TOWARDS AN OPTIMAL PRICING SYSTEM IN THE URBAN PUBLIC TRANSPORT: WHAT CAN WE LEARN FROM THE EUROPEAN EXPERIENCE?

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ABSTRACT

Fares are one of the most important attributes when travel decisions are made. In the case of urban public transport (PT) not only the fare level plays a key role, but also the fare structure: integration level, availability of travelcards, relationship between fare and trip length, among others, are relevant aspects both for the users and other actors of the system. Based on Gschwender (2007), the paper compares and analyses the PT fare systems of Santiago and three large European metropolitan areas, known for their good PT services: London, Berlin and Madrid. Taking also theoretical aspects into account, the objective is to give a normative opinion about the fare structure for the PT in large urban areas. Specific recommendations for Santiago are given as well. Although the fare structure of *Transantiago* represents an important improvement in comparison with the previous pay-each-time-you-board system, it is shown that it should be further improved in several directions.

Keywords: Urban public transport, fares, pricing

RESUMEN

Las tarifas son uno de los aspectos más relevantes al momento de tomar decisiones de viaje. En el caso del transporte público (TP) urbano no sólo el valor de la tarifa juega un rol importante, sino también la estructura tarifaria: nivel de integración de las tarifas, existencia de abonos mensuales, relación entre tarifa y distancia viajada, entre otros, son aspectos relevantes tanto para los usuarios como para otros actores del sistema. Basado en Gschwender (2007), este artículo analiza y compara el sistema tarifario del TP de Santiago con el de tres grandes ciudades europeas que destacan por sus buenos sistemas de TP: Londres, Berlín y Madrid. Considerando también aspectos teóricos acerca de tarificación en TP, el objetivo es generar una opinión normativa acerca de la estructura tarifaria del TP en grandes áreas urbanas. Se formulan además recomendaciones específicas para el caso de Santiago. Si bien la estructura tarifaria de *Transantiago* representa una mejora importante en comparación con el sistema tarifario antiguo, se muestra que ésta puede y debe ser mejorada en varios aspectos.

Palabras clave: transporte público urbano, precios, tarificación

1. INTRODUCTION

Based on Gschwender (2007), this paper presents a comparison of the public transport (PT) fare systems of Santiago, London, Berlin and Madrid, which encompasses both the fare level and the fare structure: relationship between fare and trip length, zonal fares, reduced fares in specific periods, integration level and ticket types (e.g. travelcards). Subsidies are also discussed. The objective is to give a normative opinion about the PT fare structure in large urban areas and provide specific recommendations for Santiago.

Mainly two types of tickets can be recognised in the analysed cities: single-tickets and travelcards. London and Madrid have a similar **single-ticket** system, in which bus fares have to be paid each time a vehicle is boarded (no fare integration), while metro and rail single-fares allow free transfers inside their respective networks[1] (similar to Santiago before *Transantiago*). A much more integrated single-tickets scheme is found in Berlin, where one single-ticket allows free transfers between all PT modes. After the implementation of *Transantiago*, Santiago also has an integrated single fare scheme, allowing free or reduced transfers between buses and metro. But unlike Santiago, the three European metropolitan areas have fully integrated **travelcards** that allow unlimited travel in all PT modes inside its validity period. Travelcards are discussed in the next section. The relation between fare and trip length, reduced fares in specific periods, average fare levels and subsidies are analysed in the other sections.

2. TRAVELCARDS

The first travelcards allowing unlimited travel within a given period and within a network[2] were introduced both in West Germany and Edinburgh (UK) in the 1950s (White, 1981). Travelcards are commonly available in Europe, and a high proportion of the PT passengers often use them. For example, 92 % of all PT trips in Vienna are made using a travelcard, 82 % in Stockholm, 78 % in Hamburg, over 60 % in Madrid, 54 % in Zurich and 50 % in Munich (Matas, 2004).

2.1. Impact of Travelcards on Public Transport Demand

The literature shows a positive impact of travelcards in the PT demand. Matas (2004) estimates a patronage increase in Madrid City between 1986 and 2001 of 7 % in the buses and 15 % in the metro attributable to the introduction of the travelcard (the rest of the total increase of 24 % (buses) and 65 % (metro) is due to other factors like network expansions or GDP increase). FitzRoy and Smith (1998) estimate that the introduction of travelcards in the German city of Freiburg yielded a 7 % to 22 % increase in the PT trips per capita. In another study, FitzRoy and Smith (1999) report the following impact of the introduction of travelcards in the PT patronage in four Swiss metropolitan areas: Geneve 16 %, Bern 14 %, Basle 5.4 %, Zurich 4.5 %. In London,

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[1] Greater London presents an exception to this rule, providing a special integrated single-fare for metro and rail that allow free transfers between both networks.

[2] The concept of a travelcard is completely independent of the technology used for its implementation. It can be a simple piece of paper or a very sophisticated electronic device.

the introduction of a travelcard and fare revision in May 1983 increased underground pass-miles by 33 % and bus pass-miles by 20 % from 1983 to 1991 (London Transport, 1993). Two additional studies cited in Balcombe et al. (2004) found that travelcards stimulated PT demand in London. Comparing the relative success of light rail systems in different metropolitan areas in Europe, North America and Australia, Hass-Klau and Crampton (2002) also found that the existence of a travelcard is a key issue in the systems with the highest patronage figures.

But how can a simple ticket increase the patronage of the PT? It could be argued that the introduction of travelcards may reduce the average fare, and therefore increase the patronage not because of the ticket, but due to the overall price reduction. Nevertheless, most of the studies cited in the previous paragraph separate the effects of an eventual change of the average fare and the introduction of the travelcard, so that the impacts on the demand mentioned are only those attributable to the appearance of the new ticket: the travelcard. So which are the real benefits of travelcards for the users that could explain an increase in patronage? White (1981) and Matas (2004) suggest the following advantages:

- The need to worry about the fare required is virtually removed.
- Interchange penalties are reduced as there is no need to pay a new fare (or a transfer fare).
- Boarding and queuing time can be reduced due to an "easier" payment system.
- Once the pass is purchased, it permits travel at zero marginal cost. Thus extra trips, such as returning home to lunch from work, weekend leisure trips, etc., are "free".

Probably the most important explanation for the patronage increases is the fact that after purchasing the travelcard, additional trips can be made for free[3]. These can imply the generation of new trips or a change in the origin, destination or mode of an "existing" trip. From a social viewpoint, the ability of a travelcard to divert car trips to the PT is especially interesting. Some authors state that the impacts of a travelcard include "a high probability of attracting new users" (Matas, 2004 p198). FitzRoy and Smith (1998) report that 3,000 to 4,000 regular car drivers had switched to PT one year after the introduction of the travelcard in Freiburg. However this switch is partially explained by other additional factors[4].

2.2. Critics to Travelcards

The main critic to travelcards found in the literature is that they can have a negative impact on the financial equilibrium of the system. This negative financial impact has two causes: (a) First, that frequent users buying the travelcard will do so because this is cheaper for them than continue paying the cash fares, implying <u>a reduction in the fares revenue</u> of the operator (Doxsey, 1984). And (b) second, that the extra demand generated may cause <u>additional operating costs</u>, if the new patronage occurs where the public transport did not have spare capacity.

[3] This is a very important difference with a multiple-trip coupon. With the latter, the passenger pays in advance a reduced fare for a **fixed number of trips**.

[4] Hass-Klau and Crampton (2002) argue that in addition to the travelcard and a high quality PT system, a wide range of sustainable transport policies explain the success in Freiburg: long pedestrian streets, traffic-calmed streets, a large cycle network, one of the best examples of coordinated land-use and transport planning in Europe. Between 1982 and 1998 the car modal split in Freiburg stayed constant despite a 12 % increase in car ownership and it is assumed that daily 30,000 car trips have been replaced by public transport.

Regarding the **first problem**, Doxsey (1984) builds a model that predicts losses in revenue as a consequence of introducing travelcards. Nevertheless, his model overlooks the passenger generation effect of travelcards, because it only considers the choice faced by existing PT users between purchasing a travelcard and paying cash fares (FitzRoy and Smith, 1998). On the other hand, the evidence found in the literature shows that travelcards have a lower (in absolute value) price-elasticity than single fares (Gschwender and Jara-Díaz, 2007), i.e. that the decrease in travelcards sales produced by a growth in their price is lower than the sales decrease in single fares generated by an increase in the single fares. Some authors even report price-elasticities close to zero for the travelcard. Therefore, White (1981) recommends the following strategy to reach a high market penetration with the travelcards and avoid a long term decrease in the fare revenues: to introduce the travelcards at low initial prices together with higher single fares and then, given the low price-elasticity of the travelcard, to rise its price (and eventually also the single fares). This may yield a high proportion of trips being made with travelcards without a drop in total fare revenues. Several cases where the introduction of travelcards did not affect fare revenues are found in the literature: Freiburg (FitzRoy and Smith, 1998), London (London Transport, 1993), Edinburgh and West Midlands (White, 1981), as well as others where it actually reduced them: Madrid (Matas, 2004), some German speaking metropolitan areas (Pucher and Kurth, 1996). As stated by Matas (2004), the revision of the related literature leads to the conclusion that the implementation of travelcards does not necessarily reduce fares revenue.

In relation to the **second problem**, it has to be emphasised that PT usually has spare capacity at least in the off-peak, implying that extra passengers can be carried in the already provided supply at almost no extra cost. In addition, a frequency increase in the off-peak can be made at much lower cost than in the peak period, as discussed later. However, if the additional patronage occurs where the system does not have excess capacity (peak hours, peak direction and section of the route with the highest load), an expansion of the service (e.g. higher frequency) may be necessary yielding important cost increases because new vehicles and drivers would be necessary.

Finally, there is also **theoretical support** about the convenience of travelcards, both for users and operators. Carbajo (1988) shows in a simple microeconomic diagrammatic example that the introduction of a travelcard at an appropriate price can make all users and the firm better off than under a uniform single-price regime. In his example, after introducing the travelcard, users increase their number of trips and the operator increases its profit in spite of facing higher costs. He also argues that these overall benefits of an appropriately designed non-uniform price are a well-known finding in the non-uniform pricing literature, citing Brown and Sibley (1986).

As a consequence, the author recommends the implementation of a travelcard in Santiago in the future. A critical analysis of the introduction of travelcards in Santiago in terms of its political and practical difficulties is presented in Gschwender (2007).

3. RELATION BETWEEN FARE AND TRIP LENGTH

None of the analysed fares structures shows a direct relation between travelled distance and fare. Nevertheless, some of them seem to have an implicit relationship through fares zone systems in which trips passing through more zones are more expensive than trips using fewer zones. But let us analyse to which extent the current fares are actually related with the distance travelled.

Table 1: Population, Area and Fare Zones in Each Metropolitan Area

Metropolitan area	Population (million)	Area (km^2)	Fare zones
Gran Santiago	5.7	648	1 [(a)]
Greater London	7.3	1,560	6/1 [(b)]
Berlin	3.4	892	1
Madrid City	3.1	606	1
Madrid Region	5.7	8,028	6

[(a)] After *Transantiago's* implementation cheaper fares for local trips inside specific areas will exist, but fares will not be related with the number of zones travelled. [(b)] 6 zones for metro, DLR and rail, 1 zone for buses and trams.

As shown in table 1, **Santiago** has a single-zone flat fare, totally independent of the trip length. **Madrid** has 6 fare zones in the whole Region, but in Madrid City itself there is only one single zone, i.e. a flat fare. The fare system in **Berlin** has three zones (A, B and C) with Berlin itself being divided into the fare zones A and B, whereas the additional fare zone C corresponds to the surroundings of Berlin. However no tickets for zone A are offered, being zone A+B the smallest zone available[5]. So the trips inside Berlin (origin and destination in zones A or B) have a flat fare. Moreover, the prices of the tickets for zones AB, BC and ABC are quite similar, with less than 20 % of difference[6]. The 6 fare zones in Greater **London** are relevant for the underground, DLR and national rail, whereas buses and trams have a completely flat fare over all Greater London. Though, it has to be said that buses and trams are mainly used for shorter trips, because of their lower speeds in comparison to the underground, DLR and rail. The cheapest tickets for travelling in the central zones of London are offered for fare zones 1 and 2. As was the case in Berlin, tickets for the smallest zone 1 (alone) are normally not sold[7], although some exceptions exist in the case of single fares. Zones 1 and 2 cover an estimated area of some 200 km^2.

A high proportion of low-income families live in the peripheral zones of Santiago, as is typical in Latin-American and some African cities (Gwilliam, 2005). Thus, there are **"social" arguments** in favour of not charging higher prices for longer trips. **Simplicity** is another argument in favour of flat fares. Balcombe et al. (2004) report a case where a distance-related fare was changed into a flat fare in the Brighton area (England). They state that the scheme has been popular with passengers, as they now know exactly the cost of the fare. The scheme produced a year on year patronage growth of 8.5 %, in spite of the increase on the average fare that it meant.

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[5] The reason for the existence of zones A and B is explained by the fares for trips with origin or destination outside Berlin (in zone C). Those trips have a higher fare if they use the city centre (zone A) than if they only use zones B/C.

[6] The only exception to this "almost" flat fare is a ticket valid for very short trips (*Kurzstrecke*) that allows traveling over 3 to 6 stops at a reduced fare (55 % of the normal single fare).

[7] The main reason for the existence of zone 1 is that travelcards and single tickets that do not use this zone are offered at cheaper prices than similar tickets that include zone 1, similar to the situation in Berlin.

And what does the **public transport pricing theory** say about this issue? A deep revision and discussion of the pricing theory in urban PT services was made by Gschwender (2000) and then summarised in Jara-Díaz and Gschwender (2005). About the relationship between fares and trip length, they show that a first theoretical analysis considering only the operators' costs yields that the optimal fare should increase with the trip length. However, this common analysis is not complete, because it ignores that beside the operators also the users supply an important input for the production of trips: their time. In fact, the inclusion of users' time in the analysis produces surprising results. In certain cases, even an optimal fare that decreases with the trip length is found. Therefore, the authors recommend (Jara-Díaz and Gschwender, 2005 p457):

> "As there is no clear relationship between optimal fare and trip length for a given route, flat fares seem to be a good option. Moreover, a flat fare is easier and cheaper to implement. Nevertheless, if routes with different lengths exist, it may be reasonable to have higher flat fares on the longer routes because of operators' costs."

The fare structure (mostly flat fare) found in the three European capital cities analysed fits well with the previous recommendation. Moreover, the fare structure in Santiago both before and after *Transantiago* seems also to be concordant with the here very briefly described PT pricing theory.

4. REDUCED FARES IN SPECIFIC PERIODS

From the four capital cities analysed only **Madrid** does not have time-related reductions in its PT fares. In the case of **Santiago**, before *Transantiago* the metro had a 20 % reduced fare in the off-peak periods. This changed to a 10 % higher fare in the peak hours when using metro, in comparison to the integrated fare for buses and metro. The main impact of the scheme should be in the modal split of the PT, moving users from the metro to buses. A small impact in the time-of-travel decision may also occur (passengers changing the time of travel to avoid the higher fare in the metro). In **Greater London** there are 20 % to 45 % reduced single fares in buses, trams, underground and DLR in off-peak periods. Moreover 20 % to 50 % reduced one-day and 3-day travelcards are also available (on weekdays they can only be used after the morning peak period). **Berlin** also has a 26 % reduced monthly travelcard that allows travelling after 10:00 on weekdays and anytime at the weekends.

4.1. Theoretical Considerations and Recommendation for Santiago

There are 2 theoretical reasons for the existence of different fares in **peak and off-peak periods**:

- Firstly, price-elasticity is normally lower in the peak than in off-peak periods, as there are more work trips in the peak (see Gschwender and Jara-Díaz, 2007). Optimal pricing rules suggest that higher prices should be related with lower price-elasticities (*Ramsey Pricing Rule*, Ramsey, 1927): It does make theoretical sense to have lower fares in the off-peak.
- Secondly, there is usually spare capacity in off-peak periods, yielding an almost zero marginal cost for an extra passenger. But even if more vehicles have to be added in the off-peak, the incremental cost is much lower than if more vehicles had to be added in the peak. This is so because extra vehicles in the peak mean that new vehicles have to be

bought, and that new drivers have to be contracted, whereas extra vehicles to run in the off-peak may be already available (if more vehicles are used in the peak than in the off-peak) and drivers could also be partially available (Jansson, 1980; Gschwender, 2000). So reduced fares in off-peak periods may offer an incentive to some passengers to change their trips form the peak to the off-peak, when operating costs are lower.

Thus there is a clear match between the pricing theory and the reduced fares in the off-peak found in some of the observed metropolitan areas. As a result, we recommend the implementation of different fares in peak and off-peak periods in all the PT system of Santiago (not only in the metro). This could be done in the form of reduced single-fares in the off-peak, but also as reduced travelcards for off-peak periods, if travelcards are introduced in the future.

4.2. Numerical Example of the Impact of a Time-Related Fare Differentiation

Let us assume an initial situation in which 37 % of the PT trips are made in the peak and the other 63 % are made in off-peak[8], with the same fare in both periods. If the peak fare is increased by 10 % and the off-peak fare is reduced by 5.9 %, the weighted average fare is maintained. An estimation of the impact on demand that these changes produce can be made using price-elasticities for each period. The demand is reduced by 2.3 % in the peak period and incremented by 2.6 % in the off-peak (table 2), yielding an overall demand growth of 0.8 %. The revenue in the peak period is increased by 7.5 %, whereas the off-peak revenue decreases by 3.4 %. As the fare changes are higher than the demand variations (which have opposite sign), the impact of revenue has the same sign that the fare change in each period. The overall revenue is increased by 0.6 %. Qualitatively, the same happens in the long term, but the impacts on demand and revenue are more pronounced because of higher elasticities (Gschwender, 2007). This exercise shows that it is possible to increase both the demand and the revenue through the implementation of different fares in peak and off-peak periods.

Table 2: Impact of Time-Differentiated Single Fare on Demand and Revenue

Period	Initial trip distribution (%)	Fare change (%)	Price-elasticity [(a)]	Impact on demand (%)	Impact on revenue (%)
Peak	37	10.0	-0.23	-2.3	7.5
Off-peak	63	-5.9	-0.45	2.6	-3.4
TOTAL	**100**			**0.8**	**0.6**

[(a)] Source: middle of the ranges recommended by Litman (2004), as cited in Gschwender and Jara-Díaz (2007)

5. AVERAGE FARE

Now we want to compare the fares of the PT in the analysed metropolitan areas. Which capital city has the more expensive system for the user? The easiest way to calculate the average fare is by dividing the total fares' revenue by the number of PT trips (table 3). By doing so the average fare includes all type of fares: single-fares, travelcards, reduced fares, etc. The average fare in

[8] These figures correspond to the motorised trips on a weekday in Santiago (EOD, 2001).

Santiago is slightly lower than the average fares in Berlin and Madrid, whereas the average fare in London is almost twice as high as the others.

Table 3: Average Fare [a]

Metropolitan area	Yearly public transport trips (million)	Revenue from ticket sales (million €/year)	Average fare (€)	Average fare (US$)
Santiago	1,400 [b]	570 [c]	0.41	0.49
Greater London	3,189	2,805	0.88	1.06
Berlin	1,205	N/A	0.52 [d]	0.62 [d]
Madrid Region	1,514	797	0.53	0.63

[a] Data for years 2002 to 2004 [b] Shared-taxi trips not included. [c] Estimation. [d] Estimated only for BVG: 906 million trips in 2004 (BVG, 2005 p3) and 468 million EUR fare income in the same year (SfS, 2006 p7)

Given the important difference in the GDP per capita of Santiago and the European capital cities (table 4), it is interesting to include in the analysis of the average fare the effect of this difference. The idea is to compare the relation between the average fare and the average disposable income of the population, taking the **GDP as a proxy for the disposable income**. This shows how expensive the PT is in relative terms. To do that, we assume a fictitious user that makes a certain amount of yearly PT trips (600 trips/year) and calculate his total yearly expenditure in PT fares, supposing that he pays the average fare. Then we divide this expenditure by the GDP per capita, yielding the relative importance of the average fare in the GDP per capita. It has to be emphasised that the aim of this analysis is not to accurately estimate the expenditures in mobility, but just to compare the relative fares. The expenditure of our fictitious traveller represents 4.2 % of the GDP per capita in Santiago, in comparison to only 1.7 %, 1.1 % and 1.4 % in London, Berlin and Madrid respectively (table 4). Normalising with respect to Santiago (last column), the average fares in London, Berlin and Madrid vary between 26 % and 42 % of the average fare in Santiago. The use of a purchasing power parity exchange rate does not affect the qualitative results, although it produces some quantitative changes in the figures (Gschwender, 2007).

Table 4: How Expensive is Public Transport in Each Metropolitan Area?

Metropolitan area	GDP (nominal) per capita 2005 [a] (US$)	Average fare (US$)	Average fare * 600 / GDP per capita	
			%	Normalised
Santiago	7,040	0.49	4.2	100
Greater London	36,599	1.06	1.7	42
Berlin	33,922	0.62	1.1	26
Madrid Region	27,226	0.63	1.4	33

[a] Source: International Monetary Fund (2006)

This exercise refutes a common wrong belief: that the fares in Santiago are lower than in Europe. This wrong idea comes from a too superficial analysis: the simple comparison of the single fares (which actually are higher in Europe than in Santiago) without considering the importance of European travelcards that give frequent travellers a better value for money.

6. SUBSIDIES AND FINANCIAL EQUILIBRIUM

The PT systems in London, Berlin and Madrid receive important subsidies for their operation (table 5). This is not the case in Santiago, where there is no operational subsidy.

Table 5: Operation Costs, Fare Revenues and Subsidies

Metropolitan area	Year	Operation costs (€ mill./year)	Revenue from ticket sales (€ mill./year)	Subsidies (€ mill./year)	Relation between subsidy and operation costs (%)
Santiago	2003	N/A	570 [a]	0	0
Greater London [b]	2003	7,200	3,450	4,200	58
Berlin [c]	2004	994	468	420	42
Madrid Region	2003	1,255	623	667	53

[a] Estimation. [b] Data for Transport for London including street management and infrastructure investment.
[c] Data for BVG (underground, buses and trams)

There are good **economic justifications** for PT operational subsidies. Jara-Díaz and Gschwender (2005) show that a careful optimal pricing analysis in urban PT yields lower fares than the average cost, implying that a subsidy is necessary. This happens because the relevant cost (users' and operators' costs) increases less than proportional with the demand, i.e. there are decreasing average costs and scale economies. The underpricing of cars is an additional argument in the direction of PT subsidy. PT subsidies can not be seen only as a burden on the public budget, but also as a correct (economically justified) decision. A critical analysis of the implementation of operational subsidies for the PT in Santiago in terms of its political and practical difficulties is presented in Gschwender (2007). The way in which an operational subsidy is given has to be carefully designed to avoid negative incentives for operators, users and the authority.

The high levels of subsidy in the reviewed European capital cities (about 50 % of the operational costs) make it very difficult to imagine there how PT could be operated without subsidies. In addition to the lower quality of the PT systems in Latin-America, there are other reasons that explain why it is possible here to operate without subsidies[9]:

1. **Labour costs** are cheaper in Latin-America than in Europe, and labour costs are an important part of the operating costs of a PT company[10].
2. The **vehicles** used in Latin-America are normally cheaper than those used in Europe, because of different technological standards (for instance, floor level).
3. The **occupancy factor** of the PT vehicles in Latin-America is higher than in Europe due to the acceptance of higher crowding levels inside the vehicles there. Comfort inside PT vehicles receives much more attention in Europe than in Latin-America[11].

It is often wrongly argued that the total demand for PT is higher in Latin-American metropolitan areas than in Europe. However, the total demand for PT and the number of PT trips per inhabitant are not higher in Santiago than in London, Berlin and Madrid (Gschwender, 2007).

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[9] There are at least a few examples of high quality services in Latin-America that also operate without subsidy, for instance the metro in Santiago, and the Bus Rapid Transit system *TransMilenio* in Bogotá, Colombia.

[10] The costs of drivers in Santiago represent about 30 % of the total operating costs of the bus system (Sectra, 2003), whereas in Germany drivers can represent up to 70 % (Leuthardt, 1998) of the total costs (in both cases including the capital costs of the vehicles).

[11] CRTM in Madrid has the aim of reducing passenger density inside their vehicles to 3.5 people/m^2 (Cristóbal-Pinto, 2005), while values of up to 6 people/m^2 are typically considered in Latin-America.

On the other hand, **regressive cross-subsidies** that have a negative impact on PT users should be avoided. This is the case of infrastructure paid by PT users that also benefit car users, a formula used in the last years in Santiago. Another regressive cross-subsidy exists in Santiago in the reduced fares for students. PT operators receive no compensation for these lower fares implying a cross-subsidy between passengers paying the full fare and those that pay the reduced fare. But PT users paying the full fare are mainly poorer people (those who do not have a car), whereas students, especially at the higher educational levels (e.g. universities), come mainly from middle and high-income households. Thus it can be seen that this cross-subsidy is regressive[12]. This last issue is solved in a very simple way in other metropolitan areas. For example, the PT system of Berlin receives an explicit subsidy because of the existence of reduced fares for certain groups[13] (e.g. students and disabled people). We recommended maintaining the reduced students' fare in Santiago, but incorporating an explicit compensation for the PT system, in order to eliminate the regressive cross-subsidy. It should be highlighted that this is a subsidy for the educational system, i.e. a subsidy that benefits students and schoolchildren, and not a subsidy for the PT operators.

7. CONCLUSIONS

Travelcards as found in London, Berlin and Madrid should be included in the PT fare system of Santiago. They usually have a positive impact on PT patronage. Evidence suggests that it is possible to find appropriate fare levels (for travelcards and single tickets) to make both users and operators better off, avoiding a negative financial impact for the operators due to the introduction of travelcards. Given the low price-elasticity of travelcards, it is recommendable to introduce them at a low initial price to achieve a quick market penetration, and later increase their cost to reach the desired long-term price. By doing so, a higher market share should be achieved than if the long-term price was charged from the beginning.

PT fares in London, Berlin and Madrid use concentric zones, but Berlin and Madrid actually have flat fares inside the main urban areas, whereas buses also have a flat fare in all Greater London. Theoretical evidence suggests that a flat fare should be preferred inside an urban area, instead of distance-related fares. There is also a "social" argument for flat fares in Santiago because many low-income households are situated in the periphery of the metropolitan area. Therefore we recommend maintaining the (mostly) flat fare introduced with *Transantiago*.

Reduced fares in the off-peak period exist in London and Berlin, in agreement with the theoretical evidence. The PT system of Santiago should include general time-related price differentiations in the future as well (not only in the metro). This could be done through differentiated single-tickets and also through reduced travelcards allowing travel only after the

[12] A similar situation is described by Gwilliam (2005 p2) for the metropolitan area of Dakar in Senegal, where middle class students were found to be the main beneficiaries of reduced fares. There, the imposition of reduced fares without direct compensation to the operator had a negative effect on service quality.

[13] The BVG (operator of metro, tram and buses in Berlin) received € 91 million from the Federal State of Berlin through this subsidy in 2004, as a compensation for the reduced fares offered (BVG, 2006 pp25-26).

morning-peak, as used in London and Berlin. A numerical exercise showed that it is possible to increase both demand and revenue when different fares are introduced in the peak and off-peak.

The average PT fares (including both single tickets and travelcard users) are very similar in Santiago, Berlin and Madrid, but higher in London. When the gross domestic product (GDP) is included in the comparison (as a proxy of the disposable income) the average fare in Santiago becomes even higher than in London. This happens because of the lower GDP per capita in Santiago. Thus, PT expenditure represents a higher proportion of the available income in Santiago than in the analysed European metropolitan areas.

Unlike Santiago, the PT systems in London, Berlin and Madrid receive important operational subsidies. This kind of subsides is justified by the economic theory in the case of urban PT and also represent a clear policy decision of promoting the use of PT. Therefore we recommend introducing subsidies for the operation of the PT system in Santiago. On the other hand, an explicit subsidy should replace the current regressive cross-subsidy between full-fare-payers and students.

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