

CIV5314: Transport Planning and Policy

Zero-Fare Public Transport

Julian Reynolds 20462794

Abstract

Public transport systems throughout the world are typically subsidised by governments. While a few transit systems make a profit, notably in Japan, many governments pay a large proportion of transit operating costs to improve social, environmental and economic outcomes.

Zero-fare public transport systems represent the largest form of subsidy, with the entire cost of the transit system being paid by the government. A passenger does not directly pay a fare. This paper discuss a range of different zero-fare systems throughout the world and the effects of such a policy on system operation and patronage.

Fare subsidy programs for students that are funded by universities are examined. Research suggests that these programs benefit not only students, but transit operators and the universities as well.

Fare and service elasticities are discussed, and the case for zero-fare transit is compared that of improving service. It is suggested that in larger transport systems, where the marginal cost of improving service is low and passenger volumes are high, zero-fare programs may be a expensive way to increase patronage.

A hypothetical example of implementing a zero-fare program in a rural city in Victoria is described. It is shown that where passenger volumes and service levels are low, a zero-fare system is a good way of increasing patronage. Options for further research into this topic are highlighted, such as detailed comparison of the effectiveness of zero-fare policies between small and large transit systems.

Contents

1	Introduction	3
2	Public Transport Funding	5
3	Zero-fare public transport systems	7
3.1	Funding	10
3.2	Elasticities	12
4	Swan Hill case study	14
5	Conclusions	19

1 Introduction

Public Transport users are typically charged a fare for using the service. This fare may be paid on boarding the transit vehicle or on a weekly, monthly or yearly basis. The cost of the fare may be based on the distance that the passenger travels or provide travel for a specific length of time.

The reason for charging passengers a fare is to offset the cost of running the public transport system. Employee wages, fuel or electricity, maintenance and purchase of vehicles are all expenses involved in operating a transit service. Governments often pay a significant proportion of these expenses out of general funds, but income from fares is still an important revenue stream.

However, charging passengers a fare can increase the complexity of operating the transit system. Handling of money, printing, selling and inspecting tickets, enforcement and prosecution of fare evaders adds to the administration costs and increases the number of staff required. Boarding times on vehicles may also be higher if payment of a fare is required, particularly if the driver is also responsible for fare collection.

Charging passengers a fare also discourages use. When choosing between travel on public transport or by private vehicle, the price of the fare may affect the decision. Many drivers perceive the marginal cost of using their cars as almost zero, whereas the costs of traveling on public transport are paid with every use. Automobile users tend to pay only the costs of running their own vehicles, with road-construction costs paid by government, although with increased use of toll-roads and road-pricing the real costs of automobile transport is beginning to be paid directly by the motorist.

Many commentators have suggested not charging transit passengers a fare at all. Zero-fare public transport systems would ‘even the playing field’ and encourage travellers to shift from cars to public transport.

It is also suggested that free transit would be good for society, particularly lower income earners or otherwise disadvantaged people. Concession fares are an example of public transport addressing these social objectives.

This paper discusses zero fare public transport within the wider context of public transit funding. Existing public transit and the typical cost-recovery rates from fares are examined. The paper highlights some of the issues and benefits with implementing such schemes. Some existing zero-fare programs are examined and the various forms of funding are discussed. Finally, a case study is presented to hypothesize the effects of implementing a zero fare system on a rural city bus system.

2 Public Transport Funding

Fares paid by travellers typically only make up a portion of the funds required to operate a transit system. The cost-recovery ratio, that is the percentage of operating costs that are covered by fares, is quite dependent on the type of transport service (van Goeverden, Rietveld, Koelemeijer & Peeters 2006, p.16). Dutch urban bus routes have a ratio of nearly 30%, while express trains have a ratio of 120%. Shoji (2001) also identifies wide range of cost-recovery ratios across different transport systems. In Brussels and Milan the ratio is 28%, where as in Tokyo the ratio is 170% - a large profit.

Japanese appears to be the exception to the rule. All forms of transport, including railways, are expected to be self-supporting (Shoji 2001). Tolls on highway systems are also expected to pay for the cost of construction and operation. This would appear to provide a level playing field, where both automobile and transit users pay the 'true' cost of their travel.

All other systems examined by Shoji (2001) have some form of subsidy to make up the difference between costs and fares. Although cost-recovery ratios have a wide variance, many systems are in the 25-50% range. Regardless of the ratio, a system that spends more than it receives from fare income needs external funding.

Government subsidy makes up the difference for most public transport systems. This subsidy is provided to meet social, environmental or economic goals. For many members of society the cost of car ownership is too high. Other people may be unable to use a car due to youth, disability or lack of a license. Public transport can allow these people to actively participate in society by providing transport at a reasonable price. Concession fares can be further used to reduce prices for these

groups.

Transit is typically more environmentally friendly than automobile travel on a per passenger basis. Reducing greenhouse emissions and other pollution by encouraging transit use can be a key reason for governments to invest in public transport.

Economic considerations are also an important issue for governments. Transit can improve accessibility to cities and support and increase economic growth. Making the best use of existing transit infrastructure by increasing patronage can reduce highway congestion reduce the need to build more roads. For example, a trial 2004 zero-fare bus service between Leiden and The Hague was introduced to test the ability of free public transport to reduce congestion on a major highway (van Goeverden et al. 2006, p.9).

3 Zero-fare public transport systems

In the previous section we identified the typical cost recovery ratios for public transport systems. Many systems have quite low cost recovery ratios, with less than one third of operating costs being covered by passenger fares.

With such low cost-recovery from fares, why have fares at all? A number of system operators have taken this option and fully subsidise public transport. In a zero-fare public transport system the entire cost of the system is subsidised by the government (or other parties). The passenger does not directly pay for his or her trip.

The most obvious result of a zero-fare system is that people will be more likely to use transit. Rather than considering the cost of a trip or which type of ticket they need to purchase, passengers will simply board a transit vehicle when and where they choose. There are a number of other positive outcomes. Brown, Hess & Shoup (2001, p.245) notes that all users of a zero-fare system “implicitly understand that transit is free not only for individuals but also for groups...With no need to discuss the financial cost, any group...can casually board any bus...” . There can be also be positive benefits in a seemingly unrelated area. van Goeverden et al. (2006, p.7) identifies a large increase in the number of visits to patients in hospitals following the introduction of free public transport in Hasselt.

Throughout the world there are a large number of transport systems currently offering free fares. No definitive list exists, although the Wikipedia article on zero-fare systems provides a starting point (Wikipedia 2008). The idea, however, is not new. Zero-fares were considered in London as early as 1970 (Ward 1991).

Zero-fare transport systems are often associated with tourism, for example

the Melbourne City Circle Tram and the Melbourne City Tourist Shuttle. Free transport service can be an attraction in itself, but also introduces tourists to different parts of the city that they might not otherwise visit. Subsidising the cost of running a tourist specific system is justified by governments as a way to support the tourism industry.

(van Goeverden et al. 2006, p.7) identifies three types of zero-fare programs:

1. Public transport that is free for all passengers throughout the day.
2. Public transport that is free for some passengers throughout the day or during certain periods.
3. Public transport that is free at certain places or times.

The first category represents the largest step towards fare reduction. The transit system would be fully subsidised. The second and third categories allow the fare reduction to be targeted to encourage particular groups of passengers or particular types of trips, while retaining some income from fares across the entire system.

An example of the second category free travel for university student such as the 'OV-Studentenkaart' program in the Netherlands (van Goeverden et al. 2006, p.11) and programs in the USA (Brown, Hess & Shoup 2001).

Cervero (1990) identifies experiments in a number of US cities with free fare programs limited to downtown cores of the transit system. Adelaide has a similar limited system, where tram journeys within the CBD and Glenelg are free, but in other areas a fare is charged. The US programs had success in increasing ridership, but many of these new trips were made by people who previously walked or people

who would not travelled before the fare decrease. Negative implications for system operation were also encountered, with the larger numbers of passengers increasing dwell times of transit vehicles at stops.

Although free fare programs that are limited to a central business district will be cheaper to operate than programs that encompass the entire system, the benefits are questionable. Transit congestion is typically heaviest in the central areas of a city. By encouraging transit use for short trips in these central areas that could have been made on foot, congestion will be made worse. There may also be significant confusion over the free area, or fare evasion amongst those traveling into or out of the fare-free zone. Improvements in the environmental or social dimensions will not be likely either. Zero-fare programs limited to a central area will have little impact on automobile use (Balcombe, Mackett, Paulley, Preston, Shires, Titheridge, Wardman & White 2004, p.64) and will not be readily accessible to people with low incomes, who typically live outside the central areas of a city.

To promote the transit system, Salt Lake City experimented with a one month elimination of fares during off-peak periods (Train 1981). It was anticipated that allowing potential passengers the chance to try the system for free would encourage future use. While ridership increased during the zero-fare period, it decreased to below pre-trial levels when fares were reintroduced. Better results were obtaining in similar programs in Denver and Trenton, where the zero-fare programs lasted for an entire year. However, there was insufficient data to prove a positive long-term effect due to the programs. The large costs involved in implementing a zero-fare short term trial suggest that other marketing approaches, such as Travelsmart and Indimark programs, may be more cost-effective methods of increasing transit ridership.

3.1 Funding

Funding for a zero-fare program can come from a number of different sources including:

- Government general revenue,
- specific levies or taxes on residents, businesses or automobile users,
- universities or other educational institutions, and
- private industry.

In most public transport systems, the gap between expenditure and income is funded by government as part of the budget. A zero-fare program could be implemented by simply increasing the level of government funding to cover the entire cost of running a transit system.

One of the aims of the London Congestion Charge scheme is to raise money for investment in transport in London, including public transport (Hensher 2003, p.62). This style of cross-charging, with users of automobiles paying a levy that is used to fund public transport, could be used to fund a zero-fare transport system. However, this approach could become a victim of its own success. If large volumes of drivers shift to public transport there would be less income from the levy, but more demand for the public transport service. In practice it is likely that these effects would cancel out, as over crowding on transit would encourage passengers who could afford the road levy to drive instead.

Universities and other educational institutions can also fund zero-fare programs. Brown, Hess & Shoup (2001) describes a number of programs in the USA which provide free or reduced fare public transport for university students. These

programs are funded by a lump sum ‘shadow fare’ payment to the transit agency by a university on behalf of students. The ‘shadow fare’ is based on the number of trips that the student body will undertake. However, transit agencies can offer a low price per ride because the bulk purchase significantly reduces their transaction costs. As university students tend to ride transit outside of peak hours, the extra passengers use capacity that already exists in the transit system. The extra revenue may allow service frequencies to be increased, which benefits both university students and other users.

Universities benefit from these programs as there is reduced demand for on campus parking, improved access to employment and housing for students, the programs assist universities to recruit and retain students as well as reducing the costs of attending, and increases transportation equity.

Businesses can have similar benefits from fully subsidising their employees commuting, whether through agreements with transit agencies or self-run shuttle services. An example of such a system is that run for Google (Helft 2007).

Regardless of the source of funding, a key measure of the performance of a zero-fare system is the number of new passengers who use the system because of the price decrease. Spending money to fully subsidise transit will only be worthwhile if additional passengers are drawn to the service. The next section briefly describes the economic theory and some of the research into the sensitivity of passengers to price.

3.2 Elasticities

Elasticity defines the proportional change in one variable that occurs with respect to another variable. Estimation of fare and service elasticities is one of the key elements of transit pricing research. Cervero (1990) identifies that the industry standard for fare elasticity is -0.33 (the ‘Simpson-Curtin’ rule). This states that for every one percent increase in the fare price the demand for transit decreases by 0.33%. If the fare increase from \$1.00 to \$1.01, the number of passengers would drop from 1000 to 997.

However, this does not imply that a 100% decrease in the fare (free travel) will increase demand by 33%. The law of diminishing returns states that elasticity decrease as the real fare decreases almost to zero, so does the number of new passengers. If the fare drops from \$0.10 to \$0.05, it is unlikely that many new passengers will be generated.

Elasticity values can also be developed for service levels. Examining average frequency and travel times, Cervero (1990) identifies that transit riders are roughly twice as sensitive to service quality as to price.

Fare and service elasticities vary significantly for different types of users and trip purposes (Cervero 1990, p. 122-125). A high income earner is unlikely to use public transport to go on holiday, regardless of the fare or service, whereas a student will probably keep on catching the bus to school even if the fare or travel times increase.

The key question in evaluating a zero-fare program is whether the funding for the program could be better spent on improving service. Mees (2000, p.70) states that “making public transport free would do little ... because travel time is much

more important to urban travellers than out-of pocket expenses”.

If the service elasticity is twice the fare elasticity, a one percent improvement to service will have twice the effect as a one percent decrease in fare. Therefore, improving the service costs less than twice the losses from decreasing the fare, an improvement to service would give a better return on spending.

Of course, as the service is improved the service elasticity will change. If the vehicle frequency is 30 vehicles per hour a further decrease will have a small effect on patronage. There is a point where any additional improvements to service will be less cost-effective than reducing fares. This suggests that zero-fare systems should be introduced in systems that already have good service and low service elasticity.

To highlight the alternative options for additional funding a hypothetical example based on the Swan Hill bus system is examined in the next section. Although many of the values are invented, the example provides an analysis of the outcomes if funding is used to reduce fares or improve service.

4 Swan Hill case study

Swan Hill is a rural city located in north-west Victoria, on the Murray River. There are regional public transport links to other towns in the area, such as Mildura and Echuca, as well as a rail link to Melbourne. Within Swan Hill there are two bus routes, serving the north and south sides of the city respectively. A single bus serves both routes between 8am and 6pm, completing one route after the other. There are 10 round trips of both routes throughout the day, each trip taking approximately 1 hour.

Mees (2000, p.149) suggests that buses cost roughly \$40 per hour to run (1998 figures). If we adopt a figure of \$50 to account for inflation (and provide a round number), the cost of running the Swan Hill bus service is \$500 per day.

Tickets on the Swan Hill routes are valid for two hours. A full fare costs \$1.50. For the Swan Hill service to have a cost-recovery ratio of 100%, it would need to carry $\frac{500}{1.50} = 333.3$ passengers per day, or 33 passengers per round trip.

Passenger volume figures for the Swan Hill bus service are not available, but from observation the bus service is poorly patronised. Assuming the service averages 10 full fare passengers per trip, the fare income would be \$150 per day. The cost-recovery ratio is 30%.

We will examine two options:

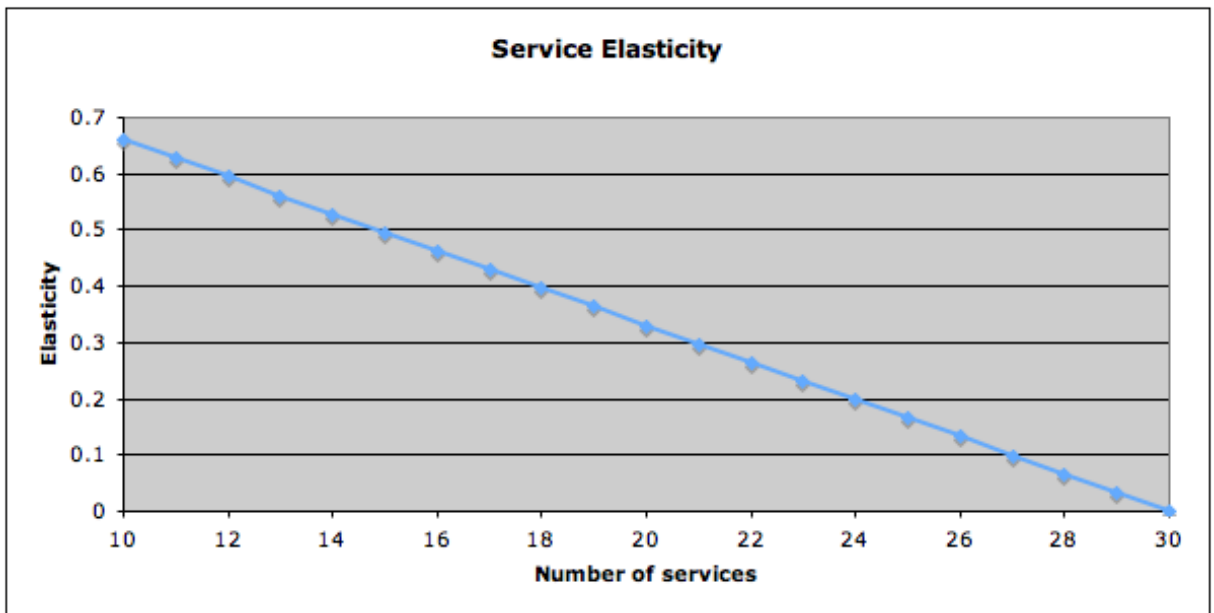
1. Implement a zero-fare system by increasing operating subsidies by \$150/day.
2. Improve services by spending an additional \$150/day.

The second option allows an additional 3 hours of bus service per day to be provided, equating to 3 more round trips per day.

What would be the effect of these two options on patronage? As discussed in section 3.3, the level of patronage with respect to fare or service level is dependent on the elasticity. Fare elasticity is typically about -0.33. Service elasticity is typically twice as large as fare elasticity, so we will adopt a value of 0.66.

These elasticity figures, however, do not take into account the law of diminishing returns. We can expect that additional price reductions or service improvements will reduce the influx of new passengers. For example, a 10% price reduction if the price is \$1.50 will have a greater impact than a 10% price reduction if the price is \$0.10. Similarly an increase from 10 to 13 services per day (30%) will have a larger effect on patronage than a increase from 100 to 130 (30%). If there are already 100 services on the route (5 buses every 3 minutes) an increase to 130 services (6.5 buses every 3 minutes) would probably go unnoticed.

For this hypothetical case study we will adopt the following simple models of the price and service elasticities:



Using a numerical model, if the fare is reduced to \$0 the number of passengers would increase from 100 to 139 per day. For \$150 per day we have increased patronage by 39 people, or \$3.85 per additional passenger.

A 30% increase in the number of services (from 10 to 13) would an increase in passengers from 100 per day to 117 per day. Importantly, those 117 passengers are all paying a fare of \$1.50, giving a total fare revenue of \$175.50. Our expenses have increased to \$650 per day making the real cost per extra passenger \$7.32. The cost-recovery ratio has reduced to 27%. The following table summarises the outcomes of the two options.

	Base case	Option 1	Option 2
Fare price	\$1.50	\$0.00	\$1.50
Services/day	10	10	13
Passengers/day	100	139	117
Income from fares	\$150	\$0	\$175.50
Costs	\$500	\$500	\$650
Cost-recovery ratio	30.0%	0.0%	27 %
Cost per extra passenger	-	\$3.85	\$7.32

Table 1: Base case and options summary

This hypothetical example of prices and elasticities shows that a zero-fare policy may be the optimum way to increase the use of public transport. However, in larger systems the costs of providing a free fare to the many existing passengers would dramatically increase the price of attracting new passengers. If funds were instead used to increase service levels, new passengers could be attracted while the existing passengers continue to make the same payment. The income from new passengers will also partially offset the costs of the improved service.

Of course, the specifics of the price-service tradeoff is entirely dependent on the local conditions. The price and service elasticities will vary considerably depending on the system, population and geographic situation. Likewise, the rate at which returns on price reductions or service improvements decrease may vary.

This example merely demonstrates the principles.

It is unfortunate that real-world passenger, elasticity and cost data could not be obtained for this case study. Further research could focus on collecting this data through interviews and surveys in Swan Hill, allowing real values to be used in the case study.

The 30% service improvement was based solely on running 3 extra round trips of the two bus routes. This may be difficult from an operational point of view, as an extra bus would only be used 3 hours a day. The characteristics of the service catchment areas were not taken into account either. Further research could investigate the operational limitations to service improvements, as well as the characteristics of the routes' catchment areas.

5 Conclusions

Public transport systems throughout the world are predominately subsidised by governments to fund the difference between operating costs and income from fares. There are some transit systems that are financially viable without a subsidy, notably in Japan where roads and highways are not subsidised either. However, in most instances the real cost of automobile travel is not directly borne by users and a transit subsidy is needed to ‘level the playing field’ and encourage use. Governments are willing to pay a large proportion of transit operating costs to improve social, environmental and economic outcomes.

Zero-fare public transport systems represent the largest form of government subsidy. The passenger does not directly pay for the cost of his or her journey. These systems can be an effective way to improve patronage. Free transport can have a positive effect on system operation by removing the costs of issuing tickets and fare enforcement, and decreasing dwell times for vehicles at stops. There are benefits for passengers, both financially and socially.

A range of different zero-fare programs exist throughout the world. Zero-fare travel may be offered across the entire system or targeted to certain areas, times or types of passengers. Free services specifically aimed at tourists, such as the Melbourne City Circle Tram, is one example of a targeted program. Zero-fare programs have also been used as a short-term marketing strategy, although there appears to be little increase in patronage once the fares are reintroduced.

Funding for zero-fare programs can come from a range of sources including government general revenue, specific levies or taxes, universities or private industry. Transit operators, students and the universities all benefit from zero-fare

programs through increased revenue, improved accessibility and reduced demand for on-campus parking.

A key aspect for evaluating a proposed zero-fare transit program is then number of new riders who will be attracted to the service. Given that all the existing riders will also receive a free ride, the cost of a zero-fare program can be quite high on a per new rider basis. Transport research suggests that patrons are twice as sensitive to service quality as to price. Therefore, in larger transport systems where the marginal cost of improving service is low, zero-fare programs may be a more expensive way to buy more passengers.

The hypothetical example of the Swan Hill city bus systems shows that where passenger volumes and service levels are low, a zero-fare system is a good way of increasing patronage. Further research could focus on replacing the estimated elasticities and passenger volumes used in this example with real data, and on comparing the effectiveness of zero-fare systems between small and large transit systems.

References

- Balcombe, R, R Mackett, N Paulley, J Preston, J Shires, H Titheridge, M Wardman & P White. 2004. "The demand for public transport: a practical guide." *TRL Limited* .
- Brown, Jeffrey, Daniel Baldwin Hess & Donald Shoup. 2001. "Unlimited Access." *Transportation* 28:233–267.
- Cervero, Robert. 1990. "Transit pricing research." *Transportation* 17:117–139.
- Helft, Miguel. 2007. "Google's Busses Help Its Workers Beat the Rush." http://www.nytimes.com/2007/03/10/technology/10google.html?_r=1 last checked May 2008.
- Hensher, David. 2003. "Congestion Charging: Lessons from the first 6 months of the London experience and its scalability to Sydney." *Road and Transport Research* 12(4):61–65.
- Mees, Paul. 2000. *A Very Public Solution*. Melbourne University Press.
- Shoji, Kenichi. 2001. "Lesson from Japanese Experiences of Roles of Public and Private Sectors in Urban Transport." *Japan Railway & Transport Review* 29:12–18.
- Train, Kenneth. 1981. "The Salt Lake City Experiment with Short Term Elimination of Transit Fares." *Transportation* 10:185–199.
- van Goeverden, Cees, Piet Rietveld, Jorine Koelemeijer & Paul Peeters. 2006. "Subsidies in public transport." *European Transport* 32:5–25.
- Ward, Colin. 1991. "Freedom from fares." *Town & Country Planning* pp. 273–275.
- Wikipedia. 2008. "Zero-fare public transport." http://en.wikipedia.org/wiki/Zero-fare_public_transport last checked May 2008.