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Do competition and ownership matter? Evidence from local public transport in Europe*

Andrea Boitani,[†] Marcella Nicolini,^{‡§} Carlo Scarpa[¶]

5th April 2011

Abstract

This paper investigates how the ownership and the selection procedure 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 77 companies operating in large European cities over the period 1997-2006. This allows us to consider firms selected either through competitive tendering or negotiated procedures. Retrieving the residuals we obtain a measure of total factor productivity, which we regress on firm and city characteristics. We find that totally or partially public firms display lower productivity than privately owned firms. 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? 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 municipalities award the service is a key aspect that affects 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 investigate 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

¹The 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.

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8 ownership has a significant and negative impact on firms' TFP. Finally, we find
9 that mixed firms are anyway different from entirely private ones, which are more
10 productive. Additionally, mixed firms are more productive than totally public
11 ones.
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13 The paper is structured as follows. Section 2 presents the literature and
14 some research hypotheses; section 3 describes the database; section 4 sketches
15 the empirical model to be tested; section 5 presents the results of our empirical
16 analysis and, finally, section 6 draws some conclusions.
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18

19 **2 Literature Review and Research Hypotheses**

20 Previous analyses of the LPT industry have focused on the impact of alternative
21 contract schemes within one country, observing a choice between fixed-price
22 contracts and cost-plus ones and relating it to efficiency. The empirical evidence
23 confirms the theoretical prediction that firms operating under a high-powered
24 incentive scheme, such as a fixed-price contract, are more efficient than firms
25 operating under a low-powered incentive scheme, such as a cost-plus contract.
26 Research on this topic relies on information on the type of contract implemented,
27 which is available only in ad hoc constructed databases. Thus, previous evidence
28 is country specific (Gagnepain and Ivaldi, 2002; Roy and Yvrande-Billon, 2007;
29 Piacenza, 2006).
30

31 Our cross-country data set does not allow us to retrieve detailed information
32 on the incentive mechanism included in each contract. This prevents us from
33 replicating the same empirical exercises as those mentioned above. In any case, a
34 cross-country comparison does not easily lend itself to such a fine-grain analysis.
35 Comparing different contracts, possibly constructing some synthetic indicator
36 to classify different contractual clauses, seems sensible only within a sufficiently
37 uniform institutional setting, which is not the case in a cross country perspective.
38 Our database allows us to investigate the productivity effects of two broadly
39 alternative institutional arrangements in place in different European countries:
40 competition "for the market" and negotiated procedures.
41

42 The label "negotiated procedure" actually denotes the decision of a local
43 public administration to directly identify the supplier of the service, possibly
44 imposing or negotiating some conditions of the service contract. On the other
45 hand, when there is competition for the market, the service provider is chosen
46 through public tendering, whereby the firm making the "best" bid is selected.
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8 Which procedure is able to select the most efficient supplier is a widely debated
9 question, at least since Williamson (1976). Recently, Bajari *et al.* (2009) chal-
10 lenge the common wisdom that competition is preferable, showing that negoti-
11 ations can indeed perform better than auctions when the object of the contract
12 is complex. Hensher and Stanley (2008) push forward a similar argument with
13 respect to bus route contracts. Moreover, they complain that the empirical
14 evidence on the effects of competitive tendering versus negotiation is lacking in
15 the local public transport industry. We aim at contributing to fill this gap in
16 the literature.

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

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36 *Hypothesis 1: Firms selected by means of competition “for the market” dis-*
37 *play higher total factor productivity than firms operating under negotiated pro-*
38 *cedures.*

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41 A large body of literature has focussed on the implications of public versus
42 private ownership, in LPT as well as in other industries. The theoretical ground
43 for this research question was laid by Hart *et al.* (1997), who show that the
44 choice the public authority has to face between in-house provision and contract-
45 ing out is nontrivial. Indeed, contract incompleteness implies that the private
46 company has a stronger incentive to engage in cost reduction and a lower in-
47 centive in quality improvement. A state-owned company has stunted incentives
48 both in cost reduction and in quality improvement. However, as cost reduction
49 may also reduce quality, private ownership may result in quality (as well as cost)
50 lower than under public ownership. Boycko *et al.* (1996) argue that publicly-
51 owned firms may be forced by politicians to hire an inefficiently high number
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8 of workers. However, diverging objectives between managers and shareholders
9 may also arise in large private corporations (Vickers and Yarrow, 1991).

10 When moving to the empirical analyses of this issue, the evidence is not
11 conclusive (See Megginson and Netter, 2001). Quite naturally, the focus of
12 these empirical analyses has been on those industries where the share of publicly
13 owned firms is large. Local public transport is one such industry. Ottoz *et*
14 *al.* (2009) use a database on Italian firms in the LPT industry and find that
15 public enterprises are slightly more inefficient than private companies. Roy
16 and Yvrande-Billon (2007) observe similar results for French firms operating in
17 LPT. Overall, previous empirical evidence on countries which are included in our
18 sample suggests that companies owned by the public sector are less productive
19 than private ones. Therefore, we state our second hypothesis as follows:
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24 *Hypothesis 2: Public ownership negatively affects firms' total factor pro-*
25 *ductivity.*
26

27
28 As for the issue of mixed public-private firms, the literature is scant. Authors
29 such as Boardman, Eckel and Vining pioneered the research in this area. They
30 suggest that mixed ownership firms can accomplish profitability and social goals
31 at a lower cost, thanks to the internal monitoring by private shareholders (Eckel
32 and Vining, 1985). They state that mixed enterprises perform better than public
33 ones, but not as well as private ones (Boardman and Vining, 1989). Filippini and
34 Prioni (2003) investigate the role of mixed ownership on a sample of bus service
35 companies in Switzerland, finding some evidence in support of this ranking.
36 Although scarce, the literature suggests a third testable hypothesis:
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40 *Hypothesis 3: Mixed ownership firms differ from entirely public and entirely*
41 *private enterprises, showing intermediate levels of total factor productivity.*
42
43

44 **3 The Data**

45
46 We test our research hypotheses on a database of LPT firms operating across
47 nine European countries. To the best of our knowledge, the sole paper that
48 investigates the productivity of local public transport companies across different
49 countries in Europe is Wunsch (1996), where labour productivity and average
50 cost for a cross-section of firms are examined. This calls for some new evidence
51 across countries.
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8 The companies in the sample have been selected following two criteria. First,
9 we choose to focus on European countries. Given the time period considered, we
10 concentrate our analysis on EU 15 countries only. As East European countries
11 were still in the transition phase, for the sake of comparability we choose to
12 exclude them from our sample. Second, in order to avoid pooling together
13 excessively different firms, we restrict our analysis to firms operating in “large”
14 cities, defined as those which wither have more than 300,000 inhabitants or
15 which are part of a metropolitan area with more than 1 million inhabitants².
16 We decide to broaden the first criterion by means of the second one in order to
17 include in the analysis those cities which have relatively “small” administrative
18 borders, but whose population is still relevant in size (e.g. Brussels).
19

20 We source balance sheet data over the period 1997-2006 from the Amadeus
21 database, maintained by Bureau van Dijk. Our final database has information
22 on 77 firms distributed across nine countries, as shown in Table 1³: our sample
23 includes firms operating in all large EU 15 cities, with the notable exception of
24 Paris⁴. On the basis of various sources (web-sites; investigation of national and
25 regional laws; etc.) we gathered information on prices and on how each service
26 provider was selected (whether or not on the basis of an explicit competitive
27 procedure).
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33 [Insert Table 1 about here]
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36 3.1 Description of the Database

37 In order to estimate a production function, we need a measure of output. As
38 our firm level data are sourced from balance sheet data, this information is
39 not directly available.⁵ However, balance sheet data provide information about
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42 ²Official data on population are sourced from Eurostat.

43 ³Unfortunately, the Amadeus database does not provide information on sales for firms
44 located in the United Kingdom. This forces us to exclude this country’s firms as sales are a
45 necessary ingredient of our analysis (as will be explained below). However, the prevalence of
46 competition “in the market” in UK cities (except London) may well have introduced a strong
47 country bias in the empirical analysis.

48 ⁴For a complete list of the cities included in the sample, as well as further descriptive
49 statistics on the firms analysed, refer to Boitani *et al.* (2010). Table A.1 in the Appendix
50 summarises the definitions and sources of the variables used in the empirical investigation.

51 ⁵To the best of our knowledge, this information does not exist. Despite their local monopoly
52 position, firms are quite reluctant to collect these data in a coordinated and fully comparable
53 way, and even more to communicate these data. Even UITP, the international association of
54 local public firms in the sector, does not have systematic data of this kind. As highlighted
55 in the previous section, some databases with specific information on the type of contract and
56 output measures are available. Nonetheless, these databases are specific to a single country,
57 or even a single region.
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8 revenues from sales of services, net of public transfers. Each firm has several
9 prices (for single tickets, season tickets, concessions and so on), which however
10 are very correlated to one another. As a proxy for the average price of the
11 service of each firm, we use the information on the monthly ticket price, which
12 we retrieve from the Urban Audit database developed by Eurostat. We integrate
13 missing observations by directly looking at companies' web-sites.

14
15 We thus define as our measure of output the ratio between sales (revenues
16 net of transfers) and this price. Notice that the use of deflated sales as a proxy
17 for output is widely adopted in the empirical literature.⁶ Notice, moreover,
18 that in this sector even "official" output figures (e.g., passengers \times km) are not
19 directly observed. As a consequence, even these measures (even when available)
20 are actually conventional estimates.

21
22 As input variables in our production function we have capital (defined as
23 tangible fixed assets); labour, expressed as the number of employees; and the
24 cost of material inputs. Nominal variables are all deflated by the country-specific
25 consumer price index for transport services, which is sourced from Eurostat.
26 Table 2 reports some summary statistics about the firms included in the analysis.

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30 [Insert Table 2 about here]

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33 Local public transport companies offer various types of services (tram, bus
34 metro and light rail), which are produced using different technologies. Table 3
35 shows that firms operating underground transportation services are larger, both
36 in terms of capital and number of employees as compared with firms operating
37 ground transportation only. Moreover, underground companies have larger costs
38 of materials, revenues, value added and sales. The test on the equality of means
39 strongly rejects the null hypothesis that the two types of firms present the same
40 mean values for all these variables. This suggests to distinguish these firms from
41 the whole sample in the subsequent analysis.

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44 [Insert Table 3 about here]

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47 ⁶ As Bartelsman and Doms (2000) point out: "The choice of output is often dictated by the
48 available data. Where possible, physical output with unchanging quality is the best measure.
49 [...] In general, researchers rely on deflating nominal variables at the sectoral level. [...] Using
50 deflated production to measure productivity has one drawback, which is the same whether
51 applied at the micro level or at the sectoral or aggregate level: Any quality improvement in
52 output that is not reflected in the deflator will result in a downward bias in productivity".
53 Notice however that the issue of quality measurement is problematic also when direct measures
54 of output are available.

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8 One of the aims of this paper is to shed light on the impact of competition for
9 the market on firm's performance. In this perspective, countries can be divided
10 into two groups: countries where LPT services are tendered out (France, Neth-
11 erlands and Sweden) and countries where LPT companies are selected through
12 negotiated procedures (Austria, Belgium, Germany, Italy, Portugal, Spain)⁷. In
13 the period considered, no change from negotiated procedures to competition for
14 the market or vice-versa was detected for the firms in the sample.
15

16
17 A simple analysis on the equality of means shows that firms operating under
18 the two alternative institutional regimes are indeed different. Table 4 shows the
19 results. When testing the equality of means on the overall sample, differences
20 are limited. Nonetheless, when we concentrate on the sample of firms operating
21 ground transportation services only, we find that firms operating under negoti-
22 ated procedure are generally smaller, both in terms of capital and labour, and
23 in terms of revenues, valued added and sales.
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26
27 [Insert Table 4 about here]

28
29 The information on ownership was retrieved from the Amadeus database,
30 with a cross-check on firms' web sites. We have considered three categories:
31 firms fully owned by central or local governments (public), firms entirely in
32 private hands, and intermediate cases, where private and public shareholders
33 coexist. Such mixed firms represent a relevant share of the sample, as shown in
34 Table 5. While totally public firms are predominant, and represent 63% of our
35 observations, about 20% of the firms have a mixed ownership. In mixed firms,
36 the public shareholder is typically in control, as its share never falls below 33.3%.
37 Moreover, in about one half of the mixed firms the share of private investors
38 remains below 15%, so that the difference between these firms and totally public
39 ones may be considered dubious.
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43 [Insert Table 5 about here]

44
45 Disentangling the data by the type of transport service provided, we observe
46 that mixed and private ownership types are equally represented in ground trans-
47 portation services, while totally private firms are almost absent in the sample
48 of companies providing metro services, which are the stronghold of public own-
49 ership.
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53 ⁷ Although Law decree 422/1997 has introduced competitive tendering in Italy, the Italian
54 firms included in the database were all operating under negotiated procedures during the time
55 period considered in the analysis.

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8 Analogously to what we observed about the diversity of arrangements for
9 awarding the service, even the actual content of public shareholding may vary
10 substantially from country to country. In some countries, political interference
11 is heavy and widespread, while elsewhere managers' autonomy may be deeply
12 rooted. In the same way, elements such as different legal traditions, different
13 budget constraints of local authorities and the governance structure of local pub-
14 lic firms are probably relevant elements, which may differ substantially across
15 countries. As argued above, it is exactly because of these institutional and
16 political differences that our cross-country analysis may have a particular value
17 added.
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22 4 The Empirical Model

23
24 In order to estimate firms' productivity, several modeling alternatives have been
25 used in the literature. Some authors follow a one-step procedure, and estimate
26 either a translog production function or a cost function including into the estimat-
27 ing equation some controls for ownership or contractual agreements. Although
28 widely adopted, this methodology seems to rely too much on the inevitably ar-
29 bitrary choice of the additional variables to be included in the econometric
30 specification. Moreover, in this case estimates would be affected by availability
31 of data on the control variables.
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35 To avoid these problems, we prefer to estimate the translog production func-
36 tion with firm fixed effects⁸. Since our controls in the second step are essentially
37 time invariant firm characteristics, the two-stages option is preferable. Indeed,
38 in this way the production function estimation takes into account *all* time-
39 invariant firm characteristics, without incurring problems of data availability.
40 Additionally, a fixed effect estimator has the advantage of providing an answer
41 to the problem of endogeneity of inputs choices⁹. Notice however that, apart
42 from the methodology chosen, a number of alternative techniques exist to re-
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46 ⁸As will be evident in the next section, this specification is supported also by our data.

47 ⁹The error term in the production function can be decomposed into two terms: $\varepsilon_{it} =$
48 $\omega_{it} + \eta_{it}$, where ω_{it} represents unobservables that are unknown to the econometrician, but
49 are observed (or predictable) by firms when choosing inputs, and η_{it} represents unobservables
50 that are not observed by the firm before input decision. For example, ω_{it} could represent
51 managerial ability, or expected down-time due to breakdowns, while η_{it} could represent devi-
52 ations from expected breakdowns. Since a firm has knowledge of its ω_{it} when making input
53 choices, these choices will be correlated with ω_{it} , thus incurring endogeneity. Fixed effects
54 estimator assumes that unobserved productivity ω_{it} is constant over time, allowing to con-
55 sistent estimate the production function. Given the short time period considered, constancy
56 of ω_{it} is not a strong assumption.
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trieve productivity at the firm level, ranging from non-parametric to parametric and semi-parametric ones. Van Biesebroeck (2007) provides an extensive discussion of alternative techniques to retrieve TFP at the firm level.

We choose the following research strategy: as a first step, we estimate a production function. We will then retrieve the residuals of this estimation¹⁰ and regress them on ownership and competition variables as well as firm specific variables.

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 translog model (Berndt and Christensen, 1973), which can be interpreted as a second-order approximation to an unknown functional form, and therefore provides considerable flexibility. Our estimate considers three inputs: capital (K_{it}), labour (L_{it}) and materials (M_{it}) and a non-neutral technical change¹¹:

$$\begin{aligned}
 \ln Y_{it} = & \beta_0 + \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_M \ln M_{it} + \beta_t time + \\
 & + \beta_{L,L} \ln L_{it} * \ln L_{it} + \beta_{L,K} \ln L_{it} * \ln K_{it} + \\
 & + \beta_{L,M} \ln L_{it} * \ln M_{it} + \beta_{L,t} \ln L_{it} * time + \\
 & + \beta_{K,K} \ln K_{it} * \ln K_{it} + \beta_{K,M} \ln K_{it} * \ln M_{it} + \\
 & + \beta_{K,t} \ln K_{it} * time + \beta_{M,M} \ln M_{it} * \ln M_{it} + \\
 & + \beta_{M,t} \ln M_{it} * time + \beta_{t,t} time * time + \varepsilon_{it}
 \end{aligned} \tag{1}$$

where 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 and $time$ is a time trend acting as a proxy for technological progress. This specification allows us to estimate input elasticities and returns to scale. Moreover, the term ε_{it} represents the productivity level of firm i .

As for the second step, we retrieve firms' total factor productivity as the residual of the estimated production function. We then regress this index of TFP on a set of firm, city and country characteristics. We estimate the following equation:

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

¹⁰This amounts to defining TFP as the unexplained residual of the production function.

¹¹Wang Chiang and Chen (2005) and Ottoz *et al.* (2009) introduce non-neutral technical change in a translog cost function on a sample of Taiwanese and Italian LPT companies, respectively.

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8 where *firm_characteristics* is a vector of firm specific characteristics such as
9 being part of a group or the transport service provided. The dummy variable
10 *procedure* defines the type of awarding procedure under which firms operate,
11 whether competitive tendering or negotiated procedure. The *ownership* dummy
12 variables distinguish between totally public, totally private or mixed firms. Fi-
13 nally, *city_characteristics* is a vector including features, such as population
14 density and GDP per capita of the cities considered, which may affect perform-
15 ance. For instance, higher density may imply higher traffic congestion resulting
16 in lower speed of buses and trams, whilst higher GDP per capita may imply
17 higher real wages and different attitudes towards the choice between public and
18 private means of transport.

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22 Finally, notice that the interpretation of coefficients is substantially different,
23 depending on whether we adopt a one-step or a two-step procedure. In the
24 first case the estimated coefficients state how a variable affects the quantity of
25 output for a given level of inputs. In the second one, the estimated coefficients
26 directly suggest how specific factors affect firms' productivity. Given the aim
27 of our analysis, the two-step procedure yields a set of coefficients which can be
28 directly interpreted¹².

31 32 33 5 Results

34 35 5.1 Production function estimation

36
37 The first step of our empirical analysis consists of the estimation of equation
38 (1). All monetary variables have been deflated by a country-specific industry
39 deflator. All variables, apart from the time trend, are expressed in logarithms.
40 Table 6 presents the results.
41

42
43 [Insert Table 6 about here]

44
45 We first estimate the translog production function by pooling our observa-
46 tions together, using ordinary least squares (see column (1) in Table 6). We test
47 the null hypothesis that all interaction terms are equal to zero, which is strongly

48
49 ¹²Take for example the role of selection mechanisms: no economic a priori suggests that the
50 amount of output should be statistically different between firms selected by means of a public
51 tendering or negotiated procedures. Indeed, the correlation between the output variable and
52 the procedure variable is 0.06 and not statistically significant. However, economic theory
53 suggests that firms selected through a competitive tendering should be more productive, and
54 this is confirmed by a correlation of 0.11, significant at 5% level, between the output variable
55 and the dummy for competitive tendering.

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8 rejected: this suggests that indeed a translog production function should be preferred to a Cobb-Douglas one.

9
10 As our data have a panel structure, we estimate a translog model with firm effects, and the results are presented in 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 firm specific fixed effects improves the estimation.

11
12 We also present an estimate including random effects, as 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 there is no correlation between explanatory variables and firm effects. This is quite a strong assumption, as we would expect firm specific effects to be correlated with factor endowments. In order to choose between the two alternative specifications, we follow the Hausman test (see the bottom line in Table 6), which suggests that a fixed effects specification should be adopted. Therefore, we choose this as our preferred specification.

13
14 As we have shown that running underground services makes a considerable difference, we repeat our exercise on the subsample of firms operating ground transportation only¹³. Table 7 presents the results 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).

15
16 The time trend shows a positive and significant coefficient in both samples, thus suggesting the presence of technological progress over the interval considered (1997-2006). However, the coefficients attached to the *time* interacted regressors are jointly statistically different from zero, therefore we are observing non neutral-technical progress: our results suggest that technical progress is significantly material saving (presumably, energy saving), and this result is robust across the two samples considered¹⁴.

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48 [Insert Table 7 about here]

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50 ¹³We classify as “metro companies” those firms which offer underground transportation services. These firms may be offering exclusively underground transportation services, or both ground and underground transportation services.

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52 ¹⁴Technical progress is labour augmenting in the full sample, but this result is not robust when considering the subsample of ground transportation companies only.

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8 To interpret the estimated first-order parameters we calculate the elasticities
9 of output to inputs at mean and median values of inputs distributions. Results
10 are presented in Table 8. We get significant coefficient estimates for the three
11 inputs included in the production function and we obtain decreasing returns to
12 scale¹⁵.
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15 [Insert Table 8 about here]
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17 **5.2 Determinants of TFP: the Role of Ownership and** 18 **Competition** 19

20 We recover our measure of total factor productivity as the difference between
21 actual and predicted output in the estimation of the translog fixed effects pro-
22 duction function (equation (1)). This allows us to estimate equation (2): we
23 regress the index of TFP on a number of features which could influence firms'
24 productivity. Table 9 presents the results.
25
26

27
28 [Insert Table 9 about here]
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30 Notice that as the coefficients reported are standardized, a comparison between
31 the size of the coefficients is possible. The results in column (1) report a basic
32 regression of our measure of TFP on a set of firm's characteristics. As expec-
33 ted, the type of transport service provided affects productivity. Tramways may
34 not accommodate the number of passengers that compensates the higher fixed
35 cost entailed by this technology, so that tram services display a negative coef-
36 ficient. Instead, firms which operate underground services, without owning the
37 network (Metro services), display higher TFP; this is hardly surprising, in that
38 these companies do the same service as those captured by the dummy "Metro",
39 without the fixed input represented by the network. The provision of extra-
40 urban services seems to negatively affect productivity, although this result is
41 not significant. Finally, a firm being part of a large (sometimes multinational)
42 group is likely to be more productive than a stand-alone firm. This could be
43 due to better managerial practices shared among members of the same group.
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48 ¹⁵Evidence on large companies in LPT is scant, however the result of diseconomies of scale
49 confirms previous findings in the literature (Bhattacharyya *et al.*, 1995; Matas and Raymond,
50 1998; Jha and Singh, 2001). Constant and increasing returns to scale are often obtained on
51 samples of small and medium-sized companies. Cambini *et al.* (2007) provide a comprehensive
52 review of previous empirical evidence on scale and density economies in LPT. Additionally,
53 notice that the econometric literature acknowledges a downward bias in the estimates of input
54 elasticities in a fixed effects framework in presence of measurement error. See Griliches and
55 Hausman (1986) for a discussion.
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8 In column (2) we control for the procedure used for awarding the service. As
9 expected, competitive tendering has a positive effect on total factor productivity:
10 the coefficient attached to the variable is always positive and significant at 1%
11 level across different specifications. This result provides empirical support to
12 our first research hypothesis, namely that a competitive setting may enhance
13 firms' TFP.
14

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16 Then, we consider ownership in column (3). Notice that in this specifica-
17 tion we distinguish two types of mixed companies: those dominated by public
18 shareholders (with more than 85% of the shares), which we label "Mainly pub-
19 lic", and those in which the private and public shares are more balanced. We
20 suspect that such a relevant public share may imply a management style which
21 is different from the one in mixed ownership companies, being, if any, closer to
22 the full public ownership type.¹⁶
23

24
25 Relative to firms in private hands, public ownership negatively affects TFP,
26 and the same holds true for mixed ownership, so that our data support Hy-
27 pothesis 2. As the coefficients are standardized, we are able to compare their
28 magnitudes, and to establish a ranking in terms of productivity. The fully and
29 mainly public firms (public share over 85%) are the least productive, while the
30 firms where the share of private investors is above 15% are more productive.
31

32
33 Moreover, the table reports the test on the equality of coefficients between
34 fully public, mostly public and mixed ownership. The tests suggest that the dif-
35 ferences in terms of TFP between the three types of firms are statistically signi-
36 ficant, thus supporting the distinction of firms into these categories. Therefore,
37 we find evidence in favour of our third hypothesis: mixed ownership firms differ
38 from private companies, being significantly less productive, and from entirely
39 public ones. Additionally, we may state that mixed ownership companies are
40 not a homogeneous category, and different groups of mixed firms are statistically
41 different in terms of productivity.
42

43
44 Columns (2) to (4) jointly show that regulatory environment and ownership
45 independently affect firm's total factor productivity: These variables are signi-
46 ficant both if considered in isolation, as in the second and third column, and
47 in combination, as in the fourth column. This is particularly relevant because,
48 as seen in Table 5, many firms in our sample are in public hands and operate
49 under negotiated procedures.
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52 ¹⁶See Section 5.3 for a discussion on the role of ownership adopting alternative definitions.
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8 Finally, thanks to the Urban Audit Database by Eurostat, we are able to
9 include some information on the cities where firms operate, such as city size
10 (both area and population), demographic indicators, income, mobility indicators
11 (Proportion of journeys to work by car, Number of registered cars per 1000
12 inhabitants, etc.) and indicators of the relevance of touristic activities in the
13 city. Although we cannot report all results, only few of these variables affect our
14 estimates, and they never change the sign and significance of other coefficients.
15 The results in column (5) show that population density does not influence firms'
16 productivity in the full sample of the firms we consider.
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20 [Insert Table 10 about here]
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22 After the analysis of the full sample of firms, Table 10 presents the results
23 for the subsample of firms that operate only ground transportation services.
24 Provision of extra urban services is still not significant. Again, firms selected
25 through competition “for the market” display higher levels of TFP. As for the
26 type of ownership, the result that public firms are less productive is confirmed.
27 Again, mixed ownership firms are less productive than private ones. The dif-
28 ferences between fully public firms, mainly public, and mixed ownership ones
29 are statistically significant in this subsample. Finally, controls for city char-
30 acteristics suggest that population density now has a negative and significant
31 coefficient, thus suggesting the presence of negative congestion externalities that
32 affect ground transports in dense cities and metropolitan areas.
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38 5.3 Robustness

39 The distinction of firms into four different categories according to their public
40 ownership share, although supported by the tests that accompany our estim-
41 ates, may seem somehow *ad hoc*. Thus, it seems important to show that our
42 preferred specification has been driven by a careful check of alternatives and
43 a deep investigation of the relationship between ownership and productivity.
44 While in the first estimate we distinguished the four aforementioned categories
45 of firms, here we consider different specifications, always confirming the main
46 message of the previous analysis.
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50 First, instead of using dummy variables, we consider the share of public
51 ownership as a continuous variable, and we include it among our regressors.
52 The results are reported in the first three columns of Table 11. We find that
53 the share of public ownership has always a negative and significant coefficient,
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8 thus suggesting that productivity is inversely related to the weight of public
9 shareholders. This result is robust to the inclusion of controls for the selection
10 mechanism (column (2)) and the city features (column (3)).

11 A second way to analyze the role of ownership is to reduce the number
12 of categories considered, grouping together all firms where public shareholders
13 have a positive (but less than 100%) stake. The results reported in columns (4)
14 to (6) show that mixed ownership firms are statistically different from private
15 ones, which are more productive, and fully public ones, the least productive
16 group.
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20 [Insert Table 11 about here]
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23 6 Conclusions

24
25 Our cross country analysis has shed light on the role that selection mechanisms
26 and ownership have on local public transport firms in Europe. The main results
27 can be summarized as follows.
28

29 First, firms selected through competition “for the market” present higher
30 levels of productivity. Secondly, we find that ownership matters: public firms are
31 generally less productive than private firms, and so are mixed firms. Moreover,
32 our results provide support to the idea that the presence of some private share-
33 holders is associated to higher productivity, probably because of the influence
34 exerted on managerial choices by private shareholders. This result calls for fur-
35 ther theoretical investigation on the nature and performance of mixed ownership
36 firms.
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40 Finally, we observe that available indicators of city characteristics rarely
41 affect local public transport firms’ TFP, except for possible negative congestion
42 effects on ground transport services in large cities.
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44 Caution is needed when drawing policy implications from our results. How-
45 ever, there is a mild indication that in the European countries under exam
46 competitive processes have been able to select more efficient firms than negoti-
47 ated procedures. This may well depend on the poor quality of the local bodies
48 in charge at negotiating the contracts, or on other causes which are beyond the
49 scope of the present analysis. Whatever the reason, policy proposals advocating
50 a limitation of competitive procedures in this institutional context would need
51 to provide very strong evidence that negotiations yield better results.
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8 As for ownership, the results above show no ambiguity: firms in public
9 hands are less productive than private ones. However, the higher productivity of
10 private firms may have at least two drivers. The first is that private shareholders
11 simply have stronger incentives to make sure that the firm is efficient. The
12 second one is that during the privatization process of the last few years more
13 productive and profitable firms have been sold to private shareholders, so that
14 only less productive firms have now remained in public hands. Understanding
15 which explanation is preferable would require further analysis. However, it is
16 apparent that privatization could be a solution only if the power of incentives is
17 the dominant driver of private firms' higher productivity. Otherwise, the path to
18 efficiency is far more complex. If one wants to consider the privatization option,
19 our evidence indicates that mixed firms are still less efficient than private ones.
20 Hence, if privatization is to be chosen, it seems preferable to go all the way (or
21 most of the way) to private ownership.
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26 However, both competition and privatization are no *panacea*: indeed, they
27 may have different effects in different set-ups, and may fail to deliver the expected
28 benefits under some circumstances. In particular, although available data
29 do not include the contractual structure, it has to be highlighted that a careful
30 contractual design is crucial in providing the proper incentives to efficiency, with
31 or without competitive tendering, with privately or publicly owned firms.
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Table 1: Country breakdown

| Country | N. of firms | Percentage | Revenues |
|-------------|-------------|------------|-----------|
| AUSTRIA | 2 | 2.6 | 100,470 |
| BELGIUM | 1 | 1.3 | 269,781 |
| FRANCE | 7 | 9.1 | 559,974 |
| GERMANY | 23 | 29.9 | 1,985,795 |
| ITALY | 14 | 18.2 | 1,030,517 |
| NETHERLANDS | 2 | 2.6 | 824,760 |
| PORTUGAL | 5 | 6.5 | 238,803 |
| SPAIN | 19 | 24.7 | 1,195,880 |
| SWEDEN | 4 | 5.2 | 938,587 |
| Total | 77 | 100.0 | 1,151,693 |

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

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 |
| Cost of materials | 31,903.1 | 44,541.6 | 1,020.0 | 280,939.0 |
| 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 |

Notes: Capital, total cost of employees, cost of materials, operating revenues, value added and sales are expressed in thousand Euros. Mean values over the period 1997-2006

Table 3: Descriptive statistics according to the 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)*** |
| Cost of materials | 76,515.9 | 22,662.8 | -9.985 | (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)*** |

Notes: Capital, total cost of employees, cost of materials, operating revenues, value added and sales are expressed in thousand Euros.

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) |
| Cost of materials | 20,729.7 | 34,321.7 | 2.344 | (0.020)** |
| 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)*** |

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)*** |
| Cost of materials | 20,022.7 | 23,370.9 | 0.752 | (0.453) |
| 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)*** |

Notes: Capital, total cost of employees, cost of materials, operating revenues, value added and sales are expressed in thousand Euros.

Table 5: Descriptive statistics: type of ownership

Panel A: Total sample

| | Negotiated procedure | Competition | Total |
|------------|-------------------------|-------------|-------|
| Public | 57.7 | 5.7 | 63.4 |
| Mixed own. | 12.6 | 6.6 | 19.2 |
| Private | 12.4 | 5.0 | 17.4 |
| Total | 82.6 | 17.4 | 100.0 |

Number of
Obs.

437

Panel B: Ground transportation

| | Negotiated procedure | Competition | Total |
|------------|-------------------------|-------------|-------|
| Public | 50.2 | 7.4 | 57.5 |
| Mixed own. | 13.9 | 6.5 | 20.4 |
| Private | 15.9 | 6.2 | 22.1 |
| Total | 79.9 | 20.1 | 100.0 |

Number of
Obs.

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Panel C: Metro

| | Negotiated procedure | Competition | Total |
|------------|-------------------------|-------------|-------|
| Public | 83.7 | 0.0 | 83.7 |
| Mixed own. | 8.2 | 7.1 | 15.3 |
| Private | 0.0 | 1.0 | 1.0 |
| Total | 91.8 | 8.2 | 100.0 |

Number of
Obs.

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Notes: Relative frequencies are reported.

Table 6: Production function estimation

| Total sample | | | |
|----------------------------|--------------------------------|---|---|
| | (1) | (2) | (3) |
| | <i>Pool</i> | <i>FE</i> | <i>RE</i> |
| $\ln L_{it}$ | -0.845*** (0.187) | -0.065 (0.173) | -0.453*** (0.165) |
| $\ln K_{it}$ | 0.401*** (0.154) | 0.310** (0.156) | 0.217 (0.145) |
| $\ln M_{it}$ | 0.954*** (0.156) | 1.236*** (0.157) | 1.106*** (0.149) |
| $\ln L_{it} * \ln L_{it}$ | 0.304*** (0.082) | 0.244*** (0.034) | 0.257*** (0.037) |
| time | 0.100*** (0.016) | 0.0517*** (0.0161) | 0.059*** (0.015) |
| $\ln L_{it} * \ln K_{it}$ | -0.0411** (0.017) | -0.159*** (0.020) | -0.119*** (0.018) |
| $\ln L_{it} * \ln M_{it}$ | 0.004 (0.020) | 0.121*** (0.019) | 0.102*** (0.017) |
| $\ln L_{it} * \text{time}$ | 0.077*** (0.016) | 0.0198*** (0.007) | 0.030*** (0.007) |
| $\ln K_{it} * \ln K_{it}$ | 0.021** (0.008) | 0.0676*** (0.012) | 0.050*** (0.011) |
| $\ln K_{it} * \ln M_{it}$ | -0.062*** (0.015) | -0.039** (0.016) | -0.029** (0.015) |
| $\ln K_{it} * \text{time}$ | -0.004 (0.008) | 0.001 (0.003) | -0.002 (0.004) |
| $\ln M_{it} * \ln M_{it}$ | 0.036*** (0.012) | -0.064*** (0.011) | -0.048*** (0.011) |
| $\ln M_{it} * \text{time}$ | -0.108*** (0.012) | -0.039*** (0.005) | -0.048*** (0.006) |
| time*time | 0.021*** (0.005) | 0.004** (0.002) | 0.005** (0.002) |
| Constant | -1.007 (0.704) | -4.041*** (0.797) | -1.447** (0.717) |
| Observations | 437 | 437 | 437 |
| R ² | 0.772 | | |
| Adjusted R ² | 0.764 | | |
| R ² within | | 0.850 | 0.841 |
| R ² between | | 0.418 | 0.487 |
| R ² overall | | 0.595 | 0.652 |
| Test on interaction terms | F(6,422) = 14.47*** (0.000) | F(6,346) = 27.05*** (0.000) | X ² (6) = 119.20*** (0.000) |
| Test on effects | | F(76,346) = 42.58*** (0.000) | X ² (1) = 328.25*** (0.000) |
| Hausman test | | X ² (14) = 77.56*** (0.000) | |

Notes: Dependent variable: $\ln Y_{it}$ is the log of index of output. $\ln L_{it}$ is the log of number of employees, $\ln K_{it}$ is the log of deflated capital, $\ln M_{it}$ is the log of deflated material costs. Column (1) reports pooled estimation (OLS); column (2) a

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3 model with firm-specific fixed effects and column (3) a model with firm-specific random effects. Test on interaction
4 terms tests the null hypothesis that all interaction terms are statistically equal to zero. Test on effects provides an F test
5 that all fixed effects are equal to zero in column (2), and Breusch and Pagan Lagrangian multiplier test for random
6 effects in column (3). Standard error in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%
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Table 7: Production function estimation, ground transportation companies only

| Ground transportation | | | |
|----------------------------|-----------------------------------|------------------------------------|--|
| | (1) | (2) | (3) |
| | <i>Pool</i> | <i>FE</i> | <i>RE</i> |
| $\ln L_{it}$ | -1.121*** (0.152) | -0.303 (0.185) | -0.893*** (0.162) |
| $\ln K_{it}$ | -0.244 (0.154) | 0.108 (0.139) | 0.0118 (0.134) |
| $\ln M_{it}$ | 2.222*** (0.166) | 1.495*** (0.145) | 1.771*** (0.141) |
| time | 0.095 (0.077) | 0.216*** (0.034) | 0.176*** (0.037) |
| $\ln L_{it} * \ln L_{it}$ | 0.144*** (0.014) | 0.076*** (0.016) | 0.114*** (0.014) |
| $\ln L_{it} * \ln K_{it}$ | -0.012 (0.015) | -0.141*** (0.018) | -0.078*** (0.017) |
| $\ln L_{it} * \ln M_{it}$ | -0.006 (0.021) | 0.118*** (0.016) | 0.067*** (0.016) |
| $\ln L_{it} * \text{time}$ | 0.006 (0.016) | 0.001 (0.007) | 0.001 (0.009) |
| $\ln K_{it} * \ln K_{it}$ | -0.008 (0.010) | 0.072*** (0.012) | 0.031*** (0.011) |
| $\ln K_{it} * \ln M_{it}$ | 0.032 (0.021) | -0.040*** (0.015) | -0.004 (0.015) |
| $\ln K_{it} * \text{time}$ | 0.006 (0.008) | 0.005 (0.004) | 0.005 (0.004) |
| $\ln M_{it} * \ln M_{it}$ | -0.108*** (0.015) | -0.086*** (0.010) | -0.099*** (0.010) |
| $\ln M_{it} * \text{time}$ | -0.021 (0.016) | -0.025*** (0.007) | -0.020** (0.008) |
| time*time | 0.006 (0.004) | 0.003 (0.002) | 0.002 (0.002) |
| Constant | -1.999*** (0.627) | -3.632*** (0.695) | -2.166*** (0.641) |
| Observations | 339 | 339 | 339 |
| R ² | 0.868 | | |
| Adjusted R ² | 0.862 | | |
| R ² within | | 0.910 | 0.898 |
| R ² between | | 0.548 | 0.711 |
| R ² overall | | 0.675 | 0.789 |
| Test on interaction terms | F(6,324) = 30.84*** (0.000) | F(6,267) = 42.96*** (0.000) | X ² (6) = 229.16*** (0.000) |
| Test on effects | | F(57,267) = 36.45*** (0.000) | X ² (1) = 395.01*** (0.000) |
| Hausman test | | | X ² (14) = 155.85*** (0.000) |

Notes: Dependent variable: $\ln Y_{it}$ is the log of index of output. $\ln L_{it}$ is the log of number of employees, $\ln K_{it}$ is the log of deflated capital, $\ln M_{it}$ is the log of deflated material costs. Model with firm-specific fixed effects. Test on interaction

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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%

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

| | Total sample | | Ground transportation | |
|------------------|---------------------|---------------------|-----------------------|---------------------|
| | Mean | Median | Mean | Median |
| Labour | 0.238*** (0.063) | 0.288*** (0.069) | 0.400*** (0.064) | 0.407*** (0.072) |
| Capital | 0.247*** (0.051) | 0.207*** (0.052) | 0.260*** (0.042) | 0.252*** (0.044) |
| Material inputs | 0.251*** (0.050) | 0.235*** (0.052) | 0.174*** (0.046) | 0.203*** (0.045) |
| Returns to scale | 0.735*** (0.078) | 0.730*** (0.082) | 0.834*** (0.066) | 0.862*** (0.071) |

Notes: Elasticities of output to inputs are calculated at the sample means, and median values for inputs. Returns to scale are obtained as the sum of input elasticities. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 9: Total factor productivity estimation

| Total sample | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) |
| Metro | -0.002 (-0.050) | 0.041 (0.935) | 0.012 (0.258) | 0.044 (0.949) | -0.003 (-0.071) |
| Metro services | 0.273*** (2.814) | 0.289*** (2.988) | 0.253** (2.433) | 0.271*** (2.632) | 0.238** (2.359) |
| Tram | -0.274*** (-6.302) | -0.324*** (-6.601) | -0.221*** (-5.248) | -0.271*** (-5.782) | -0.225*** (-5.274) |
| Bus | 0.122 (1.378) | 0.119 (1.361) | 0.084 (0.947) | 0.087 (0.992) | -0.054 (-0.565) |
| Extra-urban services | -0.051 (-1.261) | -0.019 (-0.457) | -0.080** (-2.143) | -0.044 (-1.099) | 0.007 (0.154) |
| Group member | 0.066* (1.899) | -0.003 (-0.070) | 0.005 (0.122) | -0.057 (-1.312) | -0.047 (-1.068) |
| Competition | | 0.197*** (2.951) | | 0.195*** (3.061) | 0.199*** (2.945) |
| Mixed own. | | | -0.068* (-1.762) | -0.063* (-1.724) | -0.075** (-2.134) |
| Mainly public mixed own. | | | -0.195*** (-4.443) | -0.210*** (-4.77) | -0.243*** (-5.221) |
| Fully public own. | | | -0.237*** (-3.917) | -0.201*** (-3.716) | -0.223*** (-4.222) |
| City population density | | | | | -0.006 (-0.117) |
| Observations | 434 | 434 | 434 | 434 | 427 |
| R-squared | 0.155 | 0.183 | 0.190 | 0.216 | 0.214 |
| | | | F(1,424) | F(1,423) | F(1,415) |
| | | | = | = | = |
| Test on equality between mixed own. and mainly public mixed own. | | | 12.98*** | 15.45*** | 13.45*** |
| Prob > F | | | (0.000) | (0.000) | (0.000) |
| | | | F(1,424) | F(1,423) | F(1,415) |
| Test on equality between mixed own. and fully public own. | | | = 7.20*** | = 3.96** | = 2.80* |
| Prob > F | | | (0.008) | (0.047) | (0.095) |
| | | | F(1,424) | F(1,423) | F(1,415) |
| Test on equality between mainly public mixed own. and fully public own. | | | = 2.50 | = 5.96** | = 7.65*** |
| Prob > F | | | (0.114) | (0.015) | (0.006) |

Notes: 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%

Table 10: Total factor productivity estimation, ground transportation companies only

| Ground transportation | | | | | |
|---|-----------------------|-----------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | (1) | (2) | (3) | (4) | (5) |
| Tram | -0.317*** (-6.658) | -0.369*** (-6.982) | -0.238*** (-5.321) | -0.279*** (-5.592) | -0.363*** (-7.106) |
| Bus | 0.386*** (5.993) | 0.373*** (5.828) | 0.344*** (5.288) | 0.339*** (5.213) | 0.220** (2.521) |
| Extra-urban services | 0.022 (0.450) | 0.048 (0.966) | -0.038 (-0.860) | -0.011 (-0.231) | 0.040 (0.882) |
| Group member | 0.144*** (9.747) | 0.101*** (3.884) | 0.0261 (1.068) | -0.004 (-0.144) | -0.025 (-0.859) |
| Competition | | 0.183** (2.375) | | 0.151** (2.138) | 0.131* (1.876) |
| Mixed own. | | | -0.159*** (-4.245) | -0.150*** (-4.658) | -0.075** (-2.491) |
| Mainly public mixed own. | | | -0.356*** (-6.817) | -0.364*** (-7.005) | -0.425*** (-7.471) |
| Fully public own. | | | -0.459*** (-8.513) | -0.428*** (-9.453) | -0.458*** (-9.624) |
| City population density | | | | | -0.263*** (-5.299) |
| Observations | 336 | 336 | 336 | 336 | 329 |
| R-squared | 0.276 | 0.303 | 0.410 F(1,328) = | 0.427 F(1,327) = | 0.435 F(1,319) = |
| Test on equality between mixed own. and mainly public mixed own. Prob > F | | | 15.36*** (0.000) F(1,328) = | 19.50*** (0.000) F(1,327) = | 42.05*** (0.000) F(1,319) = |
| Test on equality between mixed own. and fully public own. Prob > F | | | 16.46*** (0.000) | 15.68*** (0.000) | 52.05*** (0.005) |
| Test on equality between mainly public mixed own. and fully public own. Prob > F | | | F(1,328) = 1.68 (0.196) | F(1,327) = 3.44* (0.065) | F(1,319) = 6.08** (0.014) |

Notes: 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%

Table 11: The role of ownership

| Total sample | | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Metro | 0.0421 (1.040) | 0.0713 (1.648) | 0.030 (0.683) | 0.023 (0.539) | 0.055 (1.207) | 0.010 (0.211) |
| Metro services | 0.305*** (3.193) | 0.315*** (3.301) | 0.289*** (3.094) | 0.335*** (3.391) | 0.353*** (3.618) | 0.327*** (3.435) |
| Tram | -0.203*** (-4.956) | -0.246*** (-5.198) | -0.208*** (-4.629) | -0.214*** (-5.146) | -0.264*** (-5.558) | -0.217*** (-4.758) |
| Bus | 0.086 (1.000) | 0.086 (1.011) | -0.0440 (-0.477) | 0.114 (1.350) | 0.118 (1.419) | -0.009 (-0.105) |
| Extra-urban services | -0.111*** (-3.092) | -0.082** (-2.182) | -0.036 (-0.856) | -0.068* (-1.789) | -0.032 (-0.789) | 0.0103 (0.233) |
| Group member | -0.050 (-1.207) | -0.093** (-2.015) | -0.083* (-1.766) | 0.0034 (0.081) | -0.050 (-1.102) | -0.037 (-0.803) |
| Competition | | 0.150** (2.358) | 0.152** (2.291) | | 0.182*** (2.911) | 0.197*** (2.918) |
| Public (share) | -0.312*** (-7.927) | -0.287*** (-8.545) | -0.302*** (-8.243) | | | |
| Mixed own. | | | | -0.349*** (-6.434) | -0.351*** (-6.770) | -0.378*** (-6.907) |
| Public | | | | -0.343*** (-6.543) | -0.305*** (-6.883) | -0.325*** (-6.958) |
| City population density | | | -0.002 (-0.040) | | | 0.042 (0.934) |
| Observations | 434 | 434 | 427 | 434 | 434 | 427 |
| R-squared | 0.227 | 0.242 | 0.237 | 0.228 | 0.251 | 0.250 |
| Test on equality between public and mixed own. | | | | F(1,425) = 2.28 | F(1,424) = 4.60** | F(1,416) = 5.11** |
| Prob > F | | | | (0.132) | (0.033) | (0.024) |

Notes: 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%

Table A.1: 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 |
| Cost of materials (M) | Cost of material inputs, 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 |
| Public | A dummy equal to 1 if the ownership is totally public | Amadeus database and companies' web-sites |
| 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 companies' web-sites |
| 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 |
| 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 does not own 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 |