

EFFECTS OF SUBSIDIES AND COMPETITION LEVELS ON SERVICE QUALITY IN SUBURBAN BUS TRANSPORT: AN EMPIRICAL ANALYSIS

Abstract

Multiple linear regression models are formulated for bus routes connecting Santiago, Chile with its suburbs to estimate the effects of route operator subsidies and competition levels on service quality indicators. Subsidies and competition are key elements of the country's public transport regulatory policies. The two quality indicators examined are the number of penalties issued to operators for service regulations infractions and the number of complaints filed by users. The models were estimated using official data. Applying three complementary econometric approaches, our results provide evidence that subsidies significantly reduce the number of operator penalties and that greater competition reduces the number of user complaints. Both effects constitute important input into the design of appropriate policy instruments for improving suburban public transport.

Keywords: Suburban bus transport; subsidies; competition; service quality.

1. Introduction

The implementation in 2007 of Transantiago, a radically redesigned public bus transport system for the Chilean capital of Santiago, did not include the suburbs surrounding the city (see Briones, 2009; Muñoz and de Grange, 2010; de Grange et al., 2018). Not until 2015 did suburban bus operators in the Greater Santiago Region begin to receive subsidies from Chile's Ministry of Transport and Telecommunications (MTT).

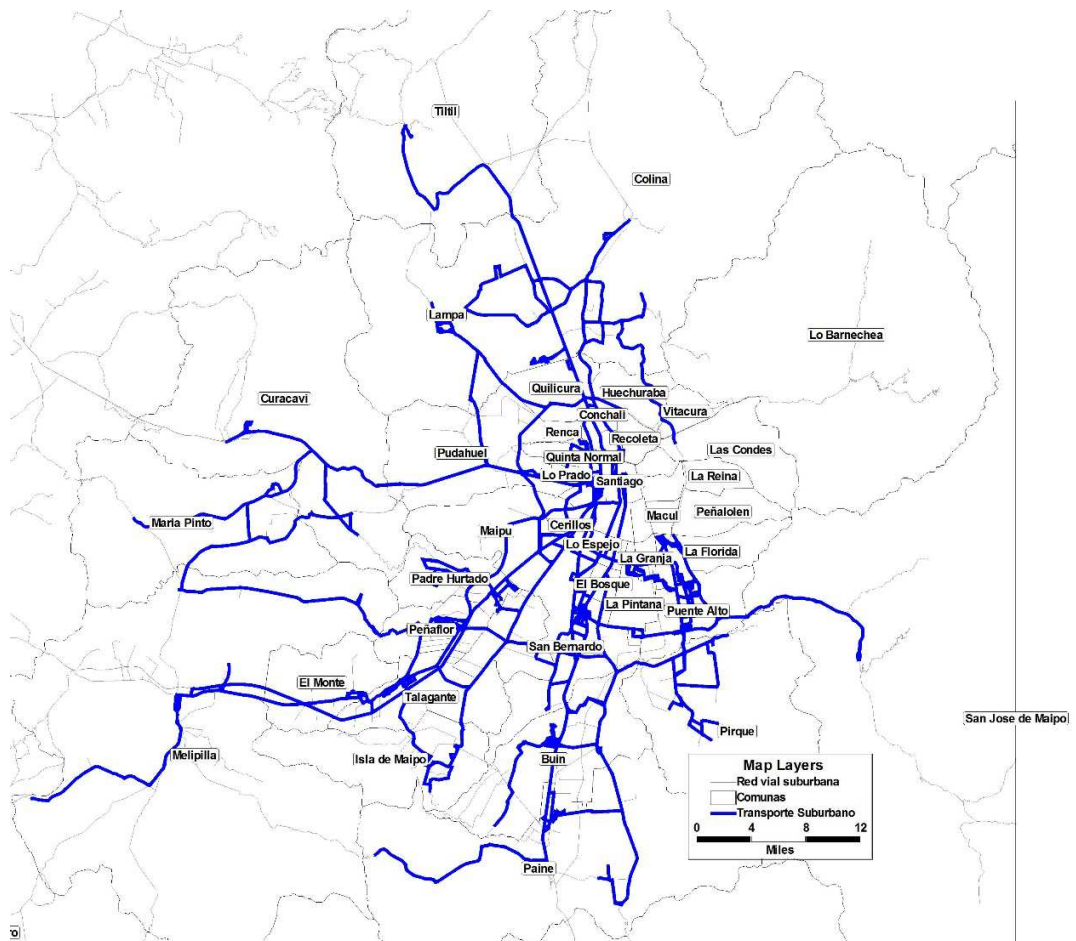
Across the Region there are 35 bus operator companies with a total fleet of approximately 1,800 vehicles serving 107 different routes that connect the city of Santiago with its suburban areas. On a typical weekday the trips taken on these services number about 300 thousand, or 1.6% of all urban trips in the city, at fares averaging 0.35USD/km. The geographical coverage provided by these routes and their corresponding distances¹ are detailed in Table 1 and Figure 1.

Table 1: Bus Routes Connecting the City of Santiago with its Suburbs

	Distance (km)	ROUTE	Distance (km)
Tiltil – Independencia	146	Lampa – Recoleta	51
Talagante - Estacion Central	113	Lampa – Santiago	87
San Jose de Maipo – La Florida	104	Lampa – Independencia	89
Pirque - San Bernardo	75	Lampa - Estacion Central	97
Pirque - La Florida	65	Isla de Maipo – Maipu	85
Pirque - La Cisterna	82	Isla de Maipo - Estacion Central	128
Penaflor – Santiago	72	El Monte – Quilicura	116
Penaflor - Puente Alto	103	El Monte - La Florida	115
Penaflor – Maipu	34	El Monte - Estacion Central	113
Penaflor - Estacion Central	73	Curacavi - Lo Prado	102
Paine - Estacion Central	134	Curacavi – Estacion Central	102
Padre Hurtado – Quinta Normal	100	Colina – Recoleta	56
Padre Hurtado - Estacion Central	46	Colina - Independencia	97
Melipilla – Maipu	140	Colina - Estacion Central	76
Melipilla - Estacion Central	134	Calera de Tango - Maipu	32
Maria Pinto - Lo Prado	105	Calera de Tango - Estacion Central	68
Maria Pinto - Estacion Central	118	Buin - Estacion Central	93
		Buin - Cerrillos	72

¹ The distances shown in Table 1 are in fact averages due to the minor variations from operator to operator in the precise route definitions.

Figure 1: Map of Bus Routes Connecting the City of Santiago with its Suburbs



The users of the suburban bus lines tend to come from the more vulnerable sectors of the population with relatively poor access to services such as health and education. This situation has prompted Starkey et al. (2002) to emphasize the role of suburban public transport in policies aimed at reducing poverty. Note, however, that suburban routes generally have higher operating costs than urban routes due to their long distances and the lower densities of the areas they serve.

Although the original design of Transantiago did not call for government subsidies, the difficulties of its implementation were such that they had to be introduced almost right from the start (Briones, 2009). To ensure this would be politically viable, the government set aside an equal amount of funding to finance services not only for Santiago proper but also for the Greater Santiago suburbs and other regions of the country.

In this study, we use data provided by the MTT to estimate the effects of these subsidies and the levels of operator competition on two indicators of the quality of services connecting Santiago's suburbs with the city: 1) the number of user complaints, and 2) the number of penalties issued for operator infractions (in proportion to the number of operator inspections). We find that the provision of subsidies significantly reduces the number of penalties while greater competition reduces the number of user complaints.

The remainder of this article is divided into five sections. Section 2 is a literature survey of previous studies into local or suburban public transport; Section 3 gives a statistical description of our data; Section 4 introduces our methodology, specifying the econometric models we designed and their explanatory, instrumental and control variables; Section 5 sets out and discusses our main findings; and finally, Section 6 presents our main conclusions.

2. Literature Review

Over the last three decades, the introduction of competition into local or suburban public transport (LPT) by the majority of cities has led to the adoption by public bus systems of a wide variety of organizational models (Amaral et al., 2009; Avenali et al., 2016; Dalen and Gomez-Lobo, 1996; Daraio et al., 2016; Papangelis et al., 2016; Piacenza, 2006; van de Velde, 2008; ZATTI, 2012).

Although suburban public transport systems have some of the characteristics that give rise to natural monopolies and do generally exhibit economies of scale (Cowie and Asenova, 1999; Daraio et al., 2016; Farsi et al., 2007; Fiorio et al., 2013), the experiences of a number of countries show that competitive tendering can bring about lower costs and better quality services (Boitani et al., 2013; Boitani and Cambini, 2006). Empirical evidence demonstrates that firms which are given incentives to keep costs down do operate more efficiently (Boitani et al., 2013; Gagnepain and Ivaldi, 2002; Piacenza, 2006).

Nevertheless, the majority of countries continue to grant some type of subsidy or transfer to providers of suburban or local public transport services, mainly to ensure they can balance their operating budgets given that costs tend to exceed revenues (Piacenza, 2006). The literature recognizes two main types of LPT subsidy arrangements: (i) management contracts, under which the authority responsible fully finances any operating deficit; and (ii) fixed-price schemes, in which the authority sets *ex-ante* a fixed subsidy covering the expected operating cost or deficit so that if the former is less than expected, the difference is retained by the operator as a direct benefit.

A series of studies have found that public transport subsidies are negatively correlated with various performance and productivity measures (Dreves et al., 2014; Karlaftis and McCarthy, 1997; Pucher et al., n.d.). Government capital grants, for example, distort resource allocation by reducing the cost of purchasing additional vehicles, thus encouraging overcapitalization as operators substitute the relatively less costly buses for other inputs to the production of transit services. The existence of a sizeable excess capacity has major implications for the design of regulations relating to future investments (McCarthy, 2001; Piacenza, 2006).

Using 7 years of data from 44 municipal public transport services in Italy, Piacenza (2006) also found that operators working under fixed-price schemes displayed less distortion in relation to minimum costs. The author further concluded that network speed levels had a significant impact on inefficiency differentials and influenced the effectiveness of incentive regulation. Relatively good traffic conditions for LPT vehicles always meant less inefficiency, the measured reductions starting at about 13%. For operators with network speeds above the sample mean in the study, these favourable operating conditions together with fixed-price regulations resulted in a major drop in inefficiency of about 64%.

Boitani et al. (2013) conducted a comparative analysis of 77 public transport operators in European cities. They found, first of all, that when companies have to “compete for the market” they exhibited higher levels of productivity. The authors also showed that ownership matters in the sense that public operators were generally less productive than private ones. Finally, they observed that city characteristics such as per capita GDP or population density did not affect operator productivity, except possibly through the effects of road congestion in major cities.

As regards competition, a number of case studies have addressed this problem and the organizational models of local public transport as they affect user satisfaction. Fiorio et al. (2013) used public transit survey data from 33 European cities to show that the existence of more than one operator reduced satisfaction by 6-8% compared to single-provider levels. They also found that per capita income, population, city size (i.e., geographical area) and even average fares were not statistically significant variables in determining satisfaction. By contrast, the number of registered vehicles (an indicator of congestion) did reduce satisfaction. In specific terms, a 1% increase in the average number of cars led to a 0.55% decline in satisfaction in all specifications of the model the authors empirically tested.

In a similar study, Zhang et al. (2016) concluded that the ownership structure of rural transport in China had a significant impact on user satisfaction. Publicly owned companies achieved greater levels of satisfaction than mixed or privately owned ones (4.2% higher in the former case, 11.4% higher in the latter). The authors also found that satisfaction varied with the type of operator contract. Where companies were regulated by “management contracts” (under which operator losses are fully financed by the transport authority), satisfaction was higher; where they were regulated by net cost contracts (paying a fixed subsidy *ex-ante* based on the expected operating deficit), satisfaction was lower.

Jansson and Pyddoke (2010) analysed the relationship between quality incentives and quality outcomes in Stockholm’s public transport services. They found that the introduction of such incentives for performance characteristics like punctuality and service cancellations were correlated with both increases and decreases in quality outcomes. The reason for this inconsistency in the results may be that a series of factors beyond the operators’ control also have an effect, such as traffic congestion, weather and business cycles. The authors’ main hypothesis for the cases where quality did not improve is that the cost would have been too high.

Preston and Almutairi (2013) found evidence suggesting that the deregulation of local bus services in the UK resulted in a substantial loss of benefits outside of London but that these were more than offset by reductions in operating costs. In London, however, both consumers and suppliers gained and the increase in welfare per capita was five times higher than in the rest of the country.

Finally, Mouwen and Rietveld (2013) analyzed the effect on service quality of tendering local and regional public transport services in the Netherlands. Using data for a 10-year period, they concluded that in regions with tendered services there was a significant change in average passenger satisfaction compared to other regions, with levels in the former areas being 0.112 points higher. Note, however, that this positive effect was registered exclusively in regions where the services were tendered for the first time.

The analysis reported in the present article follows a similar line of investigation to the works just reviewed, but provides additional and complementary evidence for the impacts of subsidies and competition on certain attributes of the quality of service offered by suburban bus operators, based on a case study of Santiago, Chile.

3. Data and Variables

The information used in this study originates from the official records of the MTT. For each year included and each operator company running bus routes connecting Santiago with its suburbs, data were gathered on the number of inspections, the number of penalties issued for infractions, the number of complaints filed by users and the subsidy received. Also obtained was a list of operators together with their respective fleet sizes and the route or routes each one served. The annual data covered the years between 2013 and 2016.

The unit of analysis is service per year. An operator may operate more than one route in any given year but the data on infractions and complaints exist only at the company level. To define the level of competition for a route we considered as substitutes for it all routes that start in the same district, keeping in mind that all of the routes in the analysis enter Santiago, at which point users have various options for transferring to other lines depending on their final destination within the city.

Based on these data we constructed a series of variables normalized for the various operator sizes or the number of inspections they experienced, as the case requires. These variables are as follows:

- i) *Complaints*: The number of annual complaints filed regarding each operator divided by the number of buses it operates.
- ii) *Penalties*: The number of annual penalties issued to each operator divided by the number of inspections it experienced.
- iii) *Subsidy*: The amount in millions of Chilean pesos² received by each operator divided by its fleet size (i.e., pesos per bus). For the years 2013 and 2014, before subsidies were granted, the variable is assigned a value of 0.
- iv) *Number of operators*: The number of different companies operating routes originating in a given district.
- v) *Number of routes*: The number of routes served by the various operators originating in a given district. A single company may operate more than one such route.
- vi) *Number of buses* (each operator's fleet size).

The descriptive statistics for the data are shown in Table 2. In the case of the subsidy variable, the statistics relate only to the years beginning 2015 since as already noted, subsidies were not available previous to that year.

² The average exchange rate over the 2013-2016 period was approximately CLP\$ 600 per US\$ 1.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Complaints	356	0.202	0.270	0.020	2.000
Penalties	456	0.023	0.075	0	0.613
Subsidy	232	0.749	0.178	0	1.155
No. Operators	456	3.2	1.3	1	6
No. Routes	456	9.5	4.6	1	19
No. of Buses	456	103.7	97.4	2	331

Source: Chilean Ministry of Transport and Telecommunications.

4. Method

To measure the effects of the subsidies and competition levels on the chosen performance measures, we conducted a series of multiple linear regressions with fixed effects as follows:

$$\ln(\text{reclamos}_{eit}) = \beta_0 + \beta_1 \text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{empresas}_{eit}) + \mu_e + u_{eit} \quad (1)$$

$$\ln(\text{reclamos}_{eit}) = \beta_0 + \beta_1 \text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{servicios}_{eit}) + \mu_e + u_{eit} \quad (2)$$

$$\text{sanciones}_{eit} = \beta_0 + \beta_1 \text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{empresas}_{eit}) + \mu_e + u_{eit} \quad (3)$$

$$\text{sanciones}_{eit} = \beta_0 + \beta_1 \text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{servicios}_{eit}) + \mu_e + u_{eit} \quad (4)$$

where μ_e is a fixed effect for each operator and u_{eit} is the stochastic error term for route i of operator e in year t .

The inclusion of fixed effects controls for the characteristics of each operator that do not change over time. The β coefficients were estimated using ordinary least squares while the standard errors of the coefficients were calculated using the heteroscedasticity-robust covariance matrix.

A potential problem in estimating Equations (1)-(4) was the possible presence of endogeneity in the *subsidy* variable given that the amount of subsidy granted to an operator could be affected by the number of complaints and penalties it received. To avoid the endogeneity problem, the equations were estimated by least squares in two stages, using as instruments a dummy variable for the 2015 introduction of subsidies (thus equal to 0 for 2013 and 2014, and 1 for 2015 and 2016) and the natural logarithm of the number of buses run by each operator in each year. Like the previous case, the standard errors were calculated using the heteroscedasticity-robust covariance matrix.

As regards the two instrumental variables, the introduction of subsidies was a public policy decision exogenous to the complaints and penalties received by any particular operator, but it was strongly related to the behaviour of the subsidy within the sample given that beginning in 2015 almost every operator was subsidized. An operator's number of buses in a given year was exogenous to the amount of its subsidy for that year, but could impact the amount received in general given that fleet size was likely to bear on a company's importance and level of influence in dealings with the public transport authority, which had discretion over what subsidies were granted. Therefore, both the dummy and the number of buses variables were good choices as instruments for the subsidy.

Finally, given that the main source of subsidy variability in the sample was the introduction of subsidies in 2015, resulting in an unusual increase that would not be expected to recur, any changes in the levels of complaints and penalties, which tended to be minor, would be related to major changes in subsidy levels that could distort the interpretation of the β_1 coefficient in the four equations above. In other words, due to limitations in the sample the marginal effect of the subsidy on complaints and penalties could be underestimated. To avoid this possibility, we also estimated four additional model specifications in which the subsidy variable measured in pesos per bus was replaced by a dichotomous variable indicating the introduction of subsidies. These specifications were as follows:

$$\ln(\text{reclamos}_{eit}) = \beta_0 + \beta_1 D\text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{empresas}_{eit}) + \mu_e + u_{eit} \quad (5)$$

$$\ln(\text{reclamos}_{eit}) = \beta_0 + \beta_1 D\text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{servicios}_{eit}) + \mu_e + u_{eit} \quad (6)$$

$$\text{sanciones}_{eit} = \beta_0 + \beta_1 D\text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{empresas}_{eit}) + \mu_e + u_{eit} \quad (7)$$

$$\text{sanciones}_{eit} = \beta_0 + \beta_1 D\text{subsidio}_{et} + \beta_2 \ln(n^\circ \text{servicios}_{eit}) + \mu_e + u_{eit} \quad (8)$$

where the difference between these and Equations (1)-(4) is the dichotomous variable *Dsubsidio* instead of the *subsidy* variable. The β_1 coefficient in Equations (5)-(8) is interpreted as the average effect of the adoption of the subsidy policy on the level of complaints and penalties regardless of the amount of subsidy any given operator received.

5. Results

The OLS estimates for Equations (1)-(4) are summarized in Table 3. To simplify the presentation, the estimates of the fixed effects by operator are omitted. The first two columns contain the estimates for the equations with complaints as the dependent variable. In both cases, the effect of the subsidy had the expected sign but was not statistically significant. On the other hand, the level of competition measured as the number of operators not only had the expected sign but was also significant. The number of routes was not statistically significant, however. Since the β_2 coefficient in Equation (1) is an elasticity, the estimates in the first column indicate that a 10% increase in the number of competing operators would mean a 1.9% reduction in complaints. The β_2 coefficient in Equation (2) is also an elasticity while in Equations (3) and (4) it is a semi-elasticity.

Table 3: OLS Estimates of Equations (1) to (4)

Dependent variable	Ln(complaints)	Ln(complaints)	Penalties	Penalties
	Eq. 1	Eq. 2	Eq. 3	Eq. 4
Subsidy	-0.088 (0.059)	-0.09 (0.059)	-0.025*** (0.004)	-0.025*** (0.004)
Ln(no. of operators)	-0.189** (0.085)		0.002 (0.003)	
Ln(no. of routes)		-0.114 (0.082)		0.004 (0.003)
R squared	0.77	0.77	0.85	0.85
No. of Obs.	356	356	456	456

Figures in parentheses are standard errors. ** indicates significance at the 5% level and *** at the 1% level.

With penalties as the dependent variable, shown in the last two columns of Table 3, the effect of competition is not significant, and although the latter's sign is contrary to what was expected, in practical terms it is very small. By contrast, the effect of the subsidy variable in both specifications is statistically significant at 1% and similar in size. A subsidy increase of 1 million pesos (approximately US\$ 1,670) per bus would thus reduce the number of inspections resulting in penalties by 2.4%.

The estimates for Equations (1)-(4) using least squares in two stages to avoid any possible endogeneity of the *subsidy* variable (see Section 4) are set out in Table 4. They are similar to those in Table 3 both in size and statistical significance, suggesting that subsidies are not endogenous to the levels of complaints and penalties, at least not contemporaneously. To check this we conducted a Hausman specification test (Hausman, 1978), which compares the coefficients generated by an estimation that is efficient but with a risk of endogeneity (in the present case, OLS) with those of a consistent but less efficient estimation (2SLS). The p-values obtained by the test estimating the variance of the error term in each of the equations for both the efficient and the consistent estimations are given in Table 5. Note that the calculation of these results included the estimates of the dummies, which for presentation purposes are not shown in Tables 3 and 4.

Table 4: 2SLS Estimates of Equations (1) to (4)

Dependent variable	Ln(complaints)	Ln(complaints)	Penalties	Penalties
	Eq. 1	Eq. 2	Eq. 3	Eq. 4
Subsidy	-0.084 (0.056)	-0.084 (0.057)	-0.024*** (0.004)	-0.024*** (0.004)
Ln(no. of operators)	-0.19** (0.081)		0.002 (0.003)	
Ln(no. of routes)		-0.115 (0.078)		0.004 (0.003)
R squared	0.77	0.77	0.85	0.85
No. of Obs.	356	356	456	456

Figures in parentheses are standard errors. ** indicates significance at the 5% level and *** at the 1% level.

Table 5: Hausman Test p-Values

2SLS vs. OLS	Estimate of disturbance variance	
	Efficient	Consistent
Equation 1	0.702	0.689
Equation 2	0.600	0.583
Equation 3	0.543	0.526
Equation 4	0.575	0.559

As can be seen, for all four equations the p-values are well above the usual significance levels, implying we cannot reject the null hypothesis that there are no systematic differences between the efficient and the consistent estimations. In other words, there is no endogeneity in the subsidy variable.

The estimates of Equations (5) to (8), which use a dichotomous variable to indicate the introduction of subsidies, are shown in Table 6. They indicate that the estimated effect of the subsidy became statistically significant at the 10% level, and suggest that complaints declined 7.6% once subsidies were introduced. As for the competition variable, both its size and significance remained at the levels shown in Tables 3 and 4 for the models using a monetary measure of the subsidy variable. Finally, the number of routes had no significant effect either on complaints or penalties.

Table 6: OLS Estimates of Equations (5) to (8)

Dependent variable	Ln(complaints) Eq. 5	Ln(complaints) Eq. 6	Penalties Eq. 7	Penalties Eq. 8
Subsidy	-0.076* (0.045)	-0.076* (0.045)	-0.02*** (0.003)	-0.02*** (0.003)
Ln(no. of operators)	-0.191** (0.085)		0.001 (0.003)	
Ln(no. of routes)		-0.113 (0.082)		0.004 (0.003)
R squared	0.77	0.77	0.85	0.85
No. of Obs.	356	356	456	456

Figures in parentheses are standard errors. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

The Table 6 estimates also indicate that the introduction of the subsidy resulted in a drop in the number of penalties of 2%. This is similar in size to the Tables 3 and 4 results, which is what one would expect given that the average subsidy value was 0.75 (see Table 2). This may mean that the coefficients in Equations (1)-(4) captured the effect of the subsidy introduction, in which case it cannot be distinguished from the marginal effect of the subsidy's size.

6. Conclusions

Multiple linear regression models were formulated for bus routes connecting Santiago, Chile with its suburbs to estimate the effects of route operator subsidies and competition levels on two service quality indicators: the number of penalties issued by the transport authority for operator infractions and the number of complaints filed by users. The models were estimated using official data.

Based on these estimates, our main conclusions are as follows:

- The subsidies significantly reduced the number of penalties, but no definite result could be derived regarding the marginal effect of the size of the subsidy.

- The level of competition measured as the number of operators competing for passengers did not have any significant effect on the number of penalties but did significantly impact the number of complaints. A 10% increase in the number of operators competing would bring about a 1.9% reduction in complaints.
- The level of competition measured as the number of routes had no significant effect on either of the service quality indicators. This suggests that in practice, different routes operated by the same company do not compete with each other.

From a public policy standpoint, it should be noted that the above-mentioned positive effect of the subsidies does not mean they also had a positive social effect. To evaluate the latter the analysis would have to incorporate, at the very least, the opportunity cost of alternative uses of the subsidy funding. Any adverse effects on the productivity of the bus services, a phenomenon that has already been documented in the literature, should also be included. Note further that our results were based on a short-term analysis given that the data included only the first two years of operations under the subsidies. Later studies covering a longer period will thus be needed to determine what effects there may be on productivity and whether the positive impacts on service quality in the form of reductions in infractions will be sustained.

References

- Alexandersson, G., Hultén, S., Fölster, S., 1998. The Effects of Competition in Swedish Local Bus Services. *J. Transp. Econ. Policy*. doi:10.2307/20053766
- Amaral, M., Saussier, S., Yvrande-Billon, A., 2009. Auction procedures and competition in public services: The case of urban public transport in France and London. *Util. Policy* 17, 166–175. doi:10.1016/J.JUP.2008.07.006
- Avenali, A., Boitani, A., Catalano, G., D’Alfonso, T., Matteucci, G., 2016. Assessing standard costs in local public bus transport: Evidence from Italy. *Transp. Policy* 52, 164–174. doi:10.1016/J.TRANPOL.2016.06.007
- Boitani, A., Cambini, C., 2006. “To Bid or Not to Bid, This is the Question: The Italian Experience in Competitive Tendering for Local Bus Services.”
- Boitani, A., Nicolini, M., Scarpa, C., 2013. Do competition and ownership matter? Evidence from local public transport in Europe. *Appl. Econ.* 45, 1419–1434. doi:10.1080/00036846.2011.617702
- Briones, I., 2009. Transantiago: Un problema de información. *Estud. Públicos* 116, 37–91.
- Cowie, J., Asenova, D., 1999. Organisation form, scale effects and efficiency in the British bus industry. *Transportation (Amst)*. 26, 231–248. doi:10.1023/A:1005121506841

- Dalen, D.M., Gómez-Lobo, A., 2003. Yardsticks on the road: Regulatory contracts and cost efficiency in the Norwegian bus industry. *Transportation (Amst)*. 30, 371–386. doi:10.1023/A:1024784517628
- Dalen, D.M., Gomez-Lobo, G.-L., 1996. Regulation and incentive contracts: An empirical investigation of the Norwegian bus transport industry. IFS Work. Pap.
- Daraio, C., Diana, M., Di Costa, F., Leporelli, C., Matteucci, G., Nastasi, A., 2016. Efficiency and effectiveness in the urban public transport sector: A critical review with directions for future research. *Eur. J. Oper. Res.* 248, 1–20. doi:10.1016/J.EJOR.2015.05.059
- de Grange, L., Troncoso, R., Briones, I., 2018. Cost, production and efficiency in local bus industry: An empirical analysis for the bus system of Santiago. *Transp. Res. Part A Policy Pract.* 108, 1–11. doi:10.1016/j.tra.2017.12.007
- Dreves, F., Tscheulin, D.K., Lindenmeier, J., Renner, S., 2014. Crowding-in or crowding out: An empirical analysis on the effect of subsidies on individual willingness-to-pay for public transportation. *Transp. Res. Part A Policy Pract.* 59, 250–261. doi:10.1016/J.TRA.2013.10.023
- Farsi, M., Fetz, A., Filippini, M., 2007. Economies of scale and scope in local public transportation. *J. Transp. Econ. Policy* 41, 345–361.
- Fiorio, C. V., Florio, M., Perucca, G., 2013. User satisfaction and the organization of local public transport: Evidence from European cities. *Transp. Policy* 29, 209–218. doi:10.1016/J.TRANPOL.2013.06.004
- Gagnepain, P., Ivaldi, M., 2002. Incentive Regulatory Policies: The Case of Public Transit Systems in France. *RAND J. Econ.* 33, 605. doi:10.2307/3087477
- Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the econometric society*, 1251-1271.
- Jansson, K., Pyddoke, R., 2010. Quality incentives and quality outcomes in procured public transport – Case study Stockholm. *Res. Transp. Econ.* 29, 11–18. doi:10.1016/J.RETREC.2010.07.004
- Karlaftis, M.G., McCarthy, P.S., 1997. Subsidy and public transit performance: A factor analytic approach. *Transportation (Amst)*. 24, 253–270. doi:10.1023/A:1004956532174
- McCarthy, P.S., 2001. *Transportation economics: theory and practice: a case study approach*. Wiley-Blackwell.
- Mouwen, A., Rietveld, P., 2013. Does competitive tendering improve customer satisfaction with public transport? A case study for the Netherlands. *Transp. Res. Part A Policy Pract.* 51, 29–45. doi:10.1016/J.TRA.2013.03.002
- Muñoz, J.C., de Grange, L., 2010. On the development of public transit in large cities. *Res. Transp. Econ.* 29, 379–386. doi:10.1016/J.RETREC.2010.07.048
- Papangelis, K., Velaga, N.R., Ashmore, F., Sripada, S., Nelson, J.D., Beecroft, M., 2016. Exploring the rural passenger experience, information needs and decision making during public transport disruption. *Res. Transp. Bus. Manag.* 18, 57–69. doi:10.1016/J.RTBM.2016.01.002
- Piacenza, M., 2006. Regulatory Contracts and Cost Efficiency: Stochastic Frontier Evidence from the Italian Local Public Transport. *J. Product. Anal.* 25, 257–277. doi:10.1007/s11123-006-7643-7

- Preston, J., Almutairi, T., 2013. Evaluating the long term impacts of transport policy: An initial assessment of bus deregulation. *Res. Transp. Econ.* 39, 208–214. doi:10.1016/J.RETREC.2012.06.015
- Pucher, J., Markstedt, A., Hirschman, I., n.d. Impacts of Subsidies on the Costs of Urban Public Transport. *J. Transp. Econ. Policy.* doi:10.2307/20052679
- Starkey, P., Ellis, S., Hine, J., Ternell, A., 2002. Improving rural mobility: options for developing motorized and nonmotorized transport in rural areas. The World Bank.
- van de Velde, D., 2008. A new regulation for the European public transport. *Res. Transp. Econ.* 22, 78–84. doi:10.1016/J.RETREC.2008.05.011
- ZATTI, A., 2012. NEW ORGANIZATIONAL MODELS IN EUROPEAN LOCAL PUBLIC TRANSPORT: FROM MYTH TO REALITY*. *Ann. Public Coop. Econ.* 83, 533–559. doi:10.1111/j.1467-8292.2012.00476.x
- Zhang, C., Juan, Z., Lu, W., Xiao, G., 2016. Do the organizational forms affect passenger satisfaction? Evidence from Chinese public transport service. *Transp. Res. Part A Policy Pract.* 94, 129–148. doi:10.1016/J.TRA.2016.09.007