

9TH CONFERENCE ON COMPETITION AND OWNERSHIP IN LAND TRANSPORT

EFFICIENT PRICING OF URBAN PUBLIC TRANSPORT WITH BUDGET CONSTRAINTS

Nils Fearnley, Institute of transport economics, Oslo, Norway

BACKGROUND AND OBJECTIVE

Urban public transport fares shall meet a number of – often contradictory – needs and requirements. Budgetary constraints and reduced subsidies, dividends to owners, service improvements and so on pull public transport fares up. On the other hand, objectives such as social inclusion, fairness, internalisation of external benefits and corrections for under-priced private transport pull in the direction of lower fares.

During the period of 1986 to 1999, the 7 largest Norwegian cities experienced 42 percent cuts in subsidies, in real terms (Carlquist and Fearnley 2001). Figure 1 illustrates what happened in the city of Trondheim during this period. The operators' dependence on fare revenues increased from around 50 percent of operating costs to nearly 100 percent. Similar developments can be found in a number of European cities (Maretope 2002, Higginson 2002). Lisbon stands out as one of the European cities with the largest subsidy cuts during the 1990s.

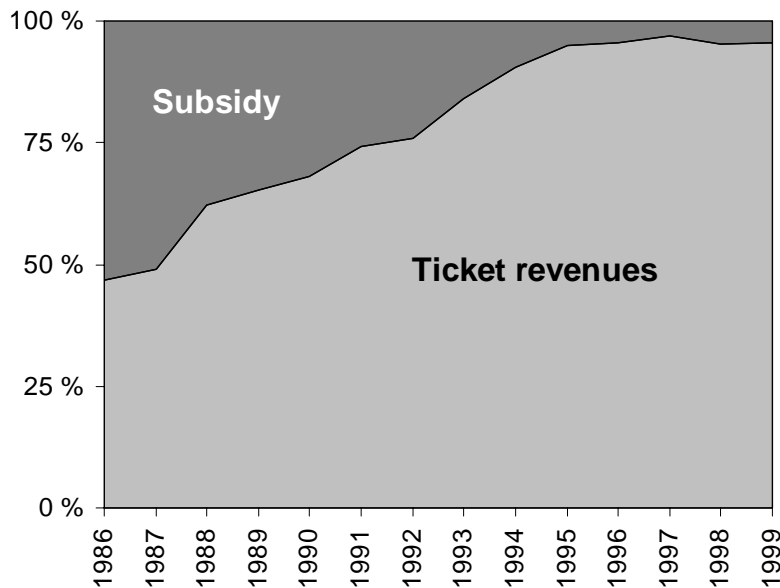


Figure 1: Developments in the allocation of cost recovery between subsidies and fare revenues in Trondheim 1986 and 1999.

Such subsidy cuts reflect to some degree efficiency gains in the industry, but have evidently also transferred costs from the public purse to the passengers who experience increasing fares and/or reduced service levels. Importantly in our respect, the subsidy cuts have increased the importance of user payments for the financing of urban public transport. In Trondheim, real fares rose by 29 percent during this period.

Subsequently, the question is:

In the light of subsidy cuts, how can urban public transport increase passenger receipts and at the same time maintain passenger numbers and market shares?

General fare policies rarely address issues of efficient cost recovery, modal shares and welfare loss adequately. An intention with this paper is therefore to show how fare systems can improve social welfare in situations where operators face budget constraints due to less-than-optimal subsidy levels, i.e, how public transport fare systems can be used more effectively to cover operating costs and at the same time to maintain market shares and/or service levels.

In the following it is not taken into consideration the fact that public transport fares are also tools for other objectives, such as social policy. Neither do we look at supply-side effects, second-best considerations of under-priced substitute services (e.g. private car) and the like. Further, we limit our focus to urban public transport.

The objective is to explain some theory which shows that public transport fares can be used effectively to recover costs and at the same time provide more benefits to

operators and passengers. A further objective is to show examples of real world applications of this theory.

This paper is an elaboration of Fearnley (2004) and focuses more on patronage growth opportunities and on the effects of different pricing strategies.

COST-BASED PRICING AND THE PEAK

A necessary condition for (Pareto) optimal resource allocation is that prices equal marginal costs. A particular problem with respect to this is the fact that operating costs normally will vary across the day. Marginal costs can be very high during peak periods, as the high demand requires investments in increased capacity. These costs should be allocated to a relatively small number of passengers, viz. those who travel during the peak periods and on sections of the routes where capacity is at its limit (design capacity demand).

Marginal costs are relatively stable and low as long as passenger numbers are well below the public transport system's capacity. In the short run, however, there is limited room for increases in capacity to meet increased design capacity demand. Hence, short run marginal costs (SRMC) increase dramatically (or even infinitely) when demand exceeds capacity. In addition, *social* SRMC increases as a result of passengers' disbenefit of crowding.

In the longer run, however, system capacity can be adjusted with new investments, and there is no sharp increase in marginal costs at a certain level of demand. Marginal costs are still higher during the rush periods than off-peak. The reason is, i.a. the fact that bus fleet and personnel cannot be utilised as efficiently to serve rush peaks as they can outside the peak periods. For example, within the period between 6am and 9am in the morning there can be a very sharp top limited to, say 30 minutes. Much of the bus fleet and personnel that are used to serve these passengers can only be used for one single roundtrip. Figure 2 is a stylised illustration of how extra buses and personnel are left unutilised between the peak periods.

In sum, and regardless of whether our time horizon is long or short, peak passengers are associated with higher marginal costs than off-peak passengers. Peak fares should therefore cost more than off-peak fares.

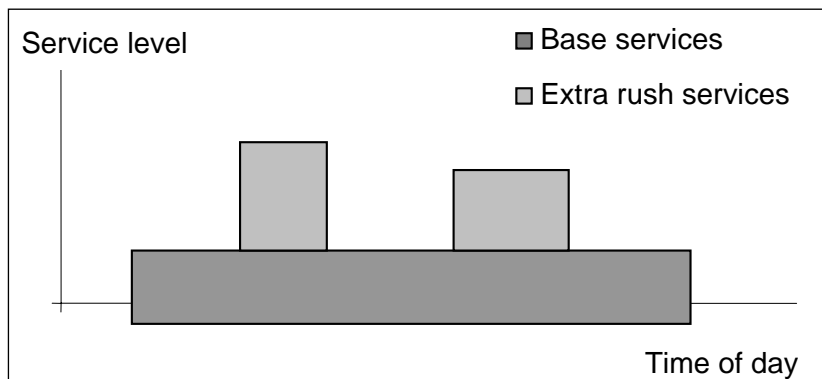


Figure 2: *Stylised example of how service levels are adjusted across the operating hours of a day in order to serve rush hour demand.*

An important feature of marginal cost pricing is the fact that passengers shall experience that each trip they make is associated with a cost. Cost can be high (during peak) or low (off-peak and with scale economies), but it will never be exactly zero. If a fare policy objective is to link fare levels to actual costs, we must conclude that season tickets (day, week, monthly etc. passes) are not associable with efficient pricing. The problem with season tickets is more acute during the peak periods than at other times. Season tickets are especially attractive for the regular passengers, like those travelling to and from work and school. At the same time, these types of trips represent a major part of the design capacity demand. This leads to a situation where the most expensive passengers travel on highly rebated season tickets and pay zero marginal fare. This self-contradictory practice is widespread. Such a pricing strategy gives passengers a wrong signal and leads to excessive demand for public transport at times when the costs are particularly high. This is why unrestricted season tickets are not associable with efficient pricing.

This argument can be moderated. Passengers travelling at times of the day and at sections of the routes where there is ample capacity probably incurs a cost that is closer to zero than to the cost of a typical single ticket. Season ticket can be a practical pricing tool for this kind of trips. This means that season tickets must be limited in time (off-peak only) or in geography (low-demand sections and low-demand travel directions in the network).

A pragmatic approach to cost-based pricing is some kind of peak pricing. With peak pricing fares are higher during the peak and/or lower during off-peak periods – in other words fare differentiation by time of day. Such a system will either

- let the passengers who incur low costs on the system (e.g. off-peak passengers) travel on heavily rebated tickets, or
- apply an extra charge on peak demand, or

- a combination of off-peak rebates and peak surcharges.

Rebates outside rush hours are the most publicly acceptable way of time-differentiated fares. Such rebates may be sufficient to transfer passengers from the rush periods and to periods with spare capacity. The rebates will also attract new passengers. The total effect would be more passengers that are less costly to serve.

Off-peak rebates mean for example that certain cheaper ticket types only are valid after, say 9am and during weekends. Existing and new types of concessionary fares can be subject to such restrictions. Although such restrictions on e.g. old age pensioners' concessionary fares are controversial in many countries, it has become a standard way of time differentiation in most of the UK.

Off-peak rebates will not – especially in the short run – increase the operator's total revenues. Rather, the average ticket revenue per passenger (or average fare) will fall. This fact provides new opportunities for operators whose overall fare levels are regulated according to a price index (for example RPI-X regulation). The off-peak rebates will give room for peak surcharges. Later, we shall see that with a combination of peak surcharges and off-peak rebates, the average fare level need not increase, and that total patronage and total revenue may well increase with such combinations of rebates and surcharges.

Peak fare surcharges will encourage more passengers to change their trip timing. Although most peak passengers are inflexible w.r.t. trip timing, there will always be a number of them who react to such price stimuli (see e.g. Jong et al. 2001). And because most passengers have no alternative, ticket revenues will increase.

When peak and off-peak fares are regarded coherently, i.e. when peak fares are higher than off-peak fares, then a number of efficiency gains can be obtained:

- Passengers realise that their trips have different costs to the operator (and other passengers in terms of crowding, delay) depending on their trip timing
- Some passengers will change the timing of their trips to periods where they are less costly to serve, hence reducing total operating costs.
- Off-peak rebates increase passenger numbers and bring the average fare level down
- Peak surcharges increase operating revenues

6 *Insert book title here*

- Off-peak rebates provide affordable services and hence improved mobility to the less affluent
- Average fare levels need not increase – they may even fall.

It is important to add a caveat relating to the fact that alternative modes of transport tend to be priced below their marginal social costs. This fact is particularly apparent for private car use during rush periods. Modal shift from public transport to private car, resulting from peak fare surcharges, will therefore have adverse effects on society as a whole. Ideally, therefore, car use should also be subject to peak pricing e.g. through time differentiated road pricing.

PRICE DIFFERENTIATION

Price differentiation is not only a tool for profit maximisation, but also a means to achieve efficient levels of service and efficient resource allocation. The starting point of price differentiation is a thorough understanding of passengers' response to changes in price - as opposed to peak pricing where prices are determined by variations in costs only.

Varian (1996) argued that under price differentiation, there will be a welfare loss if total production falls or stagnates, compared to the production under uniform pricing. A necessary, but not sufficient condition for welfare gain is therefore that production increases with price differentiation.

Price differentiation is often associated with yield management. The aim of yield management is to maximise profits by charging different prices to different groups of passengers. The least price sensitive passengers are charged the highest price.

Ramsey pricing is based on the same principles as yield management and price differentiation, but is used as a second best pricing strategy to minimise the welfare loss caused by a budget constraint (e.g. due to insufficient subsidies). Fares are being differentiated between different market segments according to their elasticities of demand, and according to variations in marginal costs.

The case for Ramsey pricing is as follows. Let us regard a market with one service (bus), before we consider an operator who offers different services. We assume that the price, p and total costs, TC are functions of quantity:

$$p = p(Q) \text{ and } TC = c(Q)$$

In addition there is a budget constraint:

$\pi = k$.

Optimal pricing means that we maximise social welfare (SW), subject to the budget constraint:

Max SW such that $pQ - c(Q) = k$

⇓

$$(b1) \quad L = \int_0^Q p(Q)dQ - TC + \lambda(PQ - TC - k),$$

First order conditions:

$$(b2) \quad \frac{\partial L}{\partial Q} = p - MC + \lambda \left(p + Q \frac{\partial p}{\partial Q} - MC \right) = 0 \quad (\text{MC is marginal cost})$$

$$(b3) \quad \frac{\partial L}{\partial \lambda} = pQ - TC - k = 0$$

From (b2) we get:

$$(b4) \quad \frac{p - MC}{p} = \frac{-\lambda}{1 + \lambda} \cdot \frac{1}{\varepsilon}, \quad \varepsilon \text{ is the elasticity of demand w.r.t. price}$$

In other words, optimal second-best solution is when the proportionate mark-up of price over marginal cost equals the inverse of the price elasticity. In other words: the more price sensitive market the lower the mark-up. From (b2) we get:

$$(b5) \quad \frac{p - MC}{MR - MC} = -\lambda,$$

so that λ is the marginal benefit in SW of relaxing the budget constraint. We see that marginal cost pricing, $P=MC$ gives $\lambda=0$ and no further benefit can be gained.

Baumol and Bradford (1970) is the traditional reference for optimal pricing when a monopolist who supplies 2 goods (e.g. peak and off-peak services) faces a budget constraint:

We have $MR_i = p_i + x_i dp_i/dp_i$, (MR = marginal revenue)

and derive $p_i - MC_i = (1 + \lambda) (MR_i - MC_i)$, λ constant.

and (b6) $\frac{p_i - MC_i}{p_i} = \frac{1 + \lambda}{\lambda} \cdot \frac{1}{\varepsilon_i}$, because $\varepsilon_i = -p_i/x_i(dx_i/dp_i)$

This is the usual representation of Ramsey pricing. When prices deviate from marginal costs because of a budget constraint, $P > MC$, then we see from equation (b6) that efficient pricing means a proportional mark-up of prices is in inverse ratio with the price elasticity of the markets. From (b6) we see that if all markets have the same elasticities then the proportional mark-up of prices over MC should be the same in all markets. The optimal mark-up depends on own and cross elasticities.

From (b4) we derive the general pricing rule for two substitute services:

$$(b7) \quad \frac{\frac{p_1 - MC_1}{p_2 - MC_2}}{p_2} = \frac{\varepsilon_2}{\varepsilon_1} \quad \text{or} \quad \left(\frac{p_1 - MC_1}{p_1} \right) \varepsilon_1 = \left(\frac{p_2 - MC_2}{p_2} \right) \varepsilon_2$$

If ε_2 is large and ε_1 is small (in absolute terms) then there should be a large proportional mark-up in market 1 and a small mark-up in market 2. For substitutes, max SW requires:

$$(b8) \quad p_1 = \frac{MC_1 - \frac{\lambda}{1 + \lambda} \left(\frac{\delta p_2}{\delta x_1} x_2 \right)}{1 + \frac{\lambda}{(1 + \lambda) \varepsilon_{11}}}$$

(b8) shows that the optimal mark-up increases,

the tougher the budget constraint, i.e. the bigger λ , for example due to insufficient subsidies

the smaller the price elasticity – price insensitive demand should, for example, be charged more

the bigger the cross price elasticity. A large cross elasticity reduces $\delta p_2 / \delta p_1$, and hence the mark-up must increase for (b8) to hold

Although Ramsey pricing is a welfare maximising approach, it is rarely applied in local public transport. There are several reasons for that. Firstly, it assumes detailed knowledge of cost and demand structures, which are usually difficult to obtain. Secondly, regulating authorities are not always happy with great variations in fares. Thirdly, the correct "Ramsey price" can in some instances be a very large mark-up over marginal cost (see Nilsson 1992). Fourthly, Ramsey pricing becomes very difficult when external costs and benefits are present. Baumol (1995) argued however that these effects are likely to be relatively small.

IMPLEMENTING PRICE DIFFERENTIATION

Pigou (1929: 275f) described ways in which a monopolist can maximise revenues, and divided between 3 degrees of price *discrimination* (which is the same as price *differentiation*).

First degree (perfect) price discrimination is when the operator knows all consumers' willingness to pay and is able to charge this. For obvious reasons this is not relevant for public transport.

Second degree price discrimination is when prices depend on quantities sold (e.g. multiple journey tickets, season tickets, zone systems) or on quality (e.g. 1st and 2nd class, express services). However, every passenger who purchases the same quantity and/or quality pays the same fare. The operator doesn't need to know each passenger's willingness to pay, or their demand elasticity, but the passengers choose themselves the price/quality combination that suits them best (*self-selection*).

Third degree price discrimination is when different groups of passengers are charged differently, and according to their elasticity of demand. Student and old age pensioner concessionary fares are examples of this. It is necessary to establish clear rules which define the different segments so that passengers cannot shop around between different rebates. Age, gender, student ID cards and so on are such indisputable criteria.

If total revenues are to be increased under third degree discrimination, then the rebates/surcharges must be seen in relation to the demand segments' price elasticity. Revenues will increase if elastic demand segments - i.e. those whose elasticity is above unity - are given rebates, and if fare levels are increased to inelastic demand segments.

What do we know about different passenger segments' price elasticity? The following are some typical findings, based on sources like Litman (2004) and Balcombe et al. (2004). Note, however, that demand studies should be undertaken in individual cities before a differentiated fare structure is determined.

- Peak passengers are the least price sensitive, as their freedom to choose trip timing and transport mode is limited by school and work hour requirements, congestion, parking restrictions and so on.
- Leisure trips are more price sensitive because they are more flexible as to whether to travel or not, where, when and why, and with which mode.
- Children and youth are more price sensitive than adults.
- Car ownership increases price elasticity because it offers an alternative.
- Low-income groups are the least price sensitive. Although the fare level is particularly important for them, they tend not to have a real choice.

- Price elasticity is higher on the very short and on the very long trips. Walking and cycling are alternatives to the short public transport trips while the car is an alternative on longer trips.

It is important in this respect to consider differences between long and short-term elasticities. Long-term elasticities tend to be 1.5 to 3 times higher than the short-term effects (Goodwin, 1988, Preston, 1998, Dargay and Hanly, 2001). This means that it may prove profitable in the longer run to reduce fares to some submarkets whose long run demand elasticities are greater than one in absolute terms.

One should be aware that there are undesirable aspects of price differentiation too. Firstly, it may seem unjust that some people receive rebates while others pay full price. Secondly, fares may deviate largely from marginal costs and be difficult to explain to the public. Thirdly, the potentially large number of different prices for the same services may itself be a barrier to travel by public transport. There is in other words a trade off between simple and "fair" fare systems, and efficient welfare maximising price differentiation. We know from other industries – not least from rail and aviation – that a large degree of differentiation can be perceived as attractive by the market. Whether you double the price on express bus services or dump prices on lower quality bus services, the result may in fact be more satisfied passengers. The former offers superior comfort and maybe even *prestige*, whilst the latter offers affordable services for the average citizen.

PATRONAGE GROWTH OPPORTUNITIES

So far we have focused on strategies to increase revenues only. This is only a partial solution to our problem statement of increasing passenger receipts *and at the same time maintaining passenger numbers and market shares*. Great care is needed if fare changes shall not lead to either passenger loss or revenue loss.

A condition for fare reductions to increase patronage *and* maintain or increase revenues is that demand is elastic, i.e. above unity. This is generally not the case for aggregate public transport demand, but may apply to particular market segments. Section 3.2 above listed some circumstances under which demand is more elastic. Figure 3 is copied from Balcombe et al (2004). It shows that public transport demand is in fact elastic in some few special cases. Although the authors are not explicit as to the interpretation of figure 3, it seems the largest elasticity values refer to non-conditional elasticities. Such elasticity estimates indicate change between different ticket types or different public transport modes rather than patronage growth per se.

Figure 3 illustrates the importance of building up markets over time. The average long-run bus fare elasticity in the UK is unity, -1. This means that fares reductions are likely to increase demand such that total revenue and patronage are unaffected or even increased. Rebates that are targeted towards more elastic demand segments are even more likely to increase patronage and revenues in the long run. This applies e.g. to leisure travellers, children or elderly and those travelling short distances.

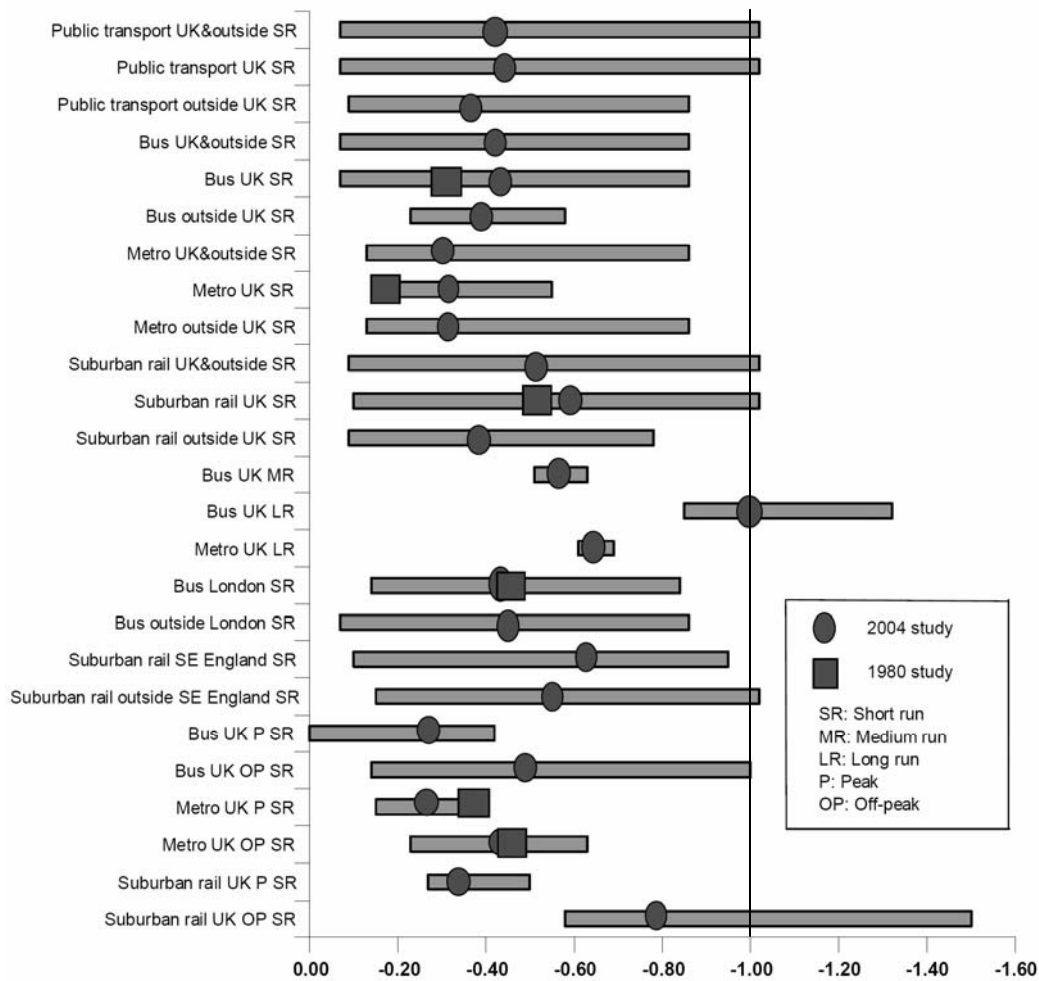


Figure 3: Range and mean values of elasticities. Source: Copy of Balcombe et al (2004) figure 3.1.

Table 1 puts together some evidence (again extracted from Balcombe et al (2004)) of elastic demand. The size of the evidence is not striking, but indicates that elastic demand (segments) can be found in urban public transport.

Table 1: Evidence of elastic public transport demand. Source: References cited in Balcombe et al (2004) appendix 6

Source	Demand segment	Elasticity
Preston 1998	UK, Rail PTE area C Travelcard	-1.02
	UK, Bus, adults, prepaid tickets, medium run	-0.74 ± 0.39
Gilbert and Jallilian 1991	UK, Bus, long run, without long run symmetry	-1.32
White 1981	UK, Bus, Morpeth, off-peak, inter-urban	-1.00
Fowkes, Sherwood and Nash 1992	London, suburban rail, leisure	-1.5

Another strategy to increase total demand is to "subsidise" fare reductions to some passengers by marking up fares paid by others. Fare reductions should be granted to the more elastic demand segments and mark-ups should be paid by the less elastic demand segments. The argument is in line with Webster and Bly (eds. 1980) who stated that

"...when the average fare per passenger in a graduated system is equal to the flat fare, the graduated system is likely to attract both more passengers and more revenue." (p 223)

and

"Thus, if fares are reduced in off-peak periods and increased in peak periods then for the same overall revenue it will generally be possible to attract more passengers in total." (p 225)

Table 2 is a thought example of how this can be applied. It shows the effect of a peak fare increase combined with an off-peak fare reduction. The initial demand (demand 0) is 70 peak and 100 off-peak passengers, and the initial fare (P0) is 1 throughout the day. In period 1 the peak fare is increased to 1.30 and off-peak fare is reduced to 0.80. With peak and off-peak demand elasticities of -0.2 and -0.5 respectively, total revenue and total patronage are increased in period 1. Total revenue increases by 3 percent and patronage by 5 percent. And, interestingly, the average fare falls by one percent. This example shows that deviations from flat or uniform fare structures can have very attractive effects.

Table 2: Demand and revenue effects in a thought example of peak fare surcharge and off-peak rebates. Peak and off-peak demand elasticities are assumed to be -0.2 and -0.5, respectively. Changes from period 0 to period 1.

	Peak	Off-Peak	Aggregate
P0	1	1	
P1	1,3	0,8	
Demand 0	70	100	170
Demand 1	66	112	178
Revenue 0	70	100	170
Revenue 1	86	89	176
Average fare 0			1,00
Average fare 1			0,99

A final strategy which will increase revenues and patronage is to see public transport fares in relation to policies directed towards car use. Car restrictions and proper road user charges and parking fees will increase public transport market share and local government revenues. Such policies are not, however, within the scope of this paper.

EXAMPLES OF PRICING STRATEGIES ASSOCIABLE WITH EFFICIENT PRICING

By efficient pricing strategies, we mean fare policies that are applied in order to increase traffic revenues and to maintain or increase service levels and patronage, despite insufficient public subsidies. This means that the fare structure minimises welfare loss due to a budget constraint and that they reflect and combine cost and demand structures.

Most of the examples below were recorded spring 2003. No effort has been made to update the information or to convert fare levels into a common currency. This is because fare levels change continuously and will most likely have changed by the time this is printed anyway. More importantly is the fact that our point of interest is the fare *structure* and not the exact fare levels.

TIME DIFFERENTIATION AND SEGMENTATION

Time-differentiated fares are common in a large number of countries. The basic principles are more or less the same as those presented below.

In Sweden, Stockholm has a monthly weekend card that is valid every *weekend* of the month. Further, youths aged 6-18 are offered the cheap "Wild card" which is valid after 4pm on weekdays and during weekends – a combination of time differentiation

and segmentation. And in Gothenburg, most season tickets have two prices: one for travel any time of the day and one for low traffic periods.

Throughout England bus saver tickets are usually valid only after the morning peak. In Manchester, for example, a 2-zone return ticket on the Metrolink costs £2.20 during rush and £1.80 off-peak. Also the senior citizen's concessionary fares are usually only available after 9am or 9:30am.

Time differentiation is widespread also in America. As an example of off-peak rebates the one day travel pass in Washington DC is only valid after 9.30 am on weekdays. Other season tickets have limited validity during the peak hours.

Surcharges on higher standard

There is ample evidence, e.g. from stated preference surveys, that passengers place a value, and are willing to pay extra, for higher standard public transport. That is faster, more frequent, more comfortable etc. services.

The different means of public transport to and from Oslo airport are priced differently. The high quality Oslo Airport Express train is about twice as expensive as the ordinary, scheduled trains; NOK 150 as opposed to NOK 72. The airport buses, which offer high quality in terms of accessibility, availability and a dense network, cost NOK 100.

Stockholm introduced a high standard bus service in 1990. It offered superior comfort, standard, and speed. Passengers could reserve seats on this bus service by paying about twice the price of an ordinary monthly pass. About 25 seats per bus departure were reserved this way and the scheme was judged to be relatively successful.

In New York the ordinary metro or bus tickets cost \$1.50 whilst express buses charge \$3. Similarly, there are two monthly passes which cost \$63 and \$120, respectively. And in Washington DC the ordinary fare is \$1.10 whilst express buses cost \$3.

In Singapore, buses with air condition are charged higher than buses without. The single ticket price for a 10-stage trip is for example \$0.90 on an ordinary bus, but \$1.20 on air-conditioned buses, when paid cash. On average, the surcharge for air-conditioned buses is about 25 on top of the ordinary bus fare. There is also a surcharge on express buses in Singapore. A 10-stage trip with express buses costs \$1.60, i.e. about 33 percent more than ordinary, air-conditioned stage buses. The express bus services are part of an effort to improve public transport services. Although the price difference between express and ordinary bus services is significant, some passengers pay willingly for the faster service. Exceptions are the

unemployed and others with lower income, who tend to be more price sensitive and to prefer the slower and less expensive alternative. Given Singapore's hot and humid climate most passengers are happy to pay the mark-up for air-conditioned bus services.

London's public transport fares reflect differences in quality between bus, tram and underground. This is shown in table 3. Bus, which is normally regarded inferior, is far cheaper than the underground. Tram fares lie somewhere between the bus and tube fares. This reflects to some extent passengers' preferences for quick, efficient and simple transport on rail tracks.

Table 3: London fares 2003, £

Ticket type	Bus	Tram¹⁾	Underground
Single	Zone 1: 1.00 Outside zone 1: 0,70	1 zone: 0.90 2 zones: 1.30	Zone 1: 1.60 Outside zone 1: 1.00-2.30 Zone 1-4: 2.80
Day	Zone 1-4: 2.00	(Also valid on buses) 2.80	(Also valid on bus and tram) Zone 1-2: 5.10 (peak) 4,10 (off-peak) Zone 1-4: 7.00 (peak) 4.50 (off-peak)
Month	Zone 1-4: 32.70		Zone 1-2: 75.30 Zone 1-4: 109.10

¹⁾ The tram fare was merged with the bus fare after this information was gathered.

In Athens, bus and trolley bus tickets are cheaper than tram tickets, which again are cheaper than Metro tickets. This applies to standard single tickets in the urban area. While a bus ticket costs €0.45, the tram fare is €0.60 and the Metro ticket costs €0.75. (One metro line has a zone based fare ranging from €0.60 to 0.75.) The difference in price between bus and Metro is greater when it comes to monthly travel cards. The bus pass costs €17.50; only half of the €35 for passes which are valid on bus, trolley and metro.

Since its opening in 2000 the Metro has been a thriving success, and has achieved a considerable market penetration despite the higher fare level. The three Metro lines in Athens have a market share of nearly 40 percent in 2005. Passengers are shifting from both buses and trolley buses, and opt for the faster, more punctual but also more expensive Metro. The tram line, which opened in 2004, is also increasing its market share, but its total size is small compared to the total market.

Although Athens' fare structure is a result of numerous governmental decisions, the higher Metro fare contributes to increased cost recovery. In fact Attiko Metro passenger receipts cover all operating costs.

Rebates on pre-sold tickets

Helsinki, Singapore and Oslo have introduced two-tiered tariffs on certain ticket types. The same ticket is sold at different prices depending on where or how it is being sold. A ticket sold onboard from the bus/tram driver is considerably more expensive than pre-sold tickets and tickets bought on ticket machines. A single ticket in Helsinki costs €2 from the driver, but only €1.20 when bought in advance. A single ticket in Oslo costs NOK 30 from the driver and NOK 20 when sold in advance. The cash price of single tickets in Singapore lies about 15 percent above the price when paid by the *ez-link card*.

These two-tiered tariffs give a strong signal to the passengers. Ticket sale from the driver takes time and causes delay. Other passengers bear this cost in terms of increased travel and waiting time and poor punctuality. There is also a cost to the operator because ticket sale on board reduces average operating speed.

The take-up of the contactless smartcard in Singapore has been substantial, as it makes little sense for most passengers to pay a higher price for cash fares. The shift has sped up boarding and alighting and reduced waiting times at bus stops substantially.

Oslo Metro reports that one year after the implementation of the two-tier tariff, nearly two thirds of the single tickets are being purchased in advance. Before implementation, 15.5 percent of tickets purchased were single tickets. Post implementation this share is reduced to 12.8 percent; 7.9 percent advance purchase and 4.9 percent on board. The sale of single tickets from the driver has in other words been halved. Further, the two-tiered tariff has contributed to substantial benefits in terms of improved punctuality and speeds. One study (StatkraftGrøner 2003) indicate that boarding and exit times on a tram line was reduced substantially. Before implementation the average boarding time was 4.5 seconds per passengers. Post implementation this was reduced to 2.7 seconds.

SUMMARY AND CONCLUDING REMARKS

Numerous cities experience public transport subsidies that are less than optimal. They depend heavily on ticket revenues to finance public transport operations. Efficient pricing strategies are those that minimise the welfare loss caused by this budget constraint, such that fare levels reflect and combine the relevant cost and demand structures.

Price differentiation increases the gap between highest and lowest price per trip. Different passengers pay different prices depending on their demand characteristics and depending on the operating cost of serving them. Given the political decision in

many cities to reduce public transport subsidies below optimal levels, we have shown that

- More flexible pricing strategies can be applied in order to increase revenues while at the same time maintain patronage
- The average fare level need not increase when price differentiation is introduced. Peak surcharges can, for example, be matched with off-peak and/or other targeted rebates
- A uniform fare structure is not optimal because it doesn't take into account differences in operating cost and differences in passengers' willingness to pay

With season tickets the cost to the passenger of an extra trip is zero. The cost to the operator is, however, typically high because season ticket holders are more likely to be commuters and students travelling during the peak. This pricing policy is not efficient because the most expensive passengers to serve are given the largest rebates.

There is a risk that too much price differentiation is regarded as unfair and too complex. Here lies a challenge to the public relations officers, who have the potential of earning a lot of goodwill from price differentiation. From other sectors, including rail and aviation, it is evident that customers appreciate increased freedom to choose between price and quality combinations.

There is no one and easy answer to what is a correct pricing strategy for urban public transport systems. This paper has pointed at some possibilities and potentials for improvements in the efficiency of cost recovery. However, a thorough understanding of the cost and demand structures is necessary in each case in order to improve the fare system. Further, we have not dealt with the fact that public transport fares typically are a political compromise between numerous objectives, such as social and environmental goals, as well as a tool for financing operations.

REFERENCES

- Baumol, W.J., 1995. Modified Regulation of Telecommunications and the Public-Interest Standard. In: Bishop, M., J. Kay and C. Mayer (eds. 1995) *The Regulatory Challenge*. O.U.P.
- Baumol, W.J. and Bradford, D.F., 1970. Optimal Departures from Marginal Cost Pricing. In *American Economic Review* vol. 60, 1970, s. 265
- Balcombe R. (ed.), Mackett, R., Pully, N., Preston, J., Shires, J., Titheridge, H., Wardman, H. and White, P., 2004. *The demand for public transport: a practical guide*. TRL report TRL593.

- Carlquist, E. and Fearnley, N., 2001. Subsidy reductions in Norwegian urban public transport: Savings - but for whom? Paper presented at the European Transport Conference (PTRC), Cambridge
- Dargay, J. and Hanly, M., 2001. The demand for local bus services in England. TSU working paper 2001/22. ESRC Transport Studies Unit, University of London Centre for Transport Studies
- de Jong, G., Daly, A., Vellay, C., Bradley, M. and Hofman, F., 2001. A model for time of day and mode choice using error component logit. Paper presented at European Transport Conference (ETC) 2001, Cambridge, UK. PTRC 2001
- Fearnley, N., 2004. Incentive pricing of urban public transport. Paper presented at the 2004 European Transport Conference in Strasbourg, France 2004
- Fowkes, AS, Sherwood, N and Nash, C, 1992, Segmentation of the travel market in London and estimates of elasticities and values of time. ITS Working paper 345, University of Leeds. Cited in: Balcombe R. (ed.), Mackett, R., Pally, N., Preston, J., Shires, J., Titheridge, H., Wardman, H. and White, P., 2004. The demand for public transport: a practical guide. TRL report TRL593
- Gilbert, C.L. and Jalilian, H., 1991. The Demand for Travel and for Travelcards on London Regional Transport. *Journal of Transport Economics and Policy* vol 25 no 1 pp3-29. Cited in: Balcombe R. (ed.), Mackett, R., Pally, N., Preston, J., Shires, J., Titheridge, H., Wardman, H. and White, P., 2004. The demand for public transport: a practical guide. TRL report TRL593
- Goodwin, P., 1988. Evidence on car and public transport demand elasticities 1980-88. University of Oxford, Transport Studies Unit. (Report 246)
- Higginson, M., 2002. Public transport finance. UITP position statement, final version 11 – long version 30 September 2002.
- Larsen, O.I., 1998. Elements in an Optimum Transport Policy. TØI report 408/1998
- Litman, T., 2004. Transit Price Elasticities and Cross-Elasticities. In *Journal of Public Transportation* Vol 7 No 2 2004.
- MARETOPE, 2002. Synthesis of case studies. Deliverable D4
- Nilsson, J.-E., 1992. Second-Best Problems in Railway Infrastructure pricing and Investment. In: *Journal of Transport Economics and Policy* 1992, s. 245-259.
- Pigou, A.C., 1929. *The Economics of Welfare*. 3rd edition. London: Macmillan
- Preston, J., 1998. Public transport elasticities: time for a re-think? Presented to UTSG Conference, Berlin, January 1998. Oxford TSU Working paper 856
- StatkraftGrøner AS, 2003. Change in dwell times resulting from changes in the fare structure (in Norwegian). Letter to Oslo Metro of 18 March 2003
- Varian, H.R., 1996. Differential pricing and efficiency. In: *First Monday* Vol.1 No.2 – 1996. firstmonday.org accessed May 2003
- Webster, F V and P H Bly (eds.) 1980. *The demand for public transport : Report of the international collaborative study of the factors affecting public transport patronage*. Transport and Road Research Laboratory, UK 1980
- White, P.R., 1981. Recent Developments in the Pricing of Local Public Transportation Services, *Transport Reviews*, vol 1 no 2 pp 127-50. Cited in:

Insert your chapter title on righthand pages 19

Balcombe R. (ed.), Mackett, R., Pully, N., Preston, J., Shires, J., Titheridge, H., Wardman, H. and White, P., 2004. The demand for public transport: a practical guide. TRL report TRL593