"TRAVELCARD" TICKETS IN URBAN PUBLIC TRANSPORT

By Peter R. White*

"Travelcard" tickets may be distinguished from traditional season, and multiple-ride, tickets because they offer use of an entire network, or substantial zones within a network, rather than of selected routes and/or fare stages only. There is no limit to the number of journeys permitted within a given period. The typical period of validity is one month; but weekly, four-weekly, three-monthly and annual versions are also available on some systems, and all are included within the range of tickets discussed in this paper. Various marketing titles are used, such as "Bus Pass" and "Ridercard"; but the West Midlands "Travelcard" is perhaps the best-known within Britain, and many other titles are of similar form, so this has been taken as a generic term for purposes of this paper.

Although in Britain the most used form of urban public transport is bus, it must be emphasised that travelcards are generally multi-modal, covering all public transport, including rail, in designated areas.

THE BENEFITS OF TRAVELCARDS
A range of benefits accrue—to operators, to passengers, to local authorities and to employers.

From the operator's viewpoint these include:

1. Reduction in boarding time on one-person-operated buses and trams. Boarding times may be reduced to about 1.5 seconds/passenger; this is especially valuable at peak periods. Unlike other forms of prepaid ticket, travelcards do not require cancelling machines, so an unobstructed passenger flow can be obtained. Random inspection with penalty fares—if

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permitted—may make possible unsupervised entry at all doors on the vehicle, with further time savings.

2. Savings in operating cost through acceleration of existing one-person-operated services, and ability to convert existing two-person-operated services without unacceptable delay.

3. Simplification of cash handling and control, through payment in advance. Reduction in range of existing station-to-station rail seasons, reducing clerical work.

4. Improvement in cash flow. Revenue received in advance is equivalent to a saving of interest on short-term borrowing. (This may be offset by the discount on longer-period tickets.)

5. Network rationalisation (for example, converting trunk bus routes into rail feeders) may be possible as a result of reducing passenger interchange penalties (see below). The high-cost section of bus routes, over congested roads into the city centre, is thus removed.

6. Marketing and “image”. Handling of small sums in cash, reminiscent of traditional meter payments for gas and electricity, is avoided, and a form of payment similar to that of many other modern consumer goods is adopted. In some cases the travelcard may resemble a standard-size credit card.

7. Enforcement of non-transferability and monitoring of use. Polaroid photographs and facsimile signatures make transfer between passengers almost impossible.

From the passenger’s point of view one may add:

8. Increased convenience. The need to worry about fare required (especially for “exact fare” systems) is virtually removed. Interchange also is made far easier, and does not incur a penalty such as the high fares for short distances found on the typical “tapered” fare scales used by most operators. (For example, on West Yorkshire PTE scales in February 1980, a five-mile journey on a single ticket costs 44 pence, two 2½-mile journeys forming part of a linked trip 62 pence.)

9. Additional journeys incur no fare. Thus extra trips, such as returning home to lunch from work, weekend leisure trips, etc., are “free”.

The local authority, in addition to any direct role as a public transport operator, may gain by:

10. Changed relative perception of costs. Cost perception for bus is placed on a similar footing to that of a private car, and is made less direct, as the cost is incurred on a periodic basis rather than each time a trip is made. This may help to retain public transport patronage, and in some cases may assist diversion from cars to public transport. The practice may be extended by accepting renewal of travelcards by banker’s order, and thus making renewal virtually automatic, as in Hamburg.1

1 In October 1977 some 35% of the weekly, monthly and annual tickets were renewed on a subscription basis rather than by individual purchase (direct communication from Hamburger Verkehrsverband).
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11. A statutory duty placed upon local authorities is to encourage co-ordination of existing public transport services provided by different operators. Establishment of a travelcard scheme, greatly reducing interchange penalties, may assist considerably in achieving this objective.

Employers (other than transport operators) also benefit:

12. It is already customary for employers to offer travel benefits, in kind if not in cash, to their employees. These include free parking, "works" buses on which no fares are charged, company cars, etc. It is difficult for employers to assist in this manner in the use of conventional public transport (where cash fares are paid) except through cumbersome issue of tokens. The travelcard provides a simple product that the transport operator can sell to employers, who may thus be able to make savings on provision of parking, works buses, etc. In some US cities car users are being encouraged to trade-in free parking spaces for a free, or reduced-rate, travelcard. Encouragement of modal shifts in this manner may also help local authorities to achieve their objectives. In Britain the use of travelcards by employers is inhibited by income tax rulings, which tend to define the travelcard as a taxable benefit.²

TRAVELCARDS IN BRITAIN AND WESTERN EUROPE

The use of travelcards has spread rapidly in recent years. That in Edinburgh (now Lothian Region) was established as early as 1957, and those in some West German cities around the same period. However, the really rapid expansion dates from the Stockholm card introduced in 1971: in Stockholm over 70% of all public transport trips are now made by holders of the monthly or annual card. Similar proportions are found in Hamburg, Paris and some other large West European cities. In Britain the greatest degree of use is probably in the West Midlands, around 20% of all public transport trips.

In two instances experience has been less satisfactory: full reasons will be discussed in the forthcoming discussion paper (White, forthcoming). In London, the "Red Bus Pass" has attained a limited market penetration, which reached a peak around the end of 1976. The Bus Pass was initially priced at a low level, and gained custom as single prices rose in 1975, but subsequently its price was increased more rapidly in real terms than single fares. The approach has to some extent been half-hearted, and use was never sufficient to permit significant increases in one-person operation or bus/rail rationalisation. In addition, travelcards in London have been largely bus-only, or sold as "add-ons" to rail-based seasons, in contrast to the all-modes patterns now commonplace elsewhere. Another brake on sales has been the low service quality of buses in London.

In Oslo, a travelcard was introduced in 1975, at a relatively low price aimed at attracting car users. Total public transport use increased slightly as a result, but with some revenue loss, and there was a much steeper price rise (no less than 50%) for

² Some of these problems have now been overcome by London Transport, which has introduced, in conjunction with Luncheon Vouchers Ltd, "The London Traveller Ticket". This is sold to employers direct, with arrangements to suit each firm.
single tickets than for monthlies in March 1976. "Social" rather than operational arguments seem to have prevailed in this case.

In general, the travelcard system, and other forms of prepaid travel, are less extensively used in Britain than in other parts of Western Europe. To some extent station-to-station rail seasons may fill a similar role, but most bus passengers continue to pay cash single fares. The later development of one-man operation, not yet universal, and differences in vehicle design provide part of the explanation. Elsewhere in Western Europe articulated single-deckers, bus and tram, have been used extensively. These permit multiple entry and exit, but the full time-saving potential at stops can only be obtained if a high proportion of passengers have prepaid tickets. In Britain the articulated single-deckers have been permitted only from autumn 1980, and the double-decker with entry adjacent to the driver remains the standard high-capacity vehicle. Tramways have largely disappeared: this has reduced both the scope for articulated vehicles and the need to overcome bus/tram interchange penalties.

Another major difference between Britain and most other parts of Western Europe lies in finance and fare structure. Low flat fares, common elsewhere, lend themselves to pre-purchase, either in multi-ride or in travelcard form. Once the price is attractive to the regular user, virtually all users (on the same flat fare) will display a similar response. Conversely, on the graduated fare scales general in Britain a travelcard will attract only those regular users whose trips exceed a certain length, and a very low price might be needed to obtain high market penetration. The graduated fare scale has also been associated with the higher proportion of costs covered by passenger revenue in Britain (about 75%, compared with under 50% in most continental cities). As I shall show later, the long-run development of a travelcard pricing policy need not conflict with the aim of covering a high proportion of costs from passenger revenue, but in the short run the risk involved in getting good market penetration undoubtedly involves some "cushion" of financial support.

On flat fares, one might add briefly that the belief in Britain that these are inconsistent with breaking even is not always supported by facts. Of the few medium-sized urban systems covering at least all operating costs from revenue, two—those in Belfast and in Newport, Gwent—do so on a largely flat-fare network.

The aim of this paper is to consider in greater depth the questions of trip length and price elasticity. Is travelcard use on graduated fare scales necessarily skewed toward those users with higher-than-average trip length? What is the elasticity of demand observed when a travelcard introduced at an initially low price is subsequently increased in price?

TRIP FREQUENCY

It is vital for an operator to know how many trips (or, preferably, passenger-km) are made on his system each year, and their composition by passenger group. The typical travelcard holder makes more trips per period than the user of single tickets, in part because of the zero marginal fare for extra trips, in part because people who make more than the average number of trips are more likely to buy travelcards in the first place. Unfortunately, the quality of data from operators is not what one might wish.
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The term "trip" is itself vaguely defined, and more consistent measures are necessary. Most operators appear to consider each occasion on which a vehicle is boarded as marking a separate trip: that is, transfer from bus to bus or from bus to rail results in an additional "trip" being recorded. This exaggerates the numbers of trips in the sense of activity-changes (for example, home to work) because of the structure of the transport network; the term is used analogously to "stage" in the National Travel Surveys. Thus a passenger making a home-to-work journey by using two buses is considered to have made two "trips", or stages. On such a definition most travelcard holders in large West European cities appear to make about 80 trips per month of four weeks (i.e. 20 per week). This is much higher than home-to-work commuting once a day by a direct route would suggest (approximately 40); it results from interchange en route, additional lunchtime home trips, and other additional off-peak trips. A travelcard is likely to stimulate more off-peak trips than a point-to-point season, because it offers a wider range of destinations (weekend shopping and entertainment centres as well as employment centres). Annual figures are in the range 700–900 (less than 12 times the monthly figure, because of holidays, etc.), but in London up to about 1,150. Some of the higher annual figures may be due to over-estimation, but in some cases the quality and frequency of the public transport system (that is, the probability that additional off-peak journeys can be made at convenient times) may be critical. In some cases, notably London, where the market penetration is small and the ticket price high in proportion to singles, only a small number of users will find it worth while to buy travelcards, and these in turn will make a higher-than-average number of trips. As market penetration increases, a lower rate of trips per holder per period is to be expected.

City structure may be an important factor in determining the frequency of trips made by travelcard holders. In Paris, where a high-density residential area is intermixed with the central core, some users may return home from work at lunch time, incurring no extra costs in consequence, whereas in London this is largely impracticable.

DISTRIBUTIONS OF TRIP LENGTH

Where a flat rate is charged for a travelcard covering a wide area, and a graduated fare scale is in force, the greatest potential net saving accrues to longer-distance passengers. Thus a revenue loss may be incurred because only the longer-distance travellers transfer to the travelcard, while those travelling short distances remain on cash fares. This contrasts with the situation in many cities elsewhere in Europe, where

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2 Attempts at better definitions have been made by the Urban Mass Transit Administration in the USA, which distinguishes "linked" from "unlinked" trips. A comparable standard definition has been introduced in Paris by RATP, and I have proposed a standard set of definitions to cover this and other points for British systems.

3 In Edinburgh a rate of 144 trips per holder per four weeks was assumed when travelcards were introduced in the 1950s. This was a high figure even for the small market penetration of that time. It has subsequently become invalid. Recent surveys suggest an average of 80 trips per four weeks, very similar to the level for other undertakings shown in Table 1.
flat fares are in force: thus as soon as a travelcard becomes attractive to regular passengers a large proportion will find purchase worth while.

As Passenger Transport Executives improve their statistics, it becomes possible to examine trip length distributions of travelcard users versus single ticket purchasers. In Greater Manchester, where the PTE monitors travel by continuous random sampling, very little difference was evident. During winter 1977/78, in a sample of 852,600 individual trips, the average cash fare paid was 17.81 pence, and the average distance per trip made by card holders was equivalent to a cash fare of 19.72 pence (Tyson, 1978). The latter is slightly greater, but the difference is small. The main market penetrated by Manchester’s “Saver Seven” was found to be that for relatively short trips (i.e. stages), often by passengers who have to interchange. In contrast, a three-week survey in December 1976 of travelcard users in Greater Glasgow showed some 66% of “Transcard” users to be travelling more than four fare stages, compared with only 31% of adult cash fare passengers. An important factor in Glasgow is the very compact nature of the city; few people within the innermost ring (up to 3 km from the centre) hold cards, and most cardholders are concentrated in a band 3 to 7 km from the centre. The travelcard trips may thus appear “long” only in comparison with a very short average length of cash trips in the inner city.

The West Midlands PTE uses a continuous sampling process similar to that of Greater Manchester. This indicates that the mean average single trip made by a travelcard holder in 1978/79 was 5.06 km, compared with 4.34 km on cash fare (for adults), but the modal trip was the same for both types of passengers (two stages, or between 1 and 2 km). A further survey indicates that a substantial proportion of travelcard holders were making linked trips, e.g. using two buses en route from home to work. On this definition of a “trip” the travelcard holder does make a substantially longer average journey, and the number of “trips” per month is reduced from about 80 (see Table 1) to about 55 in such cases (WMPTE, 1978).

PRICE DETERMINATION AND USER RESPONSE

Existing methods of fixing prices for travelcards appear to be arbitrary, often with high levels of financial support and a basically crude flat fare structure. Introduction of travelcards may also be associated (as in Paris) with a general aim of reducing costs for public transport users.

However, a more cost-related rationale may be postulated. The cost of providing peak period capacity can be seen to be a high proportion of the total, especially on capital-intensive rail-based systems. The off-peak additional marginal costs may then be relatively low, except for evening/weekend additional shifts. Conventional pricing, and some travelcard pricing, gives the opposite picture to the passenger—a low rate in the peak, standard rate in the off-peak.

Where travelcards are purchased essentially for peak travel they may appear to the customer to offer additional off-peak trips free of charge. A rational relative peak/off-peak price ratio (for travelcard holders) is thus produced. As some systems, notably in Britain, move toward breakeven operation, or covering a higher proportion

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5 Greater Glasgow PTE. Results from Transcard survey, 1977.
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Table 1
Summary Details of Some Principal "Travelcards"

<table>
<thead>
<tr>
<th>System/Card Title</th>
<th>Date Introduced</th>
<th>Date of Data</th>
<th>Number on Issue (000)</th>
<th>% of all trips</th>
<th>Trips per Holder per month&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Göteborg/70-kort, etc.</td>
<td>Jan. 1973</td>
<td>1977</td>
<td>68</td>
<td>52.5</td>
<td>60</td>
</tr>
<tr>
<td>Hamburg/Monatskarten, etc.</td>
<td>1966</td>
<td>1976</td>
<td>325</td>
<td>66.4</td>
<td>80</td>
</tr>
<tr>
<td>Stockholm/70-kort etc.</td>
<td>Oct. 1971</td>
<td>1978</td>
<td>448</td>
<td>61&lt;sup&gt;b&lt;/sup&gt;</td>
<td>65</td>
</tr>
<tr>
<td>Paris/Carte Orange</td>
<td>Aug. 1975</td>
<td>1978</td>
<td>1300&lt;sup&gt;c&lt;/sup&gt;</td>
<td>48</td>
<td>80</td>
</tr>
<tr>
<td>Oslo/Manedskort</td>
<td>1976</td>
<td>1977</td>
<td>50</td>
<td>59</td>
<td>77</td>
</tr>
<tr>
<td>Bremen</td>
<td>1977</td>
<td>1977</td>
<td>42.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Midlands/Travelcard</td>
<td>Oct. 1972</td>
<td>1978</td>
<td>125</td>
<td>29&lt;sup&gt;d&lt;/sup&gt;</td>
<td>78</td>
</tr>
<tr>
<td>Tyne &amp; Wear/Travelcard</td>
<td>May 1975</td>
<td>1976/77</td>
<td>17</td>
<td>7</td>
<td>88</td>
</tr>
<tr>
<td>Greater Manchester/Saver Seven</td>
<td>Nov. 1975</td>
<td>1978</td>
<td>60</td>
<td>20</td>
<td>84</td>
</tr>
<tr>
<td>Glasgow/Transcard</td>
<td>Sep. 1974</td>
<td>1978/79</td>
<td>37&lt;sup&gt;e&lt;/sup&gt;</td>
<td>16</td>
<td>72</td>
</tr>
<tr>
<td>London/Red Bus Pass, etc.</td>
<td>June 1972</td>
<td>1977</td>
<td>52</td>
<td>7</td>
<td>90</td>
</tr>
<tr>
<td>Lothian/Ridercard</td>
<td>1957</td>
<td>1979</td>
<td>20</td>
<td>12–15</td>
<td></td>
</tr>
<tr>
<td>West Yorkshire/Metrocard</td>
<td>1972</td>
<td>1978/79</td>
<td>28&lt;sup&gt;f&lt;/sup&gt;</td>
<td>7.2</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Or per four weeks for four-weekly cards. The lower averages for Stockholm and Göteborg result from inclusion of pensioners' reduced-rate travelcards within the total.

<sup>b</sup> As percentage of revenue.

<sup>c</sup> Excluding summer holiday period.

<sup>d</sup> As percentage of all adult fare-paying trips.

<sup>e</sup> Average for last quarter of 1979.

<sup>f</sup> Average for April–Nov. 1979.

of total costs, they may also produce a realistic relationship with actual peak costs. One system with substantial travelcard use already exists on a breakeven footing, that in Redditch New Town, operated by Midland Red (WMPTE, 1978). There is a danger that a travelcard may be priced according to peak total costs (as suggested above) while single fares remain without peak/off-peak differentiation. Some users could then switch back to singles in the peak, reducing the important savings from reduced boarding times, etc. Ideally, differential pricing of single tickets should be introduced alongside the introduction of travelcards.

In large urban areas, where a flat rate is inappropriate, a zonal structure is desirable: either simple concentric rings (as in Paris) or more complex patterns (as in Hamburg). A compromise must be made between reflecting variations in trip length in the peak, and operating simplicity. The Tyne and Wear Travelcard was divided in November 1979 into numerous local zones. A survey in April 1980 showed that four out of five purchasers were new buyers, who had not previously used the countywide card.

In some places off-peak-only travelcards are offered, as in Stratford on Avon. Low-rate or free travelcards for pensioners, offered in some British cities, could be considered as a special case of travelcard pricing.
TRAVELCARD PRICE ELASTICITY

As an overall average for single tickets, an elasticity on urban bus systems (number of trips related to real fares) of about $-0.3$ appears to apply with remarkable stability, over time, by direction (increase or decrease in real fare), and in different countries (Bly, 1980). Peak elasticity is slightly lower because of the non-optional nature of trips; and, since most travelcard holders are peak users, a lower elasticity may be expected for this reason alone. The question to which the rest of the article is addressed is whether the price elasticities for travelcard systems are consistently lower than for conventional single ticket cash-payment systems.

It may be suspected that, once a user has become committed to regular purchase of a travelcard, its convenience will be enough to ensure that very substantial price increases (either in absolute terms or relative to other public transport fares) would be necessary to induce withdrawal. In some cases, as we have seen, exceptionally low prices have been charged when travelcards were first introduced, and these may now be seen (or were intended explicitly) to act as a "promotional offer" on the lines of supermarket offers. Having purchased their tickets at an exceptionally low price, most users may find them of such value that they are willing to renew at a much higher rate subsequently.

The negligible, or small, reduction in sales after a price increase for a travelcard could perhaps be explained in terms of the component effects. When the price of a single ticket is increased on a system in which single tickets account for most journeys, this has two results: (a) some passengers cease to travel entirely, perhaps purchasing a car; (b) remaining passengers may reduce the frequency and/or length of their trips in response to rising costs.

When the price of a travelcard is raised, the first effect still applies, but not the second unless a card user switches to a much lower trip rate on single tickets. Provided that the price does not rise above the critical threshold at which the user returns to buying single tickets, there will be no reduction in trips made, since no additional cost per trip is incurred after initial purchase of the travelcard. The effect is shown in Figure 1. Only in the case of a zonal card could a reduction in trips occur, since after a price increase a user might purchase a card valid for fewer zones, eliminating some possible trips entirely and/or reducing the frequency of long-distance trips.

Another important factor in considering the effects of a travelcard price increase is the service quality perceived by users. The introduction of a card at an initially low price may induce a large number of regular users to buy it, appreciably speeding-up boarding times of buses. Where market penetration is above about 50% this in turn will have a perceptible effect on service quality. Thus when the price is raised (for single tickets or for travelcards) it relates to a higher quality of product than previously, and thus less resistance may be expected.

Extending from the price-response curve shown for a single user in Figure 1, one may construct an aggregate curve (Figure 2). If one assumes that the probability of withdrawal by a travelcard purchaser is normally distributed around the threshold price level for the average user, a cumulative-normal curve may be constructed with the average threshold value as the mid-point (at price $P_H$). Such a curve—already common in modal split models—slopes very gently at high price levels, but more
steeply around the mid-point. Maximum market penetration of the travelcard is obviously attained at a very low price, but with consequent loss of revenue. An optimal price may be defined at point $P_N$ at which, for a marginal fall in demand, much higher revenue is obtained. The exact point will depend on the support level/patronage trade-off specified by the operator, such as London Transport's “passenger miles per £”.

For the purchaser of single tickets, an individual "demand curve" would have a step form, as various changes take place in response to rising prices (abandonment of lunchtime home trip, switch to car-sharing for journey to work, etc.). Since these points would vary between users, an aggregate "demand curve" may be drawn as a smooth curve rather than a series of distributions around threshold points.

Since the first users to withdraw from holding travelcards and revert to single tickets will be those making less than average use of travelcards, the reduction in number of trips attributable to travelcard holders will be substantially less than the reduction in number of card holders. A further aggregate curve for total trips made by
Table 2

Manchester “Saver Seven” Costs and Benefits

<table>
<thead>
<tr>
<th></th>
<th>£million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saver Seven user’s gains (lower fares, time savings, etc)</td>
<td>+1.089</td>
</tr>
<tr>
<td>Passenger Transport Executive losses (revenue)</td>
<td>-0.424</td>
</tr>
<tr>
<td>Other bus users’ gains (time savings, etc)</td>
<td>+0.177</td>
</tr>
<tr>
<td>Other sectors of the economy, losses</td>
<td>-0.582</td>
</tr>
<tr>
<td>Net social gain</td>
<td>+0.260</td>
</tr>
</tbody>
</table>


card holders may thus be constructed, which falls less rapidly as price increases.

To obtain an initial take-up of travelcards, a relatively low price may be offered. During this period a net revenue loss is likely, although benefits estimated as time-savings, etc., may offset this. For example, Tyson’s study of the Manchester “Saver Seven” indicates the annual costs and benefits shown in Table 2 (based on a sample survey in late 1977, grossed up to annual figures).

At that time the PTE was unable to extend one-person operation (then about 60% of bus miles run) and thus obtain further savings. On the cost-benefit argument, an extension of the “Saver Seven” discount could be justified; but, as I argue, a second stage in pricing strategy should enable the hypothetical gains in consumer surplus to be converted back into revenue gains for operators. Possible gains and losses to other sectors of the economy are manifold and often difficult to estimate: they are not considered further in this paper.

Another system probably at a similar stage in travelcard pricing policy is Brussels, where the “mtb” ticket has been gradually reduced in price. The weekly version, when introduced in 1970, was priced at the equivalent of 21 single trips (if made on multi-journey tickets purchased off the vehicle), but by 1977 this had been reduced to the equivalent of 14 single trips. Likewise the monthly version fell from an equivalent of 83 to 44 in the same period, and the annual from 688 to 438. Single ticket sales fell from 31% of all trips in 1970 to 12% in 1977. The change is clearly a result of deliberate policies aimed at maximising patronage. A desire to minimise interchange penalties, and to permit travellers to choose the minimum-time journey path, was explicit. Benefits derived by the operators from increasing the proportion of off-vehicle sales via travelcards appear to be much the same as those listed at the beginning of this paper.

The hypothesis that, after initial take-up of travelcards has been secured by a low price, price elasticity for subsequent price increases will be lower than for equivalent increases in single ticket prices has received some support from West German studies.

Brög and Förg (1980) indicate different responses to price increases on public transport systems, related to user type, mode, type of ticket, etc., and also the differences in “atmospheric reaction” (i.e. immediate expression of opinion), hardship likely to be caused by increases, and actual change in number of trips made. The last
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![Diagram](image)

**FIGURE 2**

*Notional aggregate price response*

...was estimated as shown in Table 3. The "atmospheric reaction" tends to imply a much greater reduction in the number of trips than actually occurs (a similar exaggeration may be found in the "scare story" treatment of proposed rail fare increases in London and South East England, evinced by the British popular press).

The very small reaction to change in pensioners' tickets and students' tickets is probably explained by the fact that these are supplied to the users at very low, or zero, price.

Although the data relate to anticipated rather than observed behaviour, confidence in the results is encouraged by the similarity between those given for single trips and observed data from previous price increases (for a price increase of 1 to 10%, a reduction in trips of 0 to 3% is anticipated, corresponding to the familiar $-0.3$ elasticity for such trips). The principal feature of interest is the considerably lower reduction in demand for travelcards than for single trips for similar percentage price increases: for example, a price increase of up to 10% produces up to 3% drop in single trips, but only 1.8% in travelcard sales. In effect, this illustrates part of the pattern hypothesised in Figure 2. Figure 3 represents an enlargement of that part of the diagram covering a price increase of up to 30%, based on Brög's results.

Some overlap occurs in the travelcard and single ticket responses when the fare
TABLE 3

Estimated Percentage Reductions in Trips made, by Percentage Increase on Base Fare and Type of Ticket

<table>
<thead>
<tr>
<th>Fares increased from base level by:</th>
<th>Whole N = 2409</th>
<th>Single tickets 710</th>
<th>Travelcards 810</th>
<th>Students and pensioners 461</th>
<th>Other 428</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 10%</td>
<td>0–1.5</td>
<td>0–3</td>
<td>0–1.5</td>
<td>0–0</td>
<td>0–0</td>
</tr>
<tr>
<td>11 to 15%</td>
<td>1.5–8</td>
<td>3–10</td>
<td>1.3–13</td>
<td>0–3</td>
<td>0–0</td>
</tr>
<tr>
<td>16 to 20%</td>
<td>8–9</td>
<td>10–13</td>
<td>13–15</td>
<td>3–3.5</td>
<td>0–0.5</td>
</tr>
<tr>
<td>21 to 25%</td>
<td>9–13.5</td>
<td>13–22</td>
<td>13.5–16.5</td>
<td>3.3–7</td>
<td>0.5–0.5</td>
</tr>
<tr>
<td>26 to 30%</td>
<td>13.5–14.5</td>
<td>22–22.5</td>
<td>16.5–19</td>
<td>7–8</td>
<td>0.5–0.5</td>
</tr>
<tr>
<td>No decrease expected</td>
<td>85.5–86.5</td>
<td>77.5–78</td>
<td>81–82</td>
<td>92–93</td>
<td>99.5</td>
</tr>
</tbody>
</table>

Based on Table 2, Brög & Förg (1980).

The student fare and pensioners’ pass categories in the original reference have been combined in one column, an average of the two.

Of the fall in use of single tickets as the price rises reached 30%, about half is explained as a switch of mode, half as suppression of trips. Of the fall in use of travelcards over the same range, about three-quarters is explained by switch of mode, only one quarter by trip suppression. Only 1% of the drop of up to 19% in travelcard trips takes the form of switching to other types of cards.

Percentage changes in number of trips have been rounded to nearest 0.5.

The 2,409 trips were made by 1,473 persons in 515 households.

increase is around 11 to 25%, but in general the effect is less for travelcards, especially for a fare increase of 1 to 10%.

In effect, Brög argues, one should try to measure individuals’ perceptions or reactions to price changes, rather than derive elasticities which represent aggregate behaviour and are carelessly described as attributes of the product rather than of the users’ reaction. If sufficiently good data are available, it is better to predict the effect of price changes by aggregation of data from individuals than by inference from changes in total demand.

SOME EMPIRICAL EVIDENCE

Detailed evidence is now available to indicate users’ response to a number of instances of increases in price of travelcards. An increase of 40% in the price of the Stockholm monthly card in 1975 produced an elasticity of between −0.0 and −0.2. In Paris, the “Carte Orange” was initially introduced at a very low price, and subsequent real increases have had little effect—one of about 20% in mid-1978 merely aggravated the summer drop in sales (resulting from holidays by residents), but the number of cards on issue recovered within a few months to a slightly higher level than before—1.3 million in May 1978, almost 1.4 million in November (RATP, 1979—for further details see Deschamps, 1978).

* See data in my first version of this paper (White, 1978).
Edinburgh/Lothian Region

The oldest travelcard facility in Britain is that introduced by the former Edinburgh City Transport undertaking in July 1957, and maintained by its successor, Lothian Region Transport. Despite the change of name the area served remains the same: the city itself, with a population of about 450,000, which has been declining gradually in recent years.

A four-weekly card has accounted for the great majority of sales, and it is to this that the following discussion relates exclusively. (A two-week card was introduced in January 1969, and a “Super Ridercard”—an annual card at eleven times the four-weekly price—in 1977). Data have been supplied by LRT of sales since introduction, albeit by varying periods according to when changes took place in fares.
structures and/or accounting year. Figure 4 indicates these changes in sales, real price, and the number of journeys of 12 ordinary fare stages (6 miles) that would have to be made in each four-week period to “break even” on purchase of a four-weekly card, since 1970.

The real price of the four-weekly card increased gradually to 1976, tending to fall slightly in real terms between revisions. The 12-stage fare has increased similarly, so that the breakeven number of trips has remained about 43. By dividing sales in periods given by the number of four-weekly intervals within those periods, an average rate of sales per four weeks can be estimated. Over the entire period since 1957 it has grown from about 3,000 to 15,000, but the growth has been mostly since 1970.

Shorter periods can be identified during which the breakeven number of trips did not change noticeably, or at all, in spite of some appreciable price rises. This is particularly true of the period from August 1974 to April 1978. During such periods variations in four-weekly sales do occur, but with no clear trend or relationship with price changes; price increases are often followed by higher sales.

The curve for total sales of travelcards shown in Figure 4 is “smoothed” to remove the effect of short-term fluctuations in sales associated with bank holidays and variable accounting periods. Within these shorter-term changes, not shown, there is some evidence of a temporary drop following each price rise, followed by recovery within about two months.

The growth in travelcard sales still continues at a lower rate as more users come to appreciate the benefits of their use; some 18,000 (on average) were on issue in 1978/9 and 20,000 in October 1979. One likely factor is the “autofare” system employed on
the one-person-operated buses, in which exact fare has to be paid. As more one-person-operated conversions take place, more passengers may find it convenient to hold a travelcard instead of paying cash fares (over 97% of bus miles run as o.p.o.).

Overall, the data supports the null hypothesis that no long-term reductions in sales of four-weekly cards have resulted from price increases during periods in which the breakeven ratio remained constant. No individual price elasticity (that is, without cross-elasticity effects stemming from a change in the breakeven ratio) can be identified that is meaningfully different from zero.

Another aspect of the LRT case is that bus miles run within the city fell from about 27.5 million in 1958 to 17.5 million in 1978. (This somewhat exaggerates the effect on quality of service, because single deckers on very high frequency routes were replaced by double-deckers during this period, so seat miles provided fell by only about 20%.) The overall increase in travelcard use has thus taken place despite a reduction in average service frequency. However, absence of any fares increase since 1976 clearly reduces the real price of public transport, for all ticket types.

West Midlands

The West Midlands PTE Travelcard is the most widely used of any of the travelcards offered in Britain (as distinct from pensioners' free passes). Introduced in 1972, it initially applied to the original area only, but on formation of the Metropolitan County in 1974 the area was extended to include Coventry. The travelcard covers virtually all bus services within the Metropolitan County, following the takeover of most "Midland Red" services by the PTE.

The controlling authority placed strong emphasis on a low fares policy (at one time intended to lead to free fares) from 1972 to 1974, when the first of a series of steep increases was made following central government pressure. Introduced in October 1972 at £4, the travelcard remained at this price, falling substantially in real terms, until November 1974. During this period the PTE also began large-scale conversion to one-person bus operation (by the end of financial year 1977/78, 87% of total mileage), and adopted the "autofare" no-change system (as also used in Edinburgh) to minimise boarding delays.

The authority also introduced free travel passes for pensioners in 1972, and today these account for about 15% of all trips made. Of the adult fare-paying trips, travelcards accounted for 13% by March 1975. By March 1977 this had risen to 19%, and by the end of 1978 to 26% (West Midlands PTE, 1978). Taking travelcards and pensioners' passes together, 37% of all bus trips in 1978/79 were made without the need to collect individual cash fares on the vehicle.

As Figure 5 shows, sales of the travelcard have risen steadily since introduction, to reach over 100,000 on issue by the end of 1978. A secular trend may be observed, largely independent of real fare increases. During the period shown, total bus miles run within the county have remained virtually constant, and population has shown little variation. Two main factors may be cited for the growth of the travelcard sales:

1. Continued increase in awareness of the convenience of holding a travelcard, stimulated by substantial publicity and expansion of no-change one-person-operation: a form of "learning curve".
2. Increases in the relative price of single tickets vis-à-vis travelcards. At each fare increase since November 1974 single tickets have been increased in price marginally more than travelcards, so that by the end of 1978 single tickets had risen 18% more than travelcard prices (in real terms), taking November 1974 as a base.

As in other cases, there appears to be no significant price elasticity that can be assigned to travelcard holders, despite the real price having risen 20% between November 1974 and November 1978. Clearly, some of the growth in travelcard use is a result of the relative increase in single ticket prices. However, if the entire growth since November 1974 were to be assigned to this cause a very high cross-elasticity estimate would result, a relative price increase of 18% producing an 18% fall in sales of single tickets and 100% rise in travelcard sales.

In contrast to the general trend in British urban bus use, West Midlands PTE has retained most of its traffic in recent years. An estimated 531 million trips were carried in 1974/5, 577 million in 1976/7, and 529 million in 1978/9 (comparisons with earlier years are not possible, because the number of passengers carried on the former Midland Red services within the county is unknown). The 1974/5 traffic total has been almost retained, though total financial support (direct grants and concessionary fare contributions) was the same in real terms in 1974/5 as 1977/8 (at November 1974 prices, £12 million). To cover rising costs single fares were increased in real
"TRAVELCARD" TICKETS IN URBAN PUBLIC TRANSPORT

Peter R. White

terms by 33% between November 1974 and November 1977 and travelcards by 13%
in real terms. Clearly, the pensioners' traffic was not affected by fare increases; it has
expanded slightly in any case as the number of pensioners holding free passes has
risen. The drop in fare-paying traffic has thus been about 4%. In relation to the real
fare changes alone (that is, ignoring any decline due to "trend" factors such as rising
car ownership), an overall price elasticity may be estimated of about —0.15, within
which there may be a fairly high cross-elasticity between single tickets and
travelcards.

A somewhat higher quality of service than in other areas may be partly responsible,
but the travelcard itself could also help to explain the low overall elasticity: passengers
have been encouraged to transfer to a ticket type which is (within the price range
experienced) relatively if not completely price-inelastic. At any one time the travelcard
appears to offer a substantial discount from the equivalent single fares, but over a
longer period it has nevertheless helped to produce better financial results (by
retaining sales) than a system based on single ticket issues alone. This viewpoint is
supported by initial analysis of results by officers of West Midlands Passenger
Transport Executive.

SUMMARY AND CONCLUSIONS

Travelcards have grown rapidly in importance, and their holders now account for well
over half the trips made on some European urban public transport networks. In
Britain their importance is less marked, partly because of the graduated fare scales,
and market penetration reaches a maximum of about 20% in the West Midlands.
Pricing policies have often been arbitrary, and so have the reasons for their initial
introduction, but a more rational framework can be outlined, based on the concept of
a threshold level up to which the price may be raised with very little loss of sales,
ensuring a realistic revenue to be obtained without loss of operational benefits.
Time-series analysis of data from West Midlands PTE and Lothian Region Transport
in Britain suggests a negligible elasticity by price for moderate increases in price of
travelcards from a low initial level. This is corroborated by the work of Brög in West
Germany, in which user response to price increases is shown to differ by ticket type.
The British results suggest that the lower end of the range of Brög's estimates is most
likely to be found in practice (that is, a reduction closer to 0 than 3% in travelcard
sales after a real price increase of up to 10%).

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