Do Selection Mechanisms and Ownership Matter? Evidence from Local Public Transport in Europe

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Motivation

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?

Research Hypotheses
Selection Mechanisms/1

- Theoretical literature shows that the power of incentive schemes affects firms' efficiency. (Laffont, Tirole, 1993)
- Empirical evidence supports this insight, providing country studies on alternative contractual schemes (fixed-price vs. cost-plus):
    - Dalen and Gomez-Lobo (1996, 2003) on 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) on France;
    - Piacenza (2006) and Buzzo Margari, Erbetta, Petraglia and Piacenza (2007) on LPT in Italy

Research Hypotheses

In our comparative perspective, we focus on the impact of two alternative institutional arrangements: competition "for the market" and negotiated procedures

Hypothesis 1: Firms selected by means of competition "for the market" display higher total factor productivity than firms operating under negotiated procedures.

Research Hypotheses

Public ownership/1

- Theory does not provide clear-cut predictions: public enterprises could be less productive, due to low incentives in cost reduction (Hart, Shleifer, Vishny, 1997) and political patronage (Boyco, Shleifer, Vishny, 1996) but agency problems may arise also in large private corporations (Vickers, Yarrow, 1991)

- Overall, empirical evidence is mixed (Megginson, Netter, 2001) both in other industries and in the local public transport.

Research Hypotheses
Public ownership/2

Empirical evidence on LPT in countries included in our sample (Ottoz, Fornengo, Di Giacomo, 2008; Roy, Yvrande-Billon, 2007) suggests that public firms are less productive

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

Research Hypotheses

Mixed public-private ownership

- ▶ Scant literature on this issue, nonetheless it is a relevant phenomenon (18% of firms in our sample)
- ▶ Boardman, Vining (1989) show that mixed firms perform better than public ones, but not as well as private ones

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

The Empirical Model

We estimate a translog production function with three inputs: capital, labour, materials

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

The Empirical Model
Second step

We retrieve firms' total factor productivity as the residual of the production function, and we regress it on a set of firm, city and country characteristics

$$\ln TFP_{it} = \alpha + \beta firm\_characteristics_{it} + \gamma procedure_{ct} + (2)$$
$$+\delta ownership_{it} + \theta city\_characteristics_{rt} + \varepsilon_{it}$$

The Data
Production function estimation

We consider firms operating in "large" European cities.

Balance sheet data sourced from Amadeus Database, by Bureau van Dijk

Nominal variable have been deflated by the country-specific consumer price index for the transport service

$\ln Y_{it}$ = sales, net of public transfers, divided by the price of a monthly ticket (Urban Audit Database from Eurostat + firms' web-sites)

$\ln K_{it}$ = tangible fixed assets

$\ln L_{it}$ = number of employees

$\ln M_{it}$ = cost of material inputs

The Data
TFP estimation

- $firm\_characteristics_{it}$

type of transport service provided; extra-urban services; member of a group

- $procedure_{ct}$

competition "for the market" vs. negotiated procedures

- $ownership_{it}$

three categories: entirely public; mixed public-private; entirely private

- $city\_characteristics_{rt}$

GDP per capita; population density

The Data

The sample - Country breakdown

Country	N. of firms	Percentage	Revenues
AUSTRIA	2	2.56	100,470
BELGIUM	1	1.28	269,781
FRANCE	7	8.97	559,974
GERMANY	24	30.77	1,985,795
ITALY	14	17.95	1,030,517
NETHERLANDS	2	2.56	824,760
PORTUGAL	5	6.41	238,803
SPAIN	19	24.36	1,195,880
SWEDEN	4	5.13	938,587
Total	78	100	1,151,693

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

The Data
The sample - Descriptive statistics

	Metro	No metro	t test on equality of means	p value
Capital	796,289.3	99,213.8	-10.649	(0.000)***
N. of employees	3,972.5	1,814.2	-7.611	(0.000)***
Cost of employees	177,667.6	68,521.5	-8.717	(0.000)***
Operating revenues	304,048.8	116,427.8	-8.518	(0.000)***
Value Added	274,889.6	77,547.0	-9.562	(0.000)***
Sales	203,369.8	88,693.0	-6.667	(0.000)***
K/L	223.7	90.5	-2.143	(0.033)**
VA/L	53.6	92.3	0.416	(0.678)
REVENUES/L	170.8	173.4	0.023	(0.982)
Unit lab. Cost	63.4	37.0	-2.343	(0.020)**

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.

The Results: Translog production function

Total sample

	(1) Pool	(2) FE	(3) RE
$\ln L_{it}$	-0.600***	-0.112	-0.437**
	(0.203)	(0.235)	(0.211)
$\ln K_{it}$	0.368**	-0.0729	-0.0813
	(0.174)	(0.222)	(0.193)
$\ln M_{it}$	0.286*	1.553***	1.159***
	(0.166)	(0.215)	(0.192)
$\ln L_{it}*\ln L_{it}$	0.0717***	0.0827***	0.0572***
	(0.0177)	(0.0223)	(0.0191)
$\ln L_{it}*\ln K_{it}$	-0.0259	-0.118***	-0.0830***
	(0.0191)	(0.0266)	(0.0226)
$\ln L_{it}*\ln M_{it}$	0.0562***	0.0562**	0.0816***
	(0.0209)	(0.0239)	(0.0208)
$\ln K_{it}*\ln K_{it}$	0.0184*	0.0395**	0.0349**
	(0.00949)	(0.0168)	(0.0136)
$\ln K_{it}*\ln M_{it}$	-0.0700***	0.0301	0.000361
	(0.0163)	(0.0218)	(0.0188)
$\ln M_{it}*\ln M_{it}$	0.0202	-0.0974***	-0.0697***
	(0.0127)	(0.0141)	(0.0134)
Constant	2.710***	-3.377***	0.700
	(0.646)	(1.133)	(0.912)
Observations	439	439	439
R^2	0.683		
Adjusted R^2	0.676		
R^2 within		0.683	0.667
R^2 between		0.427	0.433
R^2 overall		0.578	0.589
Test on interaction terms	$F(6,429) = 9.21$ ***	$F(6,352) = 15.91$***	$X^2(6) = 82.83$***
	(0.000)	(0.000)	(0.000)
Test on effects		$F(77,352) = 26.48$***	$X^2(1) = 220.13$***
		(0.000)	(0.000)
Hausman test		$X^2(9) = 62.21$***	
		(0.000)	

Dependent variable: $\ln Y_{it}$ is the log of index of output. $\ln L_{it}$ is the log of number of employees,

The Results: Translog production function - no metro

Sample without metro

	(1) Pool	(2) FE	(3) RE
$\ln L_{it}$	-1.123***	-0.360	-1.105***
	(0.157)	(0.289)	(0.200)
$\ln K_{it}$	-0.292*	-0.109	-0.151
	(0.165)	(0.218)	(0.176)
$\ln M_{it}$	2.225***	1.722***	2.041***
	(0.177)	(0.222)	(0.182)
$\ln L_{it}*\ln L_{it}$	0.147***	0.0980***	0.138***
	(0.0145)	(0.0250)	(0.0175)
$\ln L_{it}*\ln K_{it}$	-0.0208	-0.118***	-0.0472**
	(0.0156)	(0.0279)	(0.0203)
$\ln L_{it}*\ln M_{it}$	0.00102	0.0692***	0.0270
	(0.0192)	(0.0252)	(0.0200)
$\ln K_{it}*\ln K_{it}$	-0.00337	0.0544***	0.00764
	(0.0102)	(0.0179)	(0.0143)
$\ln K_{it}*\ln M_{it}$	0.0389*	0.00514	0.0338*
	(0.0210)	(0.0232)	(0.0199)
$\ln M_{it}*\ln M_{it}$	-0.120***	-0.104***	-0.118***
	(0.0146)	(0.0141)	(0.0128)
Constant	-1.305**	-3.197***	-1.328*
	(0.579)	(1.076)	(0.785)
Observations	336	336	336
R^2	0.844		
Adjusted R^2	0.839		
R^2 within		0.771	0.753
R^2 between		0.666	0.815
R^2 overall		0.714	0.918
Test on interaction terms	$F(6,326) = 33.72***$	$F(6,270) = 20.36***$	$X^2(6) = 180.34***$
	(0.000)	(0.000)	(0.000)
Test on effects		$F(56,270) = 14.75***$	$X^2(1) = 303.58***$
		(0.000)	(0.000)
Hausman test		$X^2(9) = 41.90***$	
		(0.000)	

The Results: Elasticities of output to inputs and returns to scale

- ▶ We find constant returns to scale for different values of the inputs distributions (mean, first, second and third quartiles)
- ▶ This results is confirmed also in the subsample without metro companies (point estimates are slightly smaller)
- ▶ Previous literature generally find IRS, although on samples of small and medium-sized enterprises
- ▶ Empirical tests on large firms do not reach conclusive evidence:
  - ▶ IRS: Cambini, Piacenza and Vannoni (2007)
  - ▶ CRS: Matas, Raymond (1998); Jha, Singh (2001)

The Results: TFP estimation

Full sample

Total sample

	(1)	(2)	(3)	(4)	(5)	(6)
Metro	0.0197	0.0647	0.0693	0.101*	0.0287	0.0482
	(0.372)	(1.193)	(1.284)	(1.827)	(0.527)	(0.660)
Tram	-0.300***	-0.351***	-0.253***	-0.298***	-0.248***	-0.305***
	(-7.638)	(-8.408)	(-6.657)	(-7.317)	(-7.022)	(-5.882)
Bus	-0.166	-0.167*	-0.195*	-0.191*	-0.230*	-0.112
	(-1.631)	(-1.664)	(-1.955)	(-1.926)	(-1.875)	(-1.107)
Extra-urban services	-0.0423	-0.00870	-0.0740*	-0.0410	-0.0393	-0.000360
	(-1.069)	(-0.221)	(-1.934)	(-1.064)	(-0.895)	(-0.00609)
Group member	0.173***	0.0992***	0.0987**	0.0499	0.0165	0.0692
	(5.931)	(3.085)	(2.476)	(1.283)	(0.365)	(1.317)
Competition		0.201***		0.165***	0.150***	0.184***
		(4.142)		(3.658)	(3.056)	(2.915)
Public			-0.343***	-0.308***	-0.278***	-0.398***
			(-7.247)	(-7.577)	(-5.727)	(-6.117)
Mixed own.			-0.216***	-0.219***	-0.218***	-0.298***
			(-5.095)	(-5.488)	(-4.849)	(-5.304)
City population density					0.0670	0.0677
					(1.468)	(1.251)
City GDP per capita						0.0302
						(0.411)
Observations	436	436	436	436	381	320
R-squared	0.156	0.185	0.211	0.230	0.217	0.287
Test on equality between						
			$F(1,428) =$	$F(1,427) =$	$F(1,371) =$	$F(1,309) =$
public and mixed own.			4.46**	1.17	0.08	0.38
Prob > F			(0.035)	(0.280)	(0.782)	(0.539)

The Results: TFP estimation

Sample without metro

Sample without metro

	(1)	(2)	(3)	(4)	(5)	(6)
Tram	-0.366***	-0.421***	-0.315***	-0.354***	-0.475***	-0.448***
	(-8.076)	(-9.125)	(-7.271)	(-7.858)	(-9.662)	(-7.940)
Bus	0.330***	0.316***	0.283***	0.279***	0.261***	0.278***
	(7.954)	(7.523)	(6.980)	(6.759)	(4.089)	(3.819)
Extra-urban services	0.0212	0.0494	-0.0308	-0.00458	-0.0187	0.000527
	(0.457)	(1.057)	(-0.715)	(-0.104)	(-0.383)	(0.0101)
Group member	0.226***	0.181***	0.125**	0.100**	0.0511	0.0737
	(6.659)	(5.605)	(2.321)	(2.002)	(0.932)	(1.147)
Competition		0.193***		0.136**	0.117*	0.0594
		(2.871)		(2.196)	(1.813)	(0.846)
Public			-0.454***	-0.425***	-0.378***	-0.419***
			(-7.834)	(-8.266)	(-6.221)	(-6.213)
Mixed own.			-0.289***	-0.289***	-0.228***	-0.245***
			(-5.082)	(-5.376)	(-3.448)	(-3.491)
City population density					-0.170***	-0.144***
					(-3.395)	(-2.630)
City GDP per capita						-0.0547
						(-0.713)
Observations	336	336	336	336	290	245
R-squared	0.298	0.329	0.414	0.429	0.446	0.467
Test on equality between						
			$F_{(1,329)}$ =	$F_{(1,328)}$ =	$F_{(1,281)}$ =	$F_{(1,235)}$ =
public and mixed own.			3.66*	1.90	2.53	3.95**
Prob > F			(0.057)	(0.169)	(0.113)	(0.048)

Robustness

1) One step procedure: we plug factor affecting productivity directly into the production function equation

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Conclusions

- Hp 1 confirmed: firms selected by means of competition "for the market" display higher total factor productivity
- Hp 2 confirmed: public firms are generally less productive than private firms
- Hp 3 partly confirmed: mixed firms are generally less productive than private firms, nonetheless the difference with public ones is not always statistically significant

Conclusions

- Firms offering metro services are statistically different from those offering ground transportation services only
- We observe constant returns to scale (notice: our sample includes large firms)
- Group membership has a positive effect
- Ground transportation: population density negatively affects productivity

The Results: Elasticities of output to inputs and returns to scale

Full sample

Total sample				
	First Quartile	Median	Third Quartile	Mean
Labour	0.355	0.388	0.315	0.340
	(0.076)***	(0.098)***	(0.119)***	(0.088)***
Capital	0.134	0.178	0.284	0.199
	(0.054)**	(0.074)**	(0.112)**	(0.073)***
Material inputs	0.563	0.445	0.355	0.465
	(0.052)***	(0.072)***	(0.098)***	(0.070)***
Returns to scale	1.053	1.011	0.954	1.004
	(0.092)***	(0.114)***	(0.148)***	(0.109)***
Test on constant returns to scale	0.052	0.011	-0.046	0.004
	(0.092)	(0.114)	(0.148)	(0.109)

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%

The Results: Elasticities of output to inputs and returns to scale

Sample without metro

Sample without metro				
	First Quartile	Median	Third Quartile	Mean
Labour	0.437	0.466	0.471	0.435
	(0.080)***	(0.109)***	(0.134)***	(0.095)***
Capital	0.139	0.202	0.309	0.219
	(0.050)***	(0.069)***	(0.099)***	(0.066)***
Material inputs	0.482	0.402	0.204	0.364
	(0.051)***	(0.068)***	(0.095)**	(0.068)***
Returns to scale	1.057	1.070	0.984	1.017
	(0.088)***	(0.111)***	(0.138)***	(0.103)***
Test on constant returns to scale	0.057	0.070	-0.016	0.017
	(0.088)	(0.111)	(0.138)	(0.103)

Estimates obtained on the subsample without metro companies. 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%

Robustness: one-step procedure

Full sample

Total sample

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln L_{it}$	-0.732	-0.718	-0.945*	-0.925	-1.562***	-1.186***
	(-1.316)	(-1.283)	(-1.691)	(-1.646)	(-3.033)	(-2.736)
$\ln K_{it}$	0.395	0.432	0.555	0.604	1.324***	0.834**
	(0.963)	(1.064)	(1.357)	(1.473)	(2.933)	(2.266)
$\ln M_{it}$	0.685	0.675	0.591	0.678	0.445	1.700***
	(0.882)	(0.868)	(0.771)	(0.752)	(0.598)	(4.640)
$\ln L_{it}*\ln L_{it}$	1.094*	1.037*	1.089*	1.005*	1.382***	1.235
	(1.841)	(1.727)	(1.831)	(1.655)	(3.588)	(1.149)
$\ln L_{it}*\ln K_{it}$	-0.778	-0.706	-0.583	-0.481	-0.953*	-0.349
	(-1.247)	(-1.094)	(-0.914)	(-0.730)	(-1.930)	(-0.206)
$\ln L_{it}*\ln M_{it}$	0.980	0.969	1.151	1.143	1.862*	1.036***
	(0.860)	(0.846)	(0.997)	(0.988)	(1.887)	(2.983)
$\ln K_{it}*\ln K_{it}$	0.557*	0.453	0.346	0.202	-0.0650	0.0488
	(1.668)	(1.267)	(0.942)	(0.526)	(-0.156)	(0.0692)
$\ln K_{it}*\ln M_{it}$	-1.189	-1.129	-1.235	-1.152	-1.455**	-1.283**
	(-1.598)	(-1.501)	(-1.646)	(-1.530)	(-2.023)	(-2.407)
$\ln M_{it}*\ln M_{it}$	-0.0786	-0.0891	-0.0774	-0.0960	-0.159	-1.073**
	(-0.0952)	(-0.108)	(-0.0955)	(-0.118)	(-0.216)	(-2.092)
Metro	0.108***	0.117***	0.119***	0.131***	0.104***	0.100***
	(3.143)	(3.381)	(3.591)	(3.958)	(2.936)	(3.040)
Tram	-0.108***	-0.117***	-0.0785**	-0.0915***	-0.0289	-0.0231
	(-3.745)	(-3.870)	(-2.480)	(-2.769)	(-0.966)	(-0.892)
Bus	-0.102*	-0.104*	-0.0909*	-0.0927*	-0.187***	-0.111*
	(-1.871)	(-1.899)	(-1.713)	(-1.737)	(-2.819)	(-1.967)
Extra-urban services	-0.109***	-0.105***	-0.118***	-0.111***	-0.117***	-0.0577**
	(-3.419)	(-3.284)	(-3.937)	(-3.734)	(-3.679)	(-2.315)
Group member	-0.0495	-0.0570*	-0.0525*	-0.0629**	-0.0888**	-0.0340
	(-1.580)	(-1.789)	(-1.739)	(-2.059)	(-2.158)	(-1.456)
Competition		0.0369		0.0540**	0.0447	0.0521
		(1.466)		(2.086)	(1.601)	(1.331)
Public			-0.111***	-0.108***	-0.112***	-0.146***
			(-3.417)	(-3.318)	(-3.473)	(-5.599)
Mixed own.			-0.177***	-0.182***	-0.223***	-0.195***
			(-6.281)	(-6.392)	(-6.951)	(-7.818)
City population density					0.0429	0.00362
					(1.113)	(0.152)
City GDP per capita						0.0819**
						(2.206)
Observations	436	436	436	436	381	320
R^2	0.724	0.725	0.740	0.742	0.760	0.883
Adjusted R^2	0.715	0.715	0.730	0.731	0.748	0.876
Test on equality between public and mixed own.			$F_{(1,419)} =$	$F_{(1,418)} =$	$F_{(1,362)} =$	$F_{(1,300)} =$
			9.71***	11.14***	17.80***	11.64***
Prob > F			(0.002)	(0.001)	(0.000)	(0.002)

Dependent variable: lnY_it is the log of index of output. lnL_it is the log of number of employees. lnK

Sample without metro

	(1)	(2)	(3)	(4)	(5)	(6)
$\ln L_{it}$	-1.097***	-1.094***	-1.282***	-1.276***	-1.252***	-0.205
	(-6.636)	(-6.882)	(-7.900)	(-8.056)	(-8.130)	(-0.870)
$\ln K_{it}$	-0.188	-0.109	-0.170	-0.0988	-0.246	-0.637*
	(-0.625)	(-0.374)	(-0.643)	(-0.375)	(-0.824)	(-1.962)
$\ln M_{it}$	1.903***	1.921***	1.789***	1.803***	1.762***	1.236***
	(8.418)	(8.619)	(8.496)	(8.533)	(7.720)	(5.363)
$\ln L_{it}*\ln L_{it}$	1.658***	1.603***	1.628***	1.572***	1.517***	-0.709
	(8.943)	(9.396)	(9.267)	(9.498)	(9.267)	(-1.499)
$\ln L_{it}*\ln K_{it}$	-1.354***	-1.178***	-1.116***	-0.952***	-1.258***	1.727**
	(-4.324)	(-3.400)	(-3.571)	(-2.850)	(-3.384)	(2.230)
$\ln L_{it}*\ln M_{it}$	0.892***	0.793***	0.975***	0.886***	1.206***	1.043***
	(2.855)	(2.423)	(3.054)	(2.683)	(3.304)	(2.866)
$\ln K_{it}*\ln K_{it}$	0.892***	0.571	0.694**	0.393	0.942**	-0.186
	(2.629)	(1.354)	(2.034)	(0.976)	(2.325)	(-0.378)
$\ln K_{it}*\ln M_{it}$	-0.177	0.0679	0.00258	0.235	-0.0239	-0.534
	(-0.342)	(0.123)	(0.00546)	(0.474)	(-0.0384)	(-0.807)
$\ln M_{it}*\ln M_{it}$	-1.566***	-1.637***	-1.594***	-1.660***	-1.679***	-0.904***
	(-4.960)	(-5.170)	(-5.650)	(-5.873)	(-5.364)	(-2.612)
Tram	-0.146***	-0.156***	-0.116***	-0.126***	-0.165***	-0.0974***
	(-5.513)	(-6.147)	(-4.545)	(-5.040)	(-6.808)	(-4.021)
Bus	0.131***	0.127***	0.134***	0.131***	0.103***	0.0527**
	(5.494)	(5.278)	(5.663)	(5.521)	(4.618)	(2.695)
Extra-urban services	-0.0816***	-0.0796***	-0.0972***	-0.0946***	-0.0941***	-0.0699***
	(-3.125)	(-3.073)	(-3.894)	(-3.840)	(-3.846)	(-2.864)
Group member	0.0200	0.0174	-0.00539	-0.00796	-0.0205	0.00602
	(1.343)	(1.264)	(-0.298)	(-0.475)	(-1.221)	(0.326)
Competition		0.0553**		0.0538***	0.0190	0.0597
		(2.006)		(2.022)	(0.709)	(1.450)
Public			-0.157***	-0.153***	-0.138***	-0.176***
			(-5.425)	(-5.357)	(-4.701)	(-6.150)
Mixed own.			-0.162***	-0.163***	-0.162***	-0.199***
			(-6.768)	(-6.960)	(-6.787)	(-7.506)
City population density					-0.0520**	-0.0592**
					(-2.138)	(-2.471)
City GDP per capita						0.0671**
						(2.040)
Observations	336	336	336	336	290	245
R^2	0.876	0.877	0.890	0.891	0.905	0.931
Adjusted R^2	0.871	0.872	0.885	0.886	0.899	0.925
Test on equality between public and mixed own.			$F_{(1,320)}=$	$F_{(1,319)}=$	$F_{(1,272)}=$	$F_{(1,226)}=$
			3.90**	4.94**	8.98***	6.25**
Prob > F			(0.049)	(0.027)	(0.003)	(0.013)

Dependent variable: $\ln Y_{it}$ is the log of index of output; $\ln L_{it}$ is the log of number of employees; $\ln K_{it}$

Robustness: Fixed effects estimation

Full sample

Total sample

	(1)	(2)	(3)	(4)	(5)	(6)
Metro	0.0244	0.0713	0.0757	0.109*	0.0333	0.0474
	(0.454)	(1.295)	(1.383)	(1.943)	(0.603)	(0.633)
Tram	-0.311***	-0.364***	-0.262***	-0.308***	-0.250***	-0.347***
	(-7.914)	(-8.682)	(-6.966)	(-7.629)	(-7.286)	(-6.812)
Bus	-0.172*	-0.173*	-0.202**	-0.197*	-0.232*	-0.0948
	(-1.652)	(-1.687)	(-1.983)	(-1.954)	(-1.860)	(-0.972)
Extra-urban services	-0.0459	-0.0109	-0.0787**	-0.0441	-0.0458	-0.0420
	(-1.186)	(-0.282)	(-2.117)	(-1.178)	(-1.073)	(-0.708)
Group member	0.179***	0.102***	0.102**	0.0511	0.0221	0.0889*
	(6.222)	(3.236)	(2.557)	(1.323)	(0.515)	(1.803)
Competition		0.210***		0.173***	0.159***	0.178***
		(4.295)		(3.831)	(3.093)	(2.601)
Public			-0.355***	-0.318***	-0.300***	-0.425***
			(-7.866)	(-8.540)	(-6.708)	(-6.725)
Mixed own.			-0.225***	-0.228***	-0.234***	-0.304
			(-5.543)	(-6.048)	(-5.578)	(-5.891)
City population density					0.0632	0.0798
					(1.401)	(1.543)
City GDP per capita						-0.0725
						(-0.927)
Observations	436	436	436	436	381	320
R-squared	0.168	0.200	0.227	0.248	0.232	0.349
Test on equality between public and mixed own.			F(1,428) = 5.17**	F(1,427) = 1.28	F(1,371) = 0.14	F(1,309) = 1.09
Prob > F			(0.023)	(0.258)	(0.709)	(0.297)

Dependent variable: individual fixed effects, obtained from the production function estimation. OLS

Robustness: Fixed effects estimation

Sample without metro

Sample without metro

	(1)	(2)	(3)	(4)	(5)	(6)
Tram	-0.389***	-0.447***	-0.334***	-0.375***	-0.498***	-0.482***
	(-8.597)	(-9.679)	(-7.885)	(-8.474)	(-10.21)	(-8.829)
Bus	0.350***	0.336***	0.301***	0.296***	0.278***	0.300***
	(8.153)	(7.710)	(7.204)	(6.968)	(4.079)	(3.987)
Extra-urban services	0.0225	0.0524	-0.0327	-0.00486	-0.0271	-0.0239
	(0.504)	(1.162)	(-0.811)	(-0.118)	(-0.602)	(-0.502)
Group member	0.240***	0.192***	0.133**	0.106**	0.0614	0.0860
	(7.488)	(6.515)	(2.439)	(2.132)	(1.356)	(1.513)
Competition		0.205***		0.145**	0.129*	0.0614
		(2.963)		(2.286)	(1.871)	(0.812)
Public			-0.482***	-0.451***	-0.426***	-0.445***
			(-8.804)	(-9.699)	(-7.945)	(-7.090)
Mixed own.			-0.307***	-0.306***	-0.255***	-0.265***
			(-5.622)	(-6.032)	(-4.196)	(-4.204)
City population density					-0.191***	-0.134***
					(-4.039)	(-2.698)
City GDP per capita						-0.143*
						(-1.722)
Observations	336	336	336	336	290	245
R-squared	0.336	0.370	0.466	0.483	0.522	0.552
Test on equality between public and mixed own.			F(1,329) = 4.61**	F(1,328) = 2.43	F(1,281) = 3.91**	F(1,235) = 4.73**
Prob > F			(0.033)	(0.120)	(0.049)	(0.031)

Dependent variable: individual fixed effects, obtained from the production function estimation. OLS