NOTES AND COMMENTS

DEMAND FOR UNLIMITED USE TRANSIT PASSES

A Comment

By Peter R. White*

Lawrence Doxsey has thrown light on certain aspects of user choice between unlimited use passes (known in Britain as travelcards) and cash-paid single fares (Doxsey, 1984). However, while seemingly sophisticated in its mathematical approach, his view is a very limited one, and could lead to misleading conclusions on the long-run costs and benefits of travelcards.

His data source is an extensive survey of users on the MARTA (Atlanta) system in May 1979, two months after a revision of fares which included introduction of travelcards. This permitted calibration of logit-type models for a large sample of users, but the absence of other surveys (before the revision, or to ascertain longer-term changes) limits the value of any conclusions from it. Some high own-price and cross-elasticities are derived from cross-section, rather than time-series, data.

A traditional demand curve is shown as Figure 1 of Doxsey's paper, of a type which is usually held to show the relationship between the total volume for product demanded and its price. For this an elasticity derived from time-series data is usually the most appropriate. In using a logit-type formulation, he is in effect estimating a "cross elasticity" (that is, one resulting from the choice made between cash-paid fares and travelcards within the public transport market) which is likely to be rather high since two forms of pricing for the same product may, at least initially, be seen as very close substitutes. Very little importance appears to be attached to new users attracted to transit as a result of the travelcard: on page 14 these increases in use "were assumed to have been caused by factors other than the fare change". The initial impacts on operator's revenue resulting from introduction of travelcards are thus given an unduly negative bias - the loss of revenue through discount given to existing users is stressed, but there is no mention of additional revenue attracted from new users.

As I have pointed out in this Journal (White, 1981), the traditional smoothly-sloping individual demand curve which is favoured in most economic theory (and is the basis for Doxsey's Figure 1) may be a poor representation of individual response to price, especially when the travelcard is considered. If one views response to a change in price as occurring at a critical threshold value for an

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individual, then the aggregate response curve will be represented by a cumulative distribution around a mean threshold value. If, for example, the distribution around the threshold value is a normal one, the result will be an S-shaped curve similar to that used in modal split modelling. Diagrams in my 1981 paper illustrate this, and further discussion is provided in more recent papers (White, 1984a, 1984b). Use of such a curve would imply a range of price changes in which little change would occur in quantity demanded, followed by a range around the mean value in which sensitivity to price change would be very high.

Viewing response to price change as a response to a stimulus also leads one to question whether the effects are necessarily symmetrical. Because of the existence of habit formation, a second stimulus of opposite and of equal magnitude to that originally received will not necessarily have an equal and opposite effect. Therefore one may postulate the introduction of a change, such as a travelcard, at a low initial price to gain market penetration, followed by a subsequent price increase taking advantage of the resulting changes in habit, which would enable some of the traffic initially gained to be retained at higher price levels. Under such a two-stage policy the convenience of not paying in cash, as well as the money saving, would encourage users who had switched to travelcards in the initial phase to remain purchasers even at a higher price. Operators would benefit from improved cash flow, reduced boarding times, and opportunities to rationalise networks because interchange financial penalties would be eliminated. The discount offered to users would result in financial loss to the operator, though this would be partly offset by revenue from entirely new users.

The second stage is raising real prices (within the critical threshold limit) so that revenue is increased, while retaining much of the additional traffic and operational benefits that substantial use of travelcards may bring.

Doxsey's work examines only the first stage of this process, in which a financial loss is to be expected. Even here, however, a net benefit may be shown on cost-benefit analysis or by use of similar criteria. Doxset comments only on the financial loss. Since most US operators cover only about half their total costs from passenger revenue, what matters is not being unable to break even but weighing the costs of any revenue loss from travelcards, and associated user benefits, against other uses of financial support (for example, to sustain higher service levels).

Furthermore, if one were to accept his relatively high elasticity value, spending money on travelcard innovation would be a relatively attractive means of stimulating transit use per $ of revenue support. With an elasticity of 0.46 with respect to the cash fare (page 20), elimination of passes would result in a 2.8% gain in revenue but a 3.1% loss of trips, a rather poor trade-off compared with the effect of reducing service mileage or an overall fare increase, for which elasticities of +0.4 and −0.3 may be taken as reasonable average estimates (Department of Transport, 1982).

The high benefits to be obtained from travelcards are particularly evident in the recent experience of London Transport (since June 1984 renamed London Regional Transport). From May 1983 a zonal travelcard covering LT's own bus and rail services was introduced, replacing previous rail season tickets and the limited range of bus-only travelcards (most bus users paid in cash). A zonal bus
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pricing system was expanded to provide the basis for both bus and rail zones. The introduction of travelcards was associated with a general fare reduction of 25%. The take-up of the travelcard was higher than expected, probably because of its exceptional convenience within the complex London network; this resulted in a lower loss of revenue from the 25% fare reduction than would have been expected on traditional elasticity assumptions (a net fall in revenue of 14.5% compared with an estimate of 19%). In January 1985, after central government had taken over control of LRT, a common travelcard was introduced for LRT and British Rail services.

Initial analysis of the London travelcard (London Transport, 1984) suggests a generation of 8.3 passenger miles per £ expended (about double the level normally expected) and a benefit to cost ratio of 2.3:1.

The second stage of travelcard pricing could be described only in crude terms in my 1981 paper. Subsequent analysis of experience in the West Midlands supports the view that long-run performance, even in purely financial terms, may compare favourably with the retention of cash-paid fares as the only form (White, 1984b). For the same revenue target, about 7% more trips have been retained, with associated benefits to users. Taking into account costs of additional peak-period capacity thus retained, a net benefit is also shown within a cost-benefit analysis.

In view of the much more extensive use of public transport in large cities such as the West Midlands and London, and longer experience of travelcards in the West Midlands, it would be unfortunate if results from a single city in the US, analysed at one point in time only — however carefully studied — were to have a wider influence on policy.

A Rejoinder

By Lawrence B. Doxsey*

The primary conclusion of my 1984 article (Doxsey, 1984) was that introduction of unlimited use transit passes (travelcards) leads to lower fare revenue than would be obtained with an identical fare structure without the pass option. This conclusion was based on an empirical examination of what determines the individual transit user's choice between purchase of a transit pass (travelcard) and payment of fare on a per-trip basis. Not surprisingly, the evidence showed a strong tendency for individuals to choose the option which made them better off, so that for only very few pass buyers is expenditure on transit greater with a pass than it would otherwise be. Monthly rates of transit usage will inevitably vary

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considerably across transit users. Therefore, no matter where the price of a pass is set in relation to the cash fare, the pass will give some purchasers the opportunity to make a substantial reduction in their expenditure on transit. Furthermore, since passes also lead to increased total trip making, the impact on the deficit includes both the revenue loss and the cost of servicing induced trips.

I should emphasise that on a theoretical level it is not necessary for revenue to be lower with a pass than without it. To see this, consider a public transit operation offering only cash fares. As must be nearly universally true, the monthly usage rates will be assumed to vary across the system’s users. Total revenue will not fall with the introduction of a pass priced so that the single heaviest user of the system is indifferent whether to purchase or not. Indeed, unless this rider’s demand is perfectly inelastic at the cash fare level, revenue will be increased with such a pass. At a slightly lower pass price the second heaviest user of the system will become a purchaser. For the impact on revenue, however, there is trade-off between extracting the extra surplus realised by this second purchaser and reducing the revenue received from the heaviest user. Successive price reductions will attract riders with lower and lower usage rates, while at the same time increasing the number of riders who realise reductions in expenditure. Revenue is maximised at the point where the incremental fall in revenue from lowering the price to existing buyers just equals the incremental increase in revenue from extracting the induced surplus from the marginal buyer. With a bit more complexity the same process holds for joint determination of revenue-maximising cash fare and pass price, or for welfare or profit maximising levels of the two fare parameters.

However, where demand elasticities are low, and where usage rates are widely dispersed, the revenue-maximising point comes with very few pass sales and thus with only slightly more revenue than would be realised without a pass. Inducing additional sales leads only to reduction in revenue. Furthermore, the heaviest users of a system are almost inevitably people dependent on transit, who have so few trips which might be shifted from other modes that their demand is highly inelastic. In practice this means that, to be used as a revenue-enhancing tool, a pass must be priced so that it is used by very few riders. For the Atlanta case examined in my 1984 paper, revenue-maximising pass sales would have led to use of passes for considerably less than 1% of trips, compared with 17% at the observed sales level. With sales as low as this the benefits of the programme are overwhelmed by the overhead costs of its administration.

Peter White’s objections to the conclusion on revenue loss are rather differently based, though they include both theoretical and methodological criticisms as well as the assertion that my evidence was both geographically and temporally too narrow for any generalisation. I can answer the first two criticisms directly. With the last assertion I disagree, and I can make the accommodation of providing longer-term evidence from Atlanta and supplementary evidence from several other cities.

White comments that the analysis has somehow detrimentally confounded the concept of a smooth individual demand curve through its use of a logit model. Here it appears that he has missed the fact that it is not the demand for transit which has been estimated, but the choice of payment methods contingent on demand. As the first part of my paper explains in some detail, there is full
compatibility between a smoothly drawn demand curve and the treatment of the
decision on pass purchase as a discrete choice. White is entirely correct in asserting
that the two payment methods might be seen as close substitutes. Indeed,
what my analysis does is to identify the basis on which individuals make choices
between substitute methods of payment.

The most subtle of White’s objections is his assertion that the individual
demand for transit is discontinuous at some threshold fare level and that there-
fore, by holding marginal fare to zero, transit passes either attract or retain riders
who would otherwise abandon transit in favour of other modes. This characteri-
sation is indeed appealing and, I would argue, entirely valid. For example, for
the car-owning transit commuter it is not unlikely that there will be a fare level
at which a shift is made to commuting by car. White argues that, for this reason,
provision of passes can lead to greater revenue than would be otherwise obtained.
This will hold for some individual riders, but in the aggregate it can apply only
under rather extreme circumstances.

To examine this further, consider a population of commuters, each of whom
will make ten weekly transit trips if the fare is below his or her threshold fare
level but will make no trips if the fare is at or above the threshold. Clearly there
remains at the individual level a relationship between the increase in consumer’s
surplus from purchasing a pass and the willingness to do so. In this case the integra-
tion to compute consumer’s surplus runs from zero to the threshold fare level.
Threshold levels can be thought of as distributed over the population according to
some function \( f(T) \). To achieve a revenue gain one wants to price passes so that
they are attractive to a large number of those whose thresholds are below the cash
fare but to only a small number of those whose thresholds are above the cash fare.
For this to occur, and so for White’s aggregate revenue argument to hold, \( f(T) \)
must be highly concentrated just below the cash fare level, with the pass price
set so that the average fare per trip is below the concentration. However, in this
situation, a pass is weakly dominated by a cash fare set below the fare level at
which individual thresholds are concentrated, so a pass yields greater revenue only
because the cash fare has been set “too” high. If \( f(T) \) is widely dispersed, one is
faced with providing windfalls to those with high thresholds in order to attract
those with lower thresholds. Note also that demand will be highly inelastic at
fare levels where \( f(T) \) is concentrated, so that this case cannot apply in circum-
stances where aggregate elasticities are of the order of White’s suggested typical
value of \(-0.3\).

White also argues (though he does not provide much evidence) that passes
offer attractive ratios of benefits to costs and of incremental benefits to incremen-
tal deficit. In the Atlanta case examined in my paper, if we linearise the
demand curve, the 168,000 trips forgone through elimination of the pass
generated a consumer’s surplus of $21,000. The literature on scale economies in
the production of transit services has generally found neither economies nor dise-
economies, and estimates of elasticity of cost with respect to output have commonly fallen between 0.8 and 1.2. If we assume marginal cost to equal 80% of
the system’s $0.63 average cost, the pass can be estimated to have produced
$21,000 in user benefits at a cost of $85,000. Note that the conclusion of a very
poor cost/benefit ratio rests not so much on the particular estimate of the con-

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sequences of eliminating the pass as on the point that induced trips are necessarily valued below cash fare, while marginal cost is in excess of cash fare. Similarly, the incremental deficit per incremental trip is $0.72, or nearly twice the $0.38 average deficit per trip — certainly not an argument for a transit pass as an attractive way of increasing ridership.

I do not disagree with White’s observation that there is some increase in market penetration over a period of time. However, longer-term observation in Atlanta suggests that the increase comes primarily in the form of higher incidence of purchase among those people who reduce expenditure by using a pass. This is an evolution which aggravates the loss of revenue rather than easing it. In May 1979 some 12% of pass buyers indicated that they made fewer than the breakeven level of 40 monthly trips. One year later, with aggregate pass sales 17% higher, just 7% of buyers indicated that they made fewer than 40 trips. Notice also that the increase in penetration, though distinct, is still modest. Where the pass is initially well promoted, and made readily available, and where its ratio to the cash fare is unchanged, I would expect the increase in market penetration to tail off rather quickly after the first few months. Greater sales from the expansion of a pilot programme, or as the consequence of reducing the price of a pass relative to the cash fare, should not be misinterpreted as long-term response of demand.

White suggests that people are attracted to use of transit through the institution of a pass; evidence from Atlanta and from several other cities suggests otherwise. In Atlanta, in May 1979, just under 1% of pass buyers reported that they were new to the system since the March 1979 introduction of the pass. In May 1980, 16% of pass buyers but 20% of cash-paying riders had been transit users for twelve months or less. Fully 75% of pass buyers had ridden three years or more. These numbers are consistent with other estimates of rates of year-to-year turnover in ridership, and certainly provide no case for the pass as a means to attract riders.

In October 1977 and February 1978 the transit systems in Austin, Texas, undertook a sequence of two substantial discounts on their monthly passes and prepaid tickets (Bloomfield and Crain, 1979). The first reduction was of 40% and the second of 20%. Sales rose by 180% with the first of these discounts and by 70% with the second. Just 1.2% of buyers were new to transit. Furthermore, at the end of each promotion, sales reverted immediately to their pre-sale level, showing no tendency to sustain the patronage of attracted buyers.

A nearly identical picture emerges from the experience of Phoenix, Arizona, where 20% discount in February and March 1978 was followed by a 40% discount in October and November of the same year (Bloomfield and Crain, 1979). Again there were sharp sales increases concurrent with promotions, very few sales to new transit riders, and an almost immediate reversion to pre-promotion sales volume in the aftermath.

The transit system of Sacramento, California, offered a transit pass beginning with its 1973 public takeover (Daetz and Holoszyc, 1981). In June 1978 it introduced a programme of pass distribution through employers in the area. Because the sales volume was disappointing, the price of passes sold through employers was reduced so that the breakeven rate fell from 34 to 26 trips per month. This reduction led to a 170% increase in sales through the employer programme. However, when the discount ceased, sales dropped back to their earlier levels.
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Jacksonville, Florida, had a similar experience with a 1979 employer pass programme which included a temporary, promotional price reduction (Charles River Associates, 1982).

I remain convinced by both theoretical and empirical evidence that transit passes have a detrimental impact on public transit revenues and deficits, in both the short and the long run. Systems currently offering or contemplating passes as an element in their fare structures should expect to find that the financial impact will be disadvantageous. While in some circumstances this disadvantage may be offset by the attraction of a pass as a focal point for system promotion, as a mechanism to elicit third party fare payment (for example, subsidisation of commuting employees by their employers), or as a means of providing concessionary fares to select population groups, it is an error to look to pass programmes as a means of enhancing revenue.

REFERENCES

Bloomfield, Pamela, and John Crain (1979): *Transit Fare Prepayment Demonstrations in Austin, TX and Phoenix, AZ*. U.S. Department of Transportation.


