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**Measure No.12: Public transport enhancements**

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**Improvements to existing public transport networks and vehicles in a city.**

Cities can encourage greater use of public transport through more reliable, frequent or quicker services, by increasing network coverage, or by making improvements to the quality of vehicles and facilities.

## 12.1 Context and background

Demand for public transport is a 'consumer good' which means that as well as price, a range of qualitative factors, such as, frequency, network coverage, and speed will also influence consumer's choices. As a consequence this review will cover a wide range of potential interventions which might impact on availability and use of public transport in a location.

To facilitate the use of public transport, operators and municipalities aim to make ticketing systems as easy and attractive as possible. Developing what might commonly be termed integrated ticketing, but also embracing 'through' tickets, and 'cross-ticketing'. In such products pricing structures and information might be made coherent between different public transport operators and potentially valid for all modes in one specific region. Integrated tickets are not necessarily smart (regarding the technology), in fact in many cases they are likely to still be paper-based.

Key messages:

- Quality changes are likely to have a positive effect – albeit more related to existing passengers than those choosing to change their mode of travel.
- Effects of enhancements are likely to be more significant in the longer – rather than the shorter-term.
- Interventions are often delivered as part of a package of changes, making it more difficult to isolate the effects of a specific features such as low-floor access or Wi-Fi.
- Increased public transport ridership can be encouraged by low(er) cost travel passes, but this may come at an unsustainable cost to operators and municipalities.
- Success may not be a simple matter of encouraging additional passengers, as this may come at a revenue cost which is not sustainable over time, possibly confounding short-term calculations of cost-benefit.
- 'Free travel' can help new services to gain momentum, but free public transport can be a costly policy, particularly if patronage levels increase significantly.

Potential interventions

- Additional services, whether that be more frequent running of an existing route, or the introduction of new routes
- Quality improvements (better vehicles, better seats, Wi-Fi etc.)
- More accessible vehicles (for example low-floor vehicles which improve access for elderly, disabled, mothers with children etc.)
- Subsidies (concessionary passes, student passes etc.)
- Fare incentives (lower fares, 'free fares', etc.)
- Integrated Ticketing*

## 12.2 Extent and Sources of Evidence

There are extensive amounts of evidence available in respect of this particular measure, in part because it covers a wide range of interventions. There is also a longstanding interest from policy makers, planners and academics in what effect changes to public transport services might bring (in both the short and long term), and much material related to this to draw on. In particular there is a strong body of material around 'elasticity's of demand' in response to particular changes. It is the case though that much of the evidence is contained in review documents, is relatively general and generic in nature.

Perhaps the key material which underpins the review is found in body of work addressing elasticities of demand, for example the TRL report from 2004[1,] and the subsequent reviews of similar material (for example from Australia[2]). These wide-ranging review documents have been supplemented here with evidence drawn from specific implementations of additional levels of service, in particular in respect of bus services. This is an area that has received extensive academic interest over the years, and still generates material currently. This extensively-researched knowledge base provides public transport operators with an important baseline from which to consider service enhancements, and to be able to forecast the likely impacts of any change they might make.

Looking beyond enhancements such as additional and more frequent services, attempts have been made to find evidence which considers the effects on likely demand of a range of other improvements to services, whether that relates to the quality of the vehicles themselves, or the facilities they offer. Evidence here may be at a range of scales, from individual routes through to whole networks. It is worth noting that this has not proven to be as straightforward as hoped for, and in fact that it has been difficult to find post-implementation material that explicitly looks at quality of service changes such as installing 'leather seats', moving to low-floor buses, or providing 'free' Wi-Fi.

The other principal aspect of public transport services considered in this review, and one for which there is a wide range of material available, is ticketing, and more specifically the approach of 'integrated ticketing'. The evidence on integrated ticketing is introduced via a major review of integrated ticketing systems carried out for the UK passenger transport executives (major urban conurbations) in the late 2000s, which is further illustrated with specific examples of ticketing interventions in a range of European contexts. These types of intervention are being deployed at a range of scales, from individual routes to city-wide (or wider) implementations. It should be noted that smart-ticketing is dealt with in Measure 15, and the ticketing solutions discussed here are reviewed for the role that the intervention plays, not the medium the ticket is deployed on.

Allied to ticketing of course is the fare charged for travel, the primary influence on demand that the evidence relating to 'elasticity' focusses on. Although this measure review does not address ticket pricing per se, it does review evidence in respect of 'free' travel, in respect of particular interventions that have set up reduced cost or free services. To that end, concessionary fares in the UK for older and disabled people are reviewed, as are free systems in European countries, and a student scheme from the US which offers a zero marginal cost for use. Although there have been a number of long-running 'free' public transport schemes in European countries, there is limited evidence as to the effects and impacts of such schemes. Thus most evidence reviewed here comes from a review paper that considers a number of these schemes, It is acknowledged though that there is a shortfall of evaluation literature around more recent free schemes such as that in Tallinn in Estonia.

## 12.3 What the Evidence Claims

The evidence reported on here begins by exploring some fundamental econometric underpinnings relating to demand for public transport services. At its most simple, the demand for public transport can be seen to reflect on a range of factors related to the provision of services – not least the price of such services. Having

an understanding of how the public might react to price levels in bus, tram and rail has been seen to be an important factor in understanding the benefits to be achieved from using price as a tool to achieve goals in public transport use. Being able to understand the relationships between price and demand levels is particularly important when services are being provided by the state / municipality, with control over subsidy levels, as opposed to more market-orientated environments (such as that experienced in the UK post the 1986 deregulation of public transport for instance). Some considerable effort has then been invested in understanding the underlying supply / demand relationships in this area, and this has resulted in a significant body of work on the elasticity of demand in response to price, and a range of other factors. This Measure Review will not focus on 'pricing' per se, although concessionary and free services will be considered below, but will reflect on other interventions related to public transport provision such as improved levels of service, additional routes, better vehicles, etc. Generic studies have taken place on the elasticity of demand related to these factors, and these will be further illustrated with evidence from specific examples.

The second part of the evidence will look in particular at the area of ticketing and how interventions in this area can make public transport more attractive to passengers. The evidence here is prefaced by an extensive review report undertaken for the metropolitan transport authorities in the major UK cities in 2009. This sets a general context for how a range of ticketing changes can help encourage use of public transport. This then is supported by reports of a number of specific interventions from around the world looking at the benefits of changes to ticketing strategies.

### 12.3.1 Part I: Extending and improving services:

The 2004 report 'The demand for public transport: a practical guide' from the UK Transport Research Laboratory (TRL) set out to provide a comprehensive analysis of the factors that might influence demand for public transport[1]. It looked to produce quantitative indications of how these factors might influence demand. The resultant study provided an updated set of figures twenty years on from an earlier comprehensive report in this area – drawing on evidence from around the world, and reflecting changes that had occurred in the field of public transport in the intervening years.

Perhaps the most widely estimated effects covered by the report was the impact of changes in price, an area not covered explicitly here in this measure review – aside from the effects of free transport which are discussed below. One key factor which the report underlines is that the effects of change can be short-term or long-term, and that often a longer view of impacts will reflect a much bigger change. In fact immediate change may be significantly different to longer-run changes. A later addition to this evidence suggests that in the longer term (over 5–10 years), the impacts of bus Improvements on patronage are almost double short run (6–12 months) impacts[2]. These studies on elasticity also highlight that there are differences in (fare) elasticity dependant on factors such as gender, age, journey purpose, peak / off-peak, PT mode, location etc.

In addition to the (critically important) impacts of price, the TRL report also identifies seven categories of attributes of transport service that determine quality and which can also reflect on levels of demand. These other factors are considered to a greater or lesser extent in this measure review. For the purposes of this review, the element of any public transport intervention that is perhaps key is around 'service levels'. These can be measured (or described) in several ways, reflecting factors such as frequency of service or the total distance travelled by services. The common approach taken by many studies in this area is to reflect on the total vehicle Kms / Miles travelled. The TRL study[3], and others that followed, find that at its simplest the elasticity of bus demand (passengers) in relation to vehicle km is approximately +0.4 (short run) and +0.7 (long-run) (based on a range of UK studies). Thus, the more distance covered, the more passengers there will be. Within this headline figure there is variation depending on the context of services (urban / ru-

ral, and day of the week. The study did also look at urban rail interventions where the elasticity of demand may be more sensitive, but found less evidence to consider. Other aspects of service levels also have an impact. For example, longer waiting time at bus stops has an average result of -0.64 (longer waiting times, fewer passengers), whilst additional operating hours had an effect of +1 (although across a relatively limited number of studies).

The implication of the findings on typical short run elasticities is that a decrease in fares of say 10% will increase demand by 4%, an increase in service frequency of 10% will increase demand by around 3.5% and a reduction in in-vehicle travel time of 10% will increase bus patronage by about 3%. Hence the 'effectiveness' of bus improvements in patronage terms is driven by the degree to which improvements can act to reduce fares, increase service levels and reduce bus travel time. There are though limits to the interventions that can be made, and their effects on patronage of public transport systems. For instance, fares cannot be reduced by more than 100%. Hence a bus improvement offering free fares can only ever increase patronage by a maximum of around 40%. Similarly reductions in bus journey times greater than 50% would be unlikely. Hence bus improvements achieving 50% travel time reduction can only ever hope to achieve a 15% growth in patronage. Service levels, however, can be increased more than 100% (although the evidence and common sense indicates diminishing elasticities as service levels increase). This suggests that increases in service level (frequency) might be the measure which might achieve the highest bus patronage growth, assuming money was no object. UK experience has shown that: Improvements to bus frequency demonstrate the greatest proportional and absolute growth in bus use. Typical frequency increases (20–30%) can be expected to deliver patronage gains at around half of the level of service increase.

*Service enhancements:*

The first specific example of the effects of interventions to increase service levels is taken from Melbourne in Australia in the mid-2000s3. In this instance two sets of measures were being undertaken in respect of bus routes. These were broadly classified as 'mass transit' and 'safety net' enhancements. The former provided additional capacity on what were seen to be premium trunk routes, in order to increase numbers of people using public transport, whilst the latter added capacity to help avoid social exclusion issues in specific communities and at specific times (i.e. weekends). Many of the additional services / more frequent services under the transit enhancements were branded as 'SmartBus' routes.

In the year to August 2007, bus patronage grew at a rate of around 4.6% per annum, which was seen to be historically very high. Three quarters of the absolute growth in patronage was attributed to routes that had been added, extended or upgraded over the previous two years. In contrast, routes with unchanged service levels had only grown at an average of 1.3% per annum in the same period. In circumstances that were seen to favour increased bus patronage, the study here finds that this is the case only when routes are operating at a 'reasonable' service level. This is suggested to be seven days a week, with half-hourly or better frequencies. Routes not meeting these levels are still seen to be in decline. SmartBus routes are seen to have generated patronage growth over and above any growth in service mileage after 2-4 years – and this is seen to include an element of 'mode switch'. The increases in service levels to address social transit needs were also seen to be successful, and to be 'highly likely' to be reducing social exclusion issues in the many areas of Melbourne that previously suffered from poor mobility.

Although not explicitly covered in this paper, reference is made to an 'unpublished' financial evaluation of the wider development program for the public transport network in Melbourne carried out by Metlink (the local public transport marketing body). This was reported to state that that the BCR for the expanded local bus services was 1.9, whilst across the full package of changes this BCR rose to 3.0 (about half of which was attributable to congestion cost savings). The evidence made sev-

eral suggestions as to other factors that might have contributed to the success of the SmartBus corridors/routes. These reflected on wider issues around travel in Melbourne at the time such as levels of congestion, as well as macro-economic factors such as rising fuel prices and mortgage interest rates. Both of these latter factors seen to be influencing commuter location/costs. It is noted that there will be an impact from such factors in levels of demand.

The second example of additional services being implemented is seen in the English city of Winchester. Here a range of interventions around the bus services in the city were taking place, including increased frequency of service on a number of cross-city routes (for example from 4 to 6 buses an hour on one route). Several routes saw changes under the banner of becoming Quality Bus Partnership routes (QBP), and levels of patronage on these routes were compared to 'control' routes that were not receiving the same interventions. Results showed increases in numbers of passengers for the two QBP routes, but decreases for a third and the control routes4. One of the QBP routes, the X5, experienced a 25% patronage increase from 2002/2003 to 2004/2005, whilst the control routes saw decreases consistent with the average decline in England (outside London) of around 4.5% in bus patronage during the same period. About a quarter of passengers on the X5 used the service more since the changes were introduced. The three most positive influences were the frequency of service, comfort of travel on the new buses and bus traveller information. New users of the X5 stated that frequency of service was the top positive influence in attracting them to use the bus. There was an overall patronage increase on the three QBP bus routes of 12%, meeting the 8% target set in the QBP. The frequency increase for the X5 service would suggest (using the elasticity models derived by Balcombe et al 2004) an increase in use of some 20% - which in effect was 25% here, supported perhaps by the other elements within the package?

Results show that when user and non-user benefits are taken into consideration, the investment made by both the operator and the local authority to improve these bus services is recovered within 5 years. This is well within the expected life of the new vehicles and, therefore, the investment has been shown to be justified. However, from just the operator's point of view, the investment they have made will take 12 years to recover, which is still less than the life expectancy for the buses of 15 years. One factor cited in the success of the changes on the X5 was that it linked many high density residential areas, with passengers from these estates likely to have no real alternative to the bus. The route also served destinations with high passenger demand such as two major supermarkets, the city centre, the railway station, a business park, and the residential areas at either end of the route.

Reorganising Public Transport services to rationalise them, as well as introducing higher quality vehicles and facilities was an approach used effectively in the CIVITAS Mimosa programme on the island of Madeira. An evaluation of the new 'Green Line' service in the major tourist location of Funchai shows that making such changes can increase patronage whilst also reducing costs and boosting revenue5. The changes to service frequency and routes provided an opportunity to not only resolve public transport demands for residents in the tourist quarter, but also provided a new service which hotels and other tourist destinations could promote (and sell tickets for). By deploying new, Euro 5 specification buses, the service was also able to address a range of emission and air quality targets, and accessibility levels that assisted less able travellers. This implementation provides an example of where consideration of existing routes and services offered a new solution which optimised services to allow for growth in patronage at a time when other services on the island were exhibiting decline.

*Quality enhancements / improvements:*

There are a range of other 'improvements' that operators of public transport services could make in order to 'improve' the perceived quality of the services – and thereby improve patronage levels. These include improving the quality of the vehicles used, and by offering additional services

on the vehicles. This might include Wi-Fi access for example, or better quality seating, or air conditioning for instance. Some of these factors have been tested in the econometric analysis, but there appears to be little independent evidence available to substantiate benefits. Such 'soft' improvements are not expected to increase bus patronage by more than a few percent, with air conditioning, CCTV and a smoother ride seen to have the greatest impact, but even then unlikely to be more than 2% for each intervention / measure[2].

Another improvement in buses in particular is the introduction of 'low-floor', or easy access vehicles. In part driven by the need to meet legislative demands in respect of access to transport for the disabled, such 'accessible' vehicles also provide incentives for other potential bus users. For example, mothers with small children, or the elderly who might be less able to access vehicles with steps. Low floor buses have been proved to enhance accessibility for wheelchair users, parents with young children, and older people in general. They have led to significant increases in demand for some services (5-10%) although results are seen to vary from place to place. No real effect seen on some early UK routes, although slight increase in demand on one London route. The case study in Winchester also had the opportunity to explore the effects of use of low-floor buses, as theses were deployed on the X5 route when service frequency was increased. Although the authors did explicitly look for the effects of the low-floor vehicles there was not a strong impact seen.

*Fares / Subsidies / concessions:*

As noted above, changes to fares on public transport can have well understood impacts on levels of patronage and on revenues for operators. This means that interventions such as subsidies (concessionary passes, student passes etc.) and fare incentives (lower fares, 'free fares', free transfer etc.) can be used as tools to boost numbers of people travelling by public transport. As the evidence put forward in the TRL report makes clear though the interplay between passenger numbers and revenue needs to be considered carefully, as does the impacts on alternative routes and networks. Changes need to be made in the context of the fact that there will be short-run (1-2 years) and long-run (12-15 years) effects. The report also cautions that whilst fare increases may improve revenue in the short term, it will likely decrease in the longer-term, and attempts to counter falling revenues with increased fares will eventually fail. To reverse negative trends in patronage levels on public transport will require service improvements, as well as possibly fare reductions. Completely free public transport may at first sight seem to be an attractive option for encouraging a shift to public transport use. The experience reported on in a review of such schemes is though less affirmative[9]. The review instead suggests that evidence suggests instead that free public transport offers poor outcomes, and comes at a high cost. The TRL report also makes some specific observations on 'free travel'. Firstly, that there is no convincing evidence that free travel diverts journeys from private cars to public transport, and secondly that offering concessionary fares to certain groups of passengers is likely to result in additional trips being made by those people as opposed to passengers in general.

The main impact seen in the free-fare case-studies considered is a huge growth in patronage, up to 13-fold increase has been reported in a wide review of such schemes6, of which a significant section are moving from walking or cycling as their normal mode of travel. Effects on car traffic levels are though marginal and typically any modal shift benefits might be lost after a few years' traffic growth. Those free public transport schemes which are seen to be successful, are those which have a goal mainly to grow public transport patronage. Other potential benefits around congestion and social and environmental benefits are seen to be best achieved through more targeted measures, or in combination with such measures.

Notwithstanding this general weakness as an intervention, the free travel review[6] does suggest two situations where a free scheme may be appropriate, and effective.:

- For promotions of limited duration. So for example, a new service

might gain momentum if it is launched with free travel – for a limited time. Such a campaign can, raise the profile of a route, making the population aware of existing public transport following enhancements to the service (or perhaps following a service interruption).

- When the cost of operating a ticketing system and related activities exceed ticket revenues. Free public transport may be a pragmatic solution when the ticket income is very low.

The review also adds a note of caution to those municipalities thinking about introducing a 'free-fares' scheme. Free public transport can be a costly policy, particularly if patronage levels increase significantly. If this is the case, then funds that might have been spent on more targeted solutions may be displaced. The review also suggests that there is evidence that free-fare schemes have been abandoned because of high (and rising) costs, and with growing evidence that fare increases have larger effect than similar fare reductions the overall outcome of introducing free fares and later withdraw the scheme can be highly negative. This means that free fare schemes will require broad political support and long term commitment.

Free public transport introduced in the City of Tallinn (Estonia) for registered residents of the city has increased numbers of people using public transport[7], although passengers still need to check-on and off the bus using a smartcard. After the first year of this scheme, there was a claimed 6% increase in public transport users in the city, with car use in the city centre reducing by 5%. Whilst the measure is seen as successful, it has increased transport subsidy costs for the municipality, albeit offset in some respects by more local income tax from those registering for the new travel card if they were not already known to city authorities. There is no official analysis of the impacts of the intervention available as yet. Tallinn is one of a growing number of cities and towns that are experimenting with free public transport. Nysa in Poland (population 58,000) allows motorists to travel free on local buses on presentation of their drivers licence and vehicle registration documents. Surveys of passengers have shown additional passengers, and that some people travelling for free had not used public transport previously. Some users were travelling for free who had paid before, but the municipality was absorbing the relatively limited shortfall in revenue, and those who had swapped mode had not been paying for the bus beforehand so made no difference to revenue. Claim were being made about improved air quality, and noise levels in the town centre, as well as reduced numbers of cars. As for Tallinn though, there is no official analysis of the scheme available as yet.

An alternative to making all travel on public transport free is to offer free travel for a group of travellers who may be seen to be mobility disadvantaged. This is the case in the UK, which provides free travel on buses for older and disabled people outside of the morning peak period. Various schemes were introduced in different UK constituent countries (e.g. Wales, Scotland, England) during the early 2000s, culminating in a 'national' scheme in England in 2008 which allowed free, or 'concessionary' travel across the whole country for those over the age of 60, or who experienced a range of disabilities or health issues. The effect of this scheme on demand for public transport was explored in a report commissioned for the Department of Transport in 2008[8].

The results from the study show that concessionary fare schemes had a significant impact on bus travel of the over 60s, reversing what had been a trend of declining use. In fact, the modelling carried out in the study suggested that without free travel, total bus trips by eligible individuals would have declined by up to 3.0% per annum in cities and a slightly lower rate in rural communities. This would have been almost entirely due to growth in car ownership and driving licence holding amongst those over 60. Instead, trip rates and distance travelled were both seen to increase with the introduction of concessionary travel. As predicted by the report's authors, the free bus travel results in greater bus use than earlier incentive schemes that made use of half, flat and hybrid fares. The model developed in the report predicts that free fares had the effect of increasing bus travel by eligible individu-

als in 2008 by 26% in the urban areas and 45% in rural ones relative to the non-concession alternative. This is equivalent on very simple assumptions to a full fare elasticity of -0.47 (urban) and -0.75 (rural). This elasticity represents the change after 2 years, although the author's expect that over time the elasticity would be greater. Other quantification of the benefits in respect of mobility-exclusion have been less visible, although that is still seen as the primary driver of the policy in the UK. Introducing the concession across the whole population of those over 60 has led to concerns being raised about the cost of the scheme, with the reimbursement to operators in England alone being over £1billion currently. Some attempts are being made to now reduce costs, with higher age thresholds before people qualify for the pass now in place.

Another option is to offer travel at a zero-marginal cost at the time of travel. Whilst this is effectively how season tickets or travel passes work, there are also subsidised passes which are intended to increase use of public transport. One example of this is found in the study of the 'UPASS' at the University of Wisconsin-Milwaukee (UWM) in the US[9]. This pass provided students with unlimited travel on any local bus route at any time, to any place, and for any trip purpose with no additional fare. All students were able to acquire a pass, paying a fee via their tuition fees. Introduction of the new pass was partly driven by parking constraints in and around the University. Approximately 10% of the students who were driving to the university in spring 1994 had shifted to transit a year later, although the largest group shifting consisted of those who had previously walked to campus (28%). In general, the program reduced vehicle trips to campus, increased transit ridership, and reduced the overall impact of vehicles. There was a perception that the parking situation around campus had improved since the implementation of the pass, with a strong 'approval' rating for the scheme from students. Some students surveyed also indicated that the travel pass had influenced their decision to attend the university, their decision as to whether to purchase a car, and had even allowed some to find employment. Several changes had to be made to bus services to accommodate the additional demand. This included additional buses on one route, two new express routes and improved schedules on other routes.

*12.3.2 Part II: Ticketing:*

Noting the issues and effects above in respect of 'free' travel, the other area in which interventions can be made in respect of increasing public transport patronage is around ticketing, more specifically the value and usability of a ticket for passengers. There are a wide range of interventions available, covering what might be termed as 'integrated ticketing', allowing access to more than one route and / or mode, as well as options which facilitate travel at minimal marginal costs such as season tickets, or travel cards. For many municipalities, the overarching idea of a multimodal transportation ticketing system is to combine all modes on a single ticket, making the ticketing system as easy and attractive as possible. Such an Integrated Tariff System (ITS) allows users to consider the whole public transit system within a specific area (urban, metropolitan, or even regional), as if it were organized by a sole firm offering a single service.

*Integrated ticketing:*

The benefit of using an integrated ticketing approach was considered in a major study undertaken in 2009[10]. This literature review identified case studies from major urban areas across Europe, North America and Australia that had qualified and quantified the benefits of a range of integrated ticketing schemes implemented between the early 1980's and 2008. The review was completed primarily by way of desktop analysis, although this was supplemented by direct contact to some individual agencies and industry associations. The review 'identified' the following range of benefits of these integrated fare products:

- Increased patronage
- Increases in recorded passenger satisfaction
- Evidence of resulting modal shift; the review notes though that there is limited quantitative evidence to support a link between modal shift and

fare integration, although some research they reviewed did suggest an increase in public transport usage.

- Increases in revenue
- Reductions in transaction and administrative costs
- Social benefits
- Reductions in fraud
- Wider contribution to city life and identity;
- Acquisition of accurate data on passenger behaviour enabling better capacity and network planning; and
- Faster boarding times enabling buses to run more reliably, faster and frequently

Whilst the review identified a wider range of benefits of integrated fare products, the most commonly reported benefit was increased patronage, and it was only in this context that the review found robust evidence in case studies. Some of the specific findings from the review include:

- Drawing on evidence from London, Europe, Australia and the US, the review found increases in patronage in the range of 6% to 20%, with some individual modes experiencing up to 40%.
- There was limited evidence to support increased revenues, with reported increases varying widely from a 1% to a 12.6% increase in total revenue.
- Although some case studies suggested an overall increase in public transport usage, there was limited quantitative evidence to support a link between modal shift and fare integration (the case study considered here was Freiberg in Germany).
- There is some evidence to suggest improved satisfaction from fare integration primary due to increased convenience and fare savings (from UK and US)
- There is limited evidence of faster boarding times as a result of integrating ticketing, with some transport modes experiencing in order of a 10% reduction in passenger in-vehicle time; (From London and US).
- There is limited evidence to suggest that integrating ticketing in isolation has reduced fare evasion. Rather the reduction in fraud has usually been associated with integrated fares as well as a change in fare medium;
- There is only anecdotal evidence to support a reduction in transaction and administration costs from simplified and integrated ticketing.

The report also highlights the following issues with the evidence that they collected:

- The benefits of integrated ticketing are often seen to be significant, yet the post-implementation evidence of these benefits is often not captured and/or reported on in the public domain.
- The evidence that is available can be variable in both quantity and quality, with a focus on patronage levels and revenue for operators. Few studies were seen to have isolated the impact of the introduction of integrated ticket products per se, and in much of the material reviewed it was unclear what effect other factors might have had on observed outcomes.
- The study was focussed on evidence of integrated ticketing whatever the ticketing media (paper, magnetic stripe and contactless smart card).

*Ticketing interventions:*

As well as the findings of the review noted above, there are a range of ticketing-based interventions that provide evidence of specific approaches that can impact on public transport demand. One area that has received scrutiny is in the use of season tickets, or passes. The impact of the introduction of this sort of intervention has been reviewed in a range of Swiss cities over the 25 years from 1971-1996[11]. A feature of these season passes in Switzerland is that they are 'transferable', allowing more than one person to use them (although not at the same time of course). Econometric evidence was studied from four Swiss cities (Basel, Bern, Geneva and Zurich) following the introduction of deeply discounted season tickets in the mid-1980s. This was seen to have had a considerable positive impact on public transport use. The passes allowed people to transfer across modes and operator. The introduction led to 8.5% more trips in Basel, and an increase in passenger demand in Bern after the pass was extended to all operators in

the city. This was an interesting feature of the scheme in this city, as although 80% of services were provided by one operator it was only when the 'feeder' services to the city network were included that use increased.

The authors of the Swiss study suggest that Season ticket innovations are most likely to succeed when the public transport network offers a dense, frequent and fast service, which will offset the fundamental time and cost disadvantages of public transport relative to the private car. In addition, the imposition of complementary traffic restraint measures, such as large scale pedestrianization and central parking restrictions, may also be important in promoting modal change away from the cars. It is noted however that the city of Zurich had achieved high levels of public transport use without substantial pedestrianization.

The use of a 'travel card' across the whole transport network in the Madrid region between 1979 and 2001 is also seen to have positive results[12], with demand growth rates of 7% to 15% in seen in the long run. This study was not just interested in patronage levels though as it also evaluated the impact on revenue of the introduction of the travel card scheme. The number of passengers using public transport in the region grew from 951 million in 1986 to 1549 million in 2001, with patronage increasing at an annual rate of 2.2%. Results from the study suggest that the introduction of travel cards led to a growth in bus and underground patronage of 3.4% and 5.3% in the short-run, and 7% and 15% in the long-run, respectively. The market share for travel cards in 2001 exceeded 60%. The high market penetration of the low-cost travel card has though had a negative effect on operator revenues. So although the evidence here suggests that a declining trend in public transport ridership can be reversed through a policy based on low cost travel passes and improvements in the quality of services, this may come at the cost of overall revenue.
Finally in respect of integrated ticketing, empirical evidence on the impact on patronage of the introduction of such solutions in an Italian context was considered in a 2009 report[13]. This study undertook econometric analysis on a panel of 69 Italian local public transport companies over the period 1991–2002. It reviewed the effects of various qualitative features of the service (i.e., average speed, frequency and density), with the ultimate goal of evaluating the shifts in LPT demand due to the provision of an integrated ticketing system. The results show that such systems exerted a demand increase of 2% in the short-run, and up to 12% in the long-run. Three particular features were highlighted for their impacts:

1. Integrated ticketing for a single trip. In particular, within the urban networks it seemed to be important to give travellers the opportunity to choose an integrated ticket for a single trip. This is perhaps more relevant to urban areas, and/or travellers making one-off journeys as opposed to commuters who are more likely to buy season tickets. This study estimated the effect of this sort of measure to be around 7% in the short-run and as much as 26% in the long-run.
2. Zonal Pricing. The introduction of zonal pricing shows a positive impact of a similar magnitude on demand, since such pricing better discriminates according to users' needs: for example, by increasing the option of short distance/less expensive trips (e.g., by offering different travel cards to be used in the historical centres only rather than throughout the whole network).
3. Extension of integration beyond the urban area. This is estimated to induce an immediate shift of demand of 5%, and can, in the long-run, produce an increase of passenger-trips of around 25%. The positive effects seen here are more likely to emerge the higher the quality of the LPT service is, in terms of network density, frequency, inter-modal coordination, and whether other policies to encourage bus use are implemented in parallel.

### 12.4 Lessons for Successful Deployment of this measure

The evidence presented in this measure review has looked at a range of scales of intervention, and in a range of implementation models from full cost subsidy to scenarios where the changes have to

be self-financing over standard expectations of commercial return. Changes have ranged from individual routes being modified, through to wider-scale network changes. Key lessons emerging from the evidence include:

- Understanding the underlying elasticity of demand relating to supply and quality of service allows a more nuanced response to changes in service provision.
- Whilst service-level enhancements can be deployed at the level of an individual route with a reasonable expectation of positive change, some of the integrated ticketing interventions seem to be best deployed at a larger scale.
- Political will and funding are required if fare reduction schemes or free travel are offered as a way of increasing patronage levels. Whether the required level of support is justified may well depend on other financial benefits for local/national authorities. For example, in Tallinn, Estonia, citizens were offered free bus travel if they were registered for income tax.
- Public transport enhancements are more successful if accompanied by demand restraints on use of the private car.
- Ticketing integration can become more effective if it is extended beyond the urban area.

It is unlikely that wider scale deployment of 'free travel' will find favour outside of the specific circumstances considered above. As has been experienced in the UK with concessionary fares for older people, what may have started as more of a political imperative has now become an expensive, and universal support scheme for a growing part of society, and one which is now exercising political debate as to its long-term viability in a time of reducing public budgets.

Many of the interventions reported on here have explored the factors which have contributed to their success, over and above the intervention itself. In most cases this is some form of restraint, or demand constraints on use of the private car. In general there is little coverage of modal change in the results reported on here, and this would be one area of evidence that would be a useful addition to what is considered above.

### 12.5 Additional benefits

As well as the evidence of economic and financial benefits of interventions discussed above, there are a number of additional benefits that are claimed for these policies:

- Social Inclusion. Enhancing public transport can bring social inclusion benefits by providing new or additional services to areas not previously well-served, as well as improving accessibility levels for less able travellers. Free and concessionary fares can also help address affordability issues for some groups in society, again helping them to access services and facilities, as well as participate in society.
- Air quality. Claims are made for improvements in levels of emissions and air quality from moving to newer, higher quality, public transport vehicles.
- Congestion / Modal shift. The provision of free travel is claimed to have led to reductions in congestion and some transfer from car use in the cities that have implemented it (although there is limited evidence at present to support this.)

### 12.6 Summary

Much of the evidence presented in this measure review is econometric in nature, and is based on ex-post evaluations of interventions. In some instances this has been undertaken relatively quickly after an intervention has taken place, although there is an understanding supported by the literature that long-run effects are likely to be more significant. In support of this, evidence has been presented here that covers significant periods of time, twenty plus years in a number of instances.

More evidence is needed of the impacts of quality improvements before the impacts of interventions such as Wi-Fi can be clearly articulated, but some effect from these sorts of changes is likely – albeit more related to existing passengers than those making modal change choices.

What the evidence does expose in respect of interventions related to this measure is that there are perhaps competing goals at play, with increased patronage not necessarily the (only) desirable outcome. There are a number of interventions discussed above which will generate increased use of public transport, but this may be at an unsustainable cost to operators / municipalities. Thus success may not be a simple matter of encouraging additional passengers, as this may come at a revenue cost which is not sustainable over time. Understanding the underlying elasticity of demand in relation to a range of factors to do with supply and quality of service allows a more nuanced response to changes in service provision, and allows for a better use of resources.

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**Author information for the Evidence Measure Reviews**

| | | | |
|---|---|---|---|
| No.1 | Electric Battery and Fuel Cell Vehicles | Hüging, H[1,a] | hanna.hueging@wupperinst.org |
| No.2 | Cleaner Vehicles | Rudolph, F[1,a] | frederic.rudolph@wupperinst.org |
| No.3 | Urban Freight | Ricci, M[2,b] | Miriam.Ricci@uwe.ac.uk |
| No.4 | Access restrictions | Melia, S[2,b] | Steve.Melia@uwe.ac.uk |
| No.5 | Roadspace reallocation | Clark, B[2,b] | Ben4.Clark@uwe.ac.uk |
| No.6 | Environmental zones | Calvert, T[2,b] | Thomas2.Calvert@uwe.ac.uk |
| No.7 | Congestion charges | Mingardo, G. & Streng, M [3,c] | mingardo@ese.eur.nl |
| No.8 | Parking | Mingardo, G. & Streng, M [3,c] | mingardo@ese.eur.nl |
| No.9 | Site-based travel plans | Bartle, C[2,b] | Caroline.Bartle@uwe.ac.uk |
| No.10 | Personalised travel planning | Bartle, C[2,b] | Caroline.Bartle@uwe.ac.uk |
| No.11 | Marketing and rewarding | Rudolph, F[1,a] | frederic.rudolph@wupperinst.org |
| No.12 | Public transport enhancements | Shergold, I[2,b] | Ian2.shergold@uwe.ac.uk |
| No.13 | New public transport systems | Clark, B[2,b] | Ben4.Clark@uwe.ac.uk |
| No.14 | Integration of modes | Calvert, T[2,b] | Thomas2.Calvert@uwe.ac.uk |
| No.15 | e-ticketing | Shergold, I[2,b] | Ian2.shergold@uwe.ac.uk |
| No.16 | Traffic management | Clark, B[2,b] | Ben4.Clark@uwe.ac.uk |
| No.17 | Travel information | Calvert, T[2,b] | Thomas2.Calvert@uwe.ac.uk |
| No.18 | New models of car use | Calvert, T. & Chatterjee, K [2,b] | Thomas2.Calvert@uwe.ac.uk |
| No.19 | Walking | Jain, J[2,b] | Juliet.Jain@uwe.ac.uk |
| No.20 | Cycling | Parkin, J[2,b] | John.Parkin@uwe.ac.uk |
| No.21 | Bike sharing | Ricci, M[2,b] | Miriam.Ricci@uwe.ac.uk |
| No.22 | Inclusive urban design | Melia, S[2,b] | Steve.Melia@uwe.ac.uk |


| | | | |
|---|---|---|---|
| 1 | Wuppertal Institut für Klima, Umwelt und Energie GmbH | a | Wuppertal Institut, Döppersberg 19 42103 Wuppertal. Germany. |
| 2 | University of the West of England: Bristol | b | Centre for Transport and Society, University of the West of England, Frenchay Campus, Coldharbour Lane, Bristol BS16 1QY. UK |
| 3 | RHV Erasmus University Rotterdam | c | RHV BV, TAV Martijn Streng, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands |