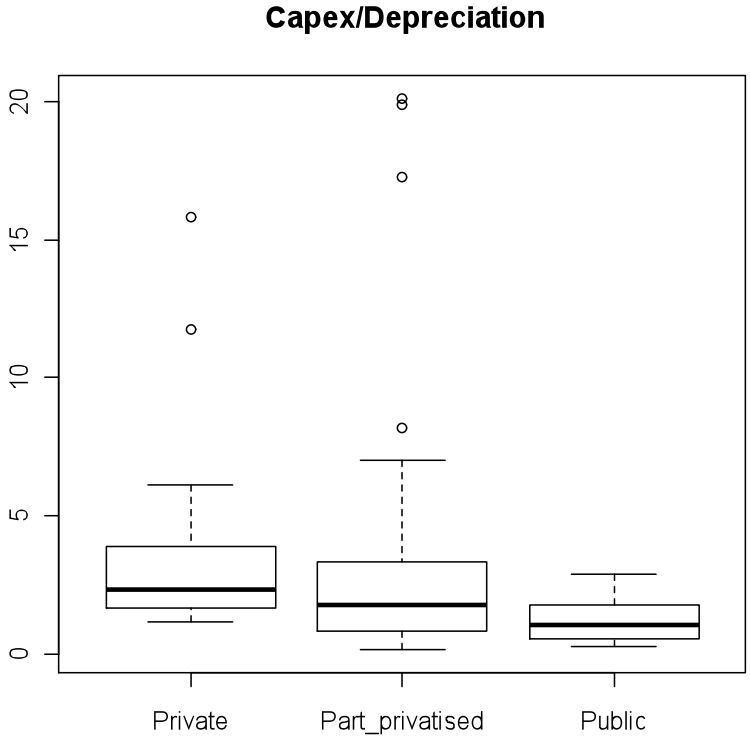


Figure A10

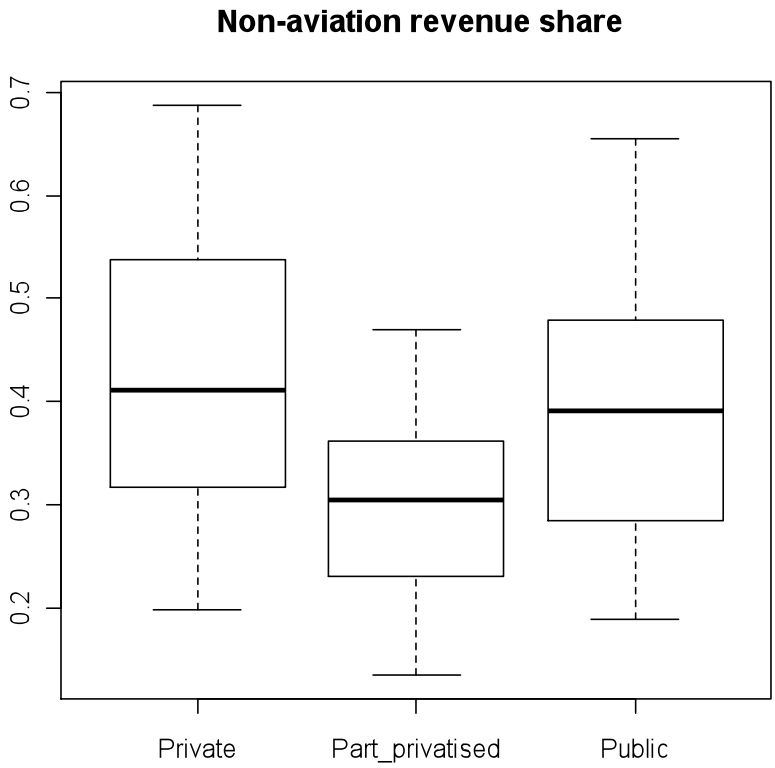


Figure A11

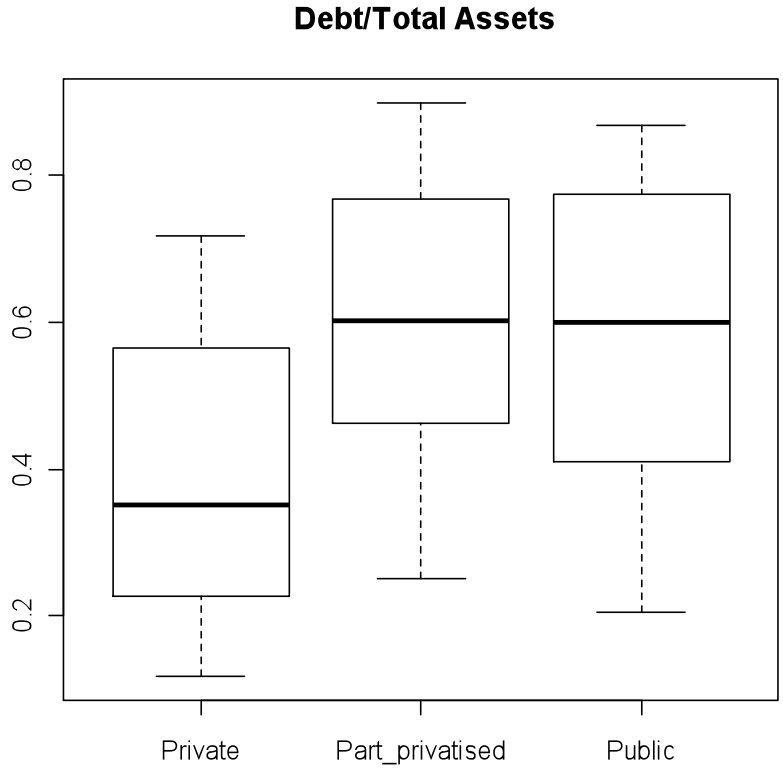
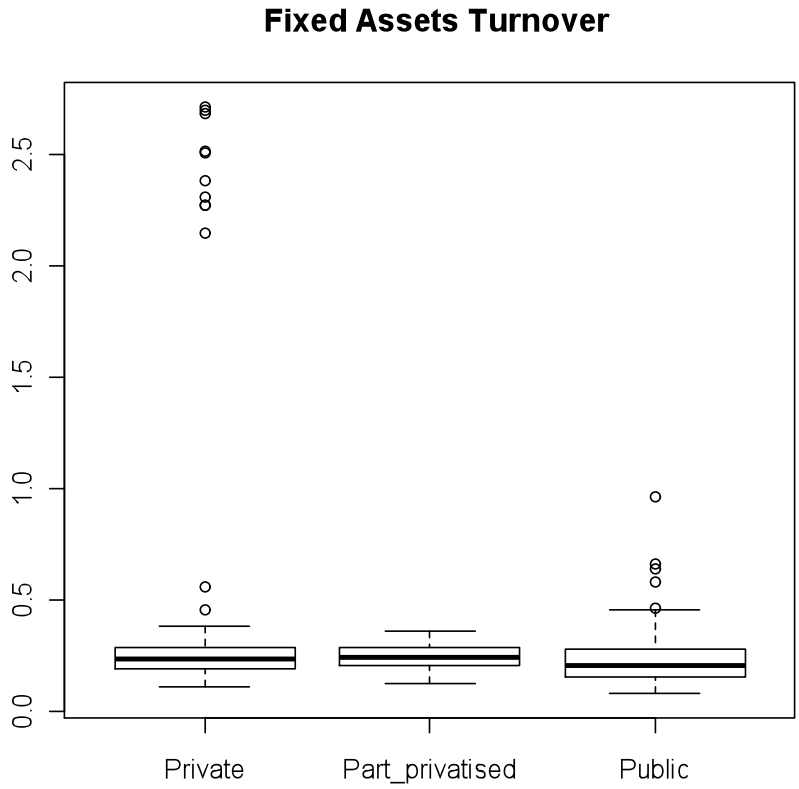


Figure A12



Regression results. Full sample

Table A4. EBITDA/Equity

(Intercept)	0.477	0	***
y1991	0.02	0.743	
y1992	0.016	0.792	
y1993	0.019	0.75	
y1994	0.021	0.732	
y1995	0.025	0.668	
y1996	-0.011	0.857	
y1997	-0.025	0.666	
y1998	-0.044	0.439	
y1999	-0.058	0.293	
y2000	-0.057	0.315	
y2001	-0.123	0.028	*
y2002	-0.137	0.017	*
y2003	-0.14	0.013	*
y2004	-0.127	0.026	*
y2005	-0.07	0.222	
y2006	-0.09	0.122	
y2007	-0.011	0.889	
Germany	0.2	0	***
UK	-0.223	0	***

Italy	0.432	0	***
France	0.083	0.137	
Privatised	0.031	0.278	
Part. privatised	0.081	0.004	**
Cost based reg.	-0.201	0	***
Incent. based reg.	-0.072	0.006	**
	R squared		
	0.344		
	P-value		
	0		

Table A5. EBIDTA/Total Assets

(Intercept)	0.148	0	***
y1991	-0.001	0.969	
y1992	0.003	0.808	
y1993	0.012	0.369	
y1994	0.005	0.697	
y1995	0.007	0.611	
y1996	0.006	0.637	
y1997	0	0.99	
y1998	-0.012	0.354	
y1999	-0.019	0.125	
y2000	-0.023	0.061	.
y2001	-0.036	0.003	**
y2002	-0.035	0.005	**
y2003	-0.043	0	***
y2004	-0.043	0.001	**
y2005	-0.033	0.008	**
y2006	-0.039	0.002	**
y2007	-0.009	0.571	
Germany	-0.012	0.095	.
UK	-0.02	0.009	**
Italy	0.035	0.022	*
France	0.004	0.749	
Privatised	0	0.944	
Part. privatised	0.028	0	***
Cost based reg.	-0.018	0.048	*
Incent. based reg.	-0.003	0.558	
	R squared		
	0.257		
	P-value		
	0		

Table A6. EBITDA/Fixed Assets

(Intercept)	0.075	0.018	*
y1991	0.021	0.622	
y1992	0.015	0.731	
y1993	0.04	0.275	
y1994	0.044	0.235	
y1995	0.057	0.125	
y1996	0.051	0.145	
y1997	0.027	0.395	
y1998	0.018	0.574	
y1999	0.017	0.585	
y2000	0.02	0.531	
y2001	0.01	0.748	
y2002	0.005	0.86	
y2003	0	0.995	
y2004	0.004	0.909	
y2005	0.005	0.88	
y2006	-0.002	0.951	
y2007	0.014	0.667	
Germany	-0.042	0	***
UK	-0.002	0.711	
Italy	NA	NA	
France	NA	NA	
Privatised	0.008	0.175	
Part. privatised	0.022	0	***
Cost based reg.	0.011	0.164	
	0.007	0.2	
	R squared		
	0.373		
	P-value		
	0		

Table A7. EBITDA Margin

(Intercept)	0.309	0	***
y1991	0.003	0.895	
y1992	0.019	0.455	
y1993	0.027	0.28	
y1994	0.03	0.222	
y1995	0.041	0.096	.
y1996	0.043	0.084	.
y1997	0.06	0.012	*
y1998	0.052	0.025	*
y1999	0.035	0.12	
y2000	0.065	0.004	**

y2001	0.039	0.08	.
y2002	0.023	0.298	
y2003	0.021	0.357	
y2004	0.037	0.092	.
y2005	0.049	0.028	*
y2006	0.043	0.056	.
y2007	0.05	0.032	*
Germany	-0.166	0	***
UK	-0.019	0.125	
Italy	-0.213	0	
France	0.037	0.024	
Privatised	0.045	0	***
Part. privatised	0.048	0	***
Cost based reg.	0.11	0	***
Incent. based reg.	0.051	0	***
	R squared		
	0.313		
	P-value		
	0		

Table A8. EBIT/Equity

(Intercept)	0.234	0	***
y1991	0	0.99	
y1992	0.027	0.44	
y1993	0.041	0.243	
y1994	0.045	0.207	
y1995	0.037	0.296	
y1996	0.036	0.307	
y1997	0.017	0.619	
y1998	0.01	0.758	
y1999	0.017	0.597	
y2000	-0.014	0.682	
y2001	-0.037	0.268	
y2002	-0.037	0.271	
y2003	-0.054	0.106	
y2004	-0.045	0.178	
y2005	-0.009	0.799	
y2006	-0.018	0.598	
y2007	0.032	0.495	
Germany	0.028	0.186	
UK	-0.113	0	***

Italy	0.246	0	
France	-0.045	0.171	
Privatised	0.031	0.064	.
Part. privatised	0.032	0.058	.
Cost based reg.	-0.106	0	***
Incent. based reg.	-0.02	0.191	
	R squared		
	0.18		
	P-value		
	0		

Table A9. EBIT/Total Assets

(Intercept)	0.083	0	***
y1991	-0.003	0.775	
y1992	0.002	0.835	
y1993	-0.001	0.943	
y1994	0.001	0.936	
y1995	0.005	0.673	
y1996	0.002	0.851	
y1997	0	0.965	
y1998	-0.006	0.58	
y1999	-0.012	0.277	
y2000	-0.011	0.305	
y2001	-0.025	0.019	*
y2002	-0.023	0.038	*
y2003	-0.026	0.017	*
y2004	-0.026	0.016	*
y2005	-0.019	0.089	.
y2006	-0.021	0.061	.
y2007	0.006	0.673	
Germany	-0.029	0	***
UK	-0.008	0.221	
Italy	0.004	0.77	
France	-0.017	0.108	
Privatised	0.014	0.012	*
Part. privatised	0.022	0	***
Cost based reg.	-0.011	0.177	
Incent. based reg.	0	0.921	
	R squared		
	0.259		
	P-value		
	0		

Table A10. EBIT/Fixed Assets

(Intercept)	0.024	0.386	
y1991	0.024	0.526	
y1992	0.05	0.127	
y1993	0.033	0.318	
y1994	0.031	0.343	
y1995	0.059	0.059	.
y1996	0.045	0.153	
y1997	0.027	0.351	
y1998	0.013	0.636	
y1999	0.022	0.42	
y2000	0.024	0.396	
y2001	0.012	0.677	
y2002	0.013	0.643	
y2003	0.011	0.684	
y2004	0.013	0.641	
y2005	0.015	0.576	
y2006	0.012	0.66	
y2007	0.027	0.341	
Germany	-0.035	0	***
UK	0.005	0.367	
Italy	0.014	0.008	
France	0.018	0	
Privatised	0.012	0.097	.
Part. privatised	0.01	0.032	*
Cost based reg.	R squared		***
Incent. based reg.	0.41		***
	P-value		
	0		

Table A11. EBIT Margin

(Intercept)	0.159	0	***
y1991	-0.001	0.974	
y1992	0.014	0.612	
y1993	0.025	0.373	
y1994	0.021	0.436	
y1995	0.023	0.409	
y1996	0.027	0.306	
y1997	0.037	0.156	
y1998	0.028	0.261	
y1999	0.029	0.239	
y2000	0.038	0.122	
y2001	0.005	0.841	
y2002	-0.008	0.731	

y2003	-0.01	0.676	
y2004	-0.008	0.733	
y2005	0.023	0.343	
y2006	0.023	0.364	
y2007	0.029	0.262	
Germany	-0.16	0	***
UK	0.011	0.394	
Italy	-0.145	0	
France	-0.028	0.089	
Privatised	0.055	0	***
Part. privatised	0.058	0	***
Cost based reg.	0.071	0	***
Incent. based reg.	0.042	0	***
	R squared		
	0.355		
	P-value		
	0		

Table A12. Non-aviation revenue share

(Intercept)	0.351	0	***
y1991	-0.001	0.977	
y1992	0.005	0.841	
y1993	-0.009	0.757	
y1994	-0.009	0.734	
y1995	0	0.995	
y1996	0.009	0.741	
y1997	0.007	0.779	
y1998	0.011	0.657	
y1999	0.002	0.944	
y2000	0.006	0.818	
y2001	0.016	0.507	
y2002	0.024	0.33	
y2003	0.026	0.295	
y2004	0.006	0.792	
y2005	0.001	0.963	
y2006	0.001	0.976	
y2007	0.017	0.511	
Germany	-0.078	0	***
UK	0.032	0.015	*
Italy	-0.101	0	
France	0.165	0	
Privatised	0.005	0.718	
Part. privatised	-0.047	0	***
Cost based reg.	0.054	0.001	**

Incent. based reg.	0.076	0	***
	R squared		
	0.324		
	P-value		
	0		

Table A13. Debt/Total Assets

(Intercept)	0.578	0	***
y1991	0.013	0.803	
y1992	0.039	0.441	
y1993	0.051	0.313	
y1994	0.039	0.436	
y1995	0.033	0.507	
y1996	0.013	0.788	
y1997	-0.003	0.951	
y1998	0.01	0.837	
y1999	0.009	0.839	
y2000	0.012	0.795	
y2001	0.003	0.948	
y2002	0.005	0.922	
y2003	-0.007	0.879	
y2004	0.004	0.934	
y2005	0.045	0.358	
y2006	0.024	0.619	
y2007	0.013	0.834	
Germany	0.14	0	***
UK	-0.21	0	***
Italy	0.309	0	
France	0.101	0.03	
Privatised	0.066	0.007	**
Part. Privatised	0.016	0.513	
Cost based reg.	-0.077	0.025	*
Incent. based reg.	-0.064	0.003	**
	R squared		
	0.377		
	P-value		
	0		

Table A14. Fixed Assets Turnover

(Intercept)	0.484	0	***
y1991	-0.014	0.908	
y1992	0.028	0.791	
y1993	-0.008	0.943	
y1994	-0.015	0.881	

y1995	-0.054	0.586	
y1996	-0.061	0.541	
y1997	-0.12	0.194	
y1998	-0.088	0.332	
y1999	-0.114	0.198	
y2000	-0.166	0.063	.
y2001	-0.17	0.056	.
y2002	-0.181	0.041	*
y2003	-0.188	0.035	*
y2004	-0.195	0.029	*
y2005	-0.202	0.023	*
y2006	-0.207	0.02	*
y2007	-0.179	0.047	*
Germany	-0.009	0.594	
UK	-0.039	0.037	*
Italy	NA	NA	
France	NA	NA	
Privatised	-0.033	0.053	.
Part. privatised	-0.019	0.18	
Cost based reg.	-0.109	0	***
Incent. based reg.	-0.029	0.05	.
	R squared		
	0.278		
	P-value		
	0		

Table A15. Non-aviation revenue per passenger

(Intercept)	4.908	0	***
y1991	0.173	0.804	
y1992	0.214	0.757	
y1993	0.477	0.49	
y1994	0.406	0.557	
y1995	0.689	0.319	
y1996	0.838	0.221	
y1997	0.313	0.635	
y1998	0.746	0.241	
y1999	0.299	0.635	
y2000	0.461	0.46	
y2001	1.158	0.065	.
y2002	1.51	0.016	*
y2003	1.573	0.013	*
y2004	1.3	0.038	*
y2005	1.28	0.039	*
y2006	1.308	0.037	*
y2007	1.366	0.035	*

Germany	-0.85	0.022	*
UK	1.486	0	***
Italy	-3.667	0	
France	0.239	0.618	
Privatised	-0.301	0.356	
Part. privatised	0.008	0.977	
Cost based reg.	2.394	0	***
Incent. based reg.	3.103	0	***
	R squared		
	0.288		
	P-value		
	0		

Table A16. Capex/Depreciation

(Intercept)	1.619	0.036	*
y1991	0.658	0.479	
y1992	1.214	0.197	
y1993	0.732	0.435	
y1994	1.105	0.238	
y1995	0.699	0.455	
y1996	-0.587	0.467	
y1997	-0.291	0.719	
y1998	-0.185	0.819	
y1999	-0.115	0.886	
y2000	-0.177	0.817	
y2001	-0.499	0.509	
y2002	-0.148	0.845	
y2003	-0.219	0.769	
y2004	0.363	0.624	
y2005	0.028	0.970	
y2006	-0.326	0.693	
y2007	-0.199	0.808	
Germany	-1.017	0.007	**
UK	0.635	0.195	
Italy	NA	NA	
France	-0.201	0.618	
Privatised	0.100	0.008	**
Part. privatised	0.088	0.825	
Cost based reg.	1.013	0.020	*
Incent. based reg.	0.832	0.028	*
	R squared		
	0.302		

	P-value	
	0.019	

Table A17. Mann-Whitney test results. Change in ownership sample.

Ratio	Test statistic, P-value
EBITDA/Equity	5527 0.011
EBITDA/Assets	5989.000 0
EBITDA/Fixed assets (H)	1246.000 0.540
EBITDA Margin	4870.500 0
EBIT/Equity	5073 0.139
EBIT/Assets	4804 0.611
EBIT/Fixed assets (H)	1090.5 0.073
EBIT Margin	4602.5 0
Capex/Depreciation	285 0.993
Non-aviation revenue share	7834.5 0.194
Debt/Assets	5314.5 0.048
Fixed Assets Turnover*	1694.5 0.078
Non-Aviation Revenue per PAX	3763 0

Graphical represantation of ratios. Change in ownership sample

Figure A13

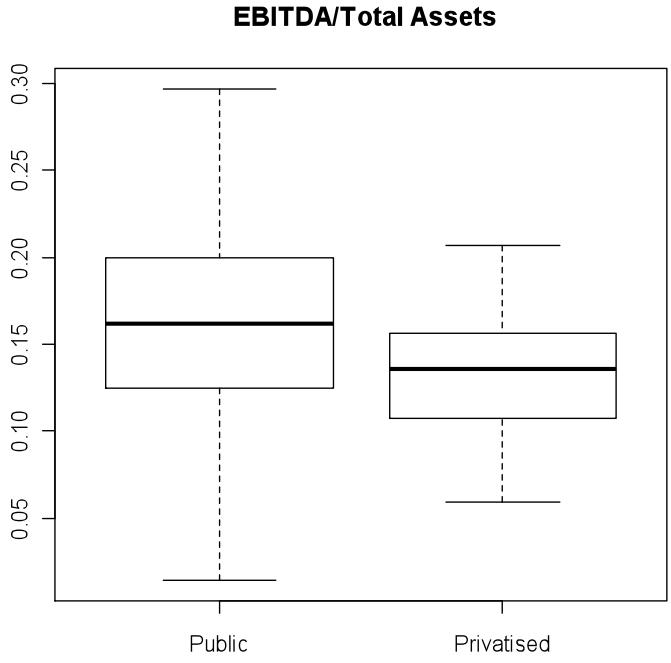


Figure A14

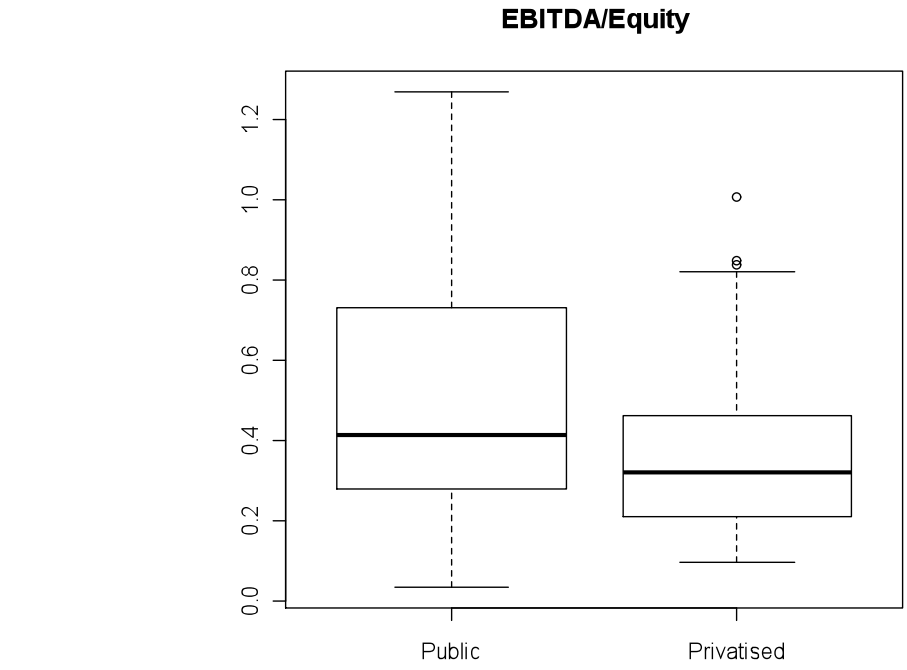


Figure A15

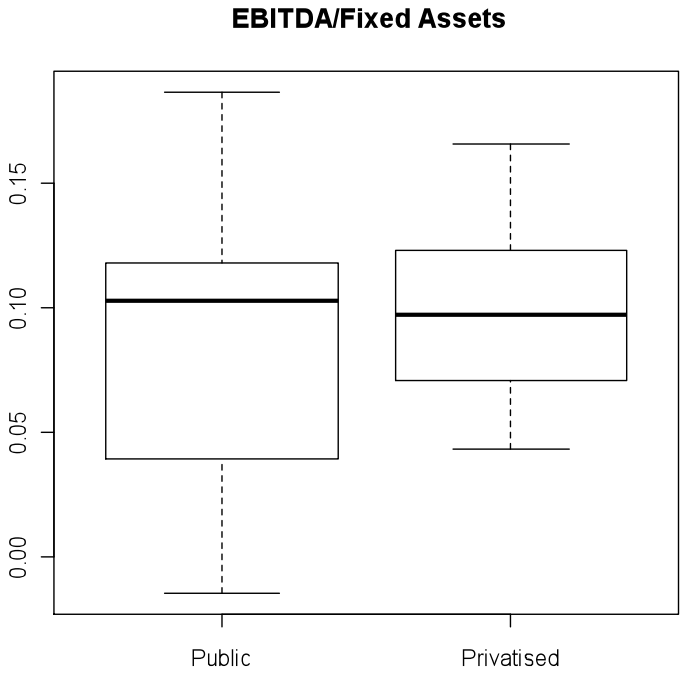


Figure A16

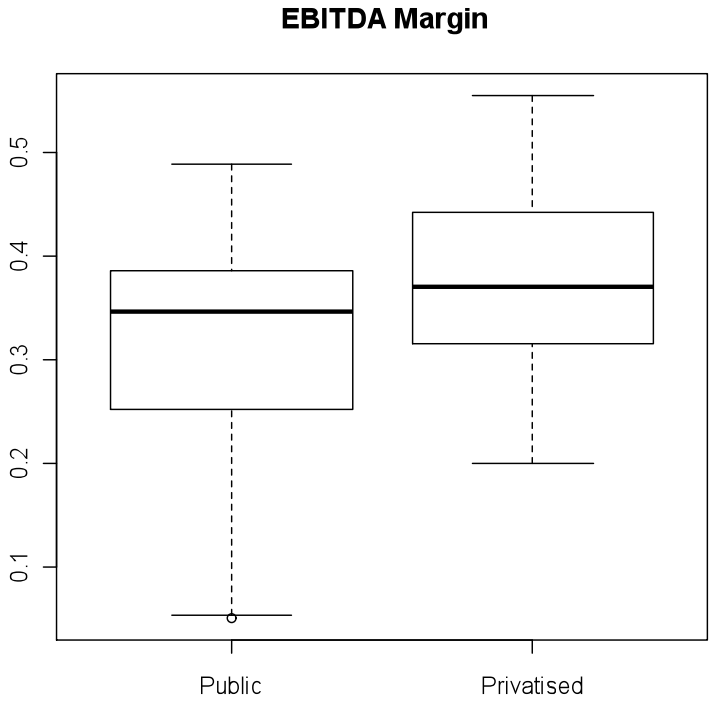


Figure A17

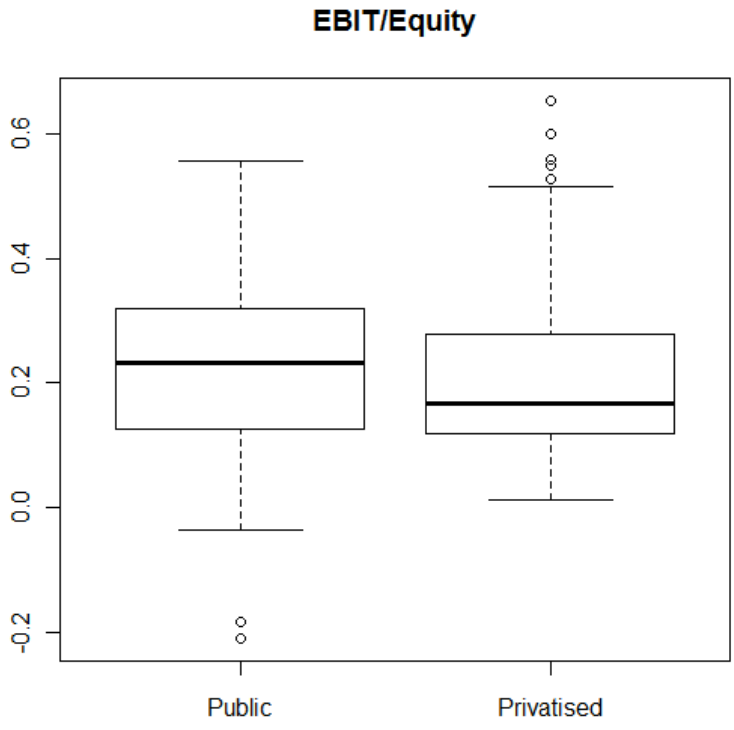


Figure A18

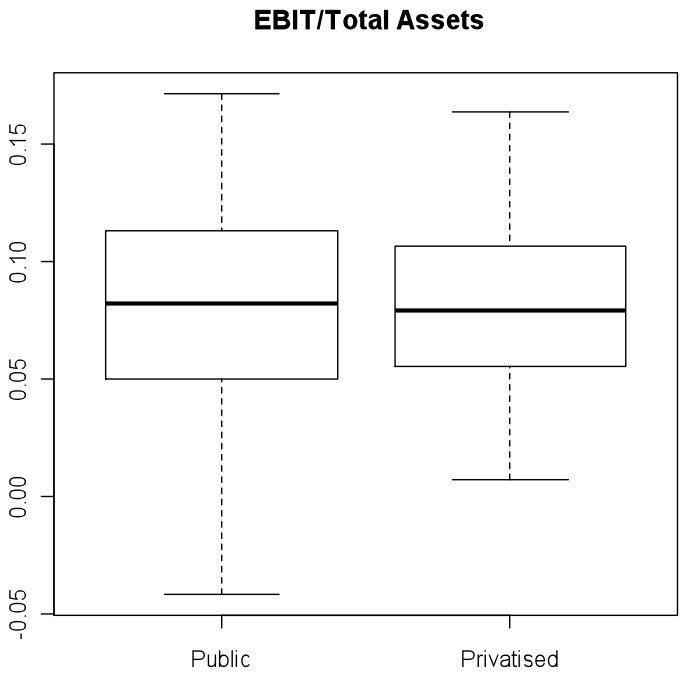


Figure A19

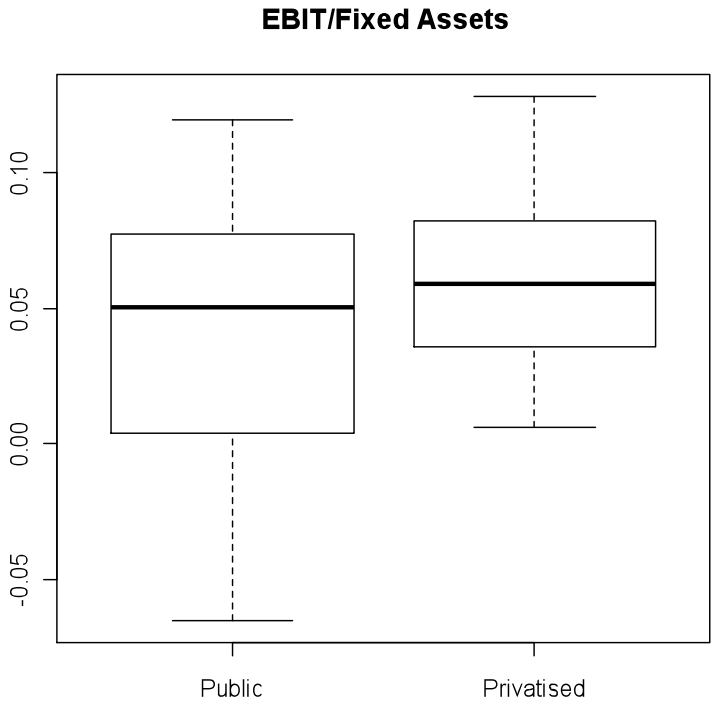


Figure A20

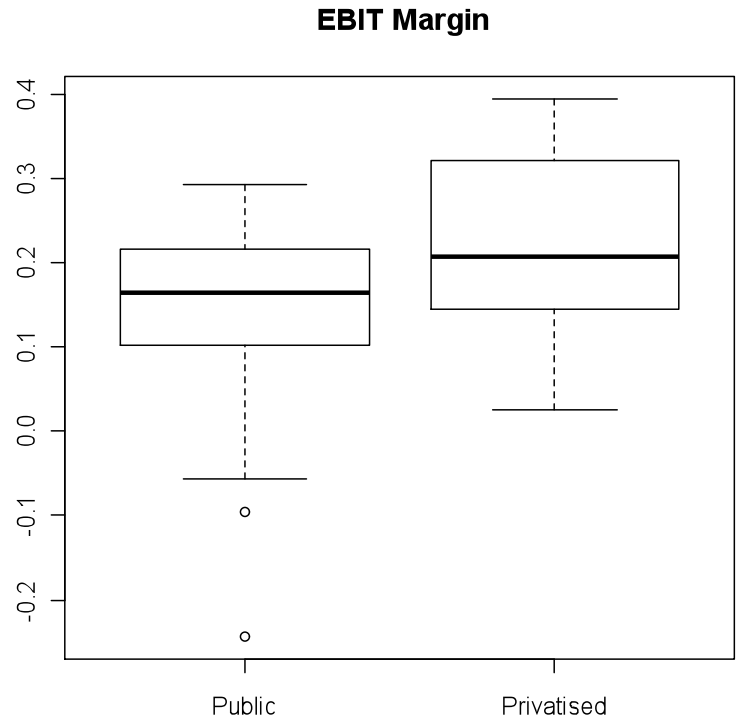


Figure A21

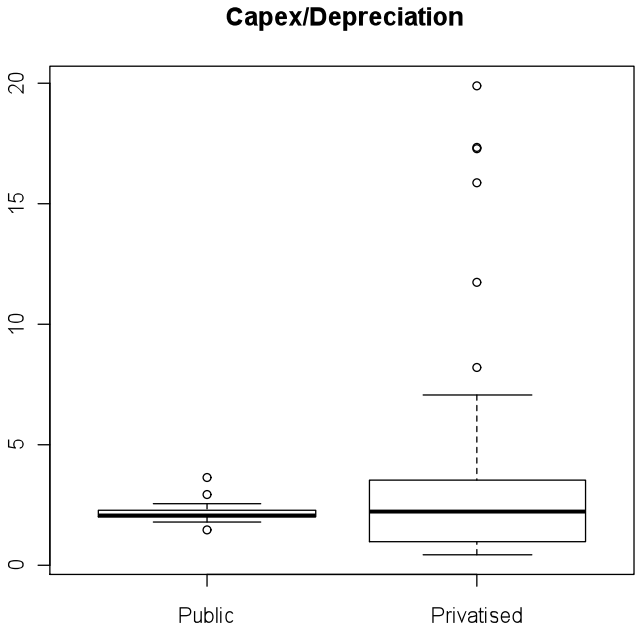


Figure A22

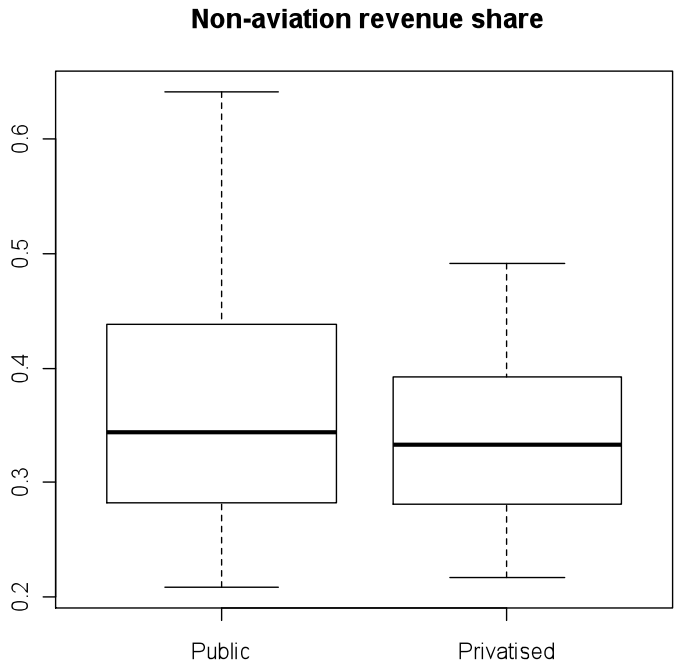


Figure A23

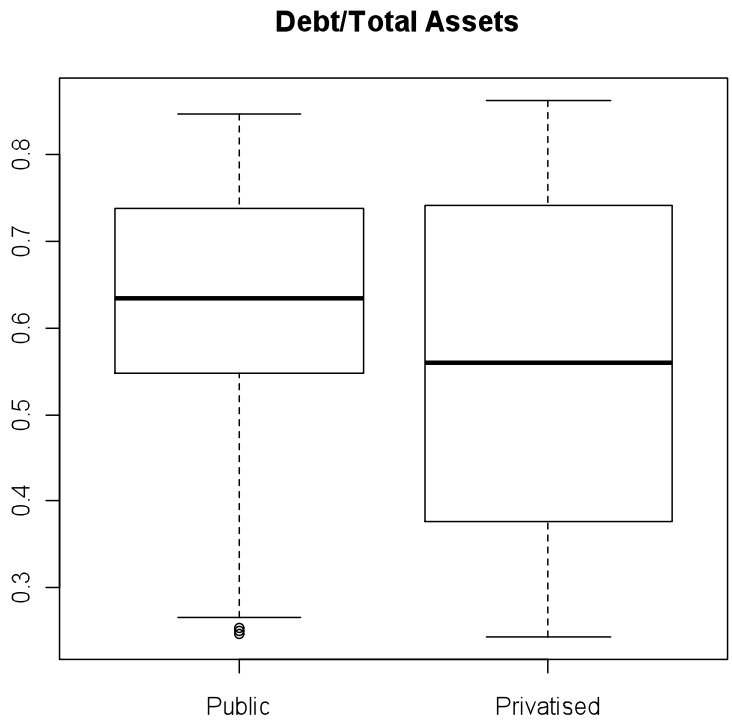


Figure A24

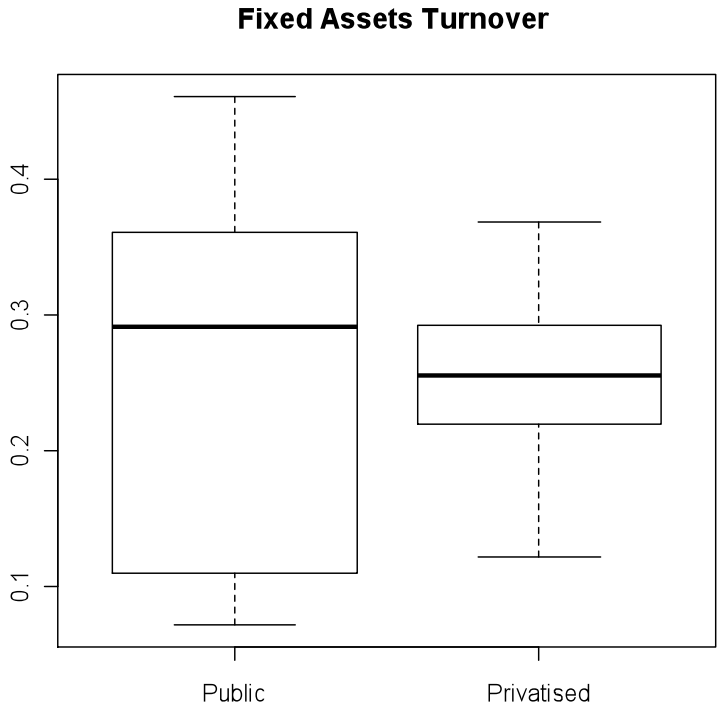
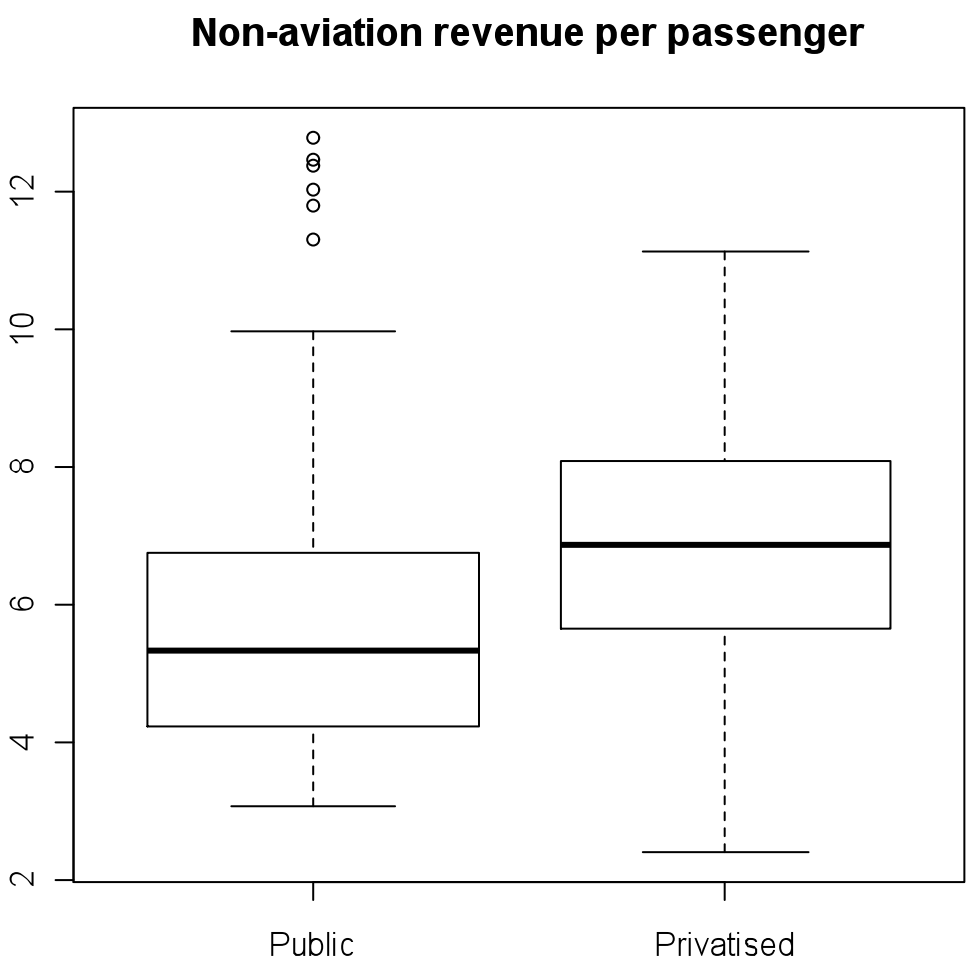


Figure A25



Regression results. Change in ownership sample

Table A18. EBITDA/Equity

(Intercept)	0.427	0	***
y1991	0.059	0.541	
y1992	0.033	0.736	
y1993	0.001	0.993	
y1994	0.032	0.743	
y1995	0.038	0.698	
y1996	0.033	0.734	
y1997	0.001	0.991	
y1998	-0.083	0.41	
y1999	-0.087	0.379	
y2000	-0.031	0.763	
y2001	-0.132	0.224	
y2002	-0.182	0.105	
y2003	-0.201	0.07	.
y2004	-0.116	0.307	
y2005	-0.144	0.214	
y2006	-0.063	0.608	

y2007	0.159	0.282	
Germany	0.301	0	***
UK	NA	NA	
Italy	NA	NA	
France	-0.035	0.653	
Public	-0.016	0.78	
Cost based reg.	-0.091	0.119	
Incent. based reg.	-0.026	0.652	
	R squared		
	0.294		
	P-value		
	0		

Table A19. EBITDA/Total Assets

(Intercept)	0.116	0	***
y1991	0.012	0.564	
y1992	0.014	0.489	
y1993	0.017	0.388	
y1994	0.04	0.047	*
y1995	0.053	0.009	**
y1996	0.038	0.063	.
y1997	0.024	0.265	
y1998	0.011	0.627	
y1999	0.014	0.535	
y2000	0.031	0.18	
y2001	0.003	0.914	
y2002	-0.003	0.896	
y2003	-0.009	0.714	
y2004	-0.003	0.907	
y2005	-0.014	0.565	
y2006	-0.009	0.715	
y2007	0.028	0.37	
Germany	-0.002	0.869	
UK	NA	NA	
Italy	NA	NA	
France	-0.017	0.293	
Public	0.025	0.052	.
Cost based reg.	0.005	0.66	
Incent. based reg.	0.034	0.004	**
	R squared		
	0.246		

	P-value		
	0.001		

Table A20. EBITDA/Fixed Assets

(Intercept)	0.073	0.029	*
y1991	0.021	0.615	
y1992	0.044	0.304	
y1993	0.055	0.134	
y1994	0.046	0.218	
y1995	0.059	0.116	
y1996	0.062	0.079	.
y1997	0.053	0.119	
y1998	0.04	0.227	
y1999	0.04	0.224	
y2000	0.039	0.236	
y2001	0.035	0.291	
y2002	0.013	0.693	
y2003	0.016	0.639	
y2004	0.019	0.572	
y2005	0.011	0.756	
y2006	0.012	0.715	
y2007	0.025	0.461	
Germany	-0.038	0	***
UK	NA	NA	
Italy	NA	NA	
France	NA	NA	
Public	0.007	0.434	
Cost based reg.	0.006	0.606	
Incent. based reg.	0.023	0.005	**
	R squared		
	0.448		
	P-value		
	0		

Table A21. EBITDA Margin

(Intercept)	0.349	0	***
y1991	0.016	0.642	
y1992	0.006	0.843	
y1993	0.023	0.48	
y1994	0.068	0.039	*
y1995	0.076	0.025	*
y1996	0.051	0.115	
y1997	0.064	0.061	.

y1998	0.055	0.093	.
y1999	0.056	0.092	.
y2000	0.07	0.035	*
y2001	0.056	0.095	.
y2002	0.009	0.793	
y2003	0.009	0.792	
y2004	0.042	0.248	
y2005	0.047	0.197	
y2006	0.053	0.156	
y2007	0.046	0.224	
Germany	-0.082	0	***
UK	NA	NA	
Italy	-0.184	0	***
France	-0.014	0.52	
Public	-0.035	0.035	*
Cost based reg.	0.047	0.021	*
Incent. based reg.	0.005	0.794	

Table A22. EBIT/Equity

(Intercept)	0.148	0.01	*
y1991	0.023	0.686	
y1992	0.049	0.39	
y1993	0.016	0.783	
y1994	0.075	0.194	
y1995	0.07	0.235	
y1996	0.04	0.5	
y1997	0.062	0.295	
y1998	-0.015	0.807	
y1999	0.045	0.455	
y2000	0.064	0.335	
y2001	0.006	0.929	
y2002	0.01	0.894	
y2003	-0.023	0.74	
y2004	0.001	0.986	
y2005	0.009	0.903	
y2006	0.016	0.827	
y2007	0.147	0.126	
Germany	0.087	0.011	*
UK	0	0.999	
Italy	NA	NA	
France	NA	NA	
Public	0.038	0.285	
Cost based reg.	-0.003	0.939	

Incent. based reg.	0.041	0.219	
	R squared		
	0.185		
	P-value		
	0.035		

Table A23. EBIT/Total Assets

(Intercept)	0.058	0.001	**
y1991	0.001	0.973	
y1992	0.019	0.267	
y1993	0.015	0.386	
y1994	0.033	0.049	*
y1995	0.048	0.005	**
y1996	0.035	0.039	*
y1997	0.033	0.061	.
y1998	0.027	0.132	
y1999	0.029	0.113	
y2000	0.035	0.07	.
y2001	0.009	0.64	
y2002	0.01	0.638	
y2003	0.001	0.965	
y2004	0.004	0.857	
y2005	0.005	0.821	
y2006	0.013	0.551	
y2007	0.044	0.091	.
Germany	-0.025	0.012	*
UK	-0.013	0.33	
Italy	NA	NA	
France	NA	NA	
Public	0.017	0.111	
Cost based reg.	0.004	0.669	
Incent. based reg.	0.029	0.004	**
	R squared		
	0.234		
	P-value		
	0.002		

Table A24. EBIT/Fixed Assets

(Intercept)	0.018	0.565	
y1991	0.024	0.545	
y1992	0.064	0.068	.
y1993	0.046	0.183	

y1994	0.039	0.274	
y1995	0.073	0.031	*
y1996	0.058	0.081	.
y1997	0.057	0.08	.
y1998	0.047	0.138	
y1999	0.052	0.093	.
y2000	0.054	0.088	.
y2001	0.033	0.297	
y2002	0.036	0.263	
y2003	0.031	0.342	
y2004	0.042	0.197	
y2005	0.034	0.3	
y2006	0.036	0.267	
y2007	0.046	0.158	
Germany	-0.037	0	***
UK	NA	NA	
Italy	NA	NA	
France	NA	NA	
Public	0.009	0.318	
Cost based reg.	0.009	0.405	
Incent. based reg.	0.021	0.007	**
	R squared		
	0.407		
	P-value		
	0		

Table A25. EBIT Margin

(Intercept)	0.188	0	***
y1991	-0.008	0.803	
y1992	0.02	0.527	
y1993	0.018	0.575	
y1994	0.044	0.174	
y1995	0.061	0.063	.
y1996	0.054	0.098	.
y1997	0.061	0.065	.
y1998	0.046	0.163	
y1999	0.051	0.123	
y2000	0.068	0.046	*
y2001	0.024	0.496	
y2002	0.006	0.866	
y2003	0.015	0.678	
y2004	0.005	0.89	
y2005	0.046	0.207	
y2006	0.021	0.596	

y2007	0.047	0.22	
Germany	-0.099	0	***
UK	-0.153	0	***
Italy	NA	NA	
France	-0.01	0.641	
Public	-0.024	0.191	
Cost based reg.	0.055	0.007	**
Incent. based reg.	0.045	0.013	*
	R squared		
	0.293		
	P-value		
	0		

Table A26. Capex/Depreciation

(Intercept)	-0.214	0.955	
y1991	0.54	0.892	
y1992	3.083	0.466	
y1993	1.728	0.682	
y1994	-0.342	0.935	
y1995	0.111	0.979	
y1996	-0.52	0.902	
y1997	-0.323	0.939	
y1998	-0.627	0.882	
y1999	-0.427	0.919	
y2000	4.292	0.262	
y2001	2.888	0.472	
y2002	0.979	0.811	
y2003	0.768	0.851	
y2004	1.681	0.663	
y2005	3.206	0.401	
y2006	3.659	0.365	
y2007	4.559	0.255	
Germany	-3.493	0.06	.
UK	NA	NA	
Italy	NA	NA	
France	-2.563	0.31	
Public	3.853	0.166	
Cost based reg.	0.388	0.876	
Incent. based reg.	3.2	0.048	*
	R squared		
	0.33		
	P-value		
	0.745		

Table A27. Non-aviation revenue share

(Intercept)	0.372	0	***
y1991	-0.001	0.967	
y1992	-0.007	0.841	
y1993	-0.013	0.704	
y1994	-0.022	0.506	
y1995	-0.007	0.837	
y1996	0.009	0.798	
y1997	0	0.998	
y1998	0.011	0.756	
y1999	-0.015	0.662	
y2000	0.002	0.958	
y2001	0.001	0.984	
y2002	0.022	0.526	
y2003	0.005	0.879	
y2004	0.017	0.631	
y2005	0.004	0.913	
y2006	0.025	0.507	
y2007	0.036	0.327	
Germany	-0.047	0.01	*
UK	NA	NA	
Italy	-0.06	0.031	*
France	0.076	0.011	*
Public	0.004	0.808	
Cost based reg.	-0.007	0.725	
Incent. based reg.	-0.064	0	***

Table A28. Debt/Total Assets

(Intercept)	0.5	0	***
y1991	0.062	0.365	
y1992	0.015	0.827	
y1993	0.041	0.551	
y1994	0.022	0.738	
y1995	0.03	0.656	
y1996	0.005	0.944	
y1997	-0.008	0.907	
y1998	-0.028	0.679	
y1999	-0.031	0.656	
y2000	0.026	0.728	
y2001	0.007	0.929	
y2002	0.025	0.753	
y2003	-0.009	0.902	
y2004	0.023	0.767	
y2005	0.016	0.838	

y2006	0.046	0.56	
y2007	0.108	0.239	
Germany	0.192	0	***
UK	NA	NA	
Italy	NA	NA	
France	0.112	0.045	*
Public	-0.009	0.82	
Cost based reg.	0.026	0.528	
Incent. based reg.	-0.061	0.137	

Table A29. Fixed Assets Turnover

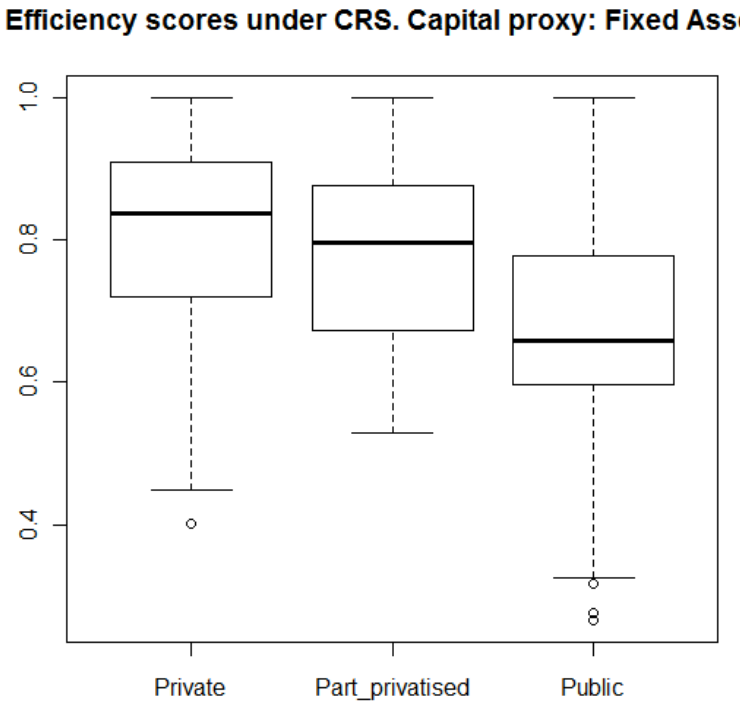
(Intercept)	0.416	0	***
y1991	-0.014	0.874	
y1992	0.016	0.835	
y1993	-0.019	0.802	
y1994	-0.098	0.215	
y1995	-0.074	0.322	
y1996	-0.08	0.28	
y1997	-0.097	0.179	
y1998	-0.134	0.056	.
y1999	-0.139	0.045	*
y2000	-0.15	0.035	*
y2001	-0.172	0.015	*
y2002	-0.193	0.007	**
y2003	-0.197	0.007	**
y2004	-0.194	0.008	**
y2005	-0.22	0.003	**
y2006	-0.217	0.003	**
y2007	-0.201	0.006	**
Germany	-0.003	0.866	
UK	NA	NA	
Italy	NA	NA	
France	NA	NA	
Public	-0.005	0.798	
Cost based reg.	-0.036	0.144	
Incent. based reg.	0.048	0.005	**

Table A30. Non-aviation revenue per passenger

(Intercept)	7.363	0	***
y1991	-0.351	0.7	
y1992	-0.118	0.894	
y1993	-0.026	0.977	

y1994	-0.415	0.641	
y1995	-0.119	0.894	
y1996	-0.468	0.61	
y1997	-0.553	0.531	
y1998	-0.484	0.59	
y1999	-1.12	0.213	
y2000	-1.694	0.071	.
y2001	-1.305	0.177	
y2002	-0.439	0.645	
y2003	-0.484	0.616	
y2004	-0.397	0.68	
y2005	-0.694	0.475	
y2006	-0.697	0.482	
y2007	-0.709	0.464	
Germany	0.816	0.097	.
UK	NA	NA	
Italy	-2.484	0	***
France	NA	NA	
Public	-1.222	0.008	**
Cost based reg.	-0.095	0.853	
Incent. based reg.	0.493	0.304	

Figure A26



After Brockett-Golany procedure application

Figure A27

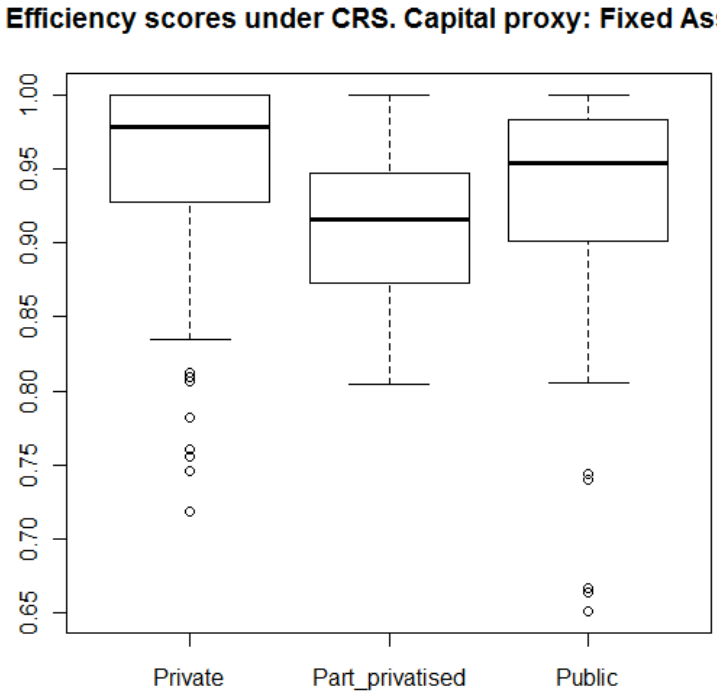


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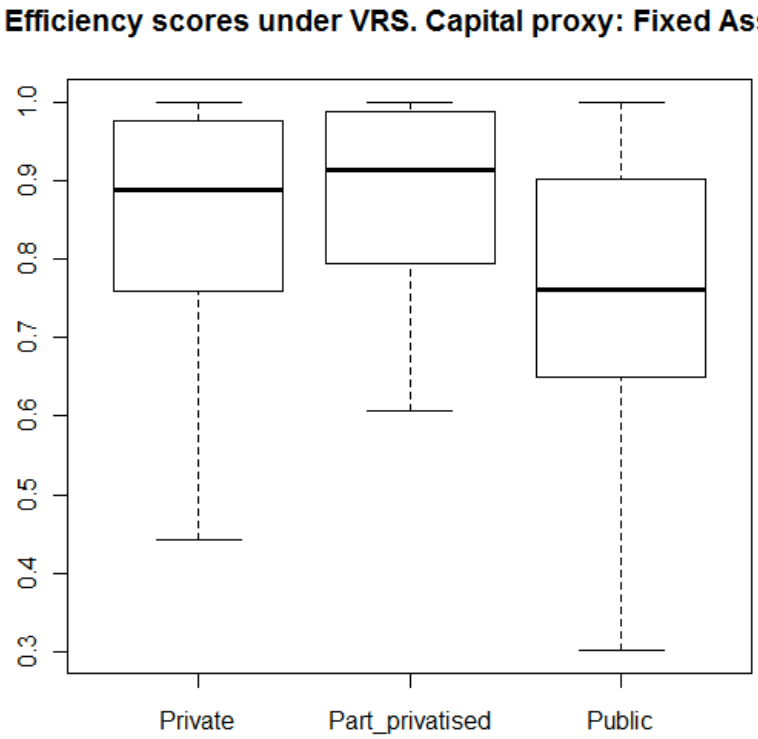
Figure A28



After Brockett-Golany procedure application

Figure A29

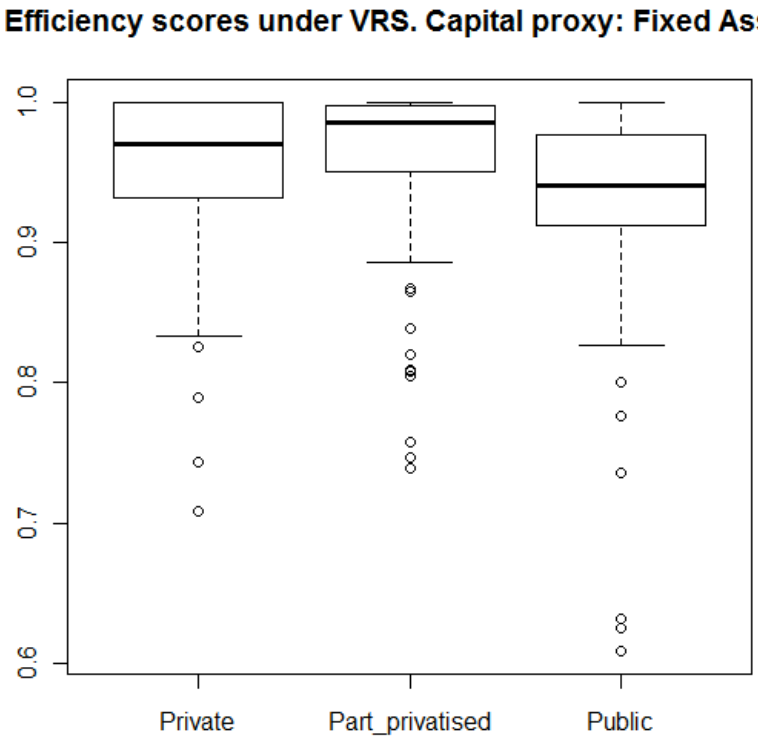
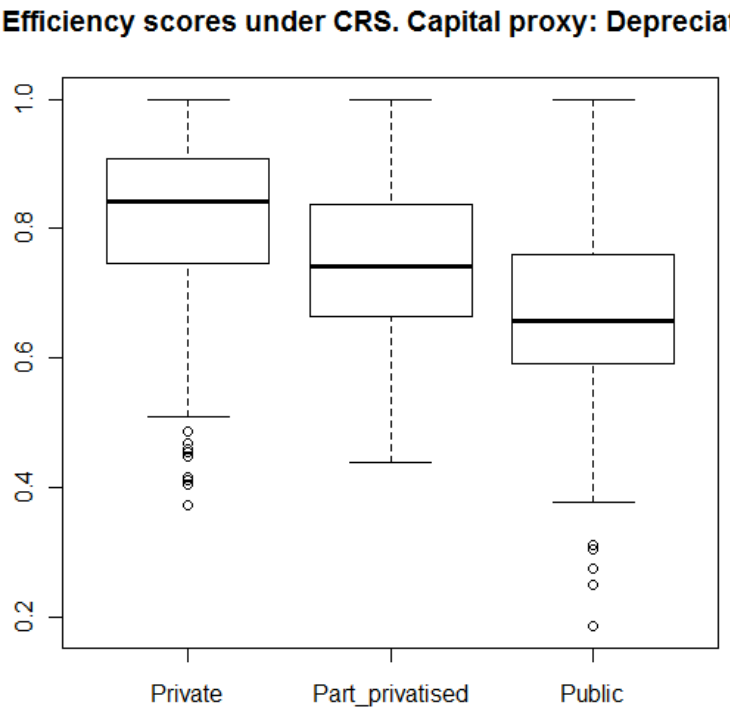


Figure A30



After Brockett-Golany procedure application

Figure A31

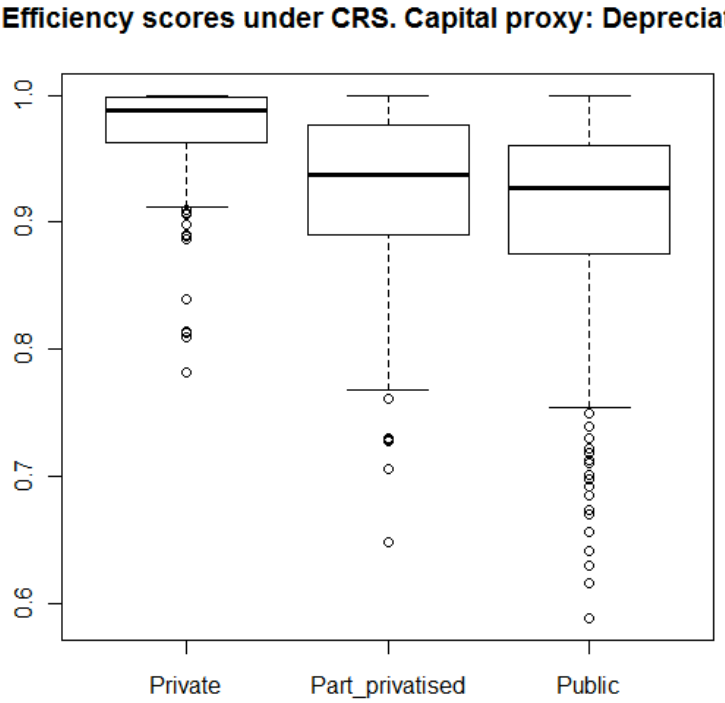
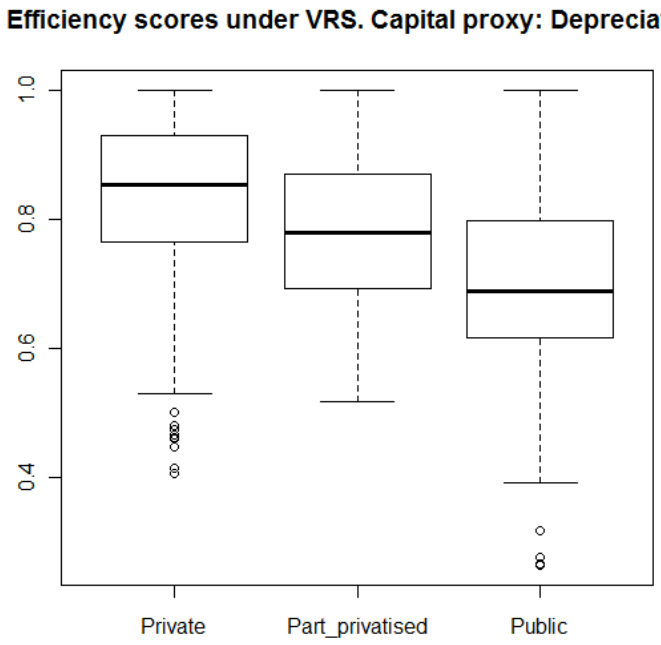


Figure A32



After Brockett-Golany procedure application

Figure A33

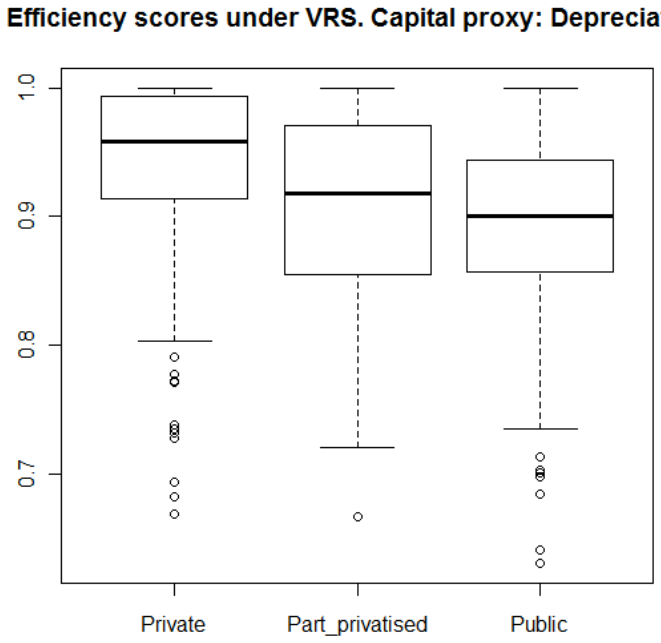
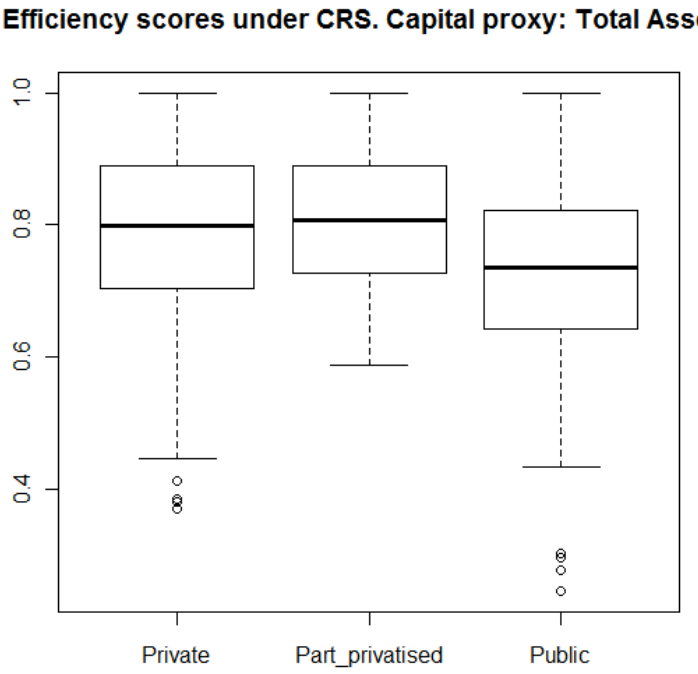


Figure A34



After Brockett-Golany procedure application

Figure A35

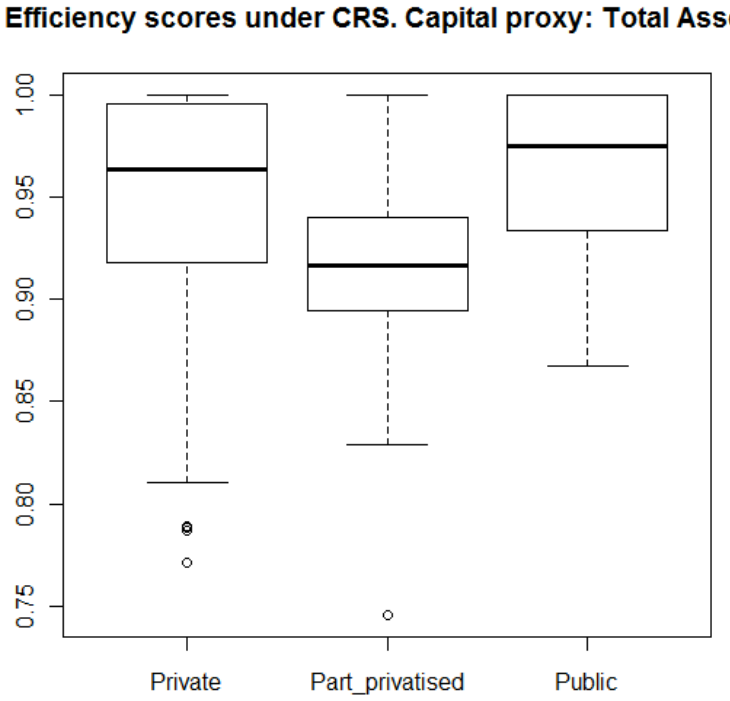
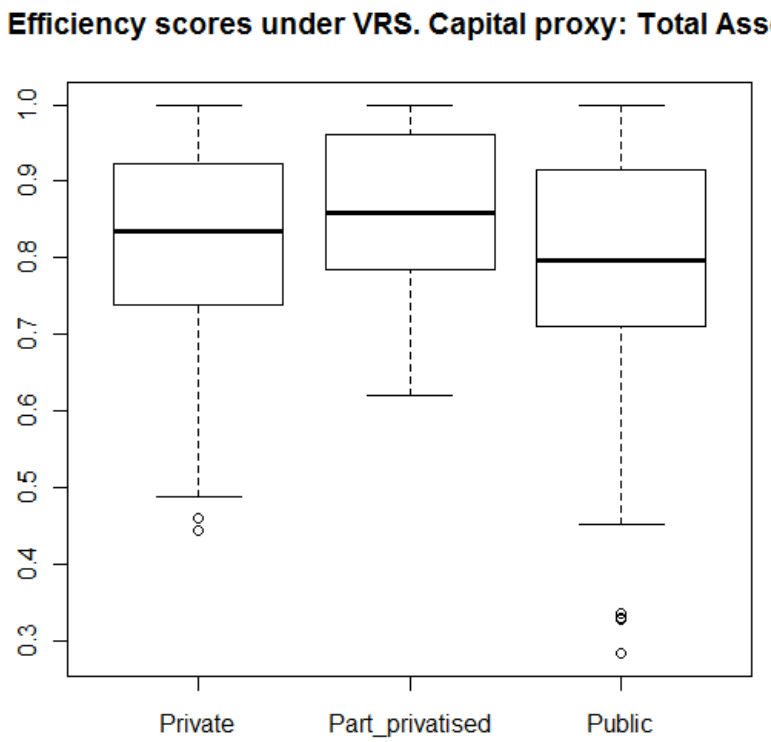
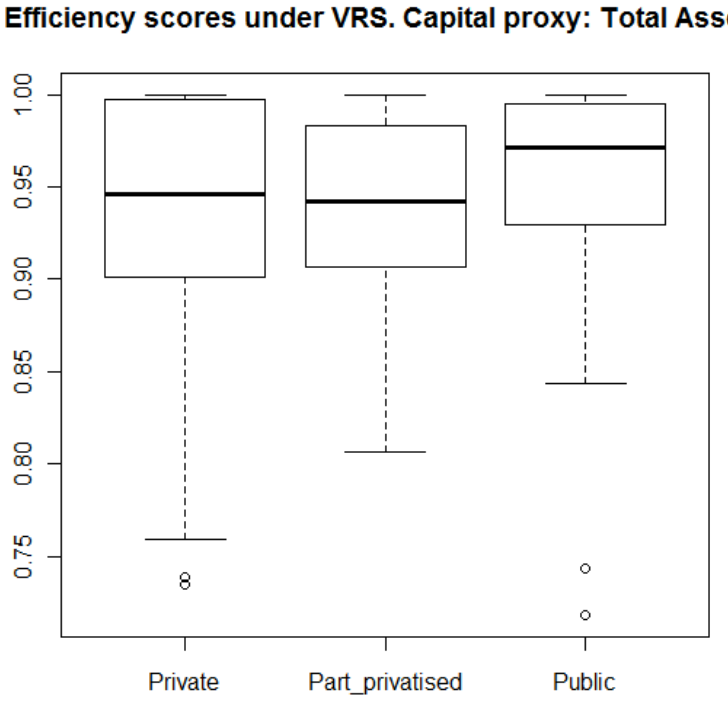


Figure A36



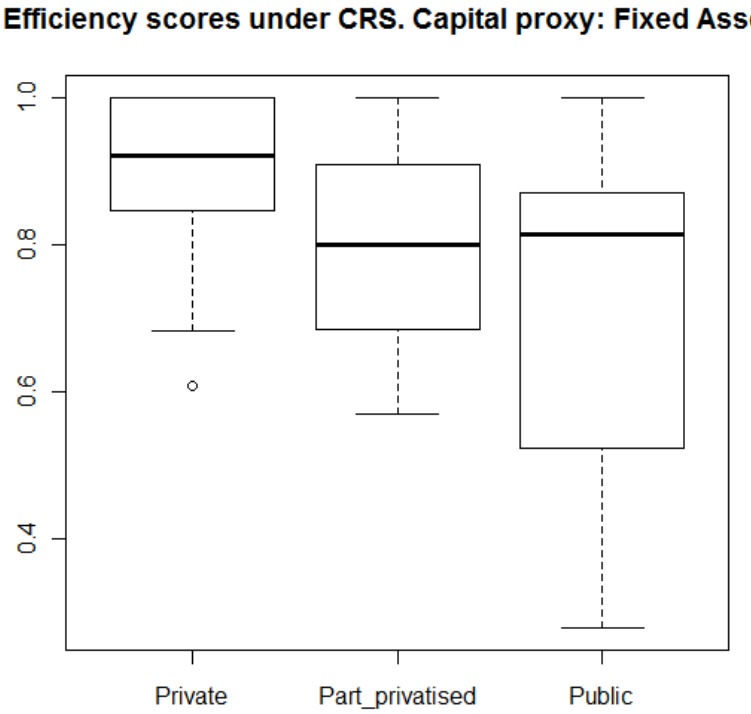
After Brockett-Golany procedure application

Figure A37



Change in ownership structure. Graphical representation of DEA scores

Figure A38



After Brockett-Golany procedure application

Figure A39

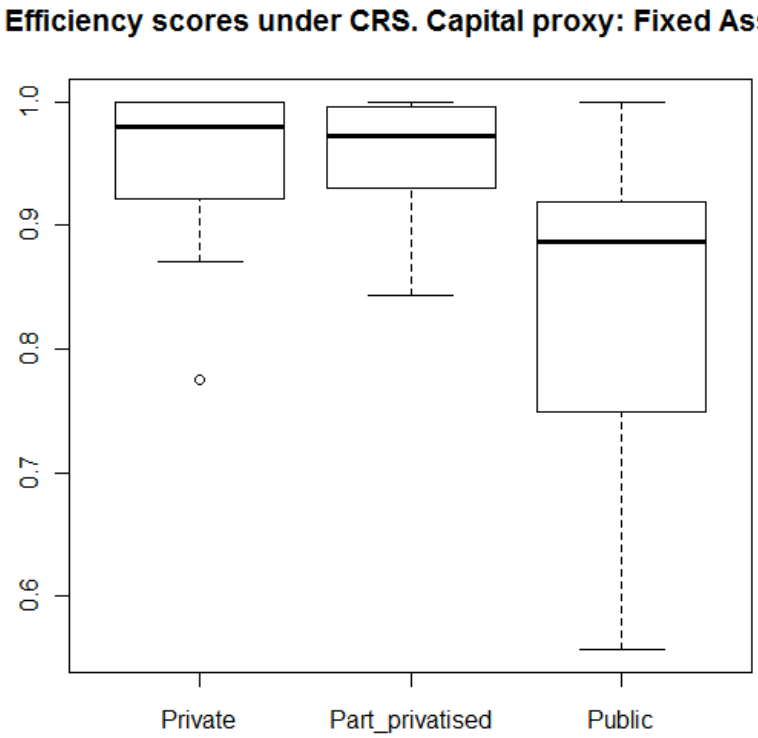
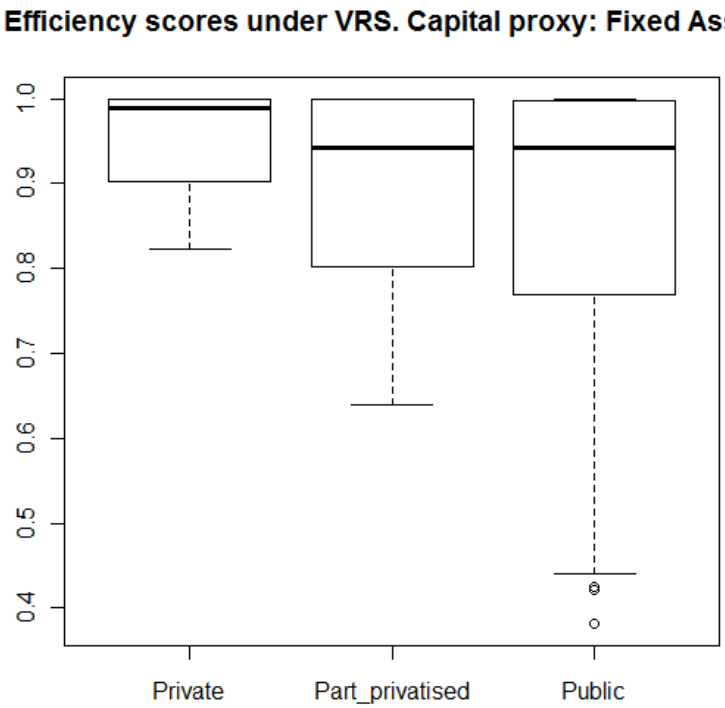


Figure A40



After Brockett-Golany procedure application

Figure A41

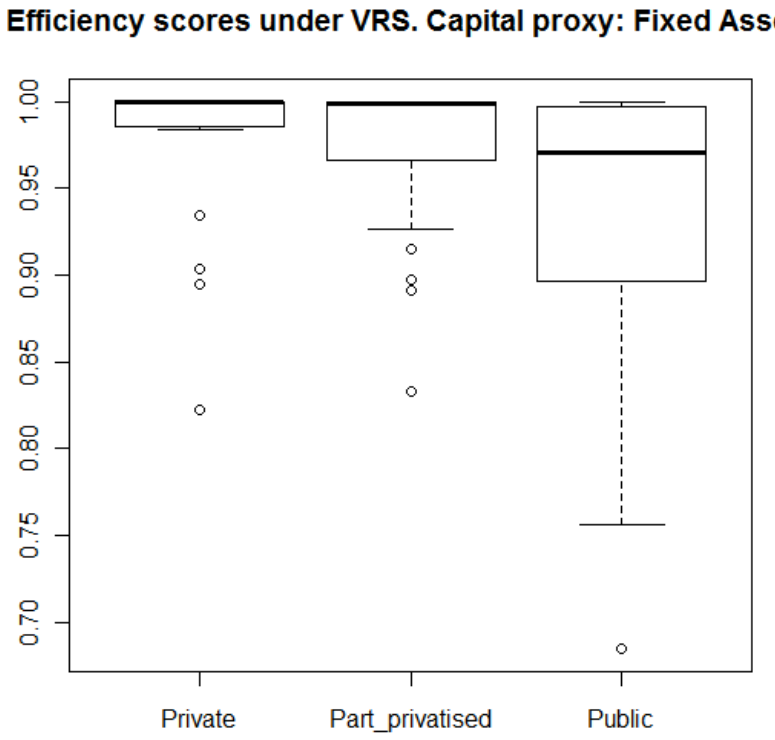
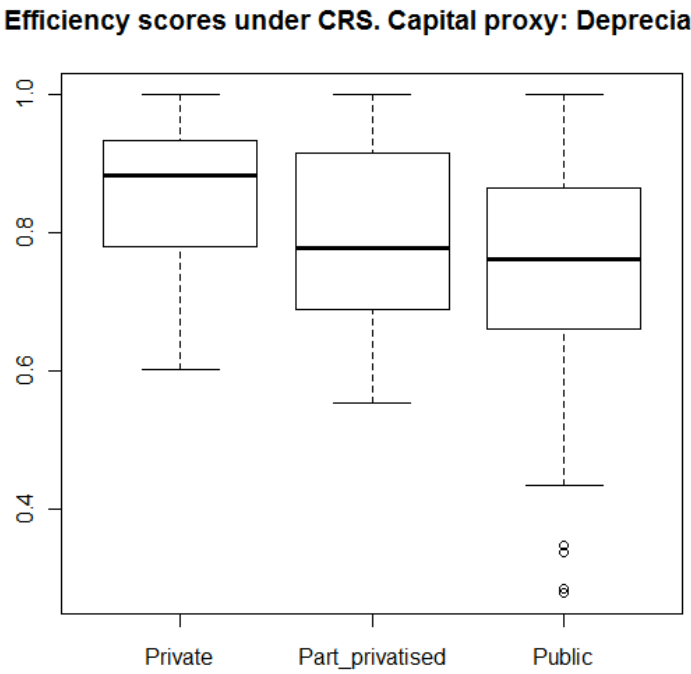


Figure A42



After Brockett-Golany procedure application

Figure A43

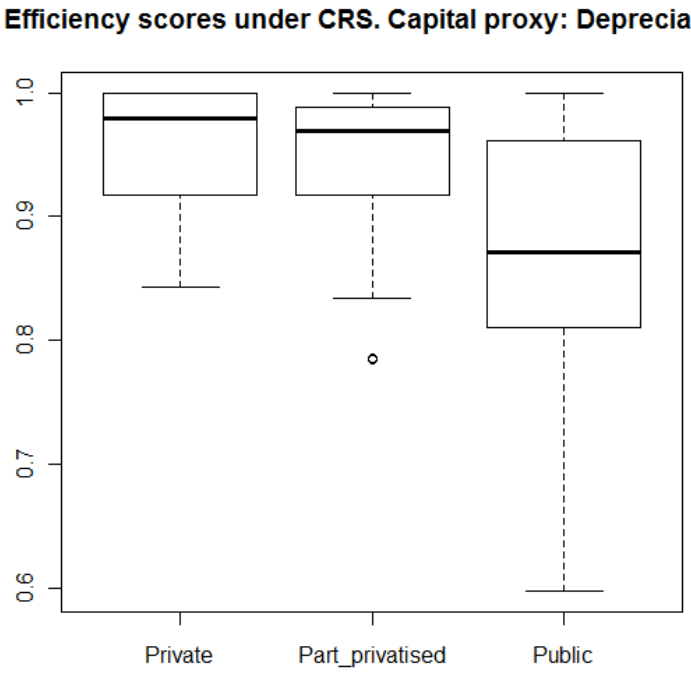
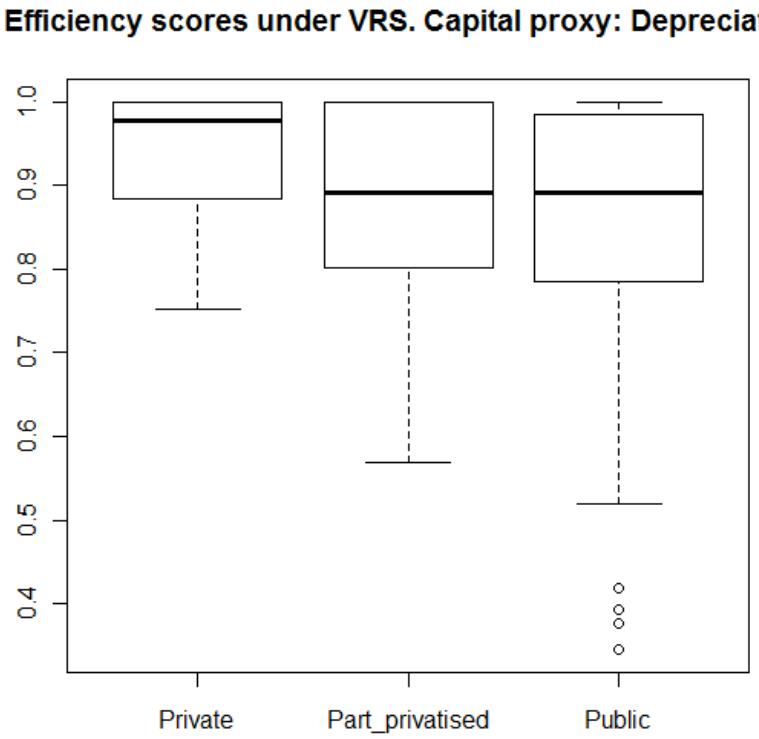


Figure A44



After Brockett-Golany procedure application

Figure A45

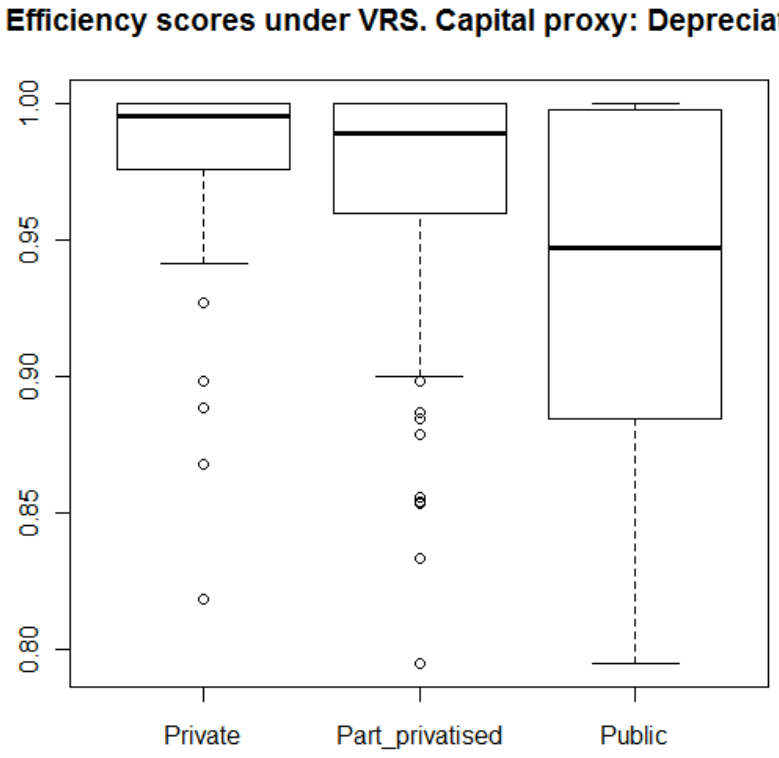
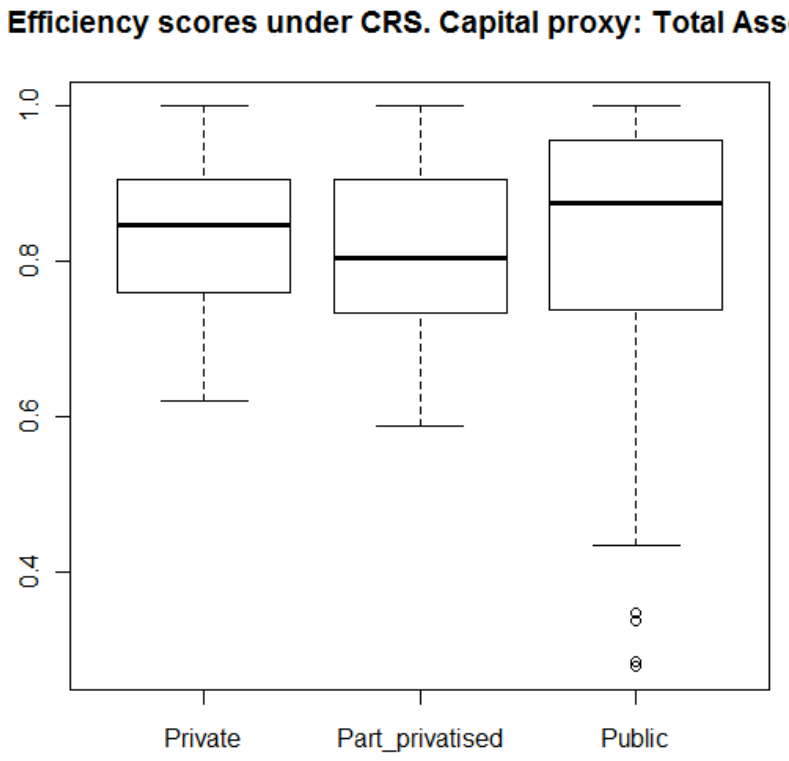


Figure A46



After Brockett-Golany procedure application

Figure A47

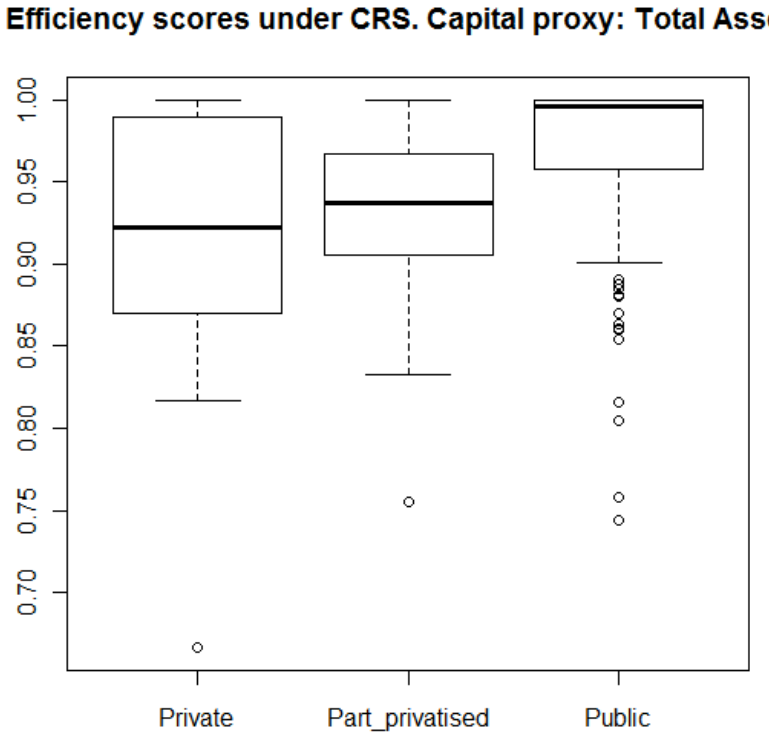
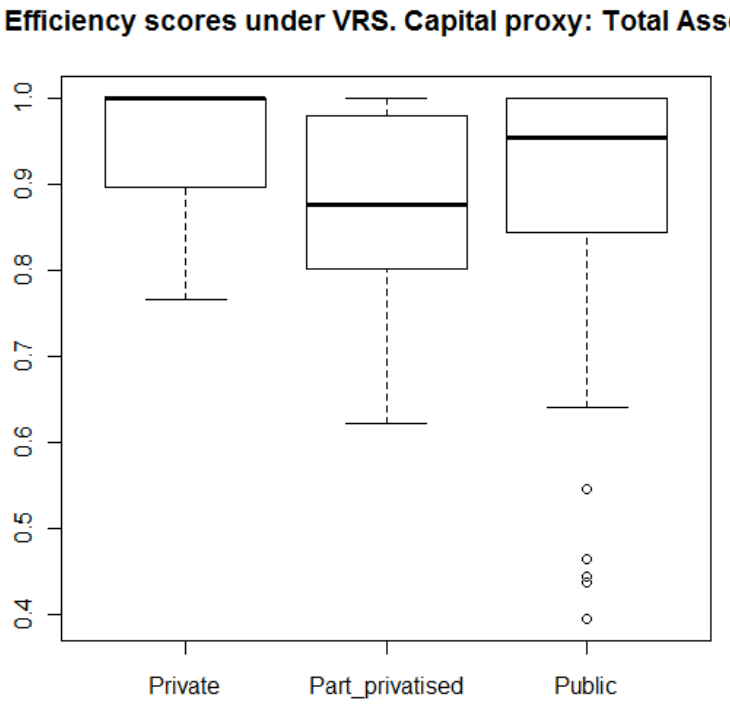


Figure A48



After Brockett-Golany procedure application

Figure A49