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Do Competition and Ownership Matter? Evidence from Local Public Transport in Europe*

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Abstract

This paper investigates how the ownership and the procedure for the selection of firms operating in the local public transport sector affect their productivity. In order to compare different institutional regimes, we carry out a comparative analysis of 72 companies operating in large European cities. This allows us to consider firms selected either through competitive tendering or negotiated procedures. The analysis of the data on 77 European firms over the period 1997-2006 indicates that firms operate under constant returns to scale. Retrieving the residuals we obtain a measure of total factor productivity, which we regress on firm and city characteristics. We find that when firms are totally or partially in public hands their productivity is lower. Moreover, firms selected through competitive tendering display higher total factor productivity.

Keywords: local public transport; public ownership; translog production function

JEL Codes: C33, K23, L25, L33, L91

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1 Introduction

This paper focuses on local public transport in Europe in order to address three main research questions: 1) is competitive tendering able to select more productive companies?; 2) does public ownership affect productivity? and 3) do mixed public-private firms in any way differ from private and public firms as for productivity?

We claim that the selection mechanism through which different cities award the service is a key aspect that influences firms' productivity. Although the debate on the impact of contractual schemes on productivity is broad, the empirical evidence on the effects of selection mechanisms on productivity is lagging behind. Nonetheless, this issue has relevant policy implications: in recent years the European Commission has promoted a number of reforms in this field, favouring competitive procedures over direct negotiation between the city and the service provider. For example, the implementation of European Directive 1191/69/EU (modified by 1893/91/EU) has led some member states (France, Sweden, The Netherlands) to introduce competitive tendering procedures in the assignment of franchised monopolies in local public transport, thus introducing some competition "for the market"[1]. Thus, the local public transport (LPT henceforth) industry is an interesting case to assess the ability of awarding mechanisms to select the best firms.

In line with a large body of literature, we also aim at investigating the relationship between ownership and productivity of firms. Indeed, theoretical predictions on the role of public versus private ownership are not clear-cut, and the empirical evidence is mixed. We contribute to the literature by examining firms that operate in nine different European countries, thus adding a comparative perspective which is lacking in most studies on this industry.

Additionally, we extend our analysis to the study of mixed public-private firms. Although these firms are a common and relevant phenomenon, they have often been neglected in econometric studies on the LPT industry.

Our data provide answers to our three questions: we observe that firms which have been awarded the service through a competitive procedure display higher total factor productivity (TFP). Additionally, we observe that public

[1] The UK is the sole European country where "competition in the market" has been experienced in urban transports. In Italy some competitive tendering (for the market) took place after 1998. However, large cities were not affected by the tendering process, but for one fifth of the bus services in Rome, since 2001. See Boitani and Cambini (2006), and the references therein.

ownership has a significant and negative impact on firms' TFP. Finally, we find that mixed firms are different from entirely private ones, being less productive. Nonetheless, the difference between mixed firms and totally public ones is not always significant, which suggests that the differences between these two types of firms are less clear-cut.

The paper is structured as follows. Section 2 presents the literature and some research hypotheses; section 3 describes the database; section 4 sketches the empirical model to be tested; section 5 presents the results of our empirical analysis and, finally, section 6 draws some conclusions.

2 Literature Review and Research Hypotheses

Previous analyses of the LPT industry have focused on the impact of alternative contract schemes within one country, observing a choice between fixed-price contracts and cost-plus ones and relating it to efficiency. Empirical evidence confirms the theoretical prediction that firms operating under a high-powered incentive scheme, such as a fixed-price contract, are more efficient than firms operating under a low-powered incentive scheme, such as a cost-plus contract. Research on this topic relies on information on the type of contract implemented, which is available only in ad hoc constructed databases. Thus, previous evidence is country specific: Dalen and Gomez-Lobo (1996, 2003) study the Norwegian bus industry; Kerstens (1996), Gagnepain and Ivaldi (2002), Roy and Yvrande-Billon (2007), Gautier and Yvrande-Billon (2008) and Gagnepain, Ivaldi and Martimont (2008) use data on France; Piacenza (2006) and Buzzo Margari, Erbetta, Petraglia and Piacenza (2007) focus their analyses on Italian LPT companies.

Our cross-country data set does not allow us to retrieve firm-specific information on the type of contract implemented. This prevents us from replicating the same empirical exercises as those mentioned above. In any case, notice that a cross-country comparison does not easily lend itself to such a fine analysis. Comparing different contracts, possibly constructing some synthetic indicator to classify different contractual clauses, seems sensible only within a sufficiently uniform institutional setting. Where contracts are sufficiently similar, as they take place within a given legal framework, one can legitimately focus one's attention on specific features. However, contractual arrangements in different countries can be so different, to make a quantitative analysis extremely difficult

to design.

Henceforth, even if such detailed information were available, the possibility of conducting an appropriate econometric analysis of contracts in a cross-country perspective would be somehow limited[2]. On the other hand, our database allows us to investigate the productivity effects of two broadly alternative institutional arrangements in place in different European countries. More precisely, we are able to compare total factor productivity of firms operating under competition "for the market" and firms operating under negotiated procedures.

The label "negotiated procedure" actually denotes the decision of a local public administration to directly identify the supplier of the service, possibly imposing or negotiating some conditions of the service contract. On the other hand, when there is competition for the market, the service provider is chosen through public tendering, whereby the firm making the "best" bid is selected. Which procedure is able to select the most efficient supplier is a widely debated question, at least since Williamson (1976). Recent analyses add further substance to the debate. In particular, Bajari, McMillan and Tadelis (2009) challenge the common wisdom that competition is preferable, showing that negotiations can indeed perform better than auctions when the object of the contract is complex. Hensher and Stanley (2008) push forward a similar argument with respect to bus route contracts. Moreover, they complain that the empirical evidence on the effects of competitive tendering versus negotiation is lacking in the local public transport industry. We aim at contributing to fill this gap in the literature.

The features of the winning bidder will depend on how the tender is organized, but in some sense the identity of the winner will depend on its efficiency. If the competitive procedure is properly designed, this will certainly be the case (Riordan and Sappington, 1987). Analogously, if the local authority were able to choose by hart the best possible candidate firm and to force the service supplier to be extremely efficient, accepting low prices for final consumers and/or low subsidies, the firms selected under negotiated procedures should not be less efficient than firms selected through competitive tendering.

On the contrary, many observations suggest that local authorities' direct choices operate a substantially worse selection of the service provider than competitive procedures do. While we label direct choices of the supplier as "nego-

[2] A study of the effects of payment structures in the French case can be found in Roy and Yvrande-Billon (2007). A purely national analysis of that kind is not subject to the above criticism.

tiations", several doubts arise on the ability (and effort) of the public administrations we consider, to effectively bargain in order to obtain the best possible result and to force the supplier to provide the service at the least cost. A reason for less than effective bargaining can be that the firm selected under a "negotiated" procedure is normally the long-time incumbent in a city market and is often owned by the same local authority awarding the licence. In such cases the "selected" firm operates under a permanent soft budget constraint. However, in many European countries negotiated procedures apply also to a number of private or mixed firms. Hence there is room for competition having a separate and non-negligible influence on productivity. On the basis of these arguments, we aim at testing the following hypothesis:

Hypothesis1: Firms selected by means of competition "for the market" display higher total factor productivity than firms operating under negotiated procedures.

Let us turn to the influence of ownership on performance. A large body of literature has focussed on the implications of public versus private ownership, in LPT as well as in other industries. The theoretical ground for this research question was laid by Hart, Shleifer and Vishny (1997), who show that the choice the public authority has to face between in-house provision and contracting out is nontrivial. Indeed, contract incompleteness implies that the private company has a stronger incentive to engage in cost reduction and a lower incentive in quality improvement. A state-owned company has stunted incentives both in cost reduction and in quality improvement. However, as cost reduction may also reduce quality, private ownership may result in quality (as well as cost) lower than under public ownership. Boycko, Shleifer and Vishny (1996) argue that publicly-owned firms may be forced by politicians to hire an inefficiently high number of workers, while Krueger (1990) suggests that political connections would lead to hiring workers with better acquaintances than better skills. On the other hand, Vickers and Yarrow (1991) argue that agency problems may arise also in large private corporations, where managers own little of the stock and are costly to monitor: in this case there is room for diverging objectives between managers and shareholders.

When moving to the empirical analyses of this issue, the evidence is not conclusive (See Megginson and Netter, 2001). Notice that authors comparing the relative ability of competitive mechanisms and privatisation to enhance a

firm's productivity also show mixed results. For instance, considering some local public services, Domberger, Hall and Li (1995) indicate that competition is what really matters, while Szymanski (1996) suggests that public ownership is associated to lower productivity.

Quite naturally, the focus of these empirical analyses has been on those industries where the share of publicly owned firms is large. Local public transport is one such industry. Caves and Christensen (1980) provide an early empirical investigations in this field. They study Canadian railroads, finding no evidence of inferior performance by companies owned by the public sector. More recently, Kerstens (1996) finds that private bus operators outperform public ones in France. Cowie and Asenova (1999) obtain the same result for Great Britain. Ottoz, Fornengo and Di Giacomo (2008) use a database on Italian firms in the LPT industry and estimate a translog cost frontier function model attaining the result that public enterprises are slightly more inefficient that private companies. Roy and Yvrande-Billon (2007) estimate a translog production frontier model on a database of French firms operating in LPT observing similar results. On the other side, Viton (1997) and Odeck and Sunde (2002) find no significant difference between public and private bus companies in the USA and Norway, respectively. Filippini and Prioni (2003) estimate a translog cost model for a sample of private, public and mixed Swiss bus companies and find ambiguous results as regards the influence of ownership on cost-efficiency. Overall, previous empirical evidence on countries which are included in our sample suggests that companies owned by the public sector are less productive than private ones. Therefore, we state our second hypothesis as follows:

Hypothesis 2: Public ownership negatively affects firms' total factor productivity.

As for the issue of mixed public-private firms, the literature is scant. Authors such as Boardman, Eckel and Vining pioneered the research in this area. They suggest that mixed ownership firms can accomplish profitability and social goals at a lower cost, thanks to the internal monitoring by private shareholders (Eckel and Vining, 1985). They state that mixed enterprises perform better that public ones, but not as well as private ones (Boardman and Vining, 1989). Nonetheless, the topic has not been further developed since very recently. Marra (2006) provides an explanation for the existence of mixed ownership firms. Within a property rights framework, he argues that mixed ownership allows for a more

effective public control that in the case of concessions to private firms, and could thus be a solution of the opportunistic behaviour entailed by contract incompleteness. Moreover, as the public intervenes as a regulator, mixed ownership may be a solution to the informational gap between regulator and regulated enterprises. Although scarce, the theoretical literature suggests a third testable hypothesis:

Hypothesis 3: Mixed ownership firms differ from entirely public and entirely private enterprises, showing intermediate levels of total factor productivity.

3 The Data

We test these hypotheses on a database of LPT firms operating across nine European countries. Data on local public transport seem to be very hard to find. Empirical studies on LPT generally focus on a single country, or even a single region at a time. To the best of our knowledge, the sole paper that investigates the productivity of local public transport companies across different countries in Europe is Wunsch (1996), where labour productivity and average cost for a cross-section of firms is examined. This calls for some new evidence across countries. Indeed, in order to inspect whether alternative institutional regimes have a differential impact on firm's production choices, we have to extend our analysis across different countries. In order to select the companies to be included in the analysis, we have followed three criteria.

First, the inclusion in the Amadeus database, maintained by Bureau van Dijk, which provides balance sheet data over the period 1997-2006. This database imposes some constraints on the dimension of firms. More precisely, for Germany, France, Italy and Spain, firms have to satisfy at least one of the following criteria: a) operating revenue equal to at least €1.5 million; b) total assets equal to at least €3 million; c) number of employees equal to at least 20. For the remaining countries these criteria are relaxed as follows: a) operating revenue equal to at least €1 million; b) total assets equal to at least €2 million; c) number of employees equal to at least 15.

Second, we choose to focus on European Countries. Given the time period considered, we concentrate our analysis on EU 15 countries only. The enlargement process was undergoing at that time, and large institutional changes where taking place in transition countries. Thus, for the sake of comparability, we choose to exclude these countries from our sample. Unfortunately, the Amadeus

database does not provide information on sales for firms located in the United Kingdom. This forces us to exclude this country's firms as sales are a necessary ingredient of our analysis (as will be explained below). However, the prevalence of competition "in the market" in UK cities (except London) may well have introduced a strong country bias in the empirical analysis.

Finally, in order to avoid pooling together widely different firms, we choose to restrict our analysis to firms operating in "large" cities, therefore excluding from the analysis those firms that operate in small cities, and are consequently more oriented to extra-urban type of services[3]. The cities included in our sample belong to either of the following two sets:

1. cities with more than 300,000 inhabitants;

2. cities with less than 300,000 inhabitants, but with a metropolitan area with more than 1 million inhabitants.

Official data on population are sourced from Eurostat. We decide to broaden the first criterion by means of the second one in order to include in the analysis those cities which have relatively "small" administrative borders, but whose population is still relevant in size. For example, Brussels would be excluded if considering only the resident population within administrative borders.

Our final database has information on 77 firms distributed across 9 countries, as shown in Table 1: our sample includes firms operating in all large EU15 cities, with the notable exception of Paris. Table 14 in the Appendix reports the list of cities included in the analysis.

The data we have are budget data for all these companies. Moreover, on the basis of various sources (web-sites; investigation of national and regional laws; etc.) we have information on how each service provider was selected (whether or not on the basis of an explicit competitive procedure). As already mentioned, we do not have any information on the type on contract each firm has, nor do we have information on whether (and if yes how) adjustments of the initial contracts are actually carried out. The absence of this information, however, does not impair the kind of cross-country analysis we are pursuing.

[3] Indeed, it has been shown that the network configuration, that is to say, the provision of urban and/or extra-urban transport services, may affect the cost function of firms (Fraquelli, Piacenza, Abrate, 2004).

Table 1: Country breakdown

Country	N. of firms	Percentage	Revenues
AUSTRIA	2	2.60	100,470
BELGIUM	1	1.30	269,781
FRANCE	7	9.09	559,974
GERMANY	23	29.87	1,985,795
ITALY	14	18.18	1,030,517
NETHERLANDS	2	2.60	824,760
PORTUGAL	5	6.49	238,803
SPAIN	19	24.68	1,195,880
SWEDEN	4	5.19	938,587
Total	77	100	1,151,693

Revenues are expressed in thousand Euros. Mean values over the period 1997-2006

3.1 Description of the Database

In order to estimate a production function, we need a measure of output. As our firm level data are sourced from balance sheet data, this information is not directly available.[4] However, balance sheet data provide information about "sales". This variable includes only the revenue from sales of services, net of public transfers. As a proxy for price, we retrieve the information on monthly ticket price for local public transport from the Urban Audit database developed by Eurostat, and we integrate missing observations by directly looking at companies' web-sites. Thus, combining the information on sales and an average price for the transport service, we are able to build a proxy for output. We are aware that this is a proxy and not a precise measure of output, as it may include revenues from other activities such as, for instance, the management of public parkings. Nonetheless, the use of deflated sales as a proxy for output is widely adopted in the empirical literature.[5] A supply-related measure of output, such

[4] As highlighted in the previous section, some databases with specific information on the type of contract and output measures are available. Nonetheless, these databases are specific to a single country, or even a single region.

UITP, the International Association of Public Transport, collects some data on output from its members, from different countries. However, this type of information is not systematically acquired, thus preventing an econometric exercise on this database.

[5] As Bartelsman and Doms (2000) point out: "The choice of output is often dictated by the available data. Where possible, physical output with unchanging quality is the best measure. [...] In general, researchers rely on deflating nominal variables at the sectoral level. [...] Using deflated production to measure productivity has one drawback, which is the same whether applied at the micro level or at the sectoral or aggregate level: Any quality improvement in output that is not reflected in the deflator will result in a downward bias in productivity".

as vehicle-kilometers or yearly seat-kilometers would be preferable but, unfortunately, it has not been possible to retrieve this information for a sufficient number of companies across countries.

As input variables in our production function we have capital (defined as tangible fixed assets); labour, expressed as the number of employees; and the cost of material inputs. Nominal variables are all deflated by the country-specific consumer price index for transport services, which is sourced from Eurostat. Table 2 reports some summary statistics about the firms included in the analysis.

Table 2: Descriptive statistics, total sample

Total sample

Variable	Mean	Std. Dev.	Min	Max
Capital	282,715.9	666,319.0	1,249.0	4,545,975.0
N. of employees	2,478.5	2,648.2	95.0	14,888.0
Cost of employees	99,561.1	120,090.7	2,589.0	843,456.0
Operating revenues	169,151.3	210,875.8	7,838.0	1,245,326.0
Value Added	116,742.5	163,328.1	3,077.0	1,187,732.0
Sales	123,610.6	160,935.2	8,972.0	948,124.0
K/L	131.9	568.5	2.9	10,010.5
VA/L	93.9	680.7	24.6	12,222.3
REVENUES/L	178.6	1,031.0	39.3	18,217.3
Unit lab. Cost	45.0	102.7	25.2	2,090.7

Capital, total cost of employees, operating revenues, value added and sales are expressed in thousand Euros. K/L is the ratio of capital over total number of employess. VA/L is the ratio of value added over total number of employees. REVENUE/L is operating revenues over total number of employees. Unit labour cost is the ratio of total cost of employees over total number of employees. Mean values over the period 1997-2006

Local public transport companies offer various types of services, which are produced using different technologies. The main difference lies in the provision of metro services versus ground transportation services (tram, bus and light rail), since infrastructure costs and technologies are widely different. We have obtained from companies' web-sites the information on the type of service provided, and whether the firms operated also extra-urban transportation services. Table 3 shows that firms operating underground transportation services are significantly different from firms operating other types of ground transportation: they are larger, both in terms of capital and number of employees. Moreover, they have larger revenues, value added and sales. The test on the

Notice however that the issue of quality measurement is problematic also when direct measures of output are available.

equality of means strongly rejects the null hypothesis that the two types of firms present the same mean values for most of these variables. This suggests to distinguish these firms from the whole sample in the subsequent analysis. Table 16 in the Appendix reports the full set of descriptive statistics for the two subsamples.

Table 3: Descriptive statistics according to type of service provided

	Underground	Ground transportation	t test on equality of means	p value
Capital	812,674.3	98,889.2	-10.891	(0.000)***
N. of employees	4,053.1	1,814.1	-7.896	(0.000)***
Cost of employees	181,253.8	68,399.4	-9.016	(0.000)***
Operating revenues	308,274.2	117,195.5	-8.642	(0.000)***
Value Added	274,889.6	77,704.7	-9.600	(0.000)***
Sales	205,547.0	89,631.5	-6.695	(0.000)***
K/L	227.6	90.0	-2.201	(0.028)**
VA/L	53.6	91.9	0.414	(0.680)
REVENUES/L	130.2	172.9	0.378	(0.706)
Unit lab. Cost	64.0	36.9	-2.385	(0.018)**

Capital, total cost of employees, operating revenues, value added and sales are expressed in thousand Euros. K/L is the ratio of capital over total number of employess. VA/L is the ratio of value added over total number of employees. REVENUE/L is operating revenues over total number of employees. Unit labour cost is the ratio of total cost of employees over total number of employees.

One of the aims of this paper is to shed light on the impact of competition for the market on firm's performance. In this perspective, countries can be divided into two groups: countries where LPT services are tendered out (France, Netherlands and Sweden) and countries where LPT companies are selected through negotiated procedures (Austria, Belgium, Germany, Italy, Portugal, Spain).[6] In the period considered, no change from negotiated procedures to competition for the market or vice-versa was detected for the firms in the sample.

We are clearly aware that some aspects of the tendering procedures may differ widely from case to case, and that competitive or collusive outcomes may depend on crucial details of the procedures. The French Competition Commission, for instance, denounced in 2005 the existence of a cartel between three leading operators, who were alleged of coordinating their bidding strategies, leading "the

[6] Although Law decree 422/1997 has introduced competitive tendering in Italy, the Italian firms included in the database were all operating under negotiated procedures during the time period considered in the analysis.

companies to impose their prices to local authorities who consequently have had to bear higher charges than those which would have resulted from a competitive functioning of the market" (Yvrande-Billon, 2006, p. 470). It is precisely because of the potential differences in the effectiveness of competition for the market in different countries that our cross-country analysis may have some value added. Analogously, "negotiated" procedures may differ widely in their incentive power. In some cases the local administration may engage in tough negotiations with the firm in order to extract the highest possible rent, may credibly state its unwilligness to enter re-contracting and/or may set clear-cut bail-out clauses. In some other cases re-contracting and bail-out are perceived by the firm as without limits. Again, a cross country perspective is useful to average out possible country-specific biases.

A simple analysis on the equality of means shows that firms operating under the two alternative institutional regimes are indeed different. Table 4 shows the results. When testing the equality of means on the overall sample, differences are limited. Nonetheless, when we concentrate on the sample of firms operating ground transportation services only, we find that institutional settings make a difference. Firms operating under negotiated procedure are generally smaller, both in terms of capital and labour, and in terms of revenues, valued added and sales. Table 17 in the Appendix shows some descriptive statistics by country.

As for the type of ownership, information was retrieved from the Amadeus database, with a cross-check on firms' web sites. Indeed, as stated in Hypothesis 2, we expect that a public owner may be different from a private one in terms of TFP.

Additionally, we observe that a third type of firms exists: those whose ownership is partly public, and partly private. Such mixed firms represent a relevant share of the sample, as shown in Table 5. In our sample, about 20% of the total number of firms have a mixed ownership, totally private ones are around 17%, while totally public firms are predominant, and represent 63% of our observations. In mixed firms, the public shareholder is typically in control, as its share never falls below 33.3 %. In many cases (about one half of the firms), private ownership remains below 15%, so that the difference between these firms and totally public ones may be considered dubious.

Disentangling the data by the type of transport service provided, we observe that mixed and private ownership types are equally represented in ground transportation services, while totally private firms are almost absent in the sample of companies providing metro services, which is the stronghold of publicly owned

Table 4: Descriptive statistics according to institutional environment

Panel A: Total sample

	Competition	Negotiated procedure	t test on equality of means	p value
Capital	141,874.1	282,650.5	1.742	(0.082)*
N. of employees	2,867.1	2,198.3	-2.021	(0.044)**
Cost of employees	106,147.6	91,088.8	-1.005	(0.316)
Operating revenues	202,862.8	151,032.1	-1.977	(0.049)**
Value Added	128,328.9	104,388.9	-1.135	(0.257)
Sales	175,699.9	102,979.2	-3.691	(0.000)***
K/L	63.8	132.7	0.997	(0.319)
VA/L	43.1	96.3	0.626	(0.532)
REVENUES/L	249.6	145.0	-0.846	(0.398)
Unit lab. Cost	35.3	44.7	0.744	(0.458)

Panel B: Ground transportation only

	Competition	Negotiated procedure	t test on equality of means	p value
Capital	156,910.1	84,276.5	-3.816	(0.000)***
N. of employees	2,748.7	1,577.0	-4.090	(0.000)***
Cost of employees	103,332.5	59,633.9	-3.902	(0.000)***
Operating revenues	199,479.8	96,548.6	-5.121	(0.000)***
Value Added	128,433.3	63,754.4	-4.720	(0.000)***
Sales	169,709.7	69,538.1	-5.368	(0.000)***
K/L	70.9	94.7	0.316	(0.752)
VA/L	44.0	105.1	0.623	(0.534)
REVENUES/L	272.0	147.8	-0.841	(0.401)
Unit lab. Cost	35.6	37.3	1.117	(0.265)

Capital, total cost of employees, operating revenues, value added and sales are expressed in thousand Euros. K/L is the ratio of capital over total number of employess. VA/L is the ratio of value added over total number of employees. REVENUE/L is operating revenues over total number of employees. Unit labour cost is the ratio of total cost of employees over total number of employees.

firms. Two thirds of mixed ownership firms in the database operate under negotiated procedure. Table 15 shows the share of firms according to ownership type by country.

Analogously to what we observed about the diversity of arrangements for awarding the service, even the actual content of public shareholding may vary substantially from country to country. In some countries, political interference is heavy and diffused, while elsewhere managers'autonomy may be deeply rooted. In the same way, elements such as different legal traditions, different budget constraints of local authorities and the governance structure of local public firms are probably relevant elements, which may differ substantially across countries. As argued above, it is exactly because of these institutional and political differences that our cross-country analysis may have a particular value added.

Table 5: Descriptive statistics: type of ownership

Panel A: Total sample

	Negotiated procedure	Competition	Total
Public	57.67	5.72	63.39
Mixed own.	12.59	6.64	19.22
Private	12.36	5.03	17.39
Total	82.61	17.39	100
Number of Obs.	437		

Panel B: Ground transportation

	Negotiated procedure	Competition	Total
Public	50.15	7.37	57.52
Mixed own.	13.86	6.49	20.35
Private	15.93	6.19	22.12
Total	79.94	20.06	100
Number of Obs.	339		

Panel C: Metro

	Negotiated procedure	Competition	Total
Public	83.67	0.00	83.67
Mixed own.	8.16	7.14	15.31
Private	0.00	1.02	1.02
Total	91.84	8.16	100
Number of Obs.	98		

Relative frequencies are reported.

4 The Empirical Model

In order to estimate firms' productivities, several modeling alternatives have been used in the literature. Some authors follow a one-step procedure, and estimate either a translog production function or a cost function including into the estimating equation some controls for ownership or contractual agreements (see, among others, Filippini and Prioni, 2003). Although widely adopted, this methodology seems to rely too much on the inevitably arbitrary choice of the additional variables to be included in the econometric specification. Moreover, in this case estimates would be affected by availability of data on the control variables.

Another widely adopted approach is the estimation of a stochastic production frontier model (Aigner, Lovell and Schmidt, 1977). In the standard pooled specification, the mean of the inefficiency term is assumed to be affected by

a number of characteristics of interest (see, among others, Roy and Yvrande-Billon, 2007). Again, a pooled specification would imply loosing the additional information that can be extracted from the panel structure of our data. Alternatively, one could parameterize the inefficiency term either with a time-invariant model or with the Battese-Coelli (1992) parametrization of time effects. The shortcoming of these two specifications is that they do not allow one to model the mean of the inefficiency term as a function of a set of covariates, such as ownership and institutional framework. This would hamper us from testing our research hypotheses.

To avoid these problems, we prefer to estimate the translog production function with firm fixed effects[7]. Since our controls in the second step are essentially time invariant firm characteristics, the two-stages option is preferable. Indeed, in this way the production function estimation takes into account *all* time-invariant firm characteristics, without incurring problems of data availability.

Additionally, a fixed effect estimator has the advantage of providing an answer to the problem of endogeneity of inputs choices. Notice that the error term in the production function can be decomposed into two terms: $\varepsilon_{it} = \omega_{it} + \eta_{it}$, where ω_{it} represents unobservables that are unknown to the econometrician, but are observed (or predictable) by firms when choosing inputs, and η_{it} represents unobservables that are not observed by the firm before input decision. For example, ω_{it} could represent managerial ability, or expected down-time due to vehicles breakdowns, while η_{it} could represent deviations from expected breakdowns. Since a firm has knowledge of its ω_{it} when making input choices, these choices will be correlated with ω_{it}, thus incurring endogeneity. A possible answer to this problem is the estimation by fixed effects. Although this estimator assumes that unobserved productivity ω_{it} is constant over time, it allows one to consistently estimate the production function. Given the short time period we consider, we believe that constancy of ω_{it} is not a strong assumption.

Thus, we choose the following research strategy. As a first step, we estimate a production function. We will then retrieve the residuals of this estimation and regress them on ownership and competition variables as well as firm specific variables. This two-step procedure is widely used and acknowledged in the literature (see e.g. Smarzynska Javorcik, 2004).

For the production function, we adopt a flexible functional form, which allows us to take into account second-order effects. More precisely, we adopt a

[7] As will be evident in the next section, this specification is supported also by our data.

translog model (Berndt and Christensen, 1973), which can be interpreted as a second-order approximation to an unknown functional form, and therefore allows for a large degree of flexibility. We estimate a translog production function with three inputs: capital (K_{it}), labour (L_{it}) and materials (M_{it}).

$$\begin{aligned} \ln Y_{it} &= \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_M \ln M_{it} + \\ &+\beta_{L,L} \ln L_{it} * \ln L_{it} + \beta_{L,K} \ln L_{it} * \ln K_{it} + \\ &+\beta_{L,M} \ln L_{it} * \ln M_{it} + \beta_{K,K} \ln K_{it} * \ln K_{it} + \\ &+\beta_{K,M} \ln K_{it} * \ln M_{it} + \beta_{M,M} \ln M_{it} * \ln M_{it} + \beta_i + \varepsilon_{it} \end{aligned} \tag{1}$$

This specification allows us to estimate input elasticities and returns to scale. Moreover, β_i is a set of dummy variables aimed at capturing the unobservable firm fixed effects, while ε_{it} represents the Hicksian neutral productivity level of firm i.

As for the second step, we retrieve firms' total factor productivity, which is the difference between the actual and predicted output, as the residual of the estimated production function. Once obtained an index of TFP from the residual of equation (1), we are able to investigate which factors affect it. Therefore, as a second step of our empirical analysis, we regress this index of TFP on a set of firm, city and country characteristics. We estimate the following equation:

$$\begin{aligned} \ln TFP_{it} &= \alpha + \gamma firm\_characteristics_{it} + \delta procedure_{ct} + \\ &+\theta ownership_{it} + \varphi city\_characteristics_{rt} + \varsigma_{it} \end{aligned} \tag{2}$$

where $firm\_characteristics$ is a vector of firm specific characteristics such as being part of a group and type of transport service provided. The dummy variable *procedure* defines the type of awarding procedure under which firms operate, whether competitive tendering or negotiated procedure. The *ownership* dummy variables define the type of owners, either totally public, totally private or mixed ownership. Finally, $city\_characteristics$ is a vector including some features of the cities in which firms operate, such as population density and GDP per capita. These city characteristics may indeed affect performance: for instance, higher density may imply higher traffic congestion resulting in lower speed of buses and trams, whilst higher GDP per capita may imply higher real

wages and different attitudes towards the choice on public or private means of transport.

Finally, notice that the interpretation of coefficients is substantially different in a one-step procedure or in a two-step. Indeed, in the first case the estimated coefficients state how a variable affects the quantity of output produced, for a given level of inputs. In the second, the estimated coefficients directly suggest how specific factors affect firms' productivity. Given the aim of our analysis, namely to investigate how selection mechanisms and ownership affect the productivity of firms, the two-step procedure yields a set of coefficients which can be directly interpreted.

Take for example the role of selection mechanisms: no economic a priori suggests that the amount of output should be statistically different between firms selected by means of a public tendering or negotiated procedures. Indeed, the correlation between the output variable and the procedure variable is 0.06 and not statistically significant. However, economic theory suggests that firms selected through a competitive tendering should be more productive, and this is confirmed by a correlation of 0.11, significant at 5% level, between the output variable and the dummy for competitive tendering.

Although the two specifications yield the same information, we choose the two-step procedure as it is preferable in terms of readability of the results.

5 Results

5.1 Production Function and Returns to Scale Estimation

The first step of our empirical analysis consists in the estimation of the translog production function (1) where, as said, Y_{it} is the index of output, L_{it} is employment, K_{it} are tangible fixed assets and M_{it} are costs for material inputs. All monetary variables have been deflated by a country-specific industry deflator. All variables are expressed in logarithms. As specified above, although we will later show that our results do not change drastically under different assumptions, total factor productivity is defined as the error term of this regression. Table 6 presents the results, obtained through different methods.

We first estimate equation (1) by pooling our observations together, using ordinary least squares (see column (1) in Table 6). We test the null hypothesis that all interaction terms are equal to zero, which is strongly rejected: this suggests that indeed a translog production function is to be preferred to a Cobb-

Table 6: Production function estimation

Total sample

	(1)	(2)	(3)
	Pool	*FE*	*RE*
lnL_{it}	-0.579***	-0.0504	-0.375*
	(0.204)	(0.244)	(0.216)
lnK_{it}	0.344**	-0.0513	-0.0837
	(0.175)	(0.223)	(0.193)
lnM_{it}	0.282*	1.509***	1.132***
	(0.167)	(0.220)	(0.195)
lnL_{it}*lnL_{it}	0.0702***	0.0781***	0.0546***
	(0.0177)	(0.0228)	(0.0194)
lnL_{it}*lnK_{it}	-0.0310	-0.127***	-0.0936***
	(0.0194)	(0.0281)	(0.0237)
lnL_{it}*lnM_{it}	0.0624***	0.0652**	0.0907***
	(0.0213)	(0.0258)	(0.0218)
lnK_{it}*lnK_{it}	0.0203**	0.0441**	0.0405***
	(0.00957)	(0.0175)	(0.0141)
lnK_{it}*lnM_{it}	-0.0672***	0.0243	-0.00305
	(0.0165)	(0.0227)	(0.0192)
lnM_{it}*lnM_{it}	0.0161	-0.0953***	-0.0702***
	(0.0131)	(0.0143)	(0.0135)
Constant	2.779***	-3.467***	0.604
	(0.647)	(1.137)	(0.914)
Observations	437	437	437
R^2	0.684		
Adjusted R^2	0.678		
R^2 within		0.683	0.668
R^2 between		0.432	0.438
R^2 overall		0.581	0.590
Test on interaction terms	F(6,427) = 8.87 ***	F(6,351) = 16.05***	$X^2(6)$ = 85.22***
	(0.000)	(0.000)	(0.000)
Test on effects		F(76,351) = 26.66***	$X^2(1)$ =220.80***
		(0.000)	(0.000)
Hausman test		$X^2(9)$ =71.35***	
		(0.000)	

Dependent variable: lnY_{it} is the log of index of output. lnL_{it} is the log of number of employees, lnK_{it} is the log of deflated capital, lnM_{it} is the log of deflated material costs. Column (1) reports pooled estimation (OLS); column (2) a model with firm-specific fixed effects and column (3) a model with firm-specific random effects. Test on interaction terms tests the null hypothesis that all interaction terms are statistically equal to zero. Test on effects provides an F test that all fixed effects are equal to zero in column (2), and Breusch and Pagan Lagrangian multiplier test for random effects in column (3). Standard error in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Douglas one.

Nonetheless, as we use panel data, it is well known that pooling observations together could distort the results, as observations of the same firm at different times are counted as totally independent. This is clearly a strong assumption, since we are neglecting that some firm-specific characteristics may influence a firm's production function. In order to include them into the analysis, we estimate a model with firm fixed effects (see column (2)). Again, the test on interaction terms suggests that the translog specification is appropriate. Additionally, a test on the significance of firm-specific fixed effects suggests that these are strongly significant. Therefore, the inclusion of a set of dummies for

firm specific fixed effects improves the estimation.

An alternative technique would be to include random effects. This possibility is presented in column (3) in Table 6. The Breusch and Pagan Lagrangian multiplier test for random effects suggests that these are again significant. However, a random effects model assumes that the correlation between explanatory variables and firm effects is 0. This is quite a strong assumption, as we would expect firm specific effects to be correlated with factor endowments. In fact, computing the correlation coefficient between random effects and explanatory variables we find that it is equal to -0.208 and is statistically significant at 1%. In order to choose between the two alternative specifications, we adopt an Hausman test[8] (see the bottom line in Table 6). The test suggests that a fixed effects specification should be adopted. Therefore, we choose this as our preferred specification.

As a robustness check, we repeat our exercise on the subsample that includes firms operating ground transportation only.[9] We have seen indeed that firms operating underground transportation services are different from ground transportation firms in terms of capital, employees, and sales. Table 7 presents the result for the production function estimations on this subsample, comparing the same methodologies considered in Table 6. Again, the fixed effects specification (in column (2)) is supported by the data, both against OLS (fixed effects are highly significant) and random effects (as suggested by the Hausman test).

To interpret the estimated first-order parameters we calculate the elasticities of output to inputs at different values of inputs distributions: namely mean, first, second and third quartiles. Results are presented in Table 8. We get significant coefficient estimates for the three inputs included in the production function. Moreover, we obtain constant returns to scale. We test the significance of this result: our null hypothesis is $H_0 : \varepsilon_L + \varepsilon_K + \varepsilon_M = 1$, which, as shown in the bottom line of Table 8, is never rejected. Interestingly, we find that the estimated returns to scale are decreasing in the size of the firms. This result is coherent with other findings in the literature, see for example Cambini and

[8] Hausman (1978) test provides a test for orthogonality of the random effects and the regressors. The test is based on the difference between RE and FE estimates. FE is consistent when the explanatory variable and the individual effects are correlated, while RE is inconsistent. Thus a statistically significant difference is interpreted as evidence against RE.

[9] We classify as "metro companies" those firms which offer underground transportation services. These firms may be offering exclusively undergound transportation services, or both ground and underground transportation services.

Table 7: Production function estimation, ground transportation companies only

Ground transportation

	(1)	(2)	(3)
	Pool	*FE*	*RE*
lnL_{it}	-1.121***	-0.365	-1.098***
	(0.157)	(0.287)	(0.199)
lnK_{it}	-0.260	-0.112	-0.143
	(0.164)	(0.217)	(0.176)
lnM_{it}	2.169***	1.720***	2.018***
	(0.175)	(0.221)	(0.180)
lnL_{it}*lnL_{it}	0.145***	0.0988***	0.137***
	(0.0144)	(0.0247)	(0.0174)
lnL_{it}*lnK_{it}	-0.0215	-0.118***	-0.0477**
	(0.0156)	(0.0278)	(0.0203)
lnL_{it}*lnM_{it}	0.00477	0.0690***	0.0275
	(0.0191)	(0.0251)	(0.0200)
lnK_{it}*lnK_{it}	-0.00337	0.0545***	0.00720
	(0.0102)	(0.0178)	(0.0142)
lnK_{it}*lnM_{it}	0.0355*	0.00536	0.0340*
	(0.0209)	(0.0231)	(0.0199)
lnM_{it}*lnM_{it}	-0.116***	-0.104***	-0.117***
	(0.0144)	(0.0141)	(0.0127)
Constant	-1.246**	-3.180***	-1.307*
	(0.579)	(1.071)	(0.782)
Observations	339	339	339
R^2	0.843		
Adjusted R^2	0.839		
R^2 within		0.771	0.754
R^2 between		0.667	0.815
R^2 overall		0.715	0.819
Test on interaction terms	F(6,329) = 34.98***	F(6,272) = 20.54***	$X^2(6)$ = 180.55***
	(0.000)	(0.000)	(0.000)
Test on effects		F(57,272) = 14.82***	$X^2(1)$ = 306.93***
		(0.000)	(0.000)
Hausman test		$X^2(9)$ = 42.15***	
		(0.000)	

Dependent variable: lnYit is the log of index of output. lnLit is the log of number of employees, lnKit is the log of deflated capital, lnMit is the log of deflated material costs. Model with firm-specific fixed effects. Test on interaction terms tests the null hypothesis that all interaction terms are statistically equal to zero. Test on effects provides an F test that all fixed effects are equal to zero. Standard error in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Filippini (2003) and Di Giacomo and Ottoz (2007).

It has to be noted that the literature frequently finds increasing returns to scale: however, these results are generally obtained on samples of small and medium-sized companies (See Cambini, Piacenza, Vannoni, 2007 for a comprehensive review of previous empirical evidence on scale and density economies in LPT). Evidence on large urban companies is scant. Matas and Raymond (1998) study 9 large urban bus companies in Spain, finding a U-shaped average cost curve. However, in the long run their results do not differ appreciably from constant returns to scale, with slight diseconomies for larger companies. Jha and Singh (2001) obtain the same result studying the cost structure of 9 large Indian bus companies. Overall, these articles suggest that scale econom-

Table 8: Elasticities of output to inputs and returns to scale

Total sample

	First Quartile	Median	Third Quartile	Mean
Labour	0.339	0.372	0.288	0.327
	(0.076)***	(0.099)***	(0.122)***	(0.090)***
Capital	0.143	0.178	0.289	0.201
	(0.055)***	(0.074)**	(0.112)***	(0.074)***
Material inputs	0.563	0.448	0.358	0.466
	(0.053)***	(0.072)***	(0.098)***	(0.070)***
Returns to scale	1.045	0.998	0.934	0.994
	(0.093)***	(0.116)***	(0.150)***	(0.111)***
Test on constant returns to scale	0.045	-0.002	-0.066	-0.006
	(0.093)	(0.116)	(0.150)	(0.111)

Elasticities of output to inputs are calculated at the sample means, first, second and third quartiles values for inputs. Returns to scale are obtained as the sum of input elasticities. The test on constant returns to scale tests the null hypothesis that there are constant returns to scale. * significant at 10%; ** significant at 5%; *** significant at 1%

ies are exhausted for larger companies. More recently, Cambini, Piacenza and Vannoni (2007) obtain the opposite result: using a sample of 31 medium and large-sized Italian companies, they find both economies of scale, and economies of density. Our sample includes large companies, and results presented in Table 8 seem to be in line with findings by Matas and Raymond (1998) and Jha and Singh (2001). Testing for the null hypothesis of constant returns to scale, we observe that although estimated returns to scale are decreasing across quartiles, this trend is not significant: at different values of size for inputs the estimated returns are never significantly different from one.

Table 9 presents the estimated elasticities of output to inputs, computed for different values of the inputs in the subsample of firms operating ground transportation only. The finding of constant returns to scale is confirmed also in this subsample of firms which are, on average, smaller than those operating also (or only) underground services. Point estimates of returns to scale are larger in size relative to the estimates obtained in the full sample.

Table 9: Elasticities of output to inputs and returns to scale, ground transportation companies only

Ground transportation

	First Quartile	Median	Third Quartile	Mean
Labour	0.438	0.468	0.477	0.440
	(0.079)***	(0.108)***	(0.132)***	(0.094)***
Capital	0.141	0.206	0.311	0.220
	(0.049)***	(0.069)***	(0.098)***	(0.066)***
Material inputs	0.481	0.400	0.204	0.361
	(0.051)***	(0.067)***	(0.094)**	(0.068)***
Returns to scale	1.061	1.074	0.991	1.021
	(0.087)***	(0.109)***	(0.135)***	(0.101)***
Test on constant returns to scale	0.061	0.074	-0.009	0.021
	(0.087)	(0.109)	(0.135)	(0.101)

Elasticities of output to inputs are calculated at the sample means, first, second and third quartiles values for inputs. Returns to scale are obtained as the sum of input elasticities. The test on constant returns to scale tests the null hypothesis that there are constant returns to scale. * significant at 10%; ** significant at 5%; *** significant at 1%

5.2 Determinants of TFP: the Role of Ownership and Competition

We recover our measure of total factor productivity as the difference between actual and predicted output in the estimation of the translog fixed effects production function (equation (1)). This allows us to estimate equation (2): we regress the index of TFP obtained from the estimation of equation (1) on a number of firm and city characteristics which could influence firms' productivity.

In particular, besides our ownership and competition variables, we consider a number of control variables. We control for the firm's structure, in terms of activities carried out (e.g., underground transportation, extra-urban services) and its management (being part of a larger group or not). Additionally, we include a control for city features (income, size, density and so on). Table 10 presents the results.

Notice that as the coefficients reported are standardized, a comparison between the magnitude of the coefficients is possible. The results in column (1) report a basic regression of our measure of TFP on a set of firm's characteristics. As expected, the type of transport service provided influences productivity. The results simply indicate that having fixed structures such as those of companies owning underground (Metro) or surface (Tram) networks, decreases estimated

Table 10: Total factor productivity estimation

Total sample

	(1)	(2)	(3)	(4)	(5)
Metro	-0.121***	-0.0810**	-0.102**	-0.0729*	-0.115**
	(-3.253)	(-2.090)	(-2.514)	(-1.760)	(-2.550)
Metro services	0.257**	0.272***	0.231**	0.247**	0.212**
	(2.530)	(2.677)	(2.139)	(2.303)	(2.068)
Tram	-0.290***	-0.336***	-0.239***	-0.284***	-0.234***
	(-7.876)	(-8.608)	(-6.619)	(-7.541)	(-6.704)
Bus	-0.109	-0.113	-0.153*	-0.150*	-0.248***
	(-1.275)	(-1.331)	(-1.814)	(-1.804)	(-2.638)
Extra-urban services	-0.0361	-0.00661	-0.0740**	-0.0409	-0.00673
	(-0.989)	(-0.179)	(-2.175)	(-1.175)	(-0.172)
Group member	0.0973**	0.0332	0.0224	-0.0331	-0.0203
	(2.072)	(0.684)	(0.460)	(-0.678)	(-0.437)
Competition		0.183***		0.176***	0.176***
		(3.630)		(3.707)	(3.561)
Mixed own.			-0.0175	-0.0128	-0.0281
			(-0.426)	(-0.335)	(-0.714)
Mainly public mixed own.			-0.182***	-0.196***	-0.212***
			(-5.117)	(-5.741)	(-6.183)
Fully public own.			-0.237***	-0.204***	-0.216***
			(-4.169)	(-3.913)	(-4.357)
City population density					0.0206
					(0.444)
Observations	434	434	434	434	427
R-squared	0.242	0.266	0.279	0.300	0.323
Test on equality between mixed own. and mainly public mixed own.			F(1,424) = 26.36***	F(1,423) = 35.61***	F(1,415) = 22.12***
Prob > F			(0.000)	(0.000)	(0.000)
Test on equality between mixed own. and fully public own.			F(1,424) = 15.35***	F(1,423) = 13.40***	F(1,415) = 8.10***
Prob > F			(0.000)	(0.000)	(0.005)
Test on equality between mainly public mixed own. and fully public own.			F(1,424) = 3.29*	F(1,423) = 9.34***	F(1,415) = 10.04***
Prob > F			(0.071)	(0.002)	(0.002)

Dependent variable: TFP_{it} is the log of Total Factor Productivity, obtained as a residual from the production function estimation. OLS estimates with robust standard errors. Standardized 'beta' coefficients are reported. t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

productivity. Moreover, tramways may not accommodate the number of passengers that compensates the higher fixed cost entailed by this technology. Instead, firms which operate underground services, without owning the network, display higher TFP; this is hardly surprising, in that these companies do the same service as those captured by the dummy "Metro", without the fixed input represented by the network. Additionally, we find that (arguably more labour intensive) ground transportation services negatively affect firm's productivity. Moreover, the provision of extra-urban services seems to negatively affect productivity, although this result is not significant. Finally, it turns out that a firm being part of a large (sometimes multinational) group is likely to be more

productive than a stand-alone firm. This could be due to better managerial practices which are shared among members of the same group.

In column (2) we add a control for the type of institutional (i.e. regulatory) regime. As expected, competitive tendering has a positive effect on total factor productivity: the coefficient attached to the variable is always positive and significant at 1% level. This result provides empirical support to our first research hypothesis, namely that a competitive setting may enhance firms' TFP. Then, we control the effect of the type of ownership in column (3).

It can be seen that public ownership negatively affects TFP, and the same holds true for mixed ownership. Notice that in this specification we distinguish two types of mixed ownership companies: those in which the public share is predominant (more than 85%), which we label "Mainly public", and those in which the private and public share are more balanced. We suspect that such a relevant public share may imply a management style which is different from the one in mixed ownership companies, being, if any, closer to the full public ownership type. Thus, we label these companies as "almost" public and in this first estimate we consider them as a separate category.[10]

These categories of ownership have a negative impact on TFP with comparison to the benchmark, which is the omitted category: privately owned firms. Thus, we can say that Hypothesis 2 is supported by our data. Our result is in line with Gautier and Yvrande-Billon (2008), who find that mixed ownership French LPT firms have a lower efficiency level than private ones, irrespective of the type of contract under which they operate. As the coefficients are standardized, we are able to compare their magnitudes, and to establish a ranking in terms of productivity. The fully public firms are the least productive, followed by the mainly public (public share over 85%). The firms where the public share is below 85% are more productive, and they are not statistically different from the private ones.

Moreover, the table reports the test on the equality of coefficients between fully public ownership, mostly public ownership, and mixed ownership. The test suggests that the difference in terms of TFP between the three types of firms is statistically significant, thus supporting the distinction of firms into these categories. Therefore, we find partial evidence in favour of our third hypothesis: mainly public mixed ownership firms differ from private companies, being significantly less productive. Nonetheless, the difference in terms of total

[10] See Section 5.3 for an extensive discussion on the role of ownership and for alternative definitions of the explanatory variables.

factor productivity between "truly" mixed and privately owned companies is not significant. Thus, we may state that mixed ownership companies are not a homogeneous category, and different groups of mixed firms are statistically different in terms of productivity.

Columns (2) to (4) jointly show that regulatory environment and ownership independently affect firm's total factor productivity: These variables are significant both if considered alone, as in the second and third column, and in combination, as in the fourth column. As seen in Table 5, many firms in our sample are in public hands and operating under negotiated procedures. One may wonder whether this "in house" providing is the key factor, rather than ownership and awarding procedures independently. As a robustness check, we include the interaction term between selection mechanism and public ownership in the specification presented in column (4). This term is not significant, while the other variables keep the same signs and significance levels. This clearly indicates that being a totally public firm, selected through negotiated procedure, does not have any additional effect on firm's TFP once public ownership and selection mechanism are controlled for[11].

Finally, thanks to the Urban Audit Database by Eurostat, we are able to include some information on some of the cities where firms operate, such as city size (both area and population), demographic indicators, income, mobility indicators (Proportion of journeys to work by car, Number of registered cars per 1000 inhabitants, etc.) and indicators of the relevance of touristic activities in the city. Although we cannot report all results, only few of these variables affect our estimates, and they never change the sign and significance of other coefficients. The results in column (5) show that population density does not influence firms' productivity in the full sample of the firms we consider.[12]

Table 11 presents the results on the factors affecting total productivity obtained on the subsample of firms that operate only ground transportation services. Provision of extra urban services is still not significant[13]. Again, being part of a larger group positively affects productivity. This result is more robust in the subsample of ground transportation companies.

Firms selected through competition "for the market" display higher levels

[11] Results are available upon request.

[12] We also included city area expressed in Km^2 as a control for the network size, generally obtaining a negative and significant coefficient.

[13] Indeed, the evidence on the presence of economies of scope between urban and intercity services is mixed. While Di Giacomo and Ottoz (2007) find some evidence of diseconomies of scope, Fraquelli, Piacenza and Abrate (2004) find economies of scope. Both papers use a sample of firms that excludes metro companies.

Table 11: Total factor productivity estimation, ground transportation companies only

Ground transportation					
	(1)	(2)	(3)	(4)	(5)
Tram	-0.368***	-0.422***	-0.287***	-0.330***	-0.416***
	(-8.104)	(-9.154)	(-6.733)	(-7.413)	(-9.243)
Bus	0.329***	0.315***	0.278***	0.272***	0.221***
	(8.021)	(7.582)	(7.073)	(6.825)	(3.781)
Extra-urban services	0.0234	0.0514	-0.0557	-0.0274	0.0121
	(0.503)	(1.099)	(-1.347)	(-0.656)	(0.295)
Group member	0.227***	0.182***	0.0956**	0.0643	0.0478
	(6.693)	(5.639)	(2.106)	(1.572)	(1.503)
Competition		0.192***		0.157**	0.130**
		(2.856)		(2.564)	(2.300)
Mixed own.			-0.476***	-0.444***	-0.448***
			(-8.501)	(-9.017)	(-8.890)
Mainly public mixed own.			-0.0785*	-0.0691*	0.0207
			(-1.673)	(-1.673)	(0.523)
Fully public own.			-0.358***	-0.367***	-0.405***
			(-7.772)	(-8.241)	(-8.856)
City population density					-0.263***
					(-5.388)
Observations	336	336	336	336	329
R-squared	0.299	0.329	0.451	0.470	0.504
Test on equality between mixed own. and mainly public mixed own.			F(1,328) = 29.39***	F(1,327) = 39.14***	F(1,319) = 76.47***
Prob > F			(0.000)	(0.000)	(0.000)
Test on equality between mixed own. and fully public own.			F(1,328) = 25.86***	F(1,327) = 28.66***	F(1,319) = 62.44***
Prob > F			(0.000)	(0.000)	(0.005)
Test on equality between mainly public mixed own. and fully public own.			F(1,328) = 1.93	F(1,327) = 4.53**	F(1,319) = 8.96***
Prob > F			(0.165)	(0.034)	(0.003)

Dependent variable: TFP_{it} is the log of Total Factor Productivity, obtained as a residual from the production function estimation. OLS estimates with robust standard errors. Standardized 'beta' coefficients are reported. t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

of TFP. However, this result is slightly less robust across specifications in this subsample. As for the type of ownership, the result that public firms are less productive is confirmed. Again, mixed ownership firms are less productive than private ones, although the ranking in terms of productivity is changed. The difference between fully public firms, mainly public, and mixed ownership ones is generally statistically significant in the subsample of firms offering ground transportation services only. Finally, controls for city characteristics suggest that population density now has a negative and significant coefficient, thus suggesting the presence of negative congestion externalities that affect ground transports in dense cities and metropolitan areas.

5.3 Robustness

The distinction of firms into four different categories according to their public ownership share, although supported by the tests that accompany our estimates, may seem somehow *ad hoc*. Thus, we aim at showing that our preferred specification has been driven by a deep investigation of the relationship between ownership and productivity in our sample. While in the first estimate we distinguished four categories of firms, namely private ones, fully public ones, and two types of mixed firms, namely the "mainly public" ones (with a share of public ownership abover 85%) and "truly" mixed ones, here we change this specification as follows.

First, instead of using dummy variables, we consider the share of public ownership as a continuous variable, and we include it among our regressors. The results are reported in the first three columns of Table 12. We find that the share of public ownership has always a negative and significant coefficient, thus suggesting that productivity is inversely related to the weight of public shareholders. This result is robust to the inclusion of controls for the selection mechanism (column (2)) and the city features (column (3)).

A second way to analyse the role of ownership is to reduce the number of categories considered, grouping together all firms where public shareholders have a positive (but less than 100%) stake. The results reported in columns (4) to (6) show that mixed ownership firms are statistically different from private ones, being less productive, while the difference with fully public ones does not seem to be significant. The latter result is driven by the heterogeneity within the group of mixed firms. This is the reason why in the main estimation above we have chosen to distinguish in a specific category firms characterised by a large presence of public ownership. However, the results on the difference between mixed firms and other types of firms must be considered with some caution.

A second aspect of our estimate for which we want to test the robustness of the evidence shown in the previous section refers to the relationship between the fixed effect of the first stage estimation and the firms' observable characteristics chosen as explanatory variables in the second stage.

The aim is to provide some additional evidence in favour of the econometric approach adopted: namely a fixed effect estimation in the first stage, as in equation (1) plus an OLS estimator on the residuals of the first stage, as shown in equation (2). Here we want to show that the inclusion of fixed effects in the first stage is appropriate, as the control variables in the second stage are

Table 12: The role of ownership

Total sample

	(1)	(2)	(3)	(4)	(5)	(6)
Metro	-0.0753**	-0.0492	-0.0883**	-0.0907**	-0.0630	-0.105**
	(-2.073)	(-1.292)	(-2.150)	(-2.297)	(-1.559)	(-2.408)
Metro services	0.290***	0.299***	0.266***	0.306***	0.323***	0.289***
	(2.897)	(2.984)	(2.793)	(2.940)	(3.124)	(2.954)
Tram	-0.216***	-0.255***	-0.211***	-0.236***	-0.279***	-0.226***
	(-6.099)	(-6.548)	(-5.632)	(-6.447)	(-7.144)	(-5.883)
Bus	-0.147*	-0.147*	-0.235***	-0.124	-0.120	-0.207**
	(-1.783)	(-1.794)	(-2.589)	(-1.552)	(-1.522)	(-2.367)
Extra-urban services	-0.0976***	-0.0719**	-0.0422	-0.0569	-0.0248	-0.00162
	(-2.857)	(-2.047)	(-1.088)	(-1.631)	(-0.693)	(-0.0407)
Group member	-0.0215	-0.0603	-0.0479	0.0336	-0.0138	-0.00177
	(-0.377)	(-1.087)	(-0.877)	(0.597)	(-0.254)	(-0.0326)
Competition		0.134***	0.138***		0.162***	0.175***
		(2.882)	(2.871)		(3.455)	(3.479)
Public (share)	-0.321***	-0.299***	-0.300***			
	(-8.619)	(-8.972)	(-8.754)			
Mixed own.				-0.297***	-0.299***	-0.314***
				(-5.481)	(-5.777)	(-5.871)
Public				-0.332***	-0.297***	-0.308***
				(-6.771)	(-6.865)	(-6.767)
City population density			0.0351			0.0741*
			(0.894)			(1.748)
Observations	434	434	427	434	434	427
R-squared	0.317	0.330	0.351	0.302	0.320	0.345
Test on equality between public and mixed own.				F(1,425) = 0.35	F(1,424) = 1.64	F(1,416) = 2.00
Prob > F				(0.555)	(0.201)	(0.158)

Dependent variable: TFP_{it} is the log of Total Factor Productivity, obtained as a residual from the production function estimation. OLS estimates with robust standard errors. Standardized 'beta' coefficients are reported. t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

significantly related to the estimated fixed effects. Indeed, as individual fixed effects capture all unobserved firm characteristics that are constant over time, we expect them to be significantly correlated with the firms' characteristics considered in the second step.

In order to implement our robustness check, we first estimate a translog production function with fixed effects, as in the first stage of our preferred methodology. Then, we retrieve estimated fixed effects β_i and we regress them on the observed firm characteristics employed in our econometric analysis, in order to see whether such characteristics can really explain unobserved heterogeneity of firms. Table 13 shows the results. Notice that the dependent variable is no longer TFP but the individual fixed effect. We observe that competition "for the market" is positively correlated with firm's fixed effects, while ownership variables confirm the ranking in productivity: public owned firms are the

least productive, followed by mainly public firms and mixed ownership firms.[14] Hence, the results obtained in section 5.2 may be regarded as robust.

Table 13: Firm fixed effects estimation

Total sample

	(1)	(2)	(3)	(4)	(5)
Metro	-0.126***	-0.0842**	-0.106***	-0.0758*	-0.120***
	(-3.446)	(-2.211)	(-2.657)	(-1.858)	(-2.662)
Metro services	0.267**	0.283***	0.241**	0.257**	0.221**
	(2.577)	(2.727)	(2.175)	(2.344)	(2.109)
Tram	-0.301***	-0.350***	-0.248***	-0.295***	-0.244***
	(-8.265)	(-8.985)	(-7.031)	(-7.986)	(-7.173)
Bus	-0.114	-0.117	-0.159*	-0.156*	-0.258***
	(-1.314)	(-1.373)	(-1.874)	(-1.866)	(-2.731)
Extra-urban services	-0.0376	-0.00688	-0.0769**	-0.0425	-0.00678
	(-1.066)	(-0.192)	(-2.388)	(-1.284)	(-0.178)
Group member	0.101**	0.0346	0.0233	-0.0344	-0.0214
	(2.134)	(0.707)	(0.477)	(-0.705)	(-0.462)
Competition		0.190***		0.183***	0.183***
		(3.746)		(3.845)	(3.701)
Mixed own.			-0.0182	-0.0133	-0.0286
			(-0.470)	(-0.375)	(-0.783)
Mainly public mixed own.			-0.189***	-0.204***	-0.221***
			(-5.438)	(-6.129)	(-6.643)
Fully public own.			-0.246***	-0.212***	-0.225***
			(-4.420)	(-4.207)	(-4.717)
City population density					0.0196
					(0.429)
Observations	434	434	434	434	427
R-squared	0.261	0.288	0.302	0.325	0.351
Test on equality between mixed own. and mainly public mixed own.			F(1,424) = 37.83***	F(1,423) = 52.90***	F(1,415) = 29.98***
Prob > F			(0.000)	(0.000)	(0.000)
Test on equality between mixed own. and fully public own.			F(1,424) = 22.38***	F(1,423) = 20.95***	F(1,415) = 11.57***
Prob > F			(0.000)	(0.000)	(0.001)
Test on equality between mainly public mixed own. and fully public own.			F(1,424) = 3.91**	F(1,423) = 10.84***	F(1,415) = 11.40***
Prob > F			(0.049)	(0.002)	(0.001)

Dependent variable: individual fixed effects, obtained from the production function estimation. OLS estimates with robust standard errors. Standardized 'beta' coefficients are reported. t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

[14] Table 18 in the Appendix reports the results on the subsample of ground transportation companies.

6 Conclusions

The cross country analysis carried out in the present paper has proved able to shed light on the role that selection mechanisms and ownership have on local public transport firms in Europe. The main results can be summarized as follows.

First of all, firms selected through competition "for the market" present higher levels of productivity. Secondly, we find that ownership matters: public firms are generally less productive than private firms. The same holds true for mixed ownership firms. However, we find that a large heterogeneity characterises mixed ownership firms, with mainly public firms (those with a public share over 85%) less productive than other mixed firms with a lower public share. Our third testable hypothesis refers to the comparison between totally public and partially public firms. Although our results provide some support to the idea that partial private participation to the shareholding is associated to higher productivity, this finding depends on the degree of private ownership and therefore on the influence exerted on managerial choices by private shareholders is not robust across specifications. This result calls for further theoretical investigation on the nature and performance of mixed ownership firms.

Finally, we observe that available indicators of city characteristics rarely affect local public transport firms' TFP, except for possible negative congestion effects on ground transport services in large cities.

Caution is needed when drawing policy implications from our results. However, there is a mild indication that in the European countries under exam competitive processes have been able to select more efficient firms than negotiated procedures. This may well depend on the poor quality of the local bodies in charge at negotiating the contracts, or on other causes which are beyond the scope of the present analysis. Whatever the reason, policy proposals advocating a limitation of competitive procedures in this institutional context would need to provide very strong evidence that negotiations yield better results. Any proposal aimed at avoiding competitive pressures in this sector should bear the burden of the proof.

As for ownership, the results above show no ambiguity: firms in public hands are less productive than private ones. However, the policy implications are less clear cut, as they would depend on what explains our result. The higher productivity of private firms may have at least two drivers. The first is that private shareholders simply have stronger incentives to make sure that

the firm is efficient. The second one is that during the privatisation process of the last few years more productive and profitable firms have been sold to private shareholders, so that only less productive firms have now remained in public hands. Understanding which explanation is preferable, would require further analysis. However it is apparent that privatisation could be a solution only if the power of incentives is the dominant driver of private firms higher productivity. Otherwise the path to efficiency is far more complex. If one wants to consider the privatisation option, our evidence indicates that mixed firms are still less efficient than private ones, when the share in private hands is limited. Hence, if privatisation is to be chosen, it seems preferable to go all the way (or most of the way) to private ownership.

However, both competition and privatisation are no panacea: indeed, they may have different effects in different set-ups, failing to deliver the expected benefits in some circumstances. In particular, although available data do not include the contractual structure, it has to be highlighted that a careful contractual design is crucial in providing the proper incentives to efficiency, with or without competitive tendering, with privately or publicly owned firms.

Nonetheless, one should be aware that efficiency is not the sole objective of (national or local) policy makers. In particular, we have no data on service quality, which is probably a very relevant and respectable goal of these firms. Finally, notice that other objectives, such as political patronage (as highlighted by Lopez-de-Silanez, Shleifer and Vishny, 1997) may well prevail. It could be argued that the slow pace of reforms in LPT across Europe is due to an excess of the perceived political costs of privatisation and pro-competitive policies over the expected perceived political gains, accruing from better services and lower costs and subsidies, which might ensue from such reforms. However, this is matter for further research.

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Appendix

More on the database

Table 14: Cities included in the sample

Country	Cities
Austria	Wien
Belgium	Brussels
France	Bordeaux; Lyon; Marseille; Nantes; Nice; Strasbourg; Toulouse
Germany	Berlin; Bielefeld; Bochum; Bonn; Bremen; Dortmund; Dresden; Duisburg; Essen; Frankfurt; Hamburg; Hannover; Koln; Leipzig; Mannheim; Munchen; Nurnberg; Stuttgart
Italy	Bari; Bologna; Firenze; Genova; Milano; Napoli; Palermo; Roma; Torino
Netherlands	Amsterdam; The Hague
Portugal	Lisboa
Spain	Barcelona; Bilbao; Las Palmas de Gran Canaria; Madrid; Malaga; Palma de Mallorca; Sevilla; Valencia; Zaragoza
Sweden	Goteborg; Stockholm

Table 15: Ownership typology by country

	Negotiated procedures						Competition		
	Austria	Belgium	Germany	Italy	Portugal	Spain	France	Netherlands	Sweden
N. of firms	2	1	23	14	5	19	7	2	4
Public	100.0	100.0	82.6	85.7	20.0	52.6	0.0	100.0	25.0
Mixed own.	0.0	0.0	17.4	14.3	20.0	10.5	71.4	0.0	0.0
Private	0.0	0.0	0.0	0.0	60.0	36.8	28.6	0.0	75.0

For each country are reported the percentages of firms characterized by alternative types of ownership.

Table 16: Descriptive statistics according to the type of transport service provided

Panel A: Underground transportation companies

Variable	Mean	Std. Dev.	Min	Max
Capital	829,774.0	1,184,715.0	1,575.0	4,545,975.0
N. of employees	4,179.2	3,277.4	210.0	14,888.0
Cost of employees	183,102.4	169,181.5	3,910.0	843,456.0
Operating revenues	311,387.0	290,473.0	9,205.0	1,245,326.0
Value Added	289,843.3	273,425.0	7,560.0	1,187,732.0
Sales	207,602.0	175,234.7	8,972.0	717,946.0
K/L	247.8	531.2	2.9	4,082.4
VA/L	60.6	22.7	29.4	174.2
REVENUES/L	136.0	430.3	42.0	3,633.2
Unit lab. Cost	64.6	208.0	26.8	2,090.7

Panel B: Ground transportation companies

Variable	Mean	Std. Dev.	Min	Max
Capital	111,109.6	147,698.1	1,249.0	782,852.0
N. of employees	1,964.3	2,193.3	95.0	12,786.0
Cost of employees	73,937.3	85,708.5	2,589.0	535,891.0
Operating revenues	124,745.7	156,389.7	7,838.0	948,124.0
Value Added	83,227.5	103,974.5	3,077.0	628,691.0
Sales	96,465.9	147,296.3	9,288.0	948,124.0
K/L	99.0	578.1	3.0	10,010.5
VA/L	100.4	743.6	24.6	12,222.3
REVENUES/L	192.5	1,161.2	39.3	18,217.3
Unit lab. Cost	38.8	9.3	25.2	122.1

Capital, total cost of employees, operating revenues, value added and sales are expressed in thousand Euros. K/L is the ratio of capital over total number of employess. VA/L is the ratio of value added over total number of employees. REVENUE/L is operating revenues over total number of employees. Unit labour cost is the ratio of total cost of employees over total number of employees. Mean values over the period 1997-2006

Table 17: Descriptive statistics by Country

	Negotiated procedures						Competition		
	Austria	Belgium	Germany	Italy	Portugal	Spain	France	Netherlands	Sweden
N. of firms	2	1	23	14	5	19	7	2	4
N. of employees	1,457.7	5,845.9	2,321.5	2,818.7	2,178.0	1,605.0	1,671.1	6,259.1	2,530.8
Operating revenues	300,645.0	389,683.3	197,419.1	192,380.8	65,054.0	95,017.4	109,405.2	483,636.5	158,795.0
Sales	287,169.8	232,213.7	138,214.5	102,384.7	48,869.3	76,599.7	91,295.9	410,264.4	157,445.3
K/L	111.4	118.4	166.7	224.4	481.8	33.5	66.0	100.1	16.1
REVENUES/L	151.4	66.5	163.6	414.6	34.4	62.2	67.5	79.6	976.5
Unit lab. Cost	40.8	52.3	64.5	40.0	27.4	33.2	36.4	43.6	23.0

Operating revenues and sales are expressed in thousand Euros. K/L is the ratio of capital over total number of employees. REVENUE/L is operating revenues over total number of employees. Unit labour cost is the ratio of total cost of employees over total number of employees.

Table 18: Firm effects estimation, ground transportation companies only

Ground transportation

	(1)	(2)	(3)	(4)	(5)
Tram	-0.390***	-0.448***	-0.304***	-0.350***	-0.444***
	(-8.624)	(-9.708)	(-7.326)	(-8.020)	(-10.08)
Bus	0.349***	0.334***	0.294***	0.289***	0.236***
	(8.226)	(7.774)	(7.316)	(7.052)	(3.810)
Extra-urban services	0.0248	0.0545	-0.0590	-0.0291	0.0131
	(0.554)	(1.208)	(-1.546)	(-0.752)	(0.347)
Group member	0.241***	0.193***	0.101**	0.0682*	0.0509*
	(7.518)	(6.543)	(2.272)	(1.742)	(1.848)
Competition		0.204***		0.166***	0.139**
		(2.947)		(2.667)	(2.431)
Mixed own.			-0.0833**	-0.0732**	0.0229
			(-1.990)	(-2.123)	(0.744)
Mainly public mixed own.			-0.379***	-0.389***	-0.432***
			(-8.469)	(-9.033)	(-9.809)
Fully public own.			-0.505***	-0.470***	-0.478***
			(-9.662)	(-10.79)	(-10.70)
City population density					-0.283***
					(-6.152)
Observations	336	336	336	336	329
R-squared	0.336	0.370	0.507	0.528	0.574
Test on equality between mixed own. and mainly public mixed own.			F(1,328) = 41.63***	F(1,327) = 58.94***	F(1,319) = 120.29***
Prob > F			(0.000)	(0.000)	(0.000)
Test on equality between mixed own. and fully public own.			F(1,328) = 42.56***	F(1,327) = 55.67***	F(1,319) = 147.50***
Prob > F			(0.000)	(0.000)	(0.005)
Test on equality between mainly public mixed own. and fully public own.			F(1,328) = 2.21	F(1,327) = 5.14**	F(1,319) = 10.23***
Prob > F			(0.138)	(0.024)	(0.002)

Dependent variable: individual fixed effects, obtained from the production function estimation. OLS estimates with robust standard errors. Standardized 'beta' coefficients are reported. t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 19: Variables' description

Variable	Definition	Source
Capital (K)	Tangible fixed assets, as reported in the company's balance sheet	Amadeus database
Number of employees (L)	Number of workers employed in the company	Amadeus database
Cost of employees	Wage bill, as reported in the company's balance sheet	Amadeus database
Operating revenues	The sum of sales, stock variations and other operating revenues. Data are reported in the company's balance sheet	Amadeus database
Value added	Value added, as reported in the company's balance sheet	Amadeus database
Sales	Only revenues from sales, as reported in the company's balance sheet	Amadeus database
K/L	Ratio of capital over total number of employees	Amadeus database
VA/L	Ratio of value added over total number of employees	Amadeus database
REVENUES/L	Ratio of operating revenues over total number of employees	Amadeus database
Unit labour cost	Ratio of cost of employees over total number of employees	Amadeus database
Public	A dummy equal to 1 if the ownership is totally public	Amadeus database and
Mixed ownership	A dummy equal to 1 if the ownership is partially public and partially private	Amadeus database and companies' web-sites
Private	A dummy equal to 1 if the ownership is totally private	Amadeus database and
Y	Index of output obtained as the ratio of sales over the monthly ticket price for local public transport	Amadeus database for the sales. Eurostat's Urban Audit database and companies' web-sites for the monthly ticket price
M	Cost of material inputs, as reported in the company's balance sheet	Amadeus database
Metro	A dummy equal to 1 if the company offers metro transportation and owns the assets	Companies' web-sites
Metro services	A dummy equal to 1 if the company offers metro transportation and owns the assets	Companies' web-sites
Tram	A dummy equal to 1 if the company offers tramway transportation	Companies' web-sites
Bus	A dummy equal to 1 if the company offers bus transportation	Companies' web-sites
Extra-urban services	A dummy equal to 1 if the company offers both urban and extra-urban routes	Companies' web-sites
Group member	A dummy equal to 1 if the company is part of larger group which provides transportation services in more than one city	Companies' web-sites
Competition	A dummy equal to 1 if the firm has been selected through competitive tendering. The dummy is equal to 0 if the firm has been selected through negotiated procedures.	Companies' web-sites
City population density	Number of inhabitants per square km, obtained as the ratio of the number of city inhabitants over the city area expressed in square km	Eurostat's Urban Audit database
City GDP per capita	Average GDP per capita defined at city level	Eurostat's Urban Audit database