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THE SCOPE FOR SIMPLIFIED FARE SYSTEMS IN URBAN BUS OPERATIONS

by

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ABSTRACT

This thesis investigates the effects of introducing simplified fare systems in urban bus operations. Initially, a review of the fare systems employed by urban bus undertakings in Great Britain and Continental Western Europe is undertaken. Wide differences in policy were found to exist, with British operators tending to prefer "graduated" fares with several fare values, whilst on the European mainland simpler flat or zonal structures predominate. Similarly, off-vehicle ticketing (travelcards and multi-ride tickets) was found to be a much more common form of fare collection abroad than in Great Britain.

There is an apparent conviction held by British operators that any deviation from the policy of graduated fares paid in single cash amounts causes a loss of revenue and/or ridership. This thesis examines the extent to which this belief is correct, by using a variety of methods to identify the effects of introducing 'continental style' fare systems.

Notwithstanding certain problems inherent in deducing the actual effects of changes in fare system, findings suggest that with careful design and pricing, simplified fare systems can make a positive overall contribution to the performance of urban bus operations. This is particularly true where objectives are more than strictly financial in nature. The product offered is rendered more attractive to passengers (through greater convience, flexibility and simplicity), with evidence indicating consequent improvements in patronage, operating speeds and fare evasion. Financial performance can therefore also be improved under certain circumstances (albeit less likely for flat fare structures than zonal ones), although a broadly neutral revenue effect is most likely. It is concluded that simplified fare systems could play a significant role in helping to regenerate urban bus operations in Great Britain.

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INTRODUCTORY NOTE ON THE OBJECTIVES, SCOPE AND ORIGINALITY OF THIS STUDY

1. Objectives of the research

There has for many years been a discrepancy between the fare systems used by major urban bus undertakings in Continental Europe and Great Britain. British operators have been the exception in employing relatively complicated systems (at least from the point of view of the passenger), whilst their continental counterparts have traditionally used simpler arrangements. The purpose of this research has been to investigate the effects of using simplified fare systems on urban bus networks, with a view to determining the extent to which the reluctance of British undertakings to adopt such systems is justifiable.

2. Methodology

a) Scope of the research

This study has been concerned with the fare systems of bus operations in urban areas with populations of 200,000 or more persons. However, due to ambiguities in the definition of urban population, some smaller towns and cities are included, as are those smaller urban areas which employ fare systems of particular interest. Urban rail systems are also considered, but only insofar as their fare systems interact with bus services as part of the integration of public transport facilities to be found in many urban areas. The nature and scope of the fare system is discussed in part one.

b) Timescale

The bulk of the material collected for this study relates to the period up to the end of 1982. The surveys carried out (see section c) relate to the situation in late 1981 and early 1982. Wherever subsequent major changes are known to have occurred these have been incorporated as far as is practicable.

c) Components of the research

The information required for this study has, of necessity, been obtained mostly from original sources. The four main sources are as follows:

- A literature search involving the collection and analysis of published evidence of both actual and postulated changes in fare systems.
- An original questionnaire survey of British operators, together with contact with Continental European operators, regarding their fare systems. This was backed up by interviews with a number of British operators which by virtue of their size or policies warranted more detailed study, and by further contact with European undertakings known to have changed their fare systems in recent years.
- A detailed assessment of an actual fares simplification scheme adopted by Plymouth City Transport.
- A modelling exercise which assessed the hypothetical impact of a change in fare structure upon certain routes of two separate and contrasting undertakings.

The methodology used for each of the four areas is described in the appropriate section:

- Part One deals with the nature of the fare system and its components, together with the 'conventional wisdom' of the majority of operators regarding their effects.
- Part Two documents the application of fare structures, the findings of the literature review, and of contact with operators regarding their experience of fare systems and of changes thereto.
- Part Three describes the Plymouth experiment and its results.
- Part Four discusses the modelling exercise and its findings.
- Part Five brings the findings from earlier sections together, lists conclusions and makes recommendations.

d) A note on originality of the work

With the exception of the literature review, all the information obtained was of an original nature. I was the principal investigator under the supervision of Mr.Russell Kilvington. Similarly, analysis of the results obtained was, under supervision, wholly my own. Gathering of information for the assessment of the Plymouth scheme required the use of part-time market researchers to administer a questionnaire designed by myself.

PART ONE : THE FARE SYSTEM

1.1. Introduction

A fare system may be described as the means by which the public transport passenger contributes his or her payment for making direct use of the undertaking's services. The fare system is the operational side of overall fares policy, which also includes the issue of fare level. It is important to recognise that fare systems do not necessarily go hand in hand with fare levels. The situation is usually complicated by socio-political considerations, with subsidies often being provided to reduce fare levels, enhance service levels and so on. Hence, it is totally invalid to relate the overall financial performance of a public transport undertaking to its fare system alone, in order to assess the performance of the latter. Consequently, isolating the effects of the various types of fare system is a difficult process, which this study nevertheless aims to shed some light on.

1.2. Components of the Fare System

The fare system is itself composed of a number of constituent aspects:

i - Fare Structure: the nature of the scale of charges;

ii - Fare Collection: the method used to collect fares from passengers;

iii - Ticket Range: the type of tickets offered and their means of purchase;

iv - Through and Integrated Ticketing: the extent to which transfer between two or more vehicles and/or modes (possibly under different ownership) on one linked journey is possible using a single ticket;

v - <u>Ticket Inspection Methods</u>: the approach used to control fare evasion by passengers.

The fare system adopted by an urban bus undertaking has wide ramifications. Given that a wide range of options exists within each of the five sub-categories above, it will be appreciated that a substantial variety of fare systems may be postulated. Along with the general level of fares, the constituent aspects of the fare system outlined above all interact to affect the performance of the undertaking and the service offered to the public. For any given level of fare, the revenue received by the undertaking can be affected by the type of fare system. Operating costs are affected through (a) boarding and alighting speeds of passengers and (b) the cost of administering the collection of fares. There can also be impacts upon the amount of travel undertaken, journey purpose, and the distribution of journey lengths. The extent to which these and other effects occur is the central theme of this thesis.

Clearly with so many potential trade-offs a compromise is needed in the final design of the fare system. The various options available within each of the fare system components will now be discussed in greater detail. It should be pointed out, however, that in doing so, it is sometimes difficult to make comparative judgements without inferring some degree of value judgement. Where this occurs, such judgements represent the 'conventional wisdom' of the majority of operators. The substance of these beliefs will be examined throughout the thesis.

i - Fare Structure

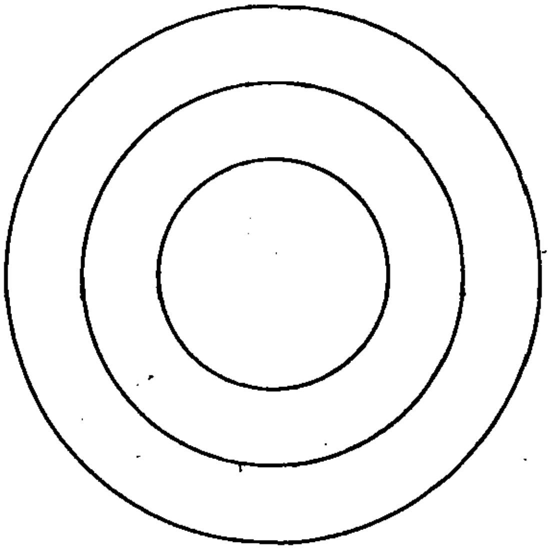
Fare structures can initially be divided into distance and non-distance based categories. The latter is generally referred to as the flat fare, whereby the same fare applies to a given category of passenger (eg. adult, child, concessionary), regardless of journey length. The flat fare is particularly suitable when most trips are of a similar length. Its advantages are judged to be as follows. Firstly, it permits rapid cash transactions which help to speed boarding times. Secondly, it facilitates the use of simple ticket-issuing and cancelling equipment. This makes self-service collection easier. An important disadvantage of the flat fare is its total failure to differentiate according to distance travelled. Depending upon the level of the fare, short distance passengers may be discouraged by the relatively high fare. Furthermore, the use of flat fares makes it awkward to increase fares beyond increments dictated by the coinage, since an excessive number of coins would destroy many of the advantages of the flat fare.

Certain modifications to the simple flat fare are sometimes used. It may be supplemented with a short distance fare, sometimes known as a "short-hop" fare. This helps to avoid the financial penalty otherwise imposed upon short distance passengers. A further variant involves charging supplements for trips going beyond city boundaries, as a way of avoiding excessive bargains for long distance travellers. Strictly speaking, both these variations destroy the principle of the flat fare.

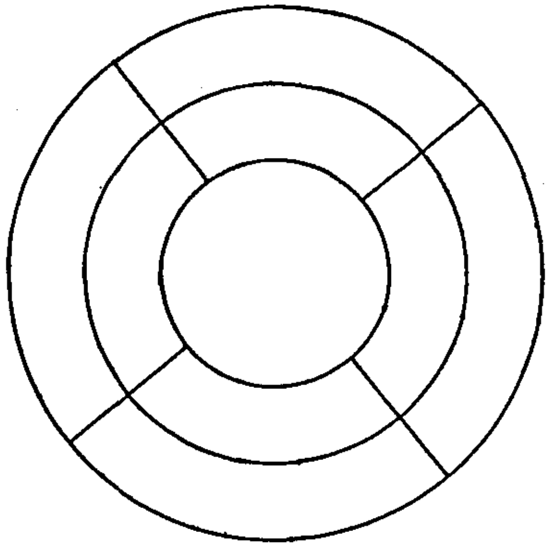
Distance-based fares involve either stage or zonal fares. Stage fares require that the network is divided into route sections (stages) of approximately the same length (usually 1 - 3 kilometres). Fares are based on the number of stages travelled through, with boundaries usually fixed at stops. Stage lengths tend to be shorter in the urban centres than in the suburbs. However, even with a coarse stage system, fare collection may still be cumbersome, due to the wide number of fare values from each point of origin. Stage fares tend to serve as an obstacle to automation of the fare system, due to the complexity they introduce (see section ii).

Zonal fares entail the dividing up of an area into geographic zones, with the fare being increased each time a zone boundary is crossed. There are several variants of the zonal fare structure, the most common of which are shown diagrammatically in figure 1. Forms employed include concentric circles, and six-sided (hexagonal) patterns. In most cases, the precise geometric forms are modified to suit local circumstances (rivers, railways, area boundaries, etc.). Concentric circle arrangements tend to be more common in free standing urban areas, although if there are a large number of orbital trips in the suburbs, then the circles can be segmented by lines radiating from the city centre. Hexagonal (or honeycomb) and grid structures predominate in large conurbations or inter-urban areas with a large number of centres. Like stage fares, zonal systems can vary in complexity. However, in practice a typical zonal system for a city of 250,000 inhabitants may have no more than four zones. It is asserted that this will be sufficiently simple to permit fast fare collection (possibly self-service), whilst retaining a strong element of distance related pricing. Even so, price differentials tend to be greater than for stage fares, a fact which can create iniquities, particularly for short distance passengers crossing a zone boundary. Overlapping zones can ameliorate this problem, but at the price of additional complication.

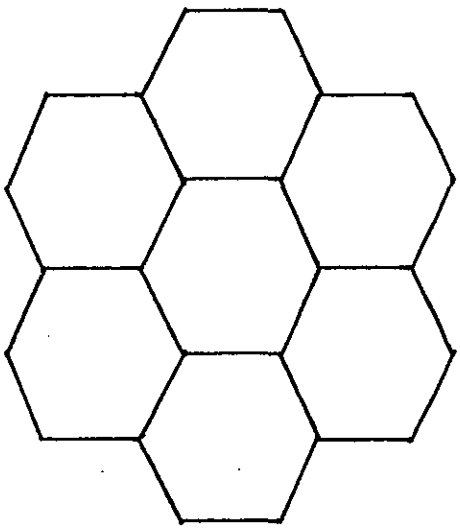
Fig. 1 : Types of zonal configuration



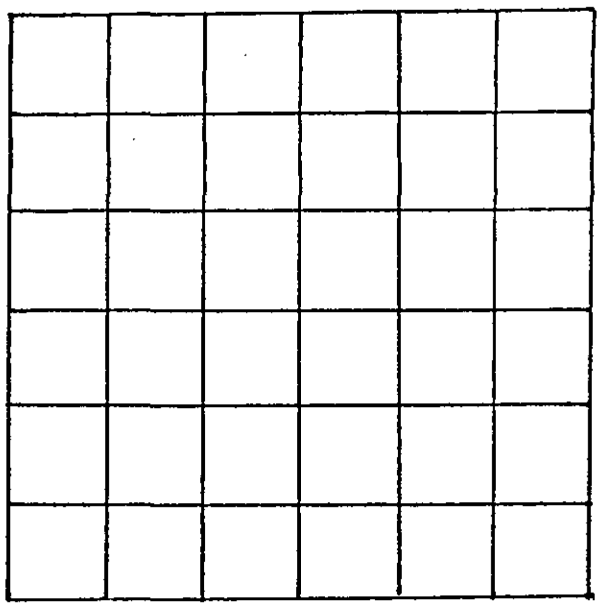
1. Concentric circles.



2. Segmented circles.



3. Hexagonal.



4. Grid.

Section 2.1. will reveal that true flat or distance-based fare structures are rarely encountered in practice. The geographical and socio-political circumstances prevailing in a city will tend to modify these basic structures, as will bus route anomalies, producing what may only be termed combined systems.

ii - Fare Collection

Operators usually base their choice of fare collection system upon factors of cost, security, attitudes of staff, and so on. However, determining the type of fare collection to be employed is also important because the choice has ramifications for all other aspects of the fare system. Certain types of fare collection preclude or make difficult the use of certain fare structures, ticket types and through ticketing arrangements. Quality of service is also affected by virtue of speed of boarding and ease of use. The importance of efficient fare collection has been summarised as follows:

> "In competing with the private automobile, the emphasis should be on the convenience associated with fare payment, recognising that this requires a flexible approach to pricing strategy. Offering a choice of ways in which payments can be made ....is anticipated to have an important impact upon consumer perceptions of the cost, convenience and simplicity of transit ridership." (Ref. 1).

Manual (on-board) collection involves, in its simplest form, the passenger paying the fare to the driver or conductor, who issues a ticket and may give change. Alternatively an exact fare system may operate whereby passengers place money in a farebox under driver supervision. It has been established (2) that the latter system is appreciably quicker than one which allows change-giving. Until fairly recently, on-board fare collection was performed by a conductor whilst the bus was in motion, allowing a relatively complex fare scale to be charged.

Automatic Fare Collection (afc) systems vary from simple coin-operated turnstiles and fareboxes to complex electronic systems that can compute fares and read magnetically encoded tickets. Automated systems are seen as posessing several advantages, such as the acceleration of boarding speeds and access times, reduction in opportunity for fraud, and reductions in staff costs, especially where conductors were previously employed.

To date most afc systems have been installed on rail services because of the potential for large savings in staff costs, the relatively small number of afc devices per passenger, and the problem of reliability of equipment on buses. Afc for buses is still in its infancy, with little implementation to date (particularly in the U.K.) (see section 2.1). The impetus for its introduction would come from cost savings realised through the elimination of conductors, or since these have mostly disappeared already, from cost savings arising from faster boarding times, reduced vehicle requirements and additional revenue generated by the more attractive service and perhaps the reduced opportunity for fraud. Automated devices for buses have to be low cost and compact to be installed on every vehicle.

Bus afc systems take the form of ticket vending machines and cancellers at bus stops or on the vehicles, or of coin-actuated fareboxes or turnstiles on the vehicles. The system with both vending machine and canceller at the bus stop avoids encumbering the bus with bulky equipment. It should also simplify fraud detection, since each passenger is required to board with a pre-validated ticket. Boarding speeds are very fast with no obstructions being caused by passengers buying or validating their ticket. However, the system requires high capital investment, and is particularly susceptible to vandalism. Where vending machines are on the street but cancellers on the vehicle, there is less investment and risk involved, but fraud is believed to become relatively more difficult to detect than with the pavement cancellation system.

Vending machines on board buses supplement the driver's role in issuing tickets. A multi-stream system of boarding can operate, whereby people with the correct combination of coins can use the self-service machine. Operational problems of such machines include a high failure rate (caused by the motion of the bus), and inflexibility in terms of the denominations of coinage that can be accepted, and hence the fare that can be charged.

Similar problems arise for coin-actuated turnstiles. These are also difficult to negotiate by people with luggage or physical disabilities. However, they permit the abolition of ticket issue and inspection, and are very resistant to fare evasion.

A final type of afc on the buses is the farebox. Originally developed in the United States to combat theft of takings, the farebox has a transparent cover with a large slot; passengers drop the correct fare into the box, which the driver checks and then releases into a container below. The farebox has most of the operational attributes of the turnstile (ease of use, elimination of tickets and prevention of fare evasion). However, an exact fare stipulation is generally required, and unless tickets are issued, there are problems with driver and garage staff accountability.

The above discussion relates to the purchase of travel in single units. It is also common for undertakings to offer travel in bulk form, usually at a discount compared with the equivalent number of single tickets. These are generally referred to as prepayment techniques, and most commonly take the form of multi-ride tickets (in book or strip form) or season tickets (allowing unlimited travel within a specified area and time limit). Prepayment methods are a very effective means of reducing or eliminating the problems associated with on-board fare collection. The various types of prepayment are dealt with below.

iii - Ticket Range

The three basic categories of ticket used in urban bus operations are the single, multi-ride, and season or 'travelcard'. Tickets have traditionally fulfilled a role of acting as a receipt for money tendered by the passenger, and as proof that the correct fare for a particular journey has been paid. Except where access is physically controlled (eg. by the use of a turnstile), fare systems require the use of a ticket of some description.

Single tickets can be issued either by the driver or from vending machines (aboard the bus or on the pavement). They may or may not be pre-validated. In the latter case, the passenger inserts the ticket into a cancelling machine upon commencement of the journey. Driver operated ticket machines come in a wide variety of specifications, and most modern equipment is capable of issuing tickets for at least ten different fares whilst meeting the need for speed of issue and reliability.

Multi-ride tickets are transferable tickets, usually taking the form of either a book of single tickets (most commonly used with flat fare systems), or a strip of card containing a specified number of segments which have to be stamped (cancelled) according to the length of the journey. Discounts are offered, and the range can include tickets for use in the off-peak only, or for specific types of passenger.

Multi-ride tickets help to reduce the volume of cash handled aboard the vehicle, with commensurate improvements in boarding speeds and reduced journey times. This benefit is maximised when multi-stream boarding is available, allowing multi-ride ticket holders to board freely without having to interact with the driver. The multi-ride ticket also enhances convenience for the passenger in a number of ways. The need to have the correct coins ready is eliminated. Furthermore, assuming fares are not increased, tickets can be stored indefinitely before use. They can also be used by more than one person, and the purchase price usually involves a much smaller outlay than for a season ticket. Indeed, multi-ride tickets offer a discount on every trip made, whereas season tickets only represent a saving when a certain minimum number of trips are made. Hence, they will only be attractive to certain categories of traveller.

Multi-ride schemes require a significant need for fixed equipment, since each vehicle requires a cancelling machine. Without direct driver supervision, a deterrent to fraudulent use is required - possibly an audible signal for each cancellation, together with enhanced levels of on-vehicle ticket inspection. The discount offered may result in a loss of revenue, unless the scheme can attract enough new journeys from people who previously used other modes or can generate more travel from existing customers. Such economic effects of the various components of the fare system form a major part of the thesis and are dealt with in greater detail in subsequent sections.

Season tickets (Travelcards) are issued for a specific period (usually a week, month or year) as a pass for an unlimited number of journeys within a designated area. Ordinary seasons are available at a discount compared with single tickets and are provided for commercial reasons, whilst concessionary seasons are provided for social or political reasons for specific groups in the community (employees, schoolchildren, and so on). In large urban areas variants are usually available for travel within smaller areas (usually zones).

For the operator, introducing a season ticket facility leads to a reduction in the need for cash handling on the vehicle (which in turn accelerates boarding speeds), and a minimal need for fixed equipment (in contrast to multi-ride tickets). Cash flow is improved, and there is growing evidence that customer loyalty is enhanced, with season ticket holders making more optional trips by bus (refs. 3, 4). For the passenger, there is enhanced flexibility and convenience. Customers need not worry about knowing the fare, and a change of vehicles en route is also made easier through avoidance of the need to rebook. Seasons share all the advantages of the multi-ride ticket, but an obvious deterrent is the relatively high cash outlay required. However, once purchased, season ticket holders have a greater incentive to make additional trips.

One problem from the operator's point of view is that to persuade passengers to part with relatively large sums of money in advance, it is necessary to offer a substantial discount on equivalent single fares. This may involve an initial loss of revenue, although evidence does exist (refs. 3, 4) to show that customer loyalty can ameliorate this in the long term (see part two and subsequent discussion). There is also a need to deter fraudulent use. This is usually done by requiring the posession of an identity card to accompany the ticket. Evidence suggests there is widespread initial resistance to this arrangement, however, with significant drops in sales when 'photocards' have been introduced (5).

Summarising prepayment techniques, it may be seen that multi-ride and season tickets share a number of common facets. They both have the important attribute of placing payment for public transport on a similar footing to that for the private car. The cost of each individual journey is no longer perceived, in contrast to the situation where a single fare is paid at the commencement of each journey. Purchase of travel in bulk, without the need to make frequent individual payments, therefore puts public transport in a more favourable light when compared with car travel.

iv - Through and Integrated Ticketing

Through ticketing may be defined as an arrangement whereby the passenger can travel from origin to destination on one ticket, irrespective of the number of changes of vehicle (operated by the same undertaking) en route. Integrated ticketing involves similar arrangements, but also permits interchange between the services of different undertakings on one ticket.

Through (and to a lesser extent, integrated) ticketing is not a new concept in public transport. With the exception of local bus services in the United Kingdom, most undertakings have a fare system which permits the purchase of a ticket for a complete journey, albeit often only through the medium of off-vehicle ticket sales (section 2.1.4).

In Britain, local bus operators have rarely introduced through ticketing with single tickets except under special circumstances. With relatively long routes and finely graduated fare structures, the need for (and penalty associated with) interchange was seen to be minimal. However, trends towards shorter routes and coarser fare structures have increased the pressure upon operators in Britain to introduce through and/or integrated ticketing. Indeed, the need for through ticketing is greatest with flat fare systems, because otherwise the fare has to be paid each time a vehicle is boarded, regardless of journey length. As such, through ticketing provisions are generally incorporated into prepayment schemes. Unless the origin, destination and route are specified, season tickets offer freedom to travel over a wide variety of services. Multi-ride tickets generally also permit as many changes of vehicle as are necessary, provided the final leg is completed within a specified period of time from the initial cancellation.

Through journeys using single tickets are generally more problematical. There are a number of options. On-vehicle driver issue is simplest from the passenger's viewpoint, but the ticket equipment required is more complex. Also, the driver needs to calculate fares to a wider range of destinations, with consequent boarding time delays. Transfer tickets are usually sold off-vehicle, with the result that sales outlets need to be staffed (or in the case of vending machines, purchased and maintained). Passengers may find the need to buy a single ticket in advance inconvenient. Alternatively, the use of prepayment systems (multi-ride and season tickets) to provide scope for through ticketing would minimise the need for special arrangements for single journey through ticketing.

v - Ticket Inspection Methods

The fare system employed by an undertaking has repercussions for the extent and nature of fraudulent travel by passengers. Whilst fare evasion is not perceived as a major problem by most undertakings, nevertheless considerable amounts of revenue can be involved. The fare system must, therefore, be designed with the minimisation of abuse as an important consideration.

The extent of fare evasion is determined by four factors (6):

The means of access or whether the system is of the 'open' or 'closed' type. A closed system involves the use of physical barriers to control entry to the vehicle, or scrutiny of tickets upon entry by staff. This involves the use of turnstiles, or driver ticket issue and scrutiny. An open system involves no physical limitations of access to vehicles, with passengers being trusted to cancel their tickets either before or after boarding. Although quicker and simpler to operate, the 'open' system usually requires higher levels of inspection in order to deter people from taking advantage of the greater scope for evasion.

The second factor is the proportion of passengers scrutinised by inspectors. Higher levels of inspection will act as a deterrent to fraudulent travel by increasing the perceived risk of detection.

The size of the fine imposed can vary appreciably, depending upon the extent of the problem, and the means of collecting the fine. Fines are often collected on the spot by inspectors, being considered more as a penal surcharge or supplementary fare. For legal reasons, they cannot be considered as fines in the sense understood by the police and criminal courts. Undertakings which do not levy on-the-spot fines tend to employ much greater financial penalties under the traditional fine system. Most concerns are reluctant to prosecute, except in extreme or persistent cases.

Finally, the type of inspection also has an impact, inasmuch that inspection by staff in plain clothes is generally more effective in deterring fraud than that by staff in uniform, primarily because of the greater "surprise" element in detection. However, public protest has made the use of non-uniformed inspectors a relatively rare phenomenon.

When considering the relative merits of the various fare systems with regard to their ability to minimise fraudulent travel, a number of further issues have to be borne in mind. Firstly, there are inherent difficulties in gathering accurate data on the true level of fraud. Only a fraction of fare evaders are ever detected, and even this proportion is difficult to ascertain because of the reticence of the undertaking. Publication of the true figures may reflect badly and serve to encourage further abuse. A second consideration is the distinction that needs to be drawn between a person who travels without a ticket of any sort, and one who overrides the validity of the ticket. Regardless of the fare system in force, the former type are encountered universally (albeit more frequently on 'open' systems), whilst the latter group are only to be found where the fare structure makes it possible for a passenger to travel beyond his stated destination without paying the extra fare. All distance-based fare structures have this problem, although whether it is more serious on zonal or graduated systems (other things being equal) is difficult to determine. Whilst the multiplicity of different fare values makes overriding on a finely graduated system quite common, the steep fare 'steps' in coarsely graduated and zonal systems are a strong incentive to override.

1.3.2. Interaction between fare system components

Whilst in theory there are many combinations of fare system components, in practice the use of one particular type of component often restricts the degree of choice for other aspects of the system. The interactions between fare structure types and other aspects of the fare system are outlined in table 1.

It is apparent that the degree of simplicity in the fare structure is a very important determinant of other aspects of the fare system. A simple fare scale permits diversification of the ticket range and simple fare collection arrangements. A complex scale, on the other hand, involves difficulties in fare collection, and tends to restrict the ticket range. Only with very sophisticated fare collection and ticket issuing arrangements would the easy collection of fares and use of a wide ticket range be compatible with a complex fare scale.

It is important to appreciate that the above observations are, by necessity, generalisations. Furthermore, the concern has been solely with the interaction between the fare system components. Their performance in economic and other terms cannot be deduced until the detailed evidence on these issues has been assembled and analysed (parts two, three and four). Furthermore, a more detailed picture of the various interactions will emerge from the survey of the application of the various fare system types contained in part two.

TABLE 1 : INTERACTION BETWEEN FARE STRUCTURE AND OTHER COMPONENTS OF THE FARE SYSTEM

FARE STRUCTURE	FARE COLLECTION	TICKET RANGE	THROUGH & INTEGRATED TICKETING	INSPECTION METHODS/EVASION
Flat →	Straightforward. Variations in fare confined to different passenger groups. 'Open' system likely.	Lack of different fare values makes diversification of ticket range easier. Different value season tickets sometimes used however.	Financial penalty for changing vehicles may create need for through ticketing.	Unitary fare regardless of journey length eliminates overriding. Use of 'open' fare collection system may require relatively high inspection levels.
Zonal * →	Simple, particularly if there are few zones. 'Open' system likely.	Simple fare scale enables wide range of tickets to be used. Season tickets often priced more finely than others in range.	Coarser zone configuration may increase need for through ticketing facility.	Larger fare 'steps' together with 'open' fare collection system if used increase need for inspection. Simplicity aids control, however.
Graduated * →	Complex, particularly if stages are closely placed with several different fare values.	Tendency for complicated fare scales makes multi-ride (and to a lesser extent season) ticket facility difficult. Hence, ticket range often limited.	Difficult, due to multiplicity of different fare values. Stage fares reduce financial penalty associated with interchange.	Greater scope for overriding provided by wide range of fare values. Tendency to use 'closed' fare collection system aids evasion control, however.

* Nature of interaction depends on the number of different zones or stages employed.

NOTE: This table summarises the main interactions between the various types of fare structure and the other components of the fare system. It does not deal with the effect of fare system components upon other issues such as revenue and ridership levels. These will be analysed in depth in subsequent sections.

PART TWO : A REVIEW OF OBSERVED AND THEORETICAL EVIDENCE ON THE EFFECTS OF CHANGES IN THE FARE SYSTEM

This part is divided into four sections, as follows:

1. The application of fare systems in Great Britain and Western Europe.
2. Discussion of published material on the effects of changes in fare systems - both actual experience and theoretical research.
3. Results of communication with operators regarding recent or proposed fare system changes and their effects.
4. Overview.

In each case, the fare system will be subdivided as follows:

- Fare structure
- Fare collection
- Ticket range
- Interchange and through ticketing
- Inspection methods

Despite the close interrelationship which exists between these elements, it is necessary to maintain the above subdivision because of the complexity of the fare system.

2.1. The application of fare systems in Great Britain and Western Europe

2.1.1. Introduction

This section will examine the geographical distribution of the various fare systems throughout Great Britain and Western Europe in 1982, using a combination of data from the U.I.T.P. and from original surveys conducted as part of this study. A list of undertakings contacted is shown in appendix 1.
The analysis will be subdivided in the normal way (see previous page).

To reiterate, the basic criterion for inclusion of a particular urban area into the analysis is that it should have a population in excess of 200,000. This cannot be adhered to very rigidly, however, because of ambiguities in the definition of an urban population. Furthermore, some smaller urban areas which employ fare systems of particular interest are also discussed.

Problems of categorising a particular fare system arise from time to time (see previous section), but in all cases the dominant characteristic has decided the ultimate classification.

2.1.2. The application of fare structures

The United Kingdom is unique in Western Europe for being predominantly committed to graduated (stage) fare structures. As can be seen from table 2, which shows the fare structures employed by Western European cities in 1979, 22 out of 26 in the U.K. employed graduated fares. Only London, Tyne and Wear, Plymouth and Cardiff used zonal structures (Merseyside has subsequently adopted a zonal structure for season tickets only).

TABLE 2 : USE OF FARE STRUCTURES BY COUNTRY (1979/82)

	Graduated	Zonal	Flat	Mixed (Flat/Graduated) (Flat/Zonal)	TOTAL
Great Britain	22	4	-	-	26
France/Belgium	5	6	11	6	28
Netherlands/Denmark	-	8	2	-	10
Spain/Portugal	6	-	10	-	16
West Germany	3	25	8	5	41
Switzerland	1	1	1	1	4
Austria	1	1	2	-	4
Italy	-	1	13	3	17
Sweden/Norway/Finland	-	2	5	-	7
	38	48	52	15	153
%	25	31	35	9	

Source: Ref. 7, updated by communication with operators

In contrast, zonal systems can be seen to dominate in West Germany, the Netherlands and Denmark, whilst flat fares prevailed in Italy, Norway, Finland, and to a lesser extent France. The unique position of Great Britain in this respect is thus highlighted. The reasons for this are unclear, but the high degree of conservatism amongst British undertakings plays a part, as does a deeply held belief that only graduated structures can maximise revenue.

2.1.3. The application of fare collection techniques

The pattern of automation vis-a-vis Great Britain and elsewhere is similarly striking. A survey undertaken in 1979 (ref. 7) revealed that 60 out of 84 (71%) of European operators questioned used some form of automatic fare collection. A.f.c. includes the use of ticket vending machines, turnstiles, fareboxes, multi-ride tickets and cancelling machines. The proportion of undertakings using a.f.c. of some description by country was as follows:

- Great Britain/Ireland	2 out of 12	(17%)
- France	8 out of 8	(100%)
- Benelux/Scandinavia	11 out of 22	(50%)
- Spain/Portugal/Italy	11 out of 13	(85%)
- Germany/Austria	22 out of 23	(96%)
- Switzerland	6 out of 6	(100%)

It will be noted that all the French and Swiss undertakings in the U.I.T.P. sample which replied, and all but one of the large urban undertakings in Germany and Austria use a.f.c. Conversely, a.f.c. is uncommon in Great Britain. Whilst London employs a.f.c. on parts of its Underground system and on certain limited stop bus services, the overwhelming majority of bus operations rely upon manual ticket issue and scrutiny. Indeed, even if multi-ride ticketing is included as a form of a.f.c., only London, Manchester, Leeds and Bournemouth bus networks had a significant role played by this type of fare collection in 1982. Communication with operators (appendix 1) as part of this study shows that by 1982 very little had changed in the U.K. and Europe since the U.I.T.P. survey.

2.1.4. The application of ticket ranges

Ticket ranges on offer in 1982 varied considerably from place to place and from country to country. In Europe, the range was generally composed of single tickets (often subject to a surcharge if purchased on the bus), season tickets, and multi-ride tickets. Most operators permitted purchase of a wide range of tickets from vending machines, kiosks or appointed agents (tobacconists, department stores, etc.), and a few did not sell any tickets on the vehicle at all. Passengers are trusted to validate their tickets upon boarding, and to contain the additional risk of fraud, levels of inspection are generally higher, with spot fines being levied.

In Great Britain the ticket range tends to be more limited. Whilst all operators provide single tickets (available on the vehicle), many also offer season tickets (travelcards). However, as has already been noted, very few market multi-ride tickets. Unlike season tickets, these need a simplified fare structure to operate satisfactorily.

The situation as revealed by the survey in ref. 7 is shown in table 3. Methods of distributing and issuing tickets were shown to be clearly linked to the type of fare structure (table 4). Again, results of surveys conducted for this study revealed little had changed by 1982. Undertakings not using a.f.c. rely on the sale of individual or multi-journey

TABLE 3 : DISTRIBUTION OF TICKET TYPE BY COUNTRY

	Single	%	Multi-ride	%	Season	%	TOTAL
Great Britain	26	100	4	15	20	77	26
France/Belgium	28	100	22	79	19	68	28
Netherlands/Denmark	2	20	10	100	10	100	10
Spain/Portugal	16	100	2	13	3	19	16
West Germany	41	100	36	88	38	93	41
Switzerland	5	100	5	100	4	80	5
Austria	4	100	3	75	2	50	4
Italy	17	100	12	71	15	88	17
Sweden/Norway/Finland	6	86	7	100	7	100	7
	145	94	101	66	118	77	154

Source: Ref. 7.

TABLE 4 : METHODS OF TICKET ISSUE

	Single tickets		Multi-ride tickets		Season tickets		TOTAL
Manual sale:		%		%		%	
- At ticket offices	23	18	40	31	32	40	95
- On vehicles	47	36	16	13	3	4	66
- By post	2	2	1	1	8	10	11
- Via agents	11	9	46	36	37	45	94
Automatic sale:							
- In the street	18	14	12	9	0	0	30
- At stations	20	16	11	9	1	1	32
- On vehicles	8	5	1	1	0	0	9
	129	100	127	100	81	100	337

Source: Ref.7.

tickets on vehicles, and the sale of multi-ride and season tickets from their offices and/or outside agents. Most undertakings using a.f.c. still sell a limited range of individual (or possibly multi-journey tickets on vehicles, but also offer passengers a wider choice of tickets from enquiry offices, by post, from agencies, and from vending machines on the vehicle or in the street. In such situations purchase of single tickets (especially from vehicles) is sometimes subject to a surcharge to discourage their use. In Paris this surcharge is 50% of the cost of a prepaid ticket.

2.1.5. The application of through and integrated ticketing

The availability of through and integrated ticketing follows a similar pattern to that of other aspects of the fare system. A survey carried out in 1973 (ref. 8) revealed that:

> ".......of the 92 undertakings covered by the survey, 22 do not operate a through fare system, particularly in the case of the British undertakings."

The research carried out for this study (see section 2.3.) again shows little had changed by 1982. Most foreign operators allow through journeys with a single ticket, albeit with a time limit and sometimes a surcharge. Indeed, wherever the so-called "Transport Communities" have been set up (as in most of the larger urban areas of West Germany), great emphasis has been placed upon the ability of the passenger to make even quite complicated journeys using one single ticket.

With the notable exception of Tyne and Wear P.T.E., in the United Kingdom in 1982 through journeys on single tickets are permitted on a purely piecemeal and sporadic basis, usually to mitigate the effects of route rationalisation. They generally cover a limited range of origins and destinations to reduce the complication of determining the correct fare and subsequent inspection. Equally, they only permit interchange at specific points, and involve additional transactions on the part of the driver when issuing the ticket. Such shortcomings are imposed chiefly by the complicated fare structure.

The situation for single journey through ticketing schemes in the larger U.K. conurbations by 1982 is as follows. Tyne and Wear P.T.E. is the only undertaking which permits systemwide through and integrated ticketing, an arrangement which was introduced in November 1981 to coincide with the opening of the new Metro system. Bus services were remodelled to act as "feeders" to local Metro stations, thereby rendering integrated ticketing essential if considerable hardship to passengers was to be avoided. Greater Manchester P.T.E. is the only undertaking to offer bus/bus through ticketing, albeit on a purely sporadic basis. There are five separate local schemes, introduced to alleviate the effects of route rationalisation schemes.

A considerable amount of integrated ticketing has existed between British Rail and London Transport rail services for many years now, either using combined season tickets, or in many cases, single journey tickets. The extension of the very popular "Travelcard" facility on L.T. services in May 1983 has further enhanced the scope for through journeys between Underground and bus services. However, further extension of integrated single ticketing between L.T. and B.R. depends upon the introduction of compatible a.f.c. equipment.

Elsewhere in the U.K. in 1982 very little provision is made for through journeys on a single ticket. Any schemes are of a "one-off" nature, such as that offered by South Yorkshire P.T.E. between an outlying area known as Dinnington and Sheffield City Centre, buses being used as a feeder to the nearest railway station.

All the urban areas of the U.K. which enjoy season ticket facilities on the buses also permit through travel to be undertaken by holders of such tickets, albeit sometimes using specified routes. Furthermore, multi-ride ticket schemes (Manchester, Leeds, London and Bournemouth in 1982) allow interchange within a specified time limit, although because of the limited nature of some of the schemes, scope for interchange using the ticket is restricted.

Recognition of the need for more comprehensive single journey through ticketing has led to the setting up of a joint working party by the Passenger Transport Executives (refs. 9 and 10). Its task is to design and assess the feasibility of a versatile fare collection system capable of offering single journey through ticketing. Several P.T.E.'s were awaiting the performance of the Tyne and Wear "Transfare" scheme before deciding whether or not to adopt through and integrated single ticketing in their own areas.

It should be pointed out that the widespread use of graduated fare scales in British cities does serve to mitigate the financial penalty otherwise associated with changing vehicles en route under a flat or zonal system. Nevertheless, widespread use of tapers in the fare scale reduces this argument, as does the justification for through ticketing on grounds of pure convenience.

A typical continental through ticketing system is that to be found in Karlsruhe, West Germany. This has a zonal fare structure and standardised ticket range of single, multi-ride and season tickets.

Both single and multi-ride tickets permit unlimited changes of vehicle within 60 minutes of initial cancellation, provided this involves travel in a roughly constant direction. Integrated ticketing arrangements also exist, whereby passengers can also use the services of a neighbouring operator, provided their destination is reached within 150 minutes of initial cancellation.

Arrangements for integrated ticketing tend to be even more far reaching on the continent if the undertakings involved are members of a 'Transport Community'. The largest example is in the Rhine-Ruhr region of West Germany, an industrial area containing 22 urban centres and a population of 8 million people.
A single ticket facilitates travel on all local bus, tram and rail services, together with inter-urban bus and rail services. Each bus stop and railway station has a map of the system, from which a colour-coded system of zones enables the user to ascertain the price category applicable to his or her journey. Sophisticated ticketing arrangements such as these require high levels of co-ordinated planning and administration between undertakings.

2.1.6. The application of ticket inspection methods

Again a distinction emerges between British and continental practice. In Britain, the 'closed' system prevails, whilst on the continent, many undertakings employ the 'open' system. The latter arrangement involves the passenger being trusted to cancel his or her ticket either after purchase or upon boarding the vehicle.

On-the-spot fines can be levied by inspectors on continental systems who find passengers without valid tickets. Viewed as surcharges by some undertakings, they are often many times greater than the fare that should have been paid. By contrast, such fines are rare in Britain. Only the Tyne and Wear Metro system and Greater Manchester P.T.E. operated an on-the-spot fine arrangement in 1982, and then only with relatively small 'supplementary fares'. A further contrast that exists is the greater tendency for inspectors in plain clothes on the continent.

2.1.7. The application of fare systems: a summary

- Whereas urban bus operations in the U.K. have been found to be overwhelmingly committed to graduated fare structures, zonal or flat fares predominate on the continent.

- Automatic fare collection and self-service in its various forms is much more prevalent on continental bus systems than in the U.K.

- The range of tickets marketed tends to be narrower in the U.K. than in Continental Europe. Whilst most operators offer both single and season tickets, those in Europe also promote multi-ride tickets to a much greater extent. It follows that prepurchase is much more common on the continent.

- Facilities for through and integrated ticketing, particularly using single tickets, are much less common in the U.K. than abroad.

  British undertakings use 'closed' systems, whilst their continental counterparts tend to opt for 'open' methods of ticket inspection. The latter involve higher levels of inspection, backed up by on-the-spot fines for those without valid tickets.

This situation emphasises the importance of the interactions between fare system components. Clearly, the fundamental differences in fare structure between U.K. and continental operators is replicated in other aspects of the fare system.

2.2. Discussion of published material on the effects of changes in fare structure

2.2.1. Introduction

Published material concerning the actual or predicted effects of changes in fare system components is rare compared with other topics in public transport. This may be due to the fact that most operators have taken it for granted that simplification of fare structures would automatically lead to a loss of revenue, or patronage, or both.

The studies reviewed may be divided into those concerning the actual effects of implemented schemes, and those which model the effects of hypothetical fare system changes.

The fifth component of the fare system, inspection methods, will be dealt with here in the sections dealing with other components of the fare system. It will be seen that evasion levels are as much a function of these other components as of inspection methods.

2.2.2. Fare Structure

(a) Review of reports on actual experience of changes in fare structure

The majority of the handful of case studies dealing with the ridership and revenue effects of fare structure changes conclude that the move away from a graduated structure was a positive step. The circumstances of each vary considerably, but all but one of the studies involved a change from graduated to flat fares.

As one of the earliest OPO conversion schemes, the simultaneous adoption of a flat (subsequently zonal) fare structure in Sunderland in 1966 generated considerable controversy as to its effects. In common with most other fare structure changes, the "purity" of the results is diminished by simultaneous changes in other factors such as routes and service levels. The introduction of the package of measures produced a decline in both revenue and patronage (a fall in revenue of 2.4% in a full year) (11). Whether this decline was directly attributable to the introduction of the flat fare, or perhaps an inherent decline in patronage is not clear. In the following year, revenue increased by 8% as a result of two fare increases introduced in an effort to cover more costs from fares. Zonal fares were introduced in January 1969, with three concentric zones radiating from the town centre. Revenue and patronage effects here are also unclear. An article describing the scheme (12) was written in favourable terms, but a much later piece (13) stated that the zonal scheme was subsequently abandoned in favour of graduated fares, "having contributed to unacceptable losses". Much of the disappointment may be attributed to difficulties encountered from the early (and rapid) conversion to OPO, together with political seesawing by the Corporation, rather than the fare structure itself. Tokens were offered as a means of reducing the burden of fare collection on the driver - details of this aspect are discussed in section 2.2.3.

Reports of other fare structure simplifications show better performance, at least as far as ridership is concerned. An example is the adoption of flat fares in Perth (Australia) in 1974. A flat fare of 30 cents replaced a graduated structure with seven values between 10 and 45 cents. Total revenue collected during comparable 12 week periods before and after the change increased by 4.2%. However, during the same period, the number of fare paying passengers fell by 11.4%. After being adjusted for the effects of network expansion, the flat fare caused a 4.2%

increase in trips longer than 15 km, and a 5.2% decrease in shorter trips (14).

Further evidence is provided by a paper describing the effects of flat fare schemes adopted in two towns in Cumbria (15). The use of a flat fare on town services in Penrith is of little value to this analysis, because it was applied to completely new services for which no before-and-after comparisons could be made. Of greater interest is the experiment in nearby Kendal, where services remained unchanged following the change in fare structure. A flat fare of 6p replaced a range of fares charged for journeys within the built-up area. Revenue fell sharply during the first week of operation (16.6%) compared with an average figure for the previous eight weeks. Over the first three months of the experiment, losses averaged 20%. However, a gain in patronage was achieved - compared with the previous year, the last two accounting periods in the year of the experiment (1976) showed that a passenger recession of 3% before the experiment was converted into a gain of nearly 4% in the first four weeks.

Continued revenue losses led to the decision to adopt a zonal structure, the town and its satellites being divided into four concentric zones with fares of 6p, 8p, 10p and 12p respectively. Revenue generation improved significantly, with increases of between 7 and 10% compared with the pre-experiment period. Passenger loadings were reported to be 16% higher.

Further evidence is provided by the experience of the Strasbourg municipal undertaking (16). In 1976, a 2F flat fare replaced a coarsely graduated structure of 1.20F, 2.10F and 2.80F. Interestingly, the new fare was fixed in such a way as to leave the overall fare level unchanged. An 8.7% increase in revenue in the year following the change was accompanied by a 1.5% increase in trips, the difference being partly attributable to an increase in sales of single tickets, which are relatively expensive compared with other ticket types. The ticket range and its relative prices were also changed at the same time as the fare structure. Clearly, in this case the introduction of a flat fare would appear to be a success, at least as regards revenue and patronage are concerned.

The application of simplified fares on bus services in the Greater London area is illuminating in that it involved an altogether larger area than those described above. Four separate schemes of specific interest in this area have been undertaken by London Transport in recent years:

- the Harrow and Havering flat fare experiments (February 1980 - April 1981);
- the Suburban flat fare scheme (April 1981 - October 1981);
- the systemwide zonal scheme for buses (adopted October 1981); and
- the introduction of zonal fares for the Underground, and of travelcards on both buses and the Underground (adopted May 1983). (The new Travelcards replaced a more restrictive range of passes).

The introduction of a 20p flat fare on a group of graduated fare routes serving the Harrow suburb of Greater London led to a 12% increase in adult cash receipts, a 9% loss of adult passenger journeys, and a 15% increase in passenger miles travelled (17). If the effect of the simultaneous change in fare level is removed to produce a neutral effect on receipts, the loss in the number of journeys would have been just 3%. A parallel experiment in the Havering (Romford) area was less conclusive, because it was already the subject of experimentation into a multi-ride ticket scheme (see section 2.2.4.), although its findings concurred broadly with those in Harrow. In the latter area, there was typically a dramatic loss of short distance traffic (44% of people previously paying the minimum fare), whilst journeys over four miles in length nearly doubled in number. Interestingly, it was found that only half of the lost mimimum distance traffic was due to actual suppression of trips - one third was due to legitimisation of fraud by those who previously paid the mimimum fare but travelled further, whilst the remainder actually increased their journey length. This would suggest that the large losses in short trips that appear to result from flat fare schemes are somewhat exaggerated.

The success of the Harrow and Havering flat fare experiments in terms of revenue and patronage encouraged London Transport to adopt a flat fare throughout the whole of suburban London (18), an area accounting for 45% of L.T. bus revenue. A 25p flat fare replaced a graduated scale ranging from 12p to 58p. After allowing for seasonal and other factors, the new fare structure was believed to have increased revenue by 1% in the first three months, but depressed passenger journeys by 7-10%. This latter figure was higher than expected, and is partly explained by the fact that the imposition of the flat fare effectively caused a 10% increase in average fare paid. Passenger miles rose by 5-8%, which again is poorer than expected. A crude loss of half the minimum distance journeys (probably overestimated for reasons discussed above), was balanced by an 80% increase in the number of trips longer than four miles. Overall, the flat fare appeared to have had little effect upon L.T.'s receipts whilst increasing passenger miles by about 50 million miles per annum. In the context of their corporate objective of increasing passenger miles at no net cost, performance was clearly positive.

Indeed, a review of the impact of London Transport's fares policies carried out early in 1984 (3) showed that trends over the three years ending in December 1983 were encouraging. Despite some extreme oscillations in overall fare level caused by external factors, the period had shown a 9.5% increase in passenger trips, an 11% rise in passenger miles, and a 10% decline in net revenue. More importantly, the changes in fare structure alone had increased passenger journeys on buses and trains by over 4% between 1980-83, whilst passenger miles had risen by 9%. The report states that:

> ".......the changes in fare structure have been worthwile both in passenger benefit and commercial terms."

These are the published results of fare structure simplifications as regards revenue and patronage. Whilst the consequences are strongly dependent upon the change in fare level represented by the new structure (they are rarely introduced at exactly the old average fare), and by other local circumstances, it is nevertheless possible to draw certain conclusions. Patronage measured in terms of passenger journeys tends to fall, often quite drastically. However, passenger miles generally increase, by virtue of the greater number of longer trips. Generalisations on the effect upon revenue are more difficult. Experience in Kendal and Sunderland showed a negative effect, whilst in Perth and Greater London trends were positive. Results suggest that independent of fare level, a flat fare will cause a small loss in revenue, although if there is scope for an appreciable increase in longer trips the inevitable loss in short distance revenue may be more than compensated for.

Documented evidence on the other effects of simplified fare structures (such as passenger perception, convenience, operating costs, boarding speeds, levels of fraud, and so on) is even rarer than that on revenue and patronage. Two areas where flat fares have been reported to be advantageous are in speed of operation and in combatting fare evasion. The change in Perth was reported to have "tended to reduce fare collection time as a result of more public awareness of fares" (14). Although no figures are given, results from the L.T. Harrow flat fare experiment are corroborative. Here it is suggested that "faster boarding times produced by the flat fare might save the average passenger about 15 seconds on an average journey, equivalent to a fare reduction of perhaps 2%" (17). The review of experience of fare changes between 1980-83 also reported an estimated fall in marginal boarding times (3). The Strasbourg undertaking reported an increase in boarding times, but this was wholly attributable to a shift towards tickets purchased from the driver.

Evidence regarding the beneficial effects of the introduction of a flat fare upon levels of fare evasion was provided by the L.T. Harrow experiment. Previous research by L.T. revealed that with a graduated scale on suburban OPO routes, the proportion of customers paying the correct fare was as low as 80%, the remaining passengers being found to be overriding (see table 5). Clearly, the relatively complicated graduated scale increases the scope for overriding. Even with a 'closed' system, driver supervision is minimal once the fare has been paid. However, the introduction of a flat fare immediately legitimises overriding, because only one fare value can be paid. As such, nearly one third of the apparent loss of minimum distance traffic was attributable to legitimised overriding. Published evidence regarding the effect of zonal fare structures upon evasion levels is unavailable. However, one can hypothesise that while "steps" remain in the fare scale, the incentive to override will always remain, but the reduction in their quantity may serve to reduce fare evasion. The unclear picture here is reiterated by the experience of London Transport, which is that fraud levels following the introduction of a systemwide zonal fare structure were almost identical to previous levels (3).

TABLE 5 : POSTULATED FARES DUE AND PAID ON AN L.T. O.P.O. SUBURBAN BUS ROUTE

FARE DUE \ FARE PAID	10p	16p	24p	32p	35p	40p
10p	100%	-	-	-	-	-
16p	14%	86%	-	-	-	-
24p	3%	15%	82%	-	-	-
32p	3%	-	16%	81%	-	-
35p	5%	-	-	10%	85%	-
40p	5%	-	-	15%	-	80%

Source: London Transport Research Memorandum M386.

A number of reports have suggested that the introduction of a flat fare leads to various additional long-term benefits, particularly in the area of fare collection. The Perth system was considering the introduction of an exact-fare farebox system, whereby the driver would no longer need to handle cash, or indeed issue tickets. Such a system was anticipated to further speed boarding times and free the driver to concentrate on the driving aspects of his work. Similarly, the results of the Harrow/Havering schemes rekindled the debate as to whether OPO is feasible throughout Greater London. It indicated that the need for simplified fares need no longer act as a debit item on the balance sheet for the extension of OPO. Subsequent observations have suggested that whilst the wholesale introduction of flat, and later zonal, fares in Greater London has not in itself enabled a move towards complete OPO, its gradual introduction for financial reasons has not been so damaging because of the presence of a simplified fare structure. Indeed, the effects of the schemes implemented between 1980-83 have been successful not only for revenue and patronage, but also in operational terms (3).

One important area which is badly neglected in the handful of available reports dealing with the effects of fare structure changes is that of passenger attitudes. It is too simplistic to assume that if ridership has increased people are generally in favour, and vice versa. One source of material in this area (14) is that dealing with the Perth changes. An on-vehicle passenger attitude survey carried out one year after the introduction of flat fares showed that 78% of passengers preferred the flat fare system, and 7% the graduated fare, whilst 15% were undecided. Approval tended to reflect the financial gain or loss caused by the new structure, but of the 78% of passengers preferring the flat fare, at least 17% preferred it despite a resulting fare increase. The explanation given for this is the simplicity and convenience offered by the flat fare. The study concludes that the travelling public as a whole endorsed the flat fare scheme, despite problems of equity it inevitably raises. The flat fare in Strasbourg was reported to have engendered a stronger public awareness of the public transport network as a means of facilitating mobility (16), although this was based upon the observation of the author rather than any specific survey.

(b) Review of reports dealing with hypothetical modelling of fare structure changes

The findings of seven studies will be reviewed, five of which compare graduated, flat and zonal structures, and the remaining two just graduated and flat. Because of the various extraneous factors present in most of the actual fare structure experiments described previously, these empirical exercises may well be more representative in showing the true "fare structure effect".

The majority of studies investigated show flat fares to lose appreciable amounts of revenue and/or ridership. Zonal fares also perform poorly in this respect compared with graduated structures, but to a much lesser extent. One such study undertaken in the United States in 1974 (19) produced the results shown in table 6 . A flat fare, together with several zonal ones were compared with the zonal structure actually employed by the Washington Metropolitan Area Transit Authority (WMATA), a concentric design using between four and ten zones, depending on the area involved. The various structures were tested to determine the scale necessary to generate approximately the same levels of patronage and revenue as were received in 1972.

Table 6 : Equal Revenue fares alternatives

Option	Number of zones	Basic Fare	Increment per zone	Practical increment per zone	Maximum Fare	Practical Maximum Fare	Percentage Intrazonal trips
1	5: Concentric with radial divisions	40c	18c	20c	112c	120c	67
2	2: Concentric with radial divisions	40c	27c	30c	94c	100c	69
3	2: Concentric with larger inner zone	45c	45c	45c	90c	90c	93
3A	2: Concentric with smaller inner zone	40c	28c	30c	68c	70c	69
4	Flat Fare	49c	-	-	49c	50c	100

Based on WMATA 1972 data. Source: Ref. 19.

With exactly two-thirds of passengers travelling wholly within one zone, the flat fare had to be fixed 25% above the minimum zonal fare. Nevertheless, even this proportion was expected to cause substantial patronage losses. The five zone option was found to be most desirable in the particular circumstances of Washington.

An investigation of the various effects of different fare structures upon an even larger city than Washington was undertaken as part of the London Rail Study (20). Flat, zonal and free fares were compared with the graduated scales operating on the British Rail and Underground networks. Actual figures for revenue and ridership were not given, but it was concluded that graduated fares "......make the most sense in financial terms by maximising the revenue from a given number of passengers......". Their flexibility in raising revenue and in catering for particular market segments was also pointed out as an attribute. Zonal fares were next best in terms of revenue earning performance, it being suggested that "......some revenue loss is likely due to through booking but otherwise (zonal fares are) nearly capable of raising the same revenue as graduated fares, depending on the size of the zones". Smaller zones were better from a revenue maximising point of view, but they increased the complexity of the system. Assuming it was to be applied over the whole of the Greater London area, a flat fare was predicted to produce large revenue deficits. Not surprisingly, free fares were expected to have an even worse financial impact.

Returning to bus services, the economic case for flat fares was also found to be weak in a study carried out by Webster (21), though not to the same extent as for rail services. A comparative analysis of flat and graduated fare systems using London data found that if the undertaking is required to break even the economic case for flat fares is weak, unless substantial operating cost savings are achieved as a result. With the flat fare fixed at the mean value of the original graduated system, patronage and revenue were both found to be about 10% less than with the graduated system, despite the level of passenger-kilometres remaining virtually unchanged. Indeed, the flat fare would need to be fixed at a level almost 20% above the previous mean fare in order to leave revenue unchanged. Passenger journeys would be appreciably reduced however. For passenger journeys to be maintained, the flat fare would need to be fixed at 80% of the previous mean graduated fare level. The effect of different flat fare values upon revenue and patronage is displayed in figure 2 . Webster's study suggests that if passenger miles travelled is used as the criterion for success instead of passenger journeys made, the case for flat fares is strengthened. Assuming that fares paid under a graduated system are directly proportional to distance travelled, and that elasticity is constant over the whole range of fares, then a flat fare will produce an identical level of passenger kilometres as a graduated structure when the flat fare is fixed equal to the mean graduated fare paid. A higher elasticity for shorter journey lengths and a lower one for longer trips would reduce passenger miles by 2 - 3%, a more likely scenario than that of constant elasticity.

When the likely operational benefits of flat fares are taken into account (in this case it was assumed greater convenience and faster boarding speeds would permit a transfer to OPO), it was found that "there would be no strong case against flat fares on economic grounds". Assuming operational cost savings of 16% following the replacement of crew buses by OPO vehicles, a flat fare based on the graduated mean would yield a 10% increase in "profit" compared with the previous graduated fare crew-operated situation (figure 3). Revenue could be maintained

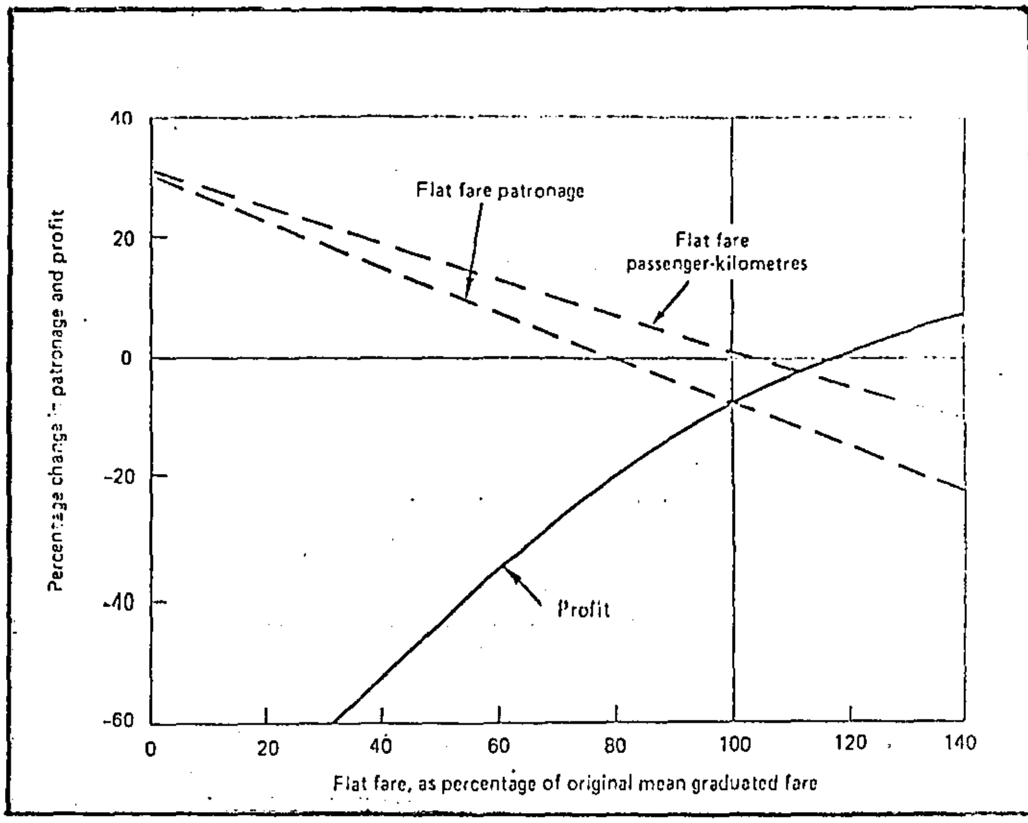


Fig. 2 : Changes in Patronage and Profit following replacement of Graduated by Flat fares (no operating cost savings, and number of buses held constant). (Source: Ref. 21)

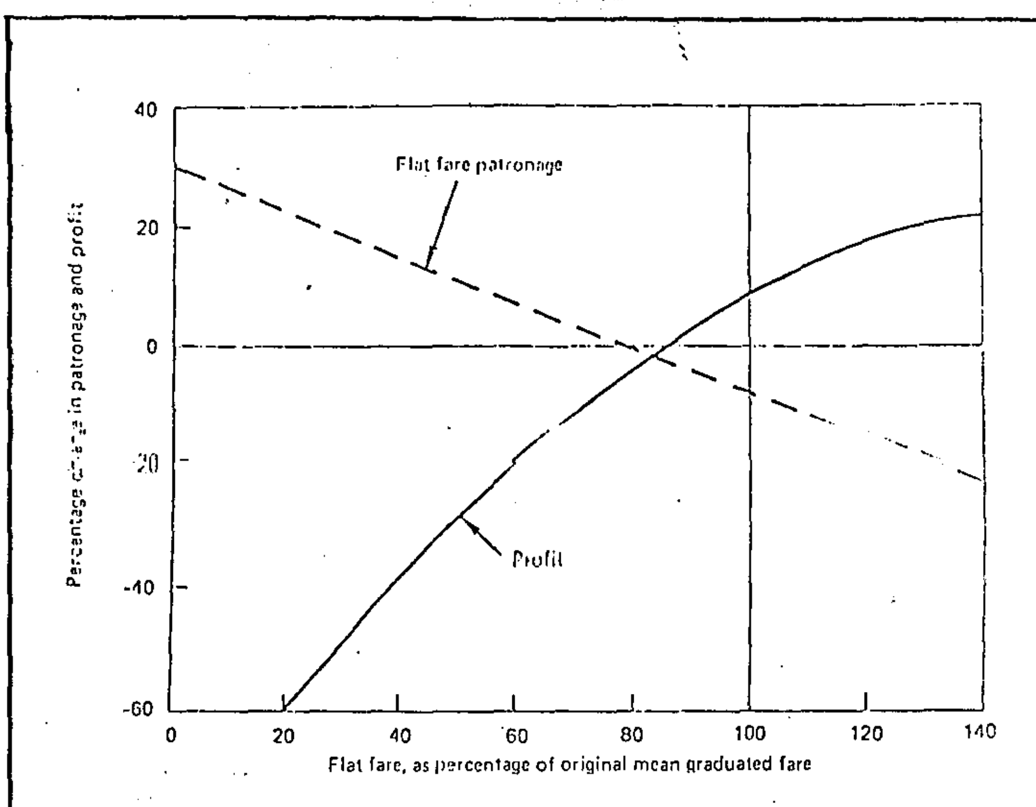


Fig. 3 : Changes in Patronage and Profit following replacement of Graduated by Flat fares (operating cost savings, but number of buses held constant). (Source: Ref. 21)

with a flat fare fixed at 85% of the mean graduated fare.

Since the vast majority of operators have already introduced OPO, the scope for operating cost savings being achieved as a result of flat fares is considerably reduced. Attention should therefore focus on Webster's conclusion that "if the introduction of a flat fare system were unlikely to produce any savings in operating costs, then the case for introducing such a system on purely economic grounds would be weak". However, if another facet of modern bus operation is acknowledged (namely the availability of operating subsidies), then the balance tips back in favour of flat fares. This is because if a cheap subsidised fares policy were implemented, the difference in level of patronage between flat and graduated fare systems would assume secondary importance compared with issues such as convenience, equity, and so on. This is often used as an explanation for the widespread use of flat fares on the continent, where higher subsidies are often "de rigeur".

Another study which came down in favour of flat (or at least simplified) fares under certain circumstances (22) gives three reasons why this is the case. Firstly, the assumption that people are prepared to pay according to distance travelled is questioned - evidence suggests "willingness to pay" rises less quickly than has been assumed. Secondly, graduated fares tend to inhibit trip length. Realising the latent demand for longer distance trips can cushion the demand effect of sharp fare rises for short trips caused by a flat fare. Thirdly, flat fares reduce the opportunity for fraud presented by a graduated structure.

The results of the LT Harrow flat fare experiment (see p.35) were explained by the three factors outlined above. When the traditional "willingness to pay" function which rises in proportion to distance travelled is replaced by one that rises less rapidly (see fig. 4), the elasticity values produced by conversion from graduated to flat fare at the various journey lengths become less extreme - lower at the short trip end, but higher at the longer trip end. With the majority of bus trips being made over relatively short distances, an argument in favour of flat fares emerges, particularly when combined with the effects of eliminating fraud and enabling "drop forward" as discussed above. The empirical "willingness to pay" analysis is a valuable contribution to the simplified fares debate. Nevertheless, it was pointed out that because elasticities at short trip lengths were still found to be high under the new function, a zonal rather than flat scale might be more appropriate.

Nash (23) presents a "grossly simplified model" of an urban bus service to illustrate the issues involved in choosing between alternative fare structures. With three trip lengths (1,2 and 3 miles) and two time periods (peak and off-peak), fare structures are assessed in terms of their ability to maximise the sum of consumers' plus producers' surpluses (the "social surplus index"). It is assumed that charging flat fares will reduce costs by 25% if OPO is facilitated, whilst free fares will reduce costs by 29% compared with the most complex structure. The results are presented in table 7.

This analysis is interesting in as much that it is favourable to flat fares, with the best result involving flat fares of 5p in the off-peak and 20p in the peak period. A considerable reduction

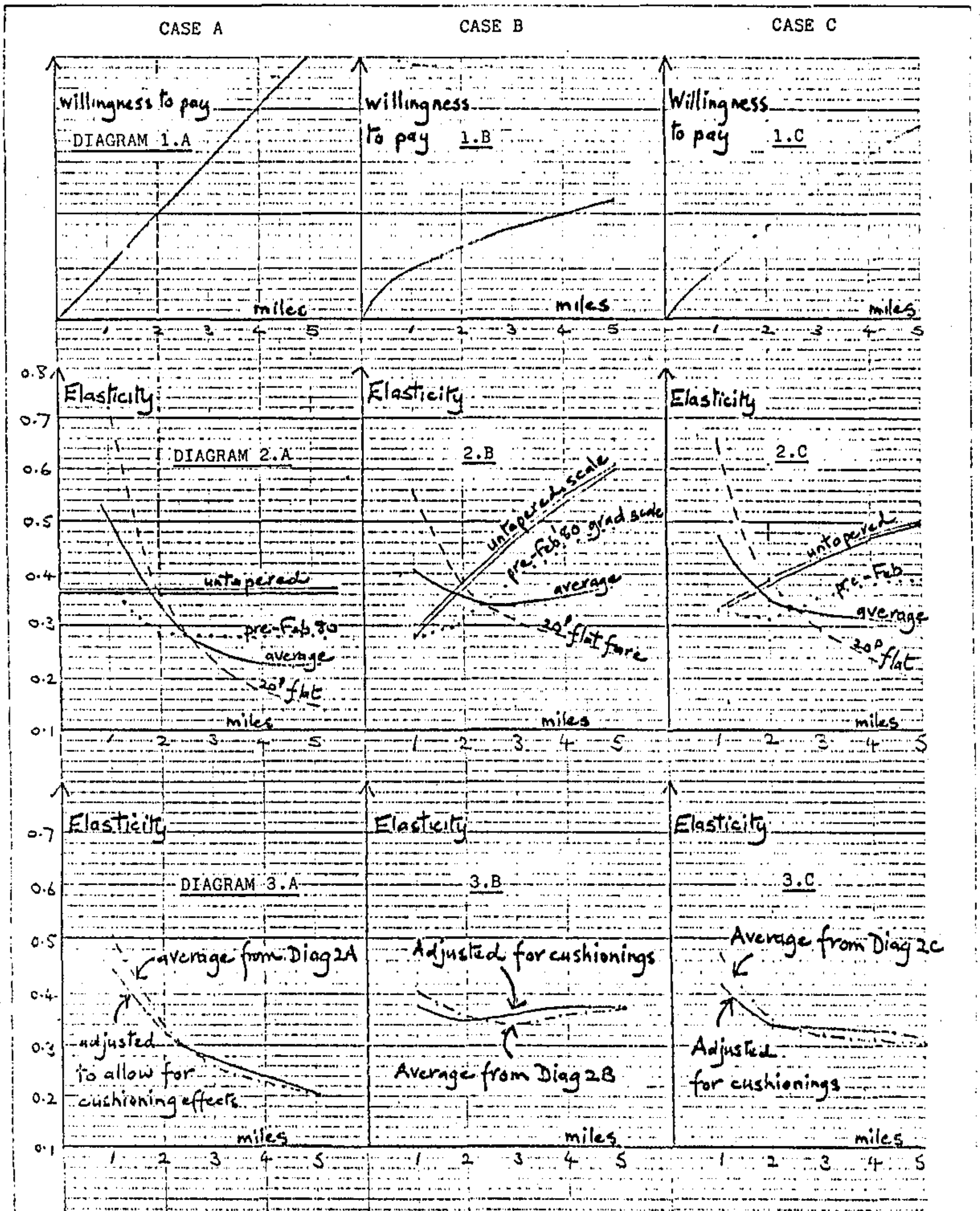


Fig. 4 : Elasticities Implied by Three Willingness to Pay Functions

Source: Fairhurst (ref. 22).

Table 7 : Effects of various fare structures

Option	Off-peak fare A	Off-peak fare B	Peak fare A	Peak fare B	Off-peak Frequency	Peak Freq.	Social Surplus Index	Financial deficit (£/day)
1	5	0	20	0	3	6	100	310
2	10	0	10	0	4	8	97.2	709
3	5	0	25	0	3	5	99.8	147
4	15	0	15	0	4	7	94.1	513
5	5	0	5	5	3	6	94.7	668
6	5	5	5	5	3	6	89.7	620
7	5	0	35	0	2	4	95.5	-110

Source: Ref.23 table 7.3.

in the deficit may be achieved with negligible loss of social benefit by raising the peak fare to 25p and by cutting the frequency to five per hour (option 3). Without time-differentiated fares, the best result is a flat fare of 10p (option 2), albeit at the cost of a large increase in deficit. With lower service frequencies, the loss would have been smaller. Nash observes that "unattractiveness of differentiated fare schemes may be the result of extremely coarse fare structures and trip length distributions assumed, but it is interesting that even with a severe financial constraint, the best procedure remains a flat fare (option 7)". However, it should be noted that the differentiated structures assume two-man operation. In the absence of any delays in loading, OPO of these differentiated structures would improve both social surplus and financial performance considerably.

Useful research on the revenue and other effects of flat fares has been undertaken in the United States. Since the widespread introduction of flat fares there in the late 1960's and early 1970's, considerable debate has surrounded their ability to maximise revenue and to appear equitable to the customer. One of the earlier exercises which found evidence of poor performance in these areas (24) concluded that "both equity and revenue considerations call for a fare structure which increases with trip length". This would narrow the range of per-kilometre fares paid by passengers, and it was argued that if it were not for administrative costs and ease of operation a per-kilometre fare should be charged at a uniform rate. Flat fares were found to be increasingly uneconomic as route length increased, with the break even point found to be at 5.5 km (close to the 6 - 8 km figure quoted elsewhere).

A later U.S. research programme which undertook a more comprehensive analysis of the performance of various fare structures (25/26) confirms certain inefficiencies and inequities arising from the use of flat fares. In particular, short distance and off-peak patrons pay disproportionately high fares for their trips. Conversely, peak hour commuters (especially those travelling longer distances) were major beneficiaries. In an attempt to find out whether other fare structures could perform better, a range of fares policies were tested. The technique used is summarised by figure 5. The model analysed fare strategies by weighting sample cases from passenger surveys based on disaggregate price elasticity estimates. Fare elasticities were then estimated for specific user groups. Costs of various fare collection options were derived and integrated into the analysis. The merger of each scenario's cost and revenue features provides the basis for analysing changes in revenue per mile (RPM) and cost per mile (CPM) amongst distance, time of day, and passenger groups. Fare structures tested against the non-time differentiated flat fare included stage and graduated scenarios, of which some were differentiated by time of day.

Results are presented individually for the three operations studied (table 8). Stage pricing (option 3) is seen to offer substantial gains in revenue, although ridership levels decline as a result. The distributional consequences of a stage

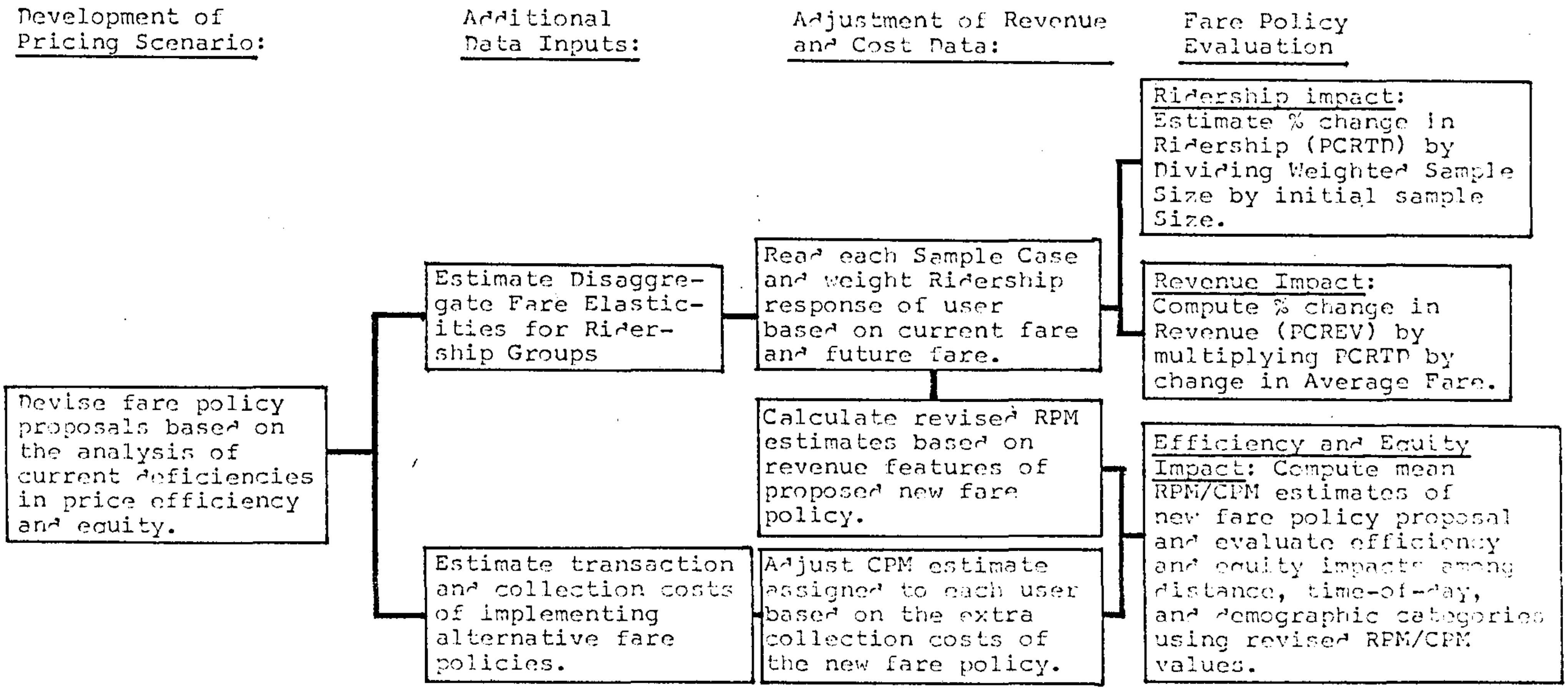


Fig. 5 : Step-by-step summary of the Pricing Evaluation Model used by Cervero.

(Source: Ref. 25).

TABLE 6 : COMPARISON OF THE EFFECTS OF ALTERNATIVE PRICING SCENARIOS

FARE POLICY	1			2			3			4			5			6			7		
UNDERTAKING	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
% CHANGE IN RIDERSHIP	–	–	–	-6.7	-20	-9.8	-2.4	-6.2	-2.6	+0.6	-2.4	+3.0	+0.1	-5.2	+0.3	+0.4	+1.3	+1.0	-5.8	-8.9	-4.3
% CHANGE IN REVENUE	–	–	–	+22	+12	+43	+31	+24	+15	+7	+17	+6	+11	+25	+17	+14	+3	+12	+68	+33	+56
RPM/CPM RATIO WHERE TRIP:																					
-< 6 MILES	0.64	0.49	0.57	0.73	0.66	0.66	0.65	0.43	0.49	0.53	0.41	0.47	0.50	0.41	0.46	0.68	0.48	0.52	0.80	0.47	0.60
-> 6 MILES	0.12	0.18	0.14	0.16	0.21	0.15	0.45	0.49	0.31	0.40	0.38	0.37	0.49	0.48	0.39	0.15	0.20	0.19	0.59	0.41	0.57
% OPERATING RATIO CHANGE		0.40			0.54			0.51			0.44			0.46			0.43			0.58	

Source: Cervero (ref. 25)

<u>Fare policies:</u>

1. Current fare structure.
2. Operator's new fare proposals.
3. Stage fare structure.
4. Logarithmic-based graduated scale.
5. Linear-based graduated scale.
6. Time dependent scale.
7. Distance/time based scale.

<u>Undertakings:</u>

A = Southern California Rapid Transit District (SCRTD).
B = San Diego Transit Corporation (SDTC).
C = Alameda-Contra Costa Transit District (AC).

fare structure are also advantageous to those users least able to pay and in the greatest need of transport services. Graduated structures also offer improvements in efficiency and distributional impacts. Revenue is not improved to such an extent as under stage fares, but ridership is maintained for two of the options. Graduated fares also conferred benefits upon poorer and less mobile sections of the community. All the innovative scenarios were found to increase the proportion of costs covered from fares. Cervero also found that the more differentiated pricing options were best at reducing fare discrepancies, thereby concluding that a strong case may be made for distance-based fares in preference to flat.

An investigation into the effects of various simplified fare structures proposed for the bus network of Bordeaux (27) provides a very useful observation on the issues involved for a continental European-type operation. Fare simplification was deemed necessary to remove anomalies inherited from the merger of several undertakings - specifically a flat fare on some routes and a graduated scale on others. The three hypothetical fare structures tested were as follows:

i - flat fare of 1.50F;

ii - 3 zones, with boundary of second zone at fifth fare stage. Fare 1.50F for 1 or 2 sections, 3F for 3 sections;

iii - 3 zones, with boundary of second zone at sixth fare stage. Fares as in (ii).

These replace a flat fare of 1.50F on some routes, and a graduated scale of 1.50F - 4.10F with up to eleven sections.

The effects of the three options are summarised in table 9. From the point of view of simplicity, not surprisingly the flat fare is preferable. However, this can only be implemented at considerable financial cost, even with a 10% rise in overall fare level. The flat fare was also criticised for handicapping the viability of making future route extensions into the outer suburbs. The déficit incurred in working these longer routes would be considerable.

Choice was thus narrowed down to the two zonal options. The placing of the second zone boundary made a considerable difference to the results achieved, although overall the zonal configuration is so coarse in both cases that three quarters of passengers would effectively pay a flat fare (Bordeaux being a large city with almost two million inhabitants). The final choice was, in fact, the second option. The actual effects of this particular fare structure are reviewed in section 2.3 .

Another continental operation which has recently favoured zonal rather than flat fares as a means of simplifying fare structures is SNCV, the Belgian urban and inter-urban undertaking. A study completed before introduction of the new structure in a number of areas reviewed its anticipated economic and other effects.(28). Maintainence of revenue levels was a prime objective in this case, and the study shows how this can be achieved using a honeycomb zonal structure. A graduated structure with a minimum fare of 14BF and 1.83BF per kilometre beyond 4km was to be replaced by a zonal system of 8BF per zone (retaining the 14BF minimum fare). This new price was derived by multiplying the old rate per km by the maximum distance that can be travelled from one side of a zone to the other under average circumstances (the distance "as the crow flies" multiplied by a coefficient of indirectness of 1.2):

$$(3.55\text{km} \times 1.2) \times 1.833 = 7.809\text{BF/zone } (8\text{BF}).$$

It was acknowledged that some passengers would pay more and others less under the new structure,

TABLE 9 : EFFECTS OF SIMPLIFIED FARE OPTIONS TESTED FOR THE CITY OF BORDEAUX, FRANCE

	OPTION 1	OPTION 2	OPTION 3
No.of sections	1	3	3
Limit of 1st zone	n.a.	3rd stage	3rd stage
Limit of 2nd zone	n.a.	5th stage	6th stage
Limit of 3rd zone	n.a.	City boundary	City boundary
Passengers affected by rise in fare	42,000	300,000	42,000
Consequent reduction in passenger trips	600	13,000	600
Passengers affected by cut in fare	8.0m	6.9m	7.9m
Overall deficit (with no change in fare level)	5.1mF	3.0mF	3.9mF
Overall deficit (with average fare rise of 10%)	2.6mF	0.5mF	1.3mF

Source: Ref. 28.

TABLE 10 : EMPIRICAL ESTIMATION OF FARE STRUCTURE REVENUE/ PATRONAGE EFFECTS : BEST OPTIONS

	FLAT	ZONAL	GRADUATED
Leicester/Wynn		✓	Not tested
London Rail Study		(✓)[1]	✓
TRRL LR704	(✓)[2]	Not tested	
Fairhurst	✓	✓	
Nash	✓	Not tested	
Hoyt/Kurgan		Not tested	✓
Cervero		Not tested	✓
Bordeaux		✓	
S.N.C.V.	Not tested	✓	

(1) Nearly capable of yielding same revenue as graduated fares, depending on size of zones.

(2) Only if high subsidy levels, and/or conversion to O.P.O involved.

but overall revenue was expected to be maintained. No quantitative justification was given for this hypothesis. Actual experience with the new fare structure is discussed in section 2.3.

Bringing together the findings of the studies discussed above, firm conclusions as to the desirability of various fare structures in terms of revenue and patronage effects are impossible to formulate, particularly when the differing circumstances and techniques used are taken into account. Nevertheless, the preferred options in each study summarised in table 10 show flat fares to be poorer performers than zonal or graduated. It will be noted that zonal fares are always the preferred option (except in one case where they are deemed to be nearly as good as graduated fares) for raising revenue whenever they are included in the analysis. (Best is defined as the option which yields most revenue).

2.2.3. Review of reports on the effects of changes in fare collection methods

This is a large area which can only be dealt with briefly in this study. It overlaps to a considerable degree with ticket range (section 2.2.4), in as much that off-bus ticketing methods are also a particular means of fare collection. It should be noted that very little quantified data is available with which to assess the direct effects of adopting a particular fare collection approach. Accurate analysis is further handicapped by the different circumstances pertaining to each example.

Ways in which the type of fare collection employed could conceivably affect an undertaking's revenue and ridership include the repercussions for fare structure (some approaches need a flat or very coarse scale to operate), and passenger reaction to the system (a highly automated system could confuse, alienate or deter some categories of passenger). Furthermore, because some fare collection methods permit faster boarding speeds than others, the slower ones will produce extended journey times and thus a risk of passenger loss. Before-and-after monitoring of thirty routes converted to conventional OPO during 1971/2 showed that on average 3-4% of receipts were lost due to this factor (29).

Apart from operating and staff costs, experience suggests the most far reaching ramifications of the choice of fare collection method are felt in boarding and operating speeds. Concern for the damaging effect upon these areas of the adoption of extensive OPO in the late 1960's and early 1970's led to a great deal of research being done to study and quantify the various effects. Perhaps the most useful general study in this area was performed by Cundill and Watts (?), who confirmed the suspicions of operators by quantifying the adverse effects of OPO. An urban route with an average of three people boarding and three people alighting at each stop, the average stop-time of a crew operated vehicle with an open rear platform was about 8 seconds, whereas on the same route the same figure for OPO vehicles was more than double at between 19-28 seconds or more. As can be seen from table 11 , boarding times per passenger ranged from about 1-6 seconds, with fare collection by the conductor being the quickest, and conventional OPO the slowest. The fastest values for OPO in the U.K. were for farebox operation with no change given, a result corroborated by experience elsewhere (many such operators have claimed operating speeds comparable to those of

TABLE 11: STOP-TIME PARAMETERS FOR VARIOUS BUS AND FARE COLLECTION OPTIONS

Option			Dead time (seconds)	Boarding time per passenger (seconds)	Alighting time per passenger (seconds)
Open rear platform bus in London (graduated)	Two-person operated	Peak	0.95 ± 0.2	1.15 ± 0.05	1.00 ± 0.1
		Off-peak	0.60 ± 0.1	1.35 ± 0.05	1.20 ± 0.05
Forward entrance bus in Reading (graduated)	Two-person operated	Peak	2.30 ± 0.4	1.50 ± 0.05	0.95 ± 0.05
		Off-peak	3.25 ± 0.3	1.75 ± 0.1	1.20 ± 0.1
Conventional OPO bus in Bristol (graduated)	One-person operated	Peak	5.50 ± 0.75	4.75 ± 0.2	1.20 ± 0.05
		Off-peak	6.40 ± 1.5	6.60 ± 0.7	1.35 ± 0.15
'Autofare' (farebox) system in Hull (graduated)	One-person operated	Peak	0.95 ± 0.15	2.25 ± 0.1	1.00 ± 0.05
		Off-peak	1.10 ± 0.1	2.45 ± 0.05	1.15 ± 0.05
'Red-Arrow' bus in London (turnstile) (flat)	One-person operated	Peak	5.65 ± 1.05	3.30 ± 0.15	1.40 ± 0.25
		Off-peak	5.55 ± 1.05	5.00 ± 0.25	1.30 ± 0.05
Split-entry type bus in London (barrier) (graduated)	One-person operated	Peak	7.65 ± 0.6	4.00 ± 0.2	1.20 ± 0.2
		Off-peak	7.20 ± 0.75	4.85 ± 0.35	1.40 ± 0.25
Continental system in the Hague (high proportion of prepurchase and on-board cancellation) (flat)*	One-person operated	Peak	4.00 ± 0.45	1.85 ± 0.15	0.75 ± 0.05
		Off-peak	4.05 ± 0.5	2.15 ± 0.1	0.95 ± 0.1

Source: Ref. 2 (*Ref. 30).

crew operation). Dead time at the bus stop (that portion of the stop time which is independent of the numbers of people boarding and alighting) is strongly influenced by whether or not doors are fitted to the vehicle.

The variant of OPO fare collection predominant on the European mainland (a high proportion of pre-purchase and self-service cancellation of multi-ride tickets) produced the lowest boarding speeds of all single-manned operations, according to a study employing identical techniques to that above (30). However, such speeds were achieved with not only a high level of prepurchase, but also flat fares.

Observations elsewhere confirm the poor performance of conventional OPO regarding boarding speeds. A case in point is a series of observations on a busy OPO route in Luton (31), where a mean boarding time of 6.35 seconds per passenger was obtained. Similar results were obtained by Morton in Sunderland (11). Because boarding times are increased so much when the driver is collecting finely graduated fares, the centre exit makes comparatively little difference in journey speeds.

Lower boarding speeds have the following consequences:

- a substantial increase in fixed costs because additional vehicles are required in peak periods;
- savings in labour costs through single manning may be reduced or lost altogether by the need to employ additional drivers;
- a deterioration in service may cause a loss of passengers (research by L.T. has revealed that a one second rise in mean boarding time causes a 0.5 - 1.0% drop in revenue (32);
- delays at bus stops impinge upon other sections of the community by aggravating traffic congest-

ion and increasing the risk of accidents; and

- constant pressure on the driver may cause fatigue, which in itself may increase accident risks.

For these and other reasons, London Transport called a halt to their OPO conversion programme in the mid-1970's, preferring to retain crew-operation on their busier routes (29/33). Analysis of the costs and benefits of conversion showed the net benefit of conversion to be very low, particularly when repercussions for the community as a whole are taken into account using cost-benefit analysis. The importance of finding fast, efficient and viable OPO fare collection systems is evident from the observation that the total saving to the community arising from reduction in delays to bus passengers, reduced congestion, and reduced costs to the bus company resulting from a drop in average stop times of 1 second was estimated to be £0.5 million per annum (at 1968 prices) in Central London (2). For a breakdown of the calculation see table 12.

Whilst a relatively straightforward relationship exists between fare collection and boarding speeds, the same is not true as regards fare evasion. Whenever OPO involves all passengers being dealt with by the driver as they board, non-payment of fares is made very difficult. However, even with this conventional OPO system, overriding is relatively easy, as proved in the earlier discussion in section 2.2.2. In the case of Great Britain, Latscha (34) has observed (using a very small sample) that ".......the higher level of fraud is explained by the absence of adequate legal means of combatting it effectively". With two-stream systems, turnstiles can encourage evasion, but if an open system is employed, evasion can become excessive (2/6) unless great emphasis is placed upon checking by inspectors with the power to levy penalty fares. If this is not done, the cost savings achieved are

TABLE 12 : COMMUNITY COSTS ARISING FROM AN INCREASE OF ONE SECOND IN THE AVERAGE TIME SPENT AT EACH BUS STOP (in £000's p.a.)

	PEAK	OFF-PEAK	TOTAL
Direct cost to bus passengers (No.of stops per km. x extra delay x no.of passengers x value of time)	118	115	233
Congestion costs:			
- to bus passengers	19	15	34
- to cars	11	17	29
- to taxis	9	20	29
- to goods vehicles	6	20	27
Sub Total	165	187	352
Cost to bus company:			
- crew operated	110	30	140
- one person operated	80	25	105
GRAND TOTAL: (crew operated)			492
(one person operated)			457

(Source: Cundill & Watts Ref.: 2)

Based on 1968 data and prices.

likely to melt away in the form of lost revenue. In conclusion to his review of fare evasion issues, Fiedler states:

> "......it cannot be overstressed that......free access on buses presents far greater dangers to the economy of the undertaking than those who, for practical reasons, advocate their introduction are willing to admit." (6)

Nevertheless, the tendency to underestimate levels of fare evasion applies to other approaches. For example, there is no evidence to suggest that crew operation is particularly effective in combatting either non-payment or overriding. Conductors rarely manage to collect all fares, particularly at busy times (2), and keeping a check on overriding is similarly difficult, particularly since challenging the suspect creates embarrassement, takes up time and may lead to legal proceedings (31).

The potential for theft by staff must also be considered, and evidence suggests that unless steps are taken to ensure both drivers and garage staff are made accountable, farebox systems can be vulnerable in this respect (29). Evasion through misuse of season tickets is a threat to operators, although security printing and a photo-identity system can reduce the threat to negligible levels.

Reduction in operating costs is widely cited as a justification for adoption of automatic fare collection. Whilst the cost of collecting fares varies considerably, it rarely accounts for more than 10% of total operating costs (35/36). A survey of European operators undertaken in 1972 (35) shows clearly that, apart from the "Swiss" system which has both high capital and operating costs, savings in capital costs are reflected in higher operating costs, and vice versa (see table 13). The higher than average operating costs for the fully automatic

"Swiss" system of kerbside vending machines and cancellors is of interest, because one would expect the high degree of automation to have enabled a substantial reduction in operating costs. A breakdown shows that 60% of fare collection operating costs are attributable to personnel, 18% to depreciation and 7% for printing of tickets. Not surprisingly, Werz concludes that "fully automatic fare collection does not seem to be the most economic solution."

Further evidence on this subject is provided by Scheiner et al (36), who undertook a detailed cost analysis of six different U.S. fare collection systems. Findings for capital and operating costs are presented in table 14, although they are not strictly comparable with those of Werz. The relatively sophisticated systems used in Harrisburg and Syracuse were found to be the most capital intensive. The Westport system was the most expensive to operate (as a proportion of total operating costs), although the Boston system also performs badly if other criteria are employed. Interestingly, both these systems have a significant proportion of pass use, suggesting such a system is relatively expensive to administer. Fareboxes (even the more sophisticated varieties) are relatively cheap to operate.

The cost savings to be realised by conversion from crew to conventional OPO have been documented in several sources, although with the notable exception of London Transport (who in 1982 still operated about 40% of their bus mileage with crew vehicles), the issue is rather a dead one. Fishwick (31) states a net saving of 14% of operating costs, taking into account additional responsibility payments made to drivers. The National Board for Prices and Incomes (37) estimated the savings at 15-20%, whilst Cundill and Watts (2) gave a figure of 21% (reduced by 0.9% for every one second increase in the average time spent at a bus stop). London Transport derived a

TABLE 13 : AVERAGE CAPITAL AND OPERATING COSTS OF FARE COLLECTION SYSTEMS

(As % of annual operating costs)

	Capital costs	Operating costs	Sample size
Crew operation	3.73	5.28	3
O.P.O.-Partial Self Service	4.86	2.98	11
O.P.O. - Full Self Service	15.70	7.30	7
Overall average	7.59	4.33	23

Source: Werz Ref.: 35.

TABLE 14 : COMPARISON OF FARE COLLECTION COSTS ON SAMPLE OF UNITED STATES PUBLIC TRANSPORT SYSTEMS

Location	Fare collection system	F/C Dep'n p.a. $	F/C Operating cost p.a. $	F/C costs as % of Op. costs
Westport	Passes account for 90% of trips	530	11,280	2.9
Lancaster	Conventional farebox	1,360	23,185	1.7
Harrisburg	Registering fare-box	10,250	63,985	2.3
Syracuse	Registering fare-box + ARCOM automatic data retrieval	55,300	128,290	2.0
Seattle	Conventional farebox	18,600	483,670	1.3
Boston	Conventional farebox	202,100	1.75m	1.4

Source: Scheiner et al Ref.: 36.

figure of 29% for an OPO system with no increase in stop times, and 21% for OPO with 12.5% longer journey times and extra buses to compensate (33). Operating costs of crew-operated systems are clearly high, and the one-off savings to be made from conversion are substantial. Most operators exploited them as soon as was practicable, although the slower boarding speeds and poorer service standards caused London Transport to call off conversion of its busier routes. It should be noted, however, that other factors (particularly the relatively poor reliability of contemporary OPO bus designs) also played a part in this decision.

It must be remembered that the fare collection system (as well as the fare structure) employed dictates the extent to which useful data can be obtained on a routine basis for managerial and planning purposes. It has already been determined that flat and coarse fare structures involve special surveys being undertaken if data on trip lengths, origins, destinations, and so on, is to be obtained. Less sophisticated fare collection equipment produces a similar need. As the requirement for information increases concurrently with pressure for simplicity of operation and use of season tickets, it is inevitable that special surveys will become essential. However, whilst the need for information is important, it should not be allowed to intervene in the choice of an undertaking's fare collection system.

Passenger resistance to highly automated fare collection systems is recorded by a number of sources. Turnstiles are troublesome to negotiate by old or disabled people, and those with bulky luggage (31). Vending machines are also a source of confusion and aggravation, according to a 1977 survey of European undertakings (7). People also find the requirement for the exact fare stipulated by many forms of fare collection inconvenient, acting in effect as a disincentive to travel. "By requiring exact change in the farebox for each and every ride, the patron must bear the administrative burden of payment." (36) Perhaps more importantly, passengers object to delays at bus stops caused by the relatively slow boarding speeds of conventional OPO. The revenue effect of this reduction in service quality is documented elsewhere in this study. It is likely that from the passenger's point of view, the use of conductors to collect fares is the most acceptable. Not only does it ensure that change is readily available, it also provides a source of guidance for passengers who are unsure of their fare, the whereabouts of their alighting point, or other aspects of the service.

Pre-purchased tickets also offer positive advantages to the user, such as convenience, simplicity and faster boarding (see section 2.2.4).

Overview

The implications of choosing a particular fare collection system are wide-ranging - costs of purchase and operation being only one area to consider. Whilst the trend towards less labour-intensive forms of fare collection has undoubtedly been influenced by the need to cut costs, the implications for operating speeds, levels of evasion and passenger acceptance appear to have produced a period of second thoughts. Furthermore, experience indicates that fully automatic systems are not particularly cost effective. Because fare collection accounts for such a small proportion of total operating costs, a strong case may be made for considering ergonomic and marketing aspects in preference to costs when choosing a system. A more convenient system may well generate sufficient additional revenue to offset higher fare collection costs.

2.2.4. Ticket Type

The discussion will be divided into the two main alternatives to single fares - multi-ride and season tickets.

i - Multi-ride Tickets

a) Review of reports on actual experience of offering multi-ride tickets

This review is hampered by a serious lack of published data, explained partly by the fact that many European operations which have used multi-ride tickets as their basic ticket type for many years do not feel the need to investigate the economics of their use. Accurate appraisal of ticketing methodologies is, in any case, very difficult.

Before discussing the revenue and patronage impacts of multi-ride tickets, it is useful to review the factors which determine their market penetration. Several sources agree that the discount offered compared with other ticket types is a crucial factor. Discount and take-up appear to be related on a one-to-one percentage basis (a 10% level of discount will lead to a 10% market share for example). This is demonstrated by many European examples, as well as by the Leeds and L.T. multi-ride ticketing experiments (see also section 2.3.1). Fishwick (31) states that continental experience indicates a minimum discount of 20% is necessary if a "substantial proportion" of passengers are to use multi-ride tickets. He backs this up with findings from the use of discounted tokens in Sunderland in 1968, where a 25% discount produced a 25% market share.

A second determinant of take-up levels of prepurchased tickets is the number and location of sales outlets. Where tickets are available on the vehicle, evidence is that sales tend to be higher (demonstrated by

L.T.'s Havering experiment). However, the time taken to sell a multi-ride ticket on the vehicle tends to absorb any time savings to be otherwise gained from its use. The most common off-vehicle purchasing points are the undertaking's offices and enquiry points, small shops and newsagents, department stores, and in some locations, vending machines placed at stations and bus stops.

Widespread publicity is also needed if the ticket is to be successful. Research by CETUR (38) in France revealed that awareness of the various ticket types available, together with their relative costs, was very low amongst bus users and non-bus users alike. For example, in the towns of Laval and Brest it was found that half the season ticket users were unaware of the existence of other seasons in the range. Furthermore, two-thirds of the people in Brest who were aware of the existence of multi-ride and season tickets but did not use them were unaware of their cost. Poor publicity was given as the main cause of this.

A final factor is the ease of use of the ticket. Equipment (both vending machines and cancellors) must be reliable if the ticket type is to achieve and retain a significant market share. Furthermore, the initial cost of the ticket should not be too high if bulk purchase of travel is to be encouraged.

To summarise, the factors determining market penetration of a multi-ride ticket scheme are:

- the price compared with other ticket types;
- the number and location of sales outlets;
- the extent of publicity for the scheme; and
- reliability of equipment used.

<u>Ridership and Revenue effects</u>

Whilst in many cases the main motive for intro-ducing multi-ride tickets has been to speed boarding times under OPO, due regard must be taken of their likely impact upon revenue and ridership. It must be remembered that in many continental operations, the multi-ride ticket is seen as the standard fare, whilst single tickets are offered at premium rates. The revenue "losses" that may be incurred by the widespread use of multi-ride tickets should therefore be seen in a different context.

Whilst information on the market share achieved by multi-ride tickets is fairly common (section 2.3.1.) data concerning their impact upon revenue and patronage is much more elusive. Two case studies in the U.K. are those by undertakings in Coventry and Bolton. Coventry City Transport introduced books of tickets in 1968 as part of their OPO conversion programme at an 8% discount. Take-up had only reached 5% of adult trips after four months (31), increasing to 8% after the effective level of discount was increased to between 13-19%. The revenue loss was estimated at £30,000 per annum (1.5% of total revenue), although it was pointed out that the new tickets had actually served to slow down the rate of loss of traffic. For patronage therefore, a positive net effect can be discerned. Tickets survived until 1978, when they were superceded by the West Midlands PTE Travelcard.

The Bolton experiment was introduced in 1971, also with the aim of accelerating boarding times (38). Details of the scheme, which involved books of tickets valid on three routes only being sold off-vehicle, are shown in table 15. Results were encouraging in terms of the effects on revenue, ridership and boarding speeds. Analysis of revenue and passenger data (summarised in tables 16 and 17) showed that the system was stimulating a sufficient number of additional trips to more than offset the revenue loss otherwise caused by providing a

TABLE 15 : TICKETS OFFERED UNDER THE BOLTON "SAVER" SCHEME

	Full value	Selling price	Discount (%)
2p tickets:			
- Books of 10	20p	17p	15%
- Books of 20	40p	32p	21%
- Books of 40	80p	54p	35%
3p tickets:			
- Books of 10	30p	25p	17%
- Books of 20	60p	45p	28%
Combined book containing 10 x 3p + 10 x 2p	50p	38p	24%

TABLE 16 : BOLTON MULTI-RIDE EXPERIMENT - REVENUE EFFECT

	June revenue (£)	August revenue index	October revenue index
Saver route 1	2,075	105.7	128.9
Saver route 2	1,100	-	143.0
Saver route 3	2,355	-	121.3
Control route 4	2,380	94.9	112.2
All crew operated services	14,960	96.3	117.0

TABLE 17 : BOLTON MULTI-RIDE EXPERIMENT - RIDERSHIP EFFECT

	June numbers	August numbers & index	Change over Control route 4	Oct. index	Change over Control route 4
Saver route 1	18,615	96.9	+6.9	99.4	+2.9
Saver route 2	-	10,250	-	94.1	-2.4
Saver route 3	-	16,485	-	101.0	+4.5
Control route 4	32,750	90.0	-	96.5	-
All crew operated services	429,193	91.4	-	99.0	-

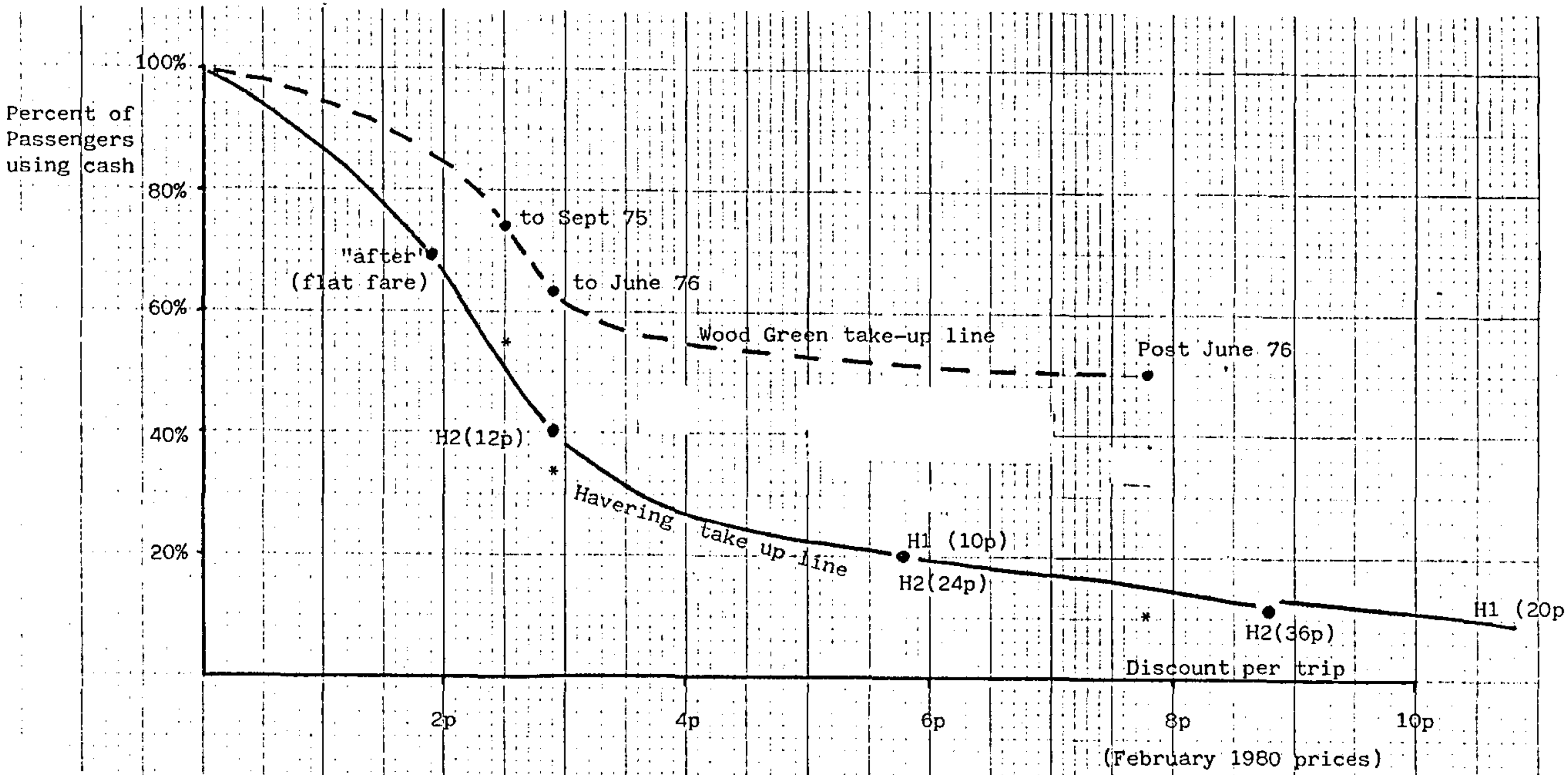
Source for Tables : Hovell (Ref.: 38)

discount (averaging 30%) . This was achieved through market shares of between 8-19%, depending upon the route.

A multi-ride scheme operated in Merseyside between 1970-75 (9) was less successful. Introduced under the title of "Bus Economy Tickets", they achieved their highest market share of 13% of revenue and 16% of trips just prior to withdrawal. One cause of their demise was the need to keep single fare increases down in a year of rapid inflation, the implication being that the multi-ride tickets were causing a loss of revenue which could only be recouped by their withdrawal. They were also susceptible to fraud, a topic which will be discussed at the end of this section.

The introduction of multi-ride tickets on London Transport services within the London Borough of Havering at a discount of 50% produced a market share of 75% and an overall increase in patronage within the area concerned by 7% (17). The revenue effect is not documented, although it is likely that a significant loss occurred, bearing in mind the high level of discount offered. L.T.'s main concern was whether the self-service concept speeded boarding times to such an extent that OPO could be introduced throughout the system - the revenue effect was of less importance, and could in any case be predicted from other L.T. multi-ride schemes. A model has been developed to show the relationship between multi-ride ticket discount and levels of take-up, using data from schemes in Havering and Wood Green (see fig. 6).
The differing levels of take-up for a given level of discount reflect the difference in the physical extent of the two schemes.

A scheme operated in Leeds involved the purchase of 10 tickets off-vehicle at a discount of about 30%. Market share was 20% of all passengers on the



NOTES Asterisks (*) refer to the Wood Green take-up related to a 55% base market
H1 relate to the initial Havering scheme - the numbers in brackets being the cash fares
H2 relate to the Havering scheme prior to the flat fare's introduction

Fig 6 : Relationship between discount per trip and multi-ride ticket take-up for two London Transport prepurchase schemes.

Source : Ref. 17.

relevant routes in 1980 (29% of those eligible to use the ticket scheme) (9). Those using the ticket claimed to have increased their trip-making by an average of 4.6%. A more recent study of the "Saver-strip" multi-ride facility offered by West Yorkshire P.T.E. at a discount of 16.7% estimated that it had produced a 6% increase in patronage at a cost of a loss of revenue of £0.97 million per annum (39).

Another scheme is that operated in Manchester, under the marketing title "Clippercard". Introduced to give shorter distance passengers the option of prepurchase, they are on sale at about 30 outlets at an average discount of 11.5%. They account for 10% of Greater Manchester P.T.E.'s revenue (1981), but their overall impact upon revenue and patronage is not known.

Boarding Speeds

All the available published evidence suggests that the use of multi-ride tickets does indeed speed boarding times, the actual extent depending upon the particular circumstances of the scheme. Self-service cancellation and dual-stream boarding are both essential if appreciable increases are to be realised. Results are excellent where the tickets are used by a large proportion of passengers. Observations at peak hour periods in Brussels and Ghent indicated that when 70% of passengers are using multi-ride tickets the mean boarding time is about 2.2 seconds (31). Similar results were obtained from a T.R.R.L. study (30) of boarding times for continental-style operations using a second stream. Times of 1.85 seconds per passenger were recorded for both Copenhagen and the Hague, whilst a figure of between 2.0 - 2.5 seconds was obtained in Rotterdam. The L.T. Havering experiment, where 75% of passengers used multi-ride tickets, produced a 3.0 second figure, compared with 3.5 seconds for people buying single tickets from the driver (17). Whilst these times represent an improvement over boarding speeds when all tickets are purchased from the driver, they fail to match the very rapid speeds achieved with crew operated buses with open rear platforms. Various figures have been quoted for this arrangement, ranging from 1.5 seconds (at peak times) to 1.35 seconds (off-peak). London Transport found that the gap in performance between the multi-ride system and traditional crew operation too great to permit replacement of the latter by OPO.

However, where conversion to OPO has already taken place, multi-ride tickets would nevertheless seem to play a useful role in helping to alleviate delays at stops. For example, the West Yorkshire study cited above (39) estimates an average boarding time of 2.10 seconds for multi-ride ticket users, compared with 5.34 seconds for cash paying passengers. This is estimated to have enabled an actual running time saving of between 0.6 - 1.8%.

Fare Evasion

Evidence on the extent of evasion caused by multi-ride systems suggests they are susceptible to abuse unless certain precautions are taken. Firstly, tickets need to be magnetically encoded to ensure other materials are not substituted, and secondly, higher levels of on-vehicle inspection combined with penalty fares are required if non-cancellation and overriding are to be contained. One of the reasons for the withdrawal of Liverpool's "Bus Economy Ticket" was its susceptability to fraud caused by the absence of magnetic encoding. Thus it was relatively easy for people to make their own ticket by cutting a suitable thickness of card to shape. These would be accepted by the canceller, and the operation would be carried out behind the driver who could not be expected to supervise it.

Even if passengers had valid tickets, it was easy for them to slip past without cancelling their ticket if the driver was busily engaged with cash-paying passengers (9). An increase in the extent of overriding was also reported during both the Havering and Leeds multi-ride schemes (see table 18). It will be noted that none of the British schemes involved enhanced levels of inspection.

Levels of evasion on European systems using multi-ride tickets are not high (for a fuller discussion see section 2.3.3). Results from one survey investigating this issue are summarised in table 20.

Collating the evidence afforded by material on actual experience of multi-ride ticket systems (see table 19), it would seem that they tend to increase boarding speeds and maintain or increase patronage, at the expense of a loss in revenue and possibly an increase in fare evasion. These drawbacks are, in the view of some operators, an acceptable price to pay for the opportunity of minimising delays caused by the introduction of one-person operation.

b) <u>Review of empirical material on the effects of offering multi-ride tickets</u>

An empirical evaluation of the various effects of adopting self-service fare collection as applied in Europe upon an American public transport system provides a useful comparative insight (40). The Tri-County Metropolitan Transportation District of Oregon was chosen as the network on which to test the options. The new fare system focuses upon multi-ride tickets and travelcards with a concentric zone fare structure. For any given fare, the new arrangements were predicted to yield more revenue, due to a reduction in fare evasion and an increase in the number of fare zones. Furthermore, operating and

TABLE 18 : EXCESS RIDING WITH MULTI-RIDE TICKETS

	% passengers		% revenue	
	before	after	before	after
Havering	5.7	8.0	3.5	5.7
Leeds	9.3	11.6	1.7	3.7

Note: Before & after relates to the introduction of the multi-ride ticket scheme.

(Source: Through Ticketing Working Party - Ref.: 9)

TABLE 19 : SUMMARY OF EFFECTS OF MULTI-RIDE TICKET SCHEMES

	Discount	Market share	Revenue	Trips	Boarding speeds	Fraud
Bolton	15-35%	8-19%	↑	↑	↑	?
Coventry	13-19%	8%	↓	↑	?	?
B.E.T.	?	13%revenue 16% trips	↓	?	?	↑
Havering	50%	75%	↓	↑	↑	↑
Leeds	30%	29%	?	↑	?	↑
Manchester	11%	10%	?	?	?	?

Table 20 : Extent of Fare Evasion revealed by U.I.T.P. survey of European undertakings using Automatic Fare Collection and Multi-ride tickets (1977).

Undertaking	Proportion of people found to be avoiding payment (%)
Budapest	5.0
Copenhagen	0.2
Genoa	1.0
Graz	1.5 - 2.0
Liege	0.13
Linz	1.0
Lyons	2.0
Marseilles	1.5
Nancy	0.5
Neuchatel	0.14
Paris	2.5
Utrecht	2.5
Winterthur	0.9
Zurich	1.0 - 2.0

Source: Ref. 7.

capital costs are reduced by virtue of the smaller fleet required to operate the same level of service through faster boarding speeds. The predicted operating and capital cost savings are shown in tables 21 and 22 respectively.

This analysis suggests very favourable results from replacing the traditional U.S. farebox type of operation with a European self-service system in which multi-ride tickets play a major role. There is no reason why most of the financial gains and losses could not be replicated if a U.K. system were to adopt this approach. The estimated gains in revenue to be had from the change in fare structure (from flat to zonal in the U.S.) would be less likely, however.

Useful insights into passenger behaviour towards ticket types (including their motives for purchase) are provided by a study by the French Ministry of Transport. Fares and ticketing policies were studied in a number of towns and cities in north-west France (41). Interviews carried out in Brest and Laval were intended to gain a better understanding of how public transport users respond to changes in fare levels and ticket types. Details of the fare systems prevailing in the two towns are given in table 23. Motives for choice of ticket type were found to be strongly influenced by cost compared with others in the range, except where infrequency of use or income limitations dictate the use of single tickets (table 24). Convenience and potential for time savings also figure amongst the reasons for using multi-ride and travelcard tickets, although convenience also figures prominently as a reason for buying single tickets.

The French study found that demand for prepurchased tickets is less elastic than that for single tickets. A 30% rise in the relative price of the ticket currently being used was found to cause 40% of single ticket

TABLE 21 : PREDICTED OPERATING COST SAVINGS DUE TO INTRODUCTION OF SELF SERVICE FARE COLLECTION

(at 1982 prices - $ 000's)

	1983	1985	1990
COSTS:			
- Fare inspection	-1696	-1846	-1846
- Administration	- 470	- 470	- 470
- Other	- 75	- 100	- 150
- Sub Total	-2241	-2416	-2466
SAVINGS:			
- Bus operation	1000	1405	1789
- LRT operation	-	910	2080
- Absenteeism	375	400	500
- Reduced fare evasion	180	240	290
- Zonal fare revenue rise	1800	2400	2900
- Premium fares	1000	1100	1200
NET OPERATING COST SAVINGS	2114	4039	6293

Source: Fox (Ref.: 40)

TABLE 22 : PREDICTED CAPITAL COST SAVINGS DUE TO INTRODUCTION OF SELF-SERVICE FARE COLLECTION

(at 1982 prices - $ 000's)

	1981-2	1983-5	1986-90
COSTS:			
- On-board equipment	-2950	-900	-1700
- Vending machines	-	-1030	-800
- Other	-250	-	-
	-3200	-1930	-2500
REDUCED CAPITAL NEEDS:			
- Bus fleet reduction	3000	1400	1500
- LRT fleet reduction	-	4000	2000
- Farebox replacement	2450	460	450
- Sub Total	5450	5860	3950
NET REDUCTION IN CAPITAL COSTS	2250	3930	1450

Source: Fox (Ref.: 40)

TABLE 23 : CHARACTERISTICS OF THE UNDERTAKINGS INVOLVED IN THE C.E.T.U.R. STUDY

	LAVAL	BREST
Population served	60,678	206,668
Fleet size (vehicles)	28	135
Single ticket - price	1.70F	2.50F
- market share	13%	12%
Multi-ride (10) - price	11F	6 or 12F
- market share	15%	41%
Season ticket - price	32F p.month	10/15F p.week
- market share	29%	37%

TABLE 24 : MOTIVES FOR CHOICE OF TICKET TYPE

	Single		Multi-ride		Travelcard	
	Laval	Brest	Laval	Brest	Laval	Bres
Most economical	6	0	76	52	93	88
Most convenient	9	30	6	20	0	14
To save time	17	7	17	8	7	22
Unaware of others	14	4	1	2	3	0
Seldom catch bus	49	52	10	19	0	0
Other	0	4	0	8	0	2
No response	9	7	3	3	3	0

Figures in percentages.

Source: C.E.T.U.R. (ref.: 41)

users in Laval and 56% in Brest to switch to another. The figures for multi-ride users were only 28% and 40% respectively, and for travelcard users 24% and 48%.

The study then goes on to develop a model whereby the effect of different relative discounts offered by multi-ride tickets compared with singles upon overall revenue can be assessed (fig. 7). It is concluded that a single/multi-ride price ratio of 1.5/1 yields the highest revenue, although the ratio can be in the range 1.3-1.8/1 without appreciable loss of revenue. Passing the 2.0/1 ratio would cause a serious loss of patronage and revenue. A 1.3/1 ratio would encourage occasional trips and new customers, whilst a 1.8/1 ratio would minimise delays caused by people buying tickets from the driver.

A similar analysis was carried out for multi-ride/ travelcard pricing effects. It was concluded that the travelcard can be priced at a cheaper rate per trip than multi-ride tickets whilst still optimising revenue. The results are shown in fig. 8 . A ratio of 50/1 between the cost of monthly seasons and individual multi-ride tickets maximises overall revenue (15/1 for weekly seasons). To go above this ratio would cause a fall in passenger journeys with no increase in total revenue, whilst to drop below would lead to a sharp fall in revenue without any compensatory operating cost savings achieved by the travelcard. (discussed in greater detail in section 2.2.4).

c) Review of reports on Actual Experience of Offering Season Tickets

Accounts of experience with season ticket schemes in urban public transport are more widespread than those of multi-ride tickets, and it is fair to remark that they tend to attract more interest. However, observations tend to focus on market share and unquantifiable effects rather than analysis of revenue and ridership implications.

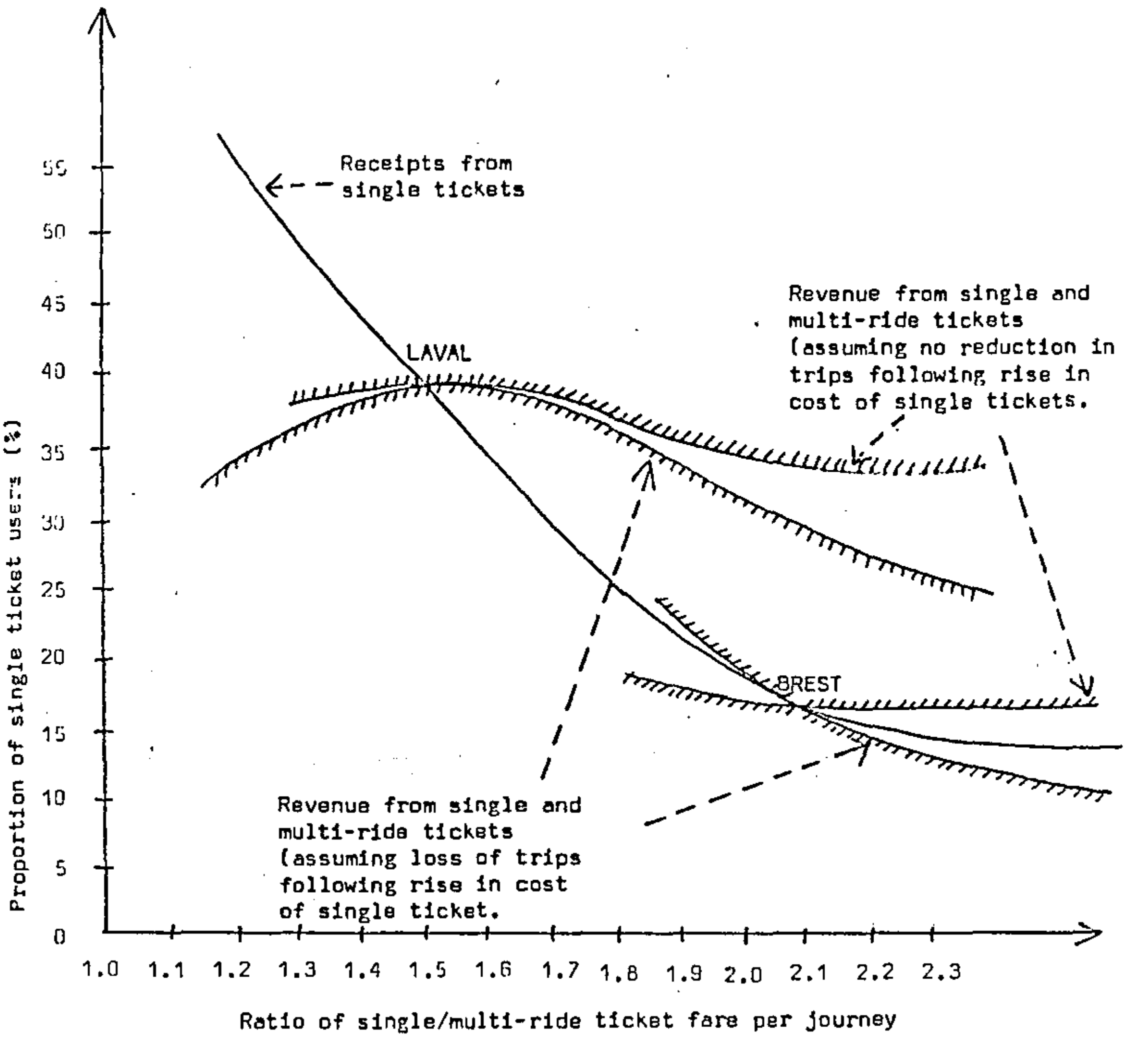


Fig. 7 : Optimum pricing relationships between single and multi-ride tickets

(Source: Ref. 41)

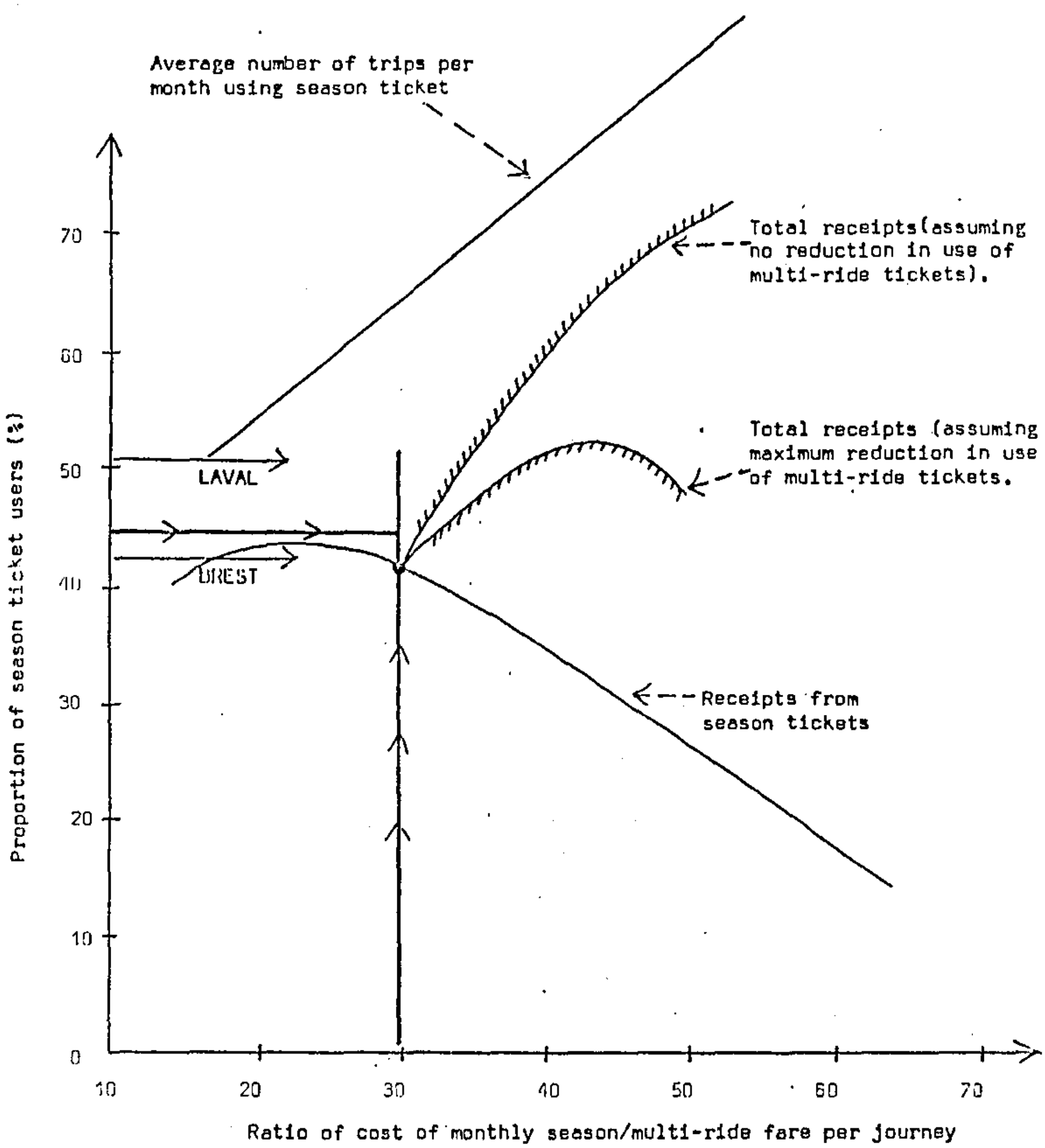


Fig. 8 : Optimum pricing relationships between season and multi-ride tickets

(Source: Ref. 41)

Market Share

The main determinants of market share is price compared with other ticket types, and to a lesser extent the convenience offered (purchasing arrangements, conditions of validity, and so on). It goes without saying that the market share achieved has a profound effect on the general impact of the ticket type upon the system - a ticket with a given level of discount will have a much greater effect on total revenue if it has a large market share. Market shares are shown in table 30 which summarises the effects of schemes reviewed. It will be seen that in the U.K. and U.S.A., the proportion of trips made using season tickets is generally below 30%, whilst in Europe the share tends to be higher (often in excess of 50%).

Revenue and Ridership

There is an unfortunate aspect to the provision of season tickets in as much that they tend to be used most by those most captive to public transport. Such people tend to be commuters travelling in peak periods, when the costs of providing services are generally much higher. As such, reducing the fare paid by peak period travellers by offering them a season ticket facility would appear to be counterproductive if the undertaking wishes to maximise revenue. Money used to reduce commuters fares in this way could instead by employed to cut off-peak fares, which would produce a net gain in passenger mileage and revenue by virtue of the greater elasticity of demand of off-peak users.

However, an important factor in favour of season tickets is the fact that holders tend to have a lower elasticity of demand than other classes of passenger. Brog and Forg (12) used a study of responses to price increases on public transport in West Germany related to user type, mode, type of ticket, and so on, to estimate that a price increase of up to 10% produces a drop in single ticket trips of up to 3%, but only 1.8% for season ticket sales. Hence, season tickets can be raised by a greater percentage than other ticket types, without a proportionately large drop in patronage. Revenue lost by the initial offer of a season ticket at a low price to attract custom can thus be recouped later by above average price increases. Details of Brog and Forg's results are summarised in table 25 . White (43) argues that this pattern is explained by the fact 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 would be necessary to induce withdrawal". The fact that the majority of season ticket users are peak-period commuters, with lower elasticities of demand, will also play a part.

Most operators do not price their travelcard facility on the phased basis outlined above (initial low price to gain custom, followed by above average price rises to recoup revenue), either because they have goals other than straightforward revenue maximisation, or they are unaware of this effect.

Tyson's study of the Greater Manchester P.T.E.'s "Saver-Seven" season ticket illustrates the complexity required for any accurate revenue effect assessment (44). Since it is net revenue (revenue - costs) that is of ultimate interest, then not only does the change in actual revenue have to be assessed, but also the cost of providing any additional services required to meet new demand, the costs of issue and distribution, cost savings from faster boarding speeds and additional interest earned through improved cash flow of receipts. Tyson also considered the costs and benefits for season ticket users, other public transport users, and the community as a whole. On this basis, the ticket produced a net gain of £259,000 per annum.

However, the net cost to the operator was found to be £424,000 per year, comprising a £768,000 drop in annual gross revenue and £72,000 distribution and administration costs, offset by a £266,000 gain in revenue from users attracted away from cars, operating cost savings of £144,000, and a small amount of extra interest earned. The net fall in revenue was 0.9%, on a total annual revenue of £68m. However, trips actually generated by the "Saver-Seven" ticket comprised 1.2% of all trips made during the year studied by Tyson. Considering that nearly 18% of passengers used these tickets, the revenue and patronage effects were very marginal indeed. Other aspects of this scheme will be discussed subsequently under the appropriate headings.

Detailed analysis of the effects of the West Midlands "Travelcard" scheme (4) has shown favourable results, not least for both revenue and patronage. Sales of the ticket, which permits travel on both bus and rail services, have risen steadily until by March 1981 over 30% of trips were made using them. This particular case is cited by White to illustrate his hypothesis that initial revenue losses caused by the need to offer a discount to regular passengers can be recouped later by increases in patronage and above average rises in price. A time series model* was used to estimate what would have occurred without the presence of "Travelcard". Results are shown in table 26. It will be noted that from 1976-77 onwards, actual observed patronage exceeds the 'expected' estimate. By 1979-80 the margin was 7%. This situation, which in practice was manifest in terms of retention of patronage instead of an increase, was described by White as "the most significant and long-term effect of Travelcard"(45).

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* $T = -0.3\Delta$ real revenue per trip + 0.4Δ bus miles run $- 1.5$.
(Where Δ = % change on previous year
T = % change in trips on network).

TABLE 25 : ESTIMATED PERCENTAGE REDUCTION IN TRIPS MADE (BY PERCENTAGE INCREASE IN BASE FARE AND TICKET TYPE)

Fare increase	Whole (sample=2409)	Singles (sample=710)	Seasons (sample=810)
1 - 10%	0 - 1.5	0 - 3.0	0 - 1.5
11 - 15%	1.5 - 8.0	3.0 -10.0	1.3 -13.0
16 - 20%	8.0 - 9.0	10.0 -13.0	13.0 -13.5
21 - 25%	9.0 -13.5	13.0 -22.0	13.5 -16.5
26 - 30%	13.5 -14.5	22.0 -22.5	16.5 -19.0

Source: Brog & Forg (ref.: 42)

TABLE 26 : W.M.P.T.E. BUSES – CHANGES IN PATRONAGE AND REVENUE

	1974–5	1975–6	1976–7	1977–8	1978–9	1979–
(a) Fare-paid bus trips (m)	461	480	472	459	429	424
(b) "Expected" trips (m)	–	480	457	427	398	394
(c) Excess of (a) over (b) (%)	–	0	+3.5	+7.3	+7.7	+7.5
(d) Actual revenue (£m)	26.1	28.9	36.3	47.6	52.6	58.9
(e) "Expected" revenue (£m)	–	28.9	35.1	44.2	49.0	54.8
(f) Difference in revenue (d)–(e) (£m)		-0.8	-0.8	-3.4	-3.6	-4.1
(g) Extra average fare as % of actual average fare			+2.3%	+7.7%	+7.3%	+7.2

Source: White (ref. 4)

The ticket has also been found to have produced a beneficial revenue effect by slowing down the loss of overall revenue from the undertaking. Had the "Travelcard" not been in existence, the average fare would have had to rise more steeply since 1974-75, simply in order to raise the same total revenue (table 26 line 'g'). It is estimated that in the years 1974-75 to 1979-80 a net deficit of £26.2m was incurred. Without "Travelcard" the deficit would have been £29.0m, representing a 9.6% improvement in performance. Other effects of the West Midlands"Travelcard" are detailed in subsequent sections.

London Transport's experience with their Bus Pass (5) appears to contradict the hypothesis that initial cheap phases can be followed by above average increases in pass price without undue loss of market share. Whilst discounts produce only limited generation - suggesting inelastic demand - price surcharges have produced considerable traffic losses in L.T.'s experience. It is argued, therefore, that to describe pass user's habits as inelastic is a misleading oversimplification. Following an initial cheap phase in 1975, the cost in real terms of the London Bus Pass was raised significantly, causing a drop in sales from a peak of 115,000 in 1976 to 45,000 during the same month in 1978.

The tendency for season tickets to cause a gain in patronage and a loss in revenue was repeated for L.T. In their case, 6% of pass users were found to be new to public transport, whilst 10% of all travel using passes is generated. Each month, a typical pass user was found to make (on average) an additional nine unlinked trips, representing about 30 miles of travel. As such, whilst no precise figures are available, the net contribution to patronage can only have been positive. Revenue, however, was damaged. Despite large shifts in market share, passes have consistently caused a loss in revenue, as table 27 demonstrates. This table gives the loss in revenue from cash bus and Underground receipts for each £ of revenue from bus passes. It will be noted that in each case, the loss is greater than £1. Indeed, during the period March 1975 - June 1976 when pass prices were at their cheapest compared with ordinary fares, losses were considerable. To confirm this effect, a contraction in pass sales in the autumn of 1977 caused by the introduction of Photo Identity Cards (with no change in either pass or cash prices) caused a net gain in overall revenue.

A more favourable outcome resulted from the integration of L.T.'s bus passes and rail season tickets as "Travelcards" in May 1983 (3). The new range has proved to be successful in generating new travel, often from "conquest" sales to relatively light users of public transport. It has been found that "a substantial proportion of the growth consists of take-up by medium-intensity users for whom the major incentives to purchase are convenience and extra travel opportunities rather than cash savings". Sales of L.T. period tickets rose by 30% during the year ending December 1983. Interestingly, total bus trips using the new travelcards rose by 78%, whilst passenger miles increased by only 45%, emphasising a shift in role for the bus as a short distance feeder to the rail mode. The anticipated loss in revenue was less than feared because of the high proportion of additional sales from people who took their benefits as extra travel rather than financial savings. The report concluded that a "substantial toning down of the predicted financial penalties associated with travelcards seems essential".

Monitoring of Greater Glasgow P.T.E.'S "Transcard" season ticket scheme, in operation since 1974, has demonstrated that once again the effect of such a ticket is to produce a net gain in ridership at the expense of a reduction in revenue (46). Results for each year of the scheme up to 1981 are summarised in table 28 . The method used involved estimating the percentage change in patronage by assuming that the 9.8% of Transcard trips which were found to be generated (47) would not have been made if the ticket had not existed, together with a small proxy for loss of non-generated Transcard trips through loss of convenience. Change in revenue was found by comparing actual revenue with that which would have been obtained from remaining ex-Transcard passengers who were assumed to pay the average cash fare.

It will be noted that, in common with other schemes reviewed, a positive effect was observed for levels of patronage. However, the long-term revenue gain as witnessed by the West Midlands example was not repeated in this case despite a steadily rising market share. This may be attributed to the fact that the overall increase in trips made was insufficient. If 9.8% of trips using Transcard in 1980 were generated, then overall the ticket generated only 2% of travel on the P.T.E. system in that year. The vast majority of Transcard users were captive to public transport and therefore eager to gain from the discount offered. Pricing of the ticket might also help explain its relatively poor performance - no attempt seems to have been made to capitalise on the building up of a hard core of established users who, experience suggests, would have been prepared to pay appreciably more for their Transcard ticket.

A more recent analysis (39) of travelcard performance in West Yorkshire has again found that an estimated loss in revenue of £1.2 million per year has been

TABLE 27 : THE LONDON BUS PASS - OVERALL REVENUE PERFORMANCE

	Index of single fare level v. pass	Loss in ordinary bus/underground revenue per £ of pass revenue
Pre-March 1975	100	103.8p
March 1975 -	124	131.0p
November 1975 -	124	131.4p
June 1976 -	108	114.6p
July 1977 -	102	107.2p
June 1978 -	102	107.8p
June 1979 -	101	107.4p
Sep 1979 -	102	107.9p

Source: L.T. Research Memorandum M378. (Ref. 5)

TABLE 28 : THE EFFECT OF G.G.P.T.E. "TRANSCARD" UPON RIDERSHIP AND REVENUE

	1974-5	1975-6	1976-7	1977-8	1978-9	1979-80	1980-1
Market share (% trips)	4.5	13.4	16.0	15.1	17.1	20.8	24.3
Actual Total trips (m)	193	166	181	173	157	165	152
Estimated Total trips without "Transcard" (m)	192	164	178	170	155	161	148
Gain in trips (%)	0.4	1.1	1.3	1.5	1.7	1.9	2.6
Actual Total revenue (£m)	14.6	17.5	21.8	22.8	21.8	25.6	28.3
Estimated Total revenue without "Transcard" (m)	14.8	18.1	22.7	23.3	22.4	26.9	30.1
Loss of revenue attributable to "Transcard" (%)	1.5	3.4	4.4	2.0	2.8	5.1	6.5

Source: Fleming (ref.: 46)

balanced by a significant gain in patronage (6.9 million generated trips per year). Indeed, survey data has shown that 13% of "Metrocard" holders had been attracted to public transport by the introduction of the ticket.

The difficulties inherent in accurately pricing season tickets and the consequent adverse effect upon revenue are evident from a study of the economics of passes in the United States (48). Analysis is hampered by the fact that most ridership effects fail to distinguish between existing riders making additional trips and riders who are new to public transport. The authors found, however, that in the U.S.A. at least, generation of trips by people in the latter category hardly ever exceeds 5% of previous adult cash-paying passengers. Conversely, the number of additional off-peak trips made by public transport users who previously paid cash is significant. An example given concerns the Ottawa system, where only 2% of trips made by pass purchasers were trips diverted from other modes, with another 2% being trips not previously made. Off-peak travel by users who previously paid cash increased by 24%. The obvious conclusion drawn from experience of pass use in the U.S.A. by the study is that the main effect of season tickets is to divert cash-paying passengers. As such, to price a pass relatively cheaply (at less than 40 single trips per month), as is the practice in many American cities, is to make revenue losses inevitable because insufficient new riders will be attracted to offset the discount given to regular passengers. Lago and Mayworm confirm previous findings that season ticket users tend to be more inelastic than other groups.

Using a hypothetical model discussed in section 2.2.4 (b), they go on to demonstrate that when properly priced, season tickets can improve both the ridership and revenue for an undertaking.

An example of how a relatively modest market penetration can drastically reduce the capability of a season ticket to generate completely new custom is provided by the Bi-State Transit Authority in St.Louis (49). One year after the introduction of a $12 monthly pass, on-bus interviews with 2,000 passengers revealed that 12.6% used it to pay for their trip. An overall increase in patronage was observed, with one in eight of pass users being new to public transport. However, this generated traffic comprised only 0.8% of total traffic. Despite the relatively high proportion of pass users being new to public transport, the ticket nevertheless caused a 4% loss of revenue. The pass itself contributed only 7% of revenue, which when compared with its share of trips, suggests that it was poorly priced. Convincing evidence of the attractiveness of the pass to regular commuters is provided by the fact that 95% of pass users claimed that their primary trip purpose was the work journey.

An earlier analysis of the entire range of prepayment techniques used by American public transport confirmed the "try-it-and-see" approach prevalent amongst operators (50). They argued that this was acceptable, given that prepayment schemes are both easy to implement and to withdraw.
A survey of operators (93% of whom had offered some form of prepurchase scheme) revealed that in 25% of cases, the respondent did not even know whether the scheme had had any effect upon ridership or revenue - let alone the magnitude of such effects. Only 12% of operators had quantitative data to support their responses in this field. In the case of season tickets, it was

found that the vast majority had either increased ridership or had a neutral effect (table 29). Revenue effects were also positive, albeit to a slightly lesser extent. It will be noted that performance of passes is, on average, consistently better than that of prepayment plans in general.

To sum up this section, experience suggests that in the majority of cases they have had a positive effect upon ridership, but at the expense of a loss in revenue. They generally fail to attract a sufficient volume of new customers to public transport, with the bulk of season ticket users being long-standing and regular bus or rail users glad to avail themselves of the discount offered for what are usually peak-time commuting trips. Only in the case of the West Midlands "Travelcard" and the survey of some American operators has the revenue effect been favourable . It should be noted that this latter survey was based largely upon unsubstantiated and unquantified observations by operators.

Boarding Speeds

Several sources mention a favourable effect upon boarding speeds following the adoption of a season ticket scheme. This in turn enabled a reduction in operating costs, by virtue of the shorter time spent at bus stops permitting faster schedules. The improvement achieved by passes in both the West Midlands and Glasgow is moderate, because no-change farebox cash collection methods are employed which themselves offer rapid boarding speeds of about 2.5 seconds per passenger (2). Using the results of two separate boarding time surveys undertaken on West Midlands P.T.E. services, White (4) derived a net time saving of one second for each passenger using a "Travelcard". This in turn would represent a 1% saving in total running time during the peaks. Because it is unlikely

TABLE 29 : REPORTED RIDERSHIP AND REVENUE EFFECTS FOR U.S. PREPAYMENT SCHEMES

Prepayment type	Number in sample	RIDERSHIP (%) Not known	Loss	No change	Gain	REVENUE (%) Not known	Loss	No change	Gain
Passes	42	21	0	24	55	27	2	27	44
Tickets	38	16	0	37	47	24	11	45	21
Tokens	34	32	0	44	24	32	3	47	18
Multi-ride	32	37	0	19	44	25	0	34	41
Permits	4	0	0	50	50	0	0	50	50
TOTAL	154	27	0	30	43	28	4	38	31

(Excludes concessionary schemes)

Source: Hershey et al (ref.: 50)

that such a small time saving could be usefully incorporated into schedules, the most likely benefit is that fluctuations in running time are reduced, enabling improved service reliability. Tyson estimated the use of the Manchester season ticket facility to have reduced running times by 0.55% (14).

The effect of passes upon boarding speeds is much more apparent when conventional OPO fare collection arrangements are in operation. With boarding times of between 5-8 seconds per cash paying passenger, a 2 second time for pass holders demonstrates the clear advantage of this type of ticketing in this area. One example of this effect is provided by the "Citywide" pass in Peterborough, although limited market share inhibited its overall impact (51). Another example is documented in the more recent West Yorkshire P.T.E. study (39), which estimated that each passenger who travels using a travelcard instead of a single ticket saves 2 seconds each time he or she boards a bus. This enables a potential running time saving of up to 1.1%, and has repercussions in terms of attracting more custom to the improved service.

Potentially more important are the savings to be had from conversion to OPO, if the faster boarding speeds afforded by the use of seasons serves to tilt the balance in favour of this method of operation. Very few operators have this cost-saving avenue left open to them, but wherever made, such cost savings are generally of the order of 20% (29). In this connection, L.T. have reported that the increased use of season tickets up to the end of 1983 has helped to reduce bus marginal boarding times, thus enabling further progress to be made towards their corporate objective of extending OPO in Central London (3). No figures were given, however.

Fare Evasion with Travelcards

Available evidence in this area suggests misuse of season tickets is minimal. A range of options are available to prevent expiry date alterations, forging, and unauthorised transfer between users. Most operators safeguard themselves by using a system of photo identity cards with a matching number on the ticket itself, together with security printing. During the first six months of operation, no fraudulent use of "Citywide" passes in Peterborough was detected (51), whilst the introduction of a photocard system for the London Bus Pass in 1977 made no perceptable difference to revenue, other than that directly attributable to an enormous 25-30% drop in sales caused by the unpopularity of the arrangements.

Administrative Costs

In addition to operating cost savings achieved through faster boarding speeds, season tickets also affect the cost of fare collection. Costs of season ticket issue and distribution are incurred, but opportunities to save on cash handling and accounting costs also exist. Tyson estimated the "Saver Seven" ticket in Manchester to have contributed an extra £78,000 per annum towards fare collection costs, comprising about 14% of the net cost to the operator (44). Experience in Glasgow suggests the need to staff season ticket sales outlets results in any reduced cash-handling requirements merely being reallocated (46). The West Yorkshire study (39) estimated additional publicity and sales costs of £0.1m per annum attributable to the "Metrocard".

A 1976 survey of American operators (50) indicated that passes tend to raise administrative costs, albeit by a negligible amount when viewed as part of total operating costs. Higher costs were attributed to the need to allocate individual numbers on each ticket and to issue a photo identity card (for which the holder is often required to pay a small fee). 5% of operators in the survey claimed a need for additional staff. However, a similar proportion cited coin handling cost savings because of prepayment. Passes requiring renewal on a weekly basis impose much higher costs than monthly ones - many operators find the former variety is just not worthwile because of this. In general, it seems that unless market share is so high that significant numbers of additional staff have to be recruited, the impact upon administrative costs is so small as to be imperceptible and/or unquantifiable.

Cash Flow

A final benefit from the adoption of season ticket systems is their ability to improve cash flow, facilitated through the receipt of revenue earlier than would otherwise have been the case with single fare payments. Interest is earned by effectively having fares paid in advance of expenses incurred in providing the service. The sums involved are again very small, but experience in the United States suggests they are sufficient to offset printing and distribution costs. Tyson also cites a very small gain (£5,700 per annum) from the earlier receipt of cash, whilst White cites a figure for the West Midlands example of £45,000 p.a. (1979-80). Receipt of revenue in advance facilitates better budgeting and cash flow management, according to the experience of Greater Glasgow P.T.E.

Other effects

The effects of the use of season tickets from the passenger's point of view are no less important than those for the operator. To reiterate the observations made in section 1.2 , not only is there a financial saving (or extra trips for the same cost), but the elimination of the need to pay cash (often exact fare only) at the beginning of each trip, together with the need to know the fare, makes a season ticket more convenient and simple to use. All passengers benefit from the faster boarding times achieved through pass use. The major drawback from the user's point of view is the need to purchase in advance, with the often sizeable outlay presenting difficulties (especially for people paid weekly). Passenger's behaviour in their choice of ticket and its subsequent use can only be gleaned from attitude surveys, which are very difficult to conduct and accurately assess. Most important of the issues are how the passenger views the ticket, his reasons for purchase (or non-purchase), and patterns of use. This area is investigated in greater detail in section 3.4.4.

Finally, it is also probable that drivers benefit through the reduced burden of fare collection. Whilst they still need to scrutinise tickets, the operation involves no manual work, unlike the processing of a cash fare. Strain is therefore reduced, perhaps resulting in greater job satisfaction, less absenteeism, and lower staff turnover, which in turn leads to less lost mileage and lower costs.

Summary

A summary of the findings from documentary evidence of actual season ticket schemes is included on the following page.

Effects of Season Tickets : Summary of documentary evidence of actual schemes (see table 30)

REVENUE -	A paradox exists whereby season tickets are most attractive to the regular and frequent user. In most costs this involves offering a discount to commuters who are the least demand elastic and most costly of public transport users. Hence, most schemes reviewed involved a net loss in revenue, because they failed to generate sufficient additional custom to offset the discount offered, being relatively unattractive to the more demand elastic and renumerative off-peak market. Further evidence indicates better pricing policies could reduce or eliminate this loss.
RIDERSHIP -	Season tickets generally stimulate a net increase in ridership, the extent depending on the discount offered. The majority of additional trips tend to be made by long-standing public transport users - only a small proportion are contributed by people attracted to public transport by the season ticket.
BOARDING SPEEDS -	These are generally accelerated, although the extent depends on the rapidity of the cash fare collection process. Where fareboxes are used, the improvement is much less than for conventional manual cash handling arrangements.
FARE EVASION -	Available evidence indicates that whilst there is potential for fraudulent use, precautions by operators have made detectable misuse very rare indeed.
ADMINISTRATIVE COSTS-	Generally unchanged or possibly slightly increased, due to a need to print and sell passes via specially staffed outlets. Overall effect on costs is negligible.
CASH FLOW -	**Improved, enabling interest to be earned on earlier receipts, and better budgeting.**

TABLE 30 : SUMMARY OF SEASON TICKET EFFECTS QUOTED IN PUBLISHED RESEARCH MATERIAL

Manchester P.T.E. "Saver-Seven" (Tyson 1977)	18%	-£424,000p.a. (-0.9%)	1.2% additional total trips	Faster		£78,000 p.a.	£5,700 p.a.
West Midlands P.T.E. "Travelcard" (White)	30%	+9.6% by 1979-80	+7.5% by 1979-80	Slightly faster (1 sec/ psgr.)	Neg.	-	£45,000 1979-80
London Transport "Red Bus Pass" (M378)		Fluctuation Overall loss	Fluctuation 10% of pass travel generated.	-	Neg.	-	-
Greater Glasgow P.T.E. "Transcard" (Fleming)	24%	-6.5% by 1980-81	+2.6% by 1980-81	Slightly faster	-	No change	-
United States (sample) (Lago/Mayworm)	n.a.	Gain	Gain (generation under 5%)	-	-	-	-
United States (sample) (Hershey)	n.a.	Gain or no change	Gain	-	-	Small increase	Improved
Bi-state Transit System "St.Louis Pass"	12%	-4%	+0.8%	-	-	-	-
Peterborough (NBC) "Citywide" (Slevin)	5%	-	-	Faster for holders but no overall effect	None	increase	-

d) Review of empirical material on the effects of offering season tickets

Hypothetical modelling of the revenue and ridership consequences of season tickets is frought with difficulties, with a large number of assumptions having to be made about trip rates of holders, and so on. One approach (48) uses a model for predicting market penetration of passes as a function of its effective discount over cash fares, its length of validity, and the number of competing ticket systems. Regression analysis of data from 62 independent fare pre-payment schemes is used to produce the following equation:

$$\text{Market share} = 23.6229 + 0.4323\,(\text{disc.}) - 0.2509\,(\text{trips}) - 2.8006\,(\text{comp.}) + 0.3341\,\frac{(\text{trips})(\text{disc})}{100} \qquad R^2 = 0.5899$$

Where disc = % discount over base fare;

trips = no. of trips made during validity of a single pass;

comp = no. of competing fare pre-payment schemes offered.

However, revenue and ridership effects can only be determined if the trip rate distribution, demand functions, and marginal cost estimates are known. Using trip rate distribution data obtained from the St.Louis monthly pass study (49), Lago and Mayworm have produced results for a hypothetical transport system, assuming an elasticity of demand of -0.3.. As can be seen from table 31 , as the price of the pass rises, market share inevitably falls, whilst the average trip rate by pass holders increases. The ultimate decision on the optimum price depends upon the marginal cost of generated off-peak trips, as well as the actual distribution of riders.

TABLE 31 : NET REVENUE EFFECTS OF ALTERNATIVE MONTHLY PASS-PRICING POLICIES FOR A HYPOTHETICAL SYSTEM

Pass price	Market share (% of trips)	Average monthly rides per purchaser	Generated trips per month	Pass sales revenue per month	Lost revenue from cash fare diversions per month	Net revenue effect (Pass sales - cash fare loss)
16.77	65.0	56	580	675.00	672.00	3.00
18.65	20.7	59	336	410.30	389.20	21.10
20.50	17.1	69	131	153.75	154.00	(0.25)
23.30	10.1	74	75	93.20	88.80	4.40
26.10	4.2	81	31	39.10	36.40	2.70
32.65	0.8	94	6	8.20	7.00	1.20

Unit of Revenue=U.S.Dollar

Source: Lago & Mayworm (ref. 48)

The overall effect on revenue is very small indeed, although it is interesting to note that in all but one case, the net effect is positive. However, the generation of new trips varies considerably as a function of pass price, and cheaper priced seasons would seem to be worth adopting by undertakings whose remit is to maximise patronage rather than revenue or profit. The authors make the following conclusion in their study:

> "This analysis of the costs and returns of transit fare prepayment reveals that when properly priced, they can improve a transit system's performance and operating ratio. If care and attention are taken to convert dwell-time savings into operating cost savings through proper schedule changes and to capture all cash flow benefits, transit fare prepayment plans can be cost-effective alternatives to cash fares." (48)

Another empirical study of season ticket ridership and revenue effects undertaken in the United States (52) is less illuminating for the purposes of this review because it fails to deal with overall effects, prefering to quote just the revenue generated from passes alone without the effect upon cash fare revenue. This analysis is confused further by the adoption of changes in fare levels in addition to ticket types. Nevertheless, it is of use in providing further corroboration of the below average demand elasticities of pass-users (-0.36 compared with -0.38 for systemwide ridership).

2.1.5. Review of published material on the economic aspects of interchange and through ticketing

Interchange has always been a fact of life for public transport users, particularly in the larger cities. Apart from the size of an urban area, its form, distribution of land uses, the nature of its transport network (especially the range of modes present), and finally the availability of through ticketing and timetable integration all play a part in determining the proportion of passengers who make transfers en route.

17% of people using West Midlands P.T.E. services changed en route in 1978 (40% in the case of "Travelcard" holders), whilst the figure was reported to be 18.5% in parts of Merseyside (10). Before introduction of the Metro network on Tyne-and-Wear, the proportion was 10%, but because of the deliberate channelling of demand onto the Metro, this figure has since risen to in excess of 30%. People using London Transport's services take on average 1.3 legs to complete each single trip if paying cash, or 1.7 legs if using a Bus Pass (5). In some large American cities, the proportion of people changing vehicles is over 50% (53). Figures for smaller urban areas are generally much lower, however, since bus only systems are the rule, and the simpler layout of activities usually permits a through service to the central business district to be provided.

Despite the prevalence of interchange amongst public transport users, the unpopularity of having to change vehicles to complete a journey is widely documented. An attitude survey of users of a demand-responsive service found that seven factors were judged to be more important than lower fares, of which the ability to make a through trip was ranked third out of 32 factors (54). Similarly, a U.I.T.P. study found that the relative value of travelling/waiting time perceived by a passenger during transfer was very high compared to other activities (55):

Seated in vehicle	1.0
Standing in vehicle	1.25-1.5
Walking to stop or station	2.1
Waiting at stop or station	3.6
Transfer	4.5

Further evidence of the detrimental effect of having to change vehicles en route is provided by two T.R.R.L. studies. Examination of the bus trips made through a rural interchange in West Yorkshire found that when alternate through and transfer journeys were offered at hourly intervals, a high proportion of travellers avoided the transfer trip. For purely rural trips 34% of travellers deliberately delayed or advanced their trip by a specified time to avoid having to make a change of vehicle; for trips from a rural area to an urban area the figure was 64%, and for trips from urban to rural 72% was obtained (56). Analysis of the effects of dividing a cross-town bus service in Chatham into two radial sections found that the interchange penalty caused a loss of revenue and patronage, although it was emphasised that such an effect could not be assessed readily in that instance (57).

Clearly, the importance of interchange as a policy issue varies considerably from place to place. However, in the larger cities (and even in smaller towns and cities where special conditions have been identified) the benefits (economic and otherwise) of incorporating a through ticket facility into the ticket range are likely to be substantial. However, very little evidence is available on the specific effects of the various through ticketing options.

Most operators in Britain have to date relied upon passes to cater for that section of the market which makes regular journeys involving interchange. As has already been demonstrated, pass holders tend to make journeys with more legs than other types of traveller (see section 2.2.4 a). Indeed, in the case of West Midlands and Greater Manchester P.T.E.s, the average trip length (single leg) undertaken with a pass is very similar to that of other classes of user. In Manchester the average "Saver Seven" trip length was found to be equal to a cash fare of 19.73 pence, compared with the average cash fare trip of 17.81 pence (44). The trip length distributions in the West Midlands example are shown in figure 9 for Travelcard holders, cash fare payers and Concessionary Pass holders. The five stage average trip length for Travelcard users is only slightly longer than the 4.25 stage figure for those paying cash (58). Clearly, this evidence indicates that passes are purchased in order to reduce the cost of making regular journeys involving interchange rather than to make longer unbroken trips. As such, usage suggests passes can be marketed very effectively as a means of overcoming the financial penalty associated with interchange.

The drawbacks to total dependence upon passes as the means of catering for through trips are obvious, however. People not making frequent medium or long distance trips will not find it worthwile to buy a pass, even if interchange is involved. Therefore, without a single journey through ticketing facility, the financial penalty incurred when cash fares are paid (even with graduated fares) will discourage a proportion of this important market. Such a policy could also be seen as socially divisive, with only those people able to afford the lump sum pass purchase price being able to enjoy free transfers.

Because the worst penalties imposed on people changing vehicles are associated with coarse fare structures, operators using such structures feel obliged to enable transfers to be made with single tickets. This applies to most American and Continental European operators. In addition, others do so to help foster a "network" mentality in the minds of their customers, and to increase the general attractiveness of their product to

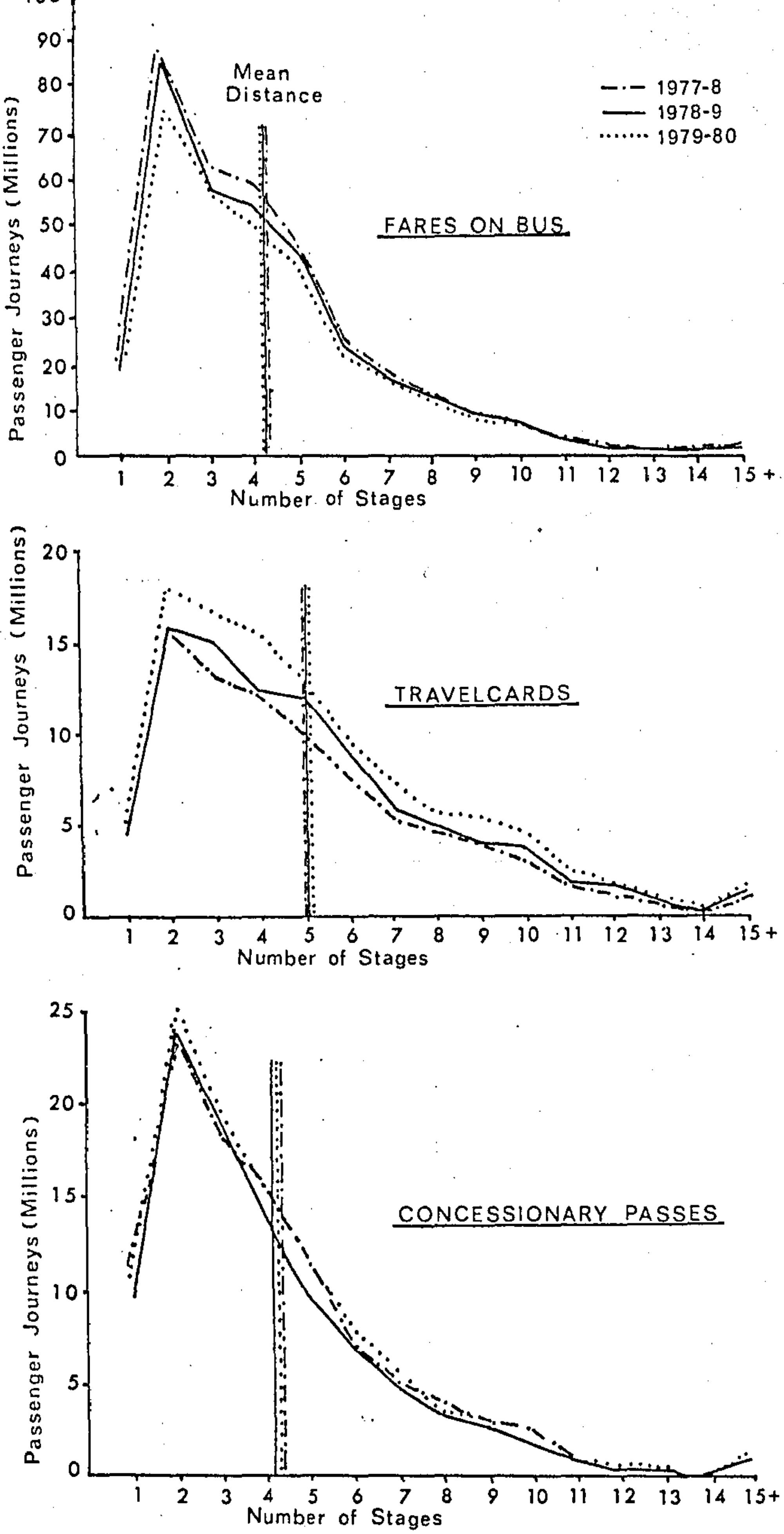


Fig. 9 : TRIP DISTRIBUTION ON WEST MIDLAND P.T.E. BUSES, STAGES TRAVELLED BY TICKET TYPE.
(Source: WMPTE Annual Statistical Report 1979–80)

those people not using multi-ride or season tickets. Very little research appears to have been done on the revenue and ridership consequences of offering such transfer facilities. A typical balance sheet for the introduction of single journey through ticketing might be:

<u>Gains</u>

- Revenue from additional custom generated by lower cost of trips and enhanced convenience;
- Revenue from transfer surcharge (if levied);
- Depending on the design of the system, faster boarding times due to the elimination of ticket purchase on the second leg;
- General goodwill from improved service.

<u>Losses</u>

- Revenue from the second leg of journey made by people captive to public transport;
- Depending on the design of the system, additional cost of more sophisticated equipment;
- Extended boarding times caused by greater complexity of system;
- Possible reduction in sale of pre-paid tickets.

As with other aspects of fares and ticketing policy, the crucial consideration is whether additional revenue generated by new custom following the introduction of the facility is sufficient to offset the effective discount offered to long standing customers who previously made transfers during their journey. The likelihood of diversion away from other ticket types also needs to be taken into account.

A small charge can be levied for passengers using single journey through tickets in order to recoup some revenue. A study in the United States of the effects of different transfer policies found that passengers making transfers react to the additional charge in a similar way to ordinary passengers faced with a change of fare level (53). Table 32 shows that as the extra charge rises, user satisfaction and ridership fall, the extent depending upon the elasticities of the affected user groups. Since such elasticities are generally low, revenue will increase as the charge rises (table 33). It is important to note that income from transfer charges generally forms only a very small proportion of total revenue. The supression or generation of trips plays a much more important role, in as much that the effective elimination of the free transfer (option 2) causes a 10% drop in ridership, and a 25% fall in the number of people making transfer trips (assuming medium elasticity values). Revenue increases by 8%. By supposing a reversal of this situation (free transfers introduced), it can be inferred that the effects upon revenue (fall) and ridership (increase) would be significant, albeit not as large as the figures quoted above.

The American study also found a tendency for rail/rail transfers to have a lower elasticity that bus/bus or bus/rail (or vice versa). This finding was corroborated by a study of work trips in the Stockholm Metropolitan area (59). There are intuitive explanations for this. Firstly, facilities at bus interchange points tend to be poorer than at railway stations. Secondly, waiting times for buses tend to be longer and less predictable than for rail services.

The provision of single journey through ticketing also has implications for other aspects of operation. If a charge is levied for the second leg and collected upon boarding the second vehicle, unless it is identical in all aspects to the basic fare, it's collection is likely to lengthen boarding times due to the "special" nature of the transaction.

TABLE 32 : EFFECT OF CHANGES IN TRANSFER CHARGE ON TOTAL RIDERSHIP AND TRANSFER RATE WITHIN A TYPICAL U.S. URBAN UNDERTAKING

Option	Initial transfer charge (cents)	New transfer charge (cents)	Base fare (cents)	LOW ELASTICITY (-0.1)		MEDIUM ELASTICITY (-0.3)		HIGH ELASTICITY (-0.58)	
				Change in total ridership (%)	New transfer rate (%)	Change in total ridership (%)	New transfer rate (%)	Change in total ridership (%)	New transfer rate (%)
1.	0	5	25	-0.6	19.6	-2.0	19.0	-3.9	18.1
2.	0	25	25	-3.3	18.4	-10.0	14.9	-19.3	9.5
3.	5	25	25	-2.2	18.9	-6.7	16.7	-13.0	13.3
4.	0	5	40	-0.4	19.8	-1.3	19.4	-2.4	18.8
5.	0	10	40	-0.8	19.6	-2.5	18.8	-4.8	17.6
6.	5	10	40	-0.4	19.8	-1.1	19.5	-2.1	19.0
7.	5	25	40	-1.5	19.3	-4.4	17.8	-8.5	15.7

Source: Chas.Rivers Associates (ref. 53)

Initial transfer rate assumed to be 20%.

TABLE 33 : EFFECT OF CHANGES IN LEVEL OF INTERCHANGE UPON RIDERSHIP AND REVENUE OF A TYPICAL UNITED STATES UNDERTAKING

				LOW ELASTICITY (-0.1)				MEDIUM ELASTICITY (-0.3)				HIGH ELASTICITY (-0.5)			
Initial Transfer charge (cents)	New Transfer charge (cents)	Base fare (cents)	Initial ratio of Transfer revenue to total revenue	Change in Overall ridership (%)	Change in overall revenue (%)	New Transfer rate (%)	New ratio of Transfer revenue to total revenue	Change in overall ridership (%)	Change in overall revenue (%)	New Transfer rate (%)	New ratio of Transfer revenue to total revenue	Change in overall ridership (%)	Change in overall revenue (%)	New Transfer rate (%)	New ratio of Transfer revenue to total revenue
0	5	25	0	-0.6	+3.5	19.6	0.038	-2.0	+2.6	19.0	0.037	-3.9	+1.2	18.1	0.035
0	25	25	0	-3.3	+16.0	18.4	0.155	-10.0	+8.0	14.9	0.130	-19.3	-3.2	9.5	0.087
5	25	25	0.038	-2.2	+12.8	18.9	0.159	-6.7	+7.7	16.7	0.143	-13.0	+0.4	13.3	0.117
0	5	40	0	-0.4	+1.9	19.8	0.024	-1.3	+1.7	19.4	0.024	-2.4	+0.8	18.8	0.023
0	10	40	0	-0.8	+4.4	19.6	0.046	-2.5	+3.1	18.8	0.045	-4.8	+1.4	17.6	0.042
5	10	40	0.024	-0.4	+2.1	19.8	0.047	-1.1	+1.6	19.5	0.046	-2.1	+0.9	19.0	0.045
5	25	40	0.024	-1.5	+8.4	19.3	0.108	-4.4	+5.5	17.8	0.100	-8.5	+1.6	15.7	0.089

Source: Chas.Rivers Associates (ref.: 53)

Suspicions that full integration of fares and ticketing, and the associated financial concessions for trips involving interchange, cause a loss in revenue are not allayed by a review of available evidence. Concluding a review of integrated urban public transport systems throughout Europe, it was stated thus:

> "The double fares collected by operators when there is no single system-wide fare may contribute a significant portion of operating revenues within a system, and may be the decisive margin between competing or co-ordinating operations."(60)

Another source dealing with the issues surrounding public transport integration states that through ticketing generally results in shortfalls of revenue, and as such the setting up of a "Transport Community" will require such shortfalls to be compensated for out of public funds if it is to succeed (61).

It is interesting to note that a range of options for a proposed cut in fares submitted to the Greater London Council by London Transport in 1982 included one which incorporated an extension of integrated and through ticketing which had a much lower overall fare level decrease than the option which was intended to raise the same revenue without a change in anything other than fare level. The London Rail Study also found a loss of revenue to be "likely" following the introduction of extensive through ticketing, although no figures were quoted (20).

Clearly, even allowing for the generation of additional trips, the provision of through and integrated ticketing loses revenue (albeit moderate amounts), which must be recouped either by higher overall fare levels or higher subsidies. This is the price to be paid for a more convenient system. However, if carefully designed, the medium and long-term attraction of additional custom should reduce initial revenue losses considerably. Furthermore, if the analyses of user preferences are correct, money spent on subsidising a system of integrated fares and ticketing would seem to give better value than the same amount used solely to lower fares.

2.2.6. Inspection Methods

The published evidence regarding this aspect of the fare system has been discussed in earlier sections dealing with the other components of the fare system (see section 2.2.1. for an explanatory note).

2.2.7. Summary of findings from the review of published material on the effects of fare system changes

Section 2.2 has analysed the available published evidence on the actual or predicted effects of simplified fare systems.

- Fare Structure : Although the consequences of fare structure simplifications upon revenue and patronage are strongly dependent upon the change in fare level and other local circumstances, it would nevertheless seem that flat fares are poorer performers than zonal or graduated structures in these areas. Zonal fares were nearly always the preferred option for raising revenue. The patronage effects of simplification tend to produce a drop in trips (particularly for flat fares) but an increase in passenger kilometres travelled.

- Fare Collection : The implications of choosing a fare collection system were found to be wide ranging. There are important effects upon operating speeds, levels of evasion, passenger accepiance, and operating costs. Experience shows that fully automatic systems are not particularly cost effective, and that ergonomic and marketing aspects should take preference over costs when choosing a system.

- Ticket Range : The two main types of prepurchased ticket - multi-ride and season - both serve to stimulate patronage, but often at the expense of a loss in revenue. The extra trips generated are usually insufficient to offset the revenue loss caused by the need to offer a discount. However, these tickets were also found to be popular due to their convenience and simplicity, and they usually reduce boarding times and thus operating costs.

- Through and Integrated Ticketing : The evidence is that even allowing for the generation of additional trips, the provision of through and integrated ticketing loses revenue (albeit moderate amounts). However, if the analyses of user preferences are correct, money spent on subsidising a system of integrated fares and ticketing would seem to give better value than the same amount used solely to lower fares.

- Inspection Methods : Choice of other fare system components affects the nature and extent of fare evasion by passengers, and thus the measures needed to control it. The more complex fare structures were found to increase the scope for fraud, as were 'open' systems of fare collection and, to a lesser extent, multi-ride tickets. Effective safeguards are available, however.

2.3. Results of Communication with Operators regarding recent or proposed Fare System changes and their effects

This section relies upon three basic sources of information:

1. Personal interviews with certain U.K. operators (most P.T.E.'s and some Municipal undertakings were represented), carried out during late 1981 and early 1982.
2. A questionnaire survey of most U.K. Municipal operators not covered by interviews (late 1981).
3. Material requested from Continental Undertakings (late 1981 and 1982).

Further details of each approach are given in the appropriate section. A list of undertakings contacted is included in appendix 1.

2.3.1. Analysis of interviews with Operators

i - Fare Structure

Fare structures employed by the P.T.E.'s in 1981-2 varied from the very finely graduated scale used by South Yorkshire P.T.E. to the coarse ring-zone system adopted for buses by London Transport. This latter arrangement effectively means that flat fares are charged for a large proportion of bus journeys. Most P.T.E.'s have simplified their fare scales on a piecemeal basis, and the majority employed a coarsely graduated scale. Beyond this, with the exception of London Transport and Tyne and Wear P.T.E., large scale innovation in basic fare structures had not occurred up to 1982.

The results of a series of fare simplification exercises conducted by London Transport have already been discussed (section 2.2.2). It was found that regardless of the effect upon boarding times, simplification was also justifiable for other reasons. Firstly, it helped to fulfil L.T.'s corporate objective of increasing passenger miles without loss of receipts, and secondly it facilitated a reduction in fraud (particularly overriding). Graduated fares were also found to inhibit trip length, with people alighting earlier than necessary in order to avoid crossing a stage boundary.

Motives for the introduction of zonal fares in the Tyne and Wear P.T.E. area were somewhat different. They were intended to help facilitate a fully integrated fares and ticketing system between bus and "Metro" services - regarded as an essential prerequisite for the role the new Metro system was designed to play. The extent of the changes to both the service structure and the fare system employed in Tyne and Wear makes any isolation of the effects of the shift to zonal fares impossible to isolate. Subsequent research has indicated that, taken as a whole, the new system has been very successful, with an increase in trips from 281 million per annum in 1975-6 to 311 million in 1983-4. This latter figure compares with a "do-nothing" estimate of under 250 million (62).

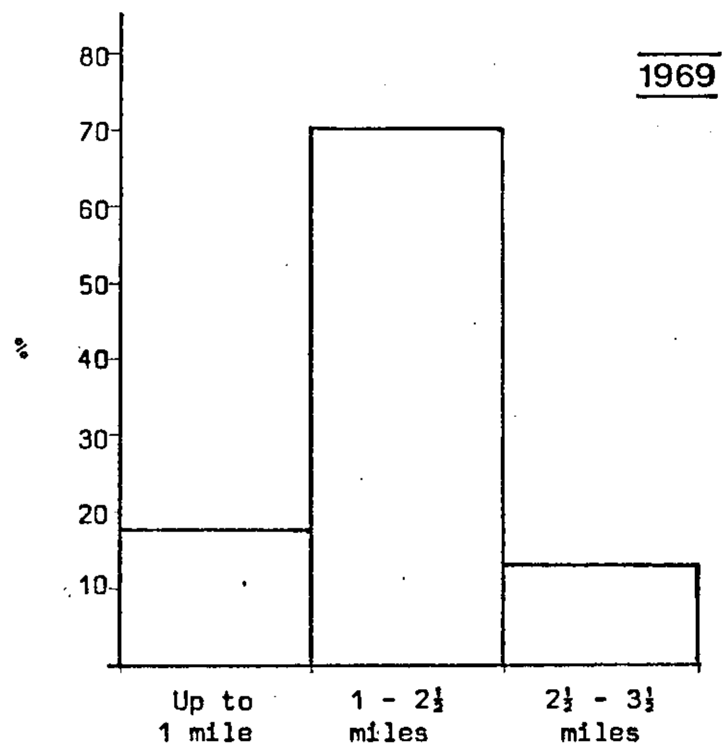
The remaining P.T.E.'s tend to be of less interest as far as innovative fare systems are concerned. Greater Manchester simplified their scale during the 1970's, primarily as an aid to OPO, with all fares being in multiples of 10p by 1981. However, the result in this particular instance was a severe imposition for travellers of between 1 - 3 miles, who were handicapped by a gap in the scale between the 10p and 30p values. This situation was rectified by the substitution of a 10p-23p-35p scale as part of a general fare revision. The fact that this change was anticipated to yield both additional revenue and patronage is a reflection of the poor design of the previous fare scale, rather than coarse fare structures in general.

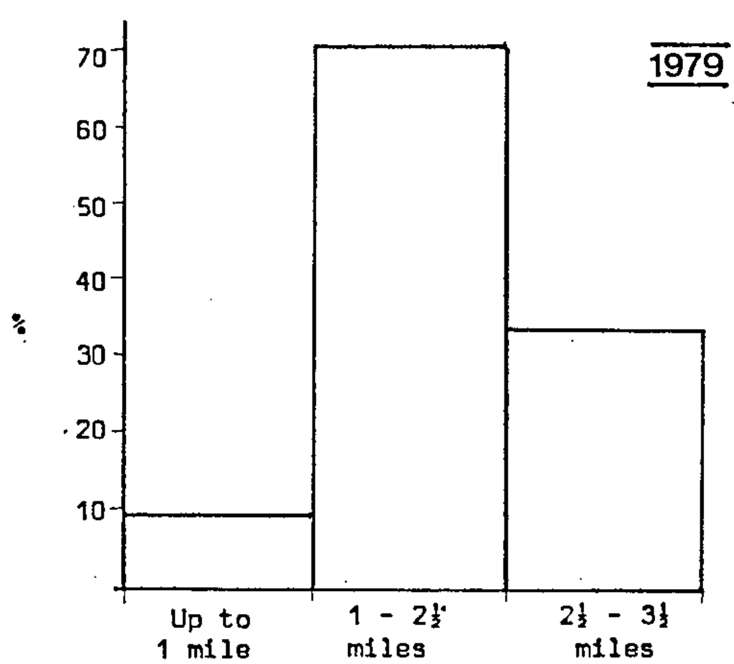
However, concern over the alleged damage caused to revenue and patronage by very coarsely graduated scales was expressed by Nottingham City Transport. Large fare steps were held to be damaging because the jumps in fare discouraged trips over certain distances.

As far as fare structures are concerned, Newport Borough Transport stands alone in the U.K. as a long standing user of systemwide flat fares. Introduced between 1971-3, they were used to help OPO to be introduced with the minimum of operational inconvenience. It was felt to be essential to keep the driver's fare collection workload to a minimum, not least because of the need to keep the job as attractive as possible during a time of full employment and keen competition for labour. Flat fares were phased in on a route-by-route basis, with a peak/off-peak fare differential also being used from time to time.

The effects upon ridership and revenue quoted in Newport's case are uncertain. No study has been attempted to isolate the flat fare from other determinants of performance. Certainly, the undertaking has fared relatively well compared with many of its municipal counterparts. During the period 1970-82 it has broken even each year, except in 1972, 1975 and 1981 (the latter involving a projected deficit caused by a direct political instruction to keep fares down to mitigate the effects of unemployment in the town). Over the period 1971-81, the undertaking performed consistently better than the municipal average in terms of patronage trends, with traffic actually rising by 5% between 1975-79. However, there has been evidence of a long-term shift in journey length distributions. The proportion of passengers travelling over 2½ miles rose from 13% in 1970 to 33% in 1979, whilst trips under one mile fell from 17% to 9% during the same period (see fig. 10). A slight outward shift in land-use

Fig. 10 : Distribution of Passenger Journey Lengths - Newport Borough Transport 1969 / 1979





Source : Ref. 63.

patterns has not been sufficient to fully account for this trend.

Boarding speeds in Newport are comparable to, or perhaps even slightly better than, other "Autofare" equipped systems, with a figure of 2.2 seconds per passenger being quoted. This helps to explain the higher than average speed of operation (10.3 mph in Newport, compared with the municipal average of 9.1 mph) (63).

Evasion levels are not known, but the problem is not regarded as a serious one. Whilst flat fares eliminate the possibility of overriding, the ticketless system operated in Newport renders the receipts susceptible to fraud by staff. This resulted in a number of dismissals some years ago. Furthermore, the flat fare encourages drivers not to scrutinise what is placed in the vault, enabling unscrupulous passengers to take advantage of this weakness in the system.

The importance of factors other than the flat fare in contributing to Newport's performance during the period 1970-82 should not be underestimated. A modern fleet has helped to reduce costs, whilst Newport has a land-use pattern well suited to public transport operation. Furthermore, service levels have actually been improved (against the general trend), with higher frequencies, faster running times and better reliability all helping to attract patronage. A lack of political interference in the affairs of N.B.T. (until 1981 at least) was claimed to have helped its performance. As such, it could well be argued that flat fares have played only a small part in the success story. Indeed, it is quite conceivable that had Newport chosen to adopt a zonal or coarsely graduated scale, its revenue and ridership performance may have been even better.

Being a relatively small urban area (population 134,000), Newport is fortunate in as much that the adverse effects of failing to differentiate fares according to distance travelled are minimsed. Nevertheless, an awareness of the weakness of flat fares was acknowledged, because if N.B.T. were to become increasingly dependent upon subsidies, there may be political pressure to revert to some form of graduated structure in order to improve revenue yield.

ii - <u>Fare Collection</u>

The majority of operators interviewed used either farebox or conventional OPO fare collection methods. As has already been discussed, London Transport still used conductors to collect fares on its busier routes (just under half the total in 1982). It has also used a variety of self-service systems, including barriers. Previous experience of various fare collection systems amongst the operators interviewed is of value, not least for the reasons for abandonment of these systems. Experience of multi-ride and season tickets will be discussed in section iii.

Experience with farebox systems has been mixed. Both Greater Manchester P.T.E. and London Transport have tried them, but subsequently phased them out because of unpopularity with the public (primarily the inconvenience of the no-change rule), together with their susceptibility to fraud, especially by[2] staff. Where drivers are made accountable for their takings by issuing tickets, fraud is less of a problem, and several of the operators visited stated they were perfectly happy with the farebox system. These tended to be in towns and cities where tourists are less common, since regular passengers are much more amenable to a farebox system after a period of adjustment.

An example of an operator using the farebox system is Kingston-upon-Hull City Transport, which was the first U.K. concern to adopt such an arrangement. Its main benefit was to enable the introduction of OPO without significant reductions in boarding speeds (this was confirmed by the Cundill and Watts study (ref. 2) which used Hull as one of its case studies). However, it was stated that a coarse fare structure is essential if the full benefits of farebox operation are to be realised. The issue of tickets was also found to be an essential prerequisite for preventing fraud by both passengers and staff. It was acknowledged that significant numbers of visitors (or other occaisional users) would have made the system much less practicable.

Another "Autofare" user, Lincoln City Transport, stated that the exact-fare policy probably causes a loss of customer goodwill, if not actual patronage losses. Most operators using exact-fare policies operate a system whereby people tendering large denomination coins or notes are given vouchers which are redeemable for future travel or for cash at the undertaking's offices. The inconvenience for both customer and operator of this system generally ensures its use is negligible. On balance, however, the risk of loss of custom as a result of no-change policies is seen by most operators as an acceptable price to pay for the combination of OPO and relatively fast boarding speeds.

Experience with other variants of semi- or full self-service fare collection methods amongst the operators visited is generally less favourable. Self-service vending machines on buses have been tried on a large scale by London Transport. Under their system, passengers using the second stream could pay a range of fares by inserting the correct combination of coins, whereupon a barrier would be released and ticket issued. The proportion of people using this arrangement was never significant, and declined to negligible proportions (less than 5% of boarders) as the machines gained a reputation for unreliability. Problems of keeping complex equipment in good condition in a hostile environment (vibration, and so on) was cited as the main reason for their poor performance, and they were finally withdrawn from all vehicles in the late 1970's. Experience with coin-actuated turnstiles on certain flat fare routes in the London area has been more favourable, primarily because of their relative simplicity. Only one fare value is payable, and no tickets are issued.

A second stream arrangement tried by South Yorkshire P.T.E. involved making an impression of coins placed into a vault by passengers upon a piece of paper, which was retained as a ticket. An unequivocal record of fare paid is thus made for both passenger and operator. This arrangement was used on three routes in 1982, although experience has been rather unsatisfactory, again because of poor reliability.

Future developments in fare collection methods used by the P.T.E.'s are likely to be influenced to a large extent by the need to provide single journey through ticketing. A Working Party has been investigating the requirements and design of such a system since 1978. Work was at a fairly advanced stage by 1982, with apparatus having been designed and tested. Having estimated that at any time, 10% of passengers on a bus are making trips with two or more legs, with a resulting demand for through ticketing standing at about 20%, it was decided that whilst the additional cost of new equipment was not justifiable for this group alone, the project was worthwile for the other benefits it would permit (improved data capture and fraud prevention in particular). Even with a memory facility for fares between all the various origin/destination permutations, it was still thought to be necessary to simplify the fare structure if on-vehicle issue of single journey through ticketing was to be a feasible proposition. A zonal configuration was envisaged for journeys involving transfers, if not all types of journey. The machine itself is similar in appearance to the updated "Autofare 3" equipment, with ten buttons for predetermined fares and an override for the issue of through tickets. These would be issued pre-encoded, for cancellation by the passenger on subsequent legs of the journey. Encoding should allow the problems encountered with the "Transfare" single journey through tickets at Tyne and Wear P.T.E. to be overcome.

Ticket issuing equipment requirements vary considerably between the P.T.E.'s, and any attempt at standardisation is bound to prove difficult. Indeed, some P.T.E.'s believe single journey through ticketing can only be accomodated if ticket issue is to be off-vehicle, otherwise adverse effects upon driver workload and boarding speeds will result. This will be discussed further in section iv.

iii - Ticket Range

Many of the visits undertaken were with the primary intention of establishing the effects of innovative pre-purchased ticketing schemes, and as such much useful evidence has been obtained in this area, for both multi-ride and season tickets.

a) Multi-ride Tickets

Of the undertakings visited, six had operated a multi-ride scheme of some description in the past, and four were still doing so. Motives for the introduction of such schemes varied, but most were seen as a means of mitigating the adverse effect of OPO upon boarding speeds. The "Clippercard" range introduced by Greater Manchester P.T.E. was also intended to offer a discount and incentive to travel to those passengers reluctant or unable to purchase season tickets.

Experience with these systems has varied, with levels of take-up being critically dependent upon the level of discount offered (this corroborates observations elsewhere). Performance in each case is summarised in table 34. The most successful in terms of take-up was the scheme operated in the Havering area of London by L.T., although this was achieved at the expense of a discount level of 50%. The details of the scheme are included in appendix 2, which is an extract from a leaflet publicising the scheme. Ridership increased - the 75% of passengers using the multi-ride ticket increased their trip-making by 7% - but the impact upon boarding speeds was insufficient to have made the scheme a success. The fact that multi-ride cards were sold by the driver helped to slow down boarding times, although this facility proved popular with users.

A far less successful experiment in terms of market penetration was that introduced by Nottingham City Transport in 1970. Twelve-journey tickets could be purchased from the driver, who also cancelled them when used. Because no discount was offered, take-up was negligible, and consequently its overall impact could only be marginal. The scheme was withdrawn after about one year. The lesson to be learned here is that the previous conclusion that multi-ride tickets are purchased primarily because of their ability to offer financial savings and less because of any other attributes (such as convenience) must be reiterated.

Another early multi-ride scheme was also withdrawn because of poor performance, albeit for somewhat different reasons. The "Bus Economy Ticket" operated on Merseyside between 1970-75, giving a discount of approximately 25%. It achieved a peak market share of 16% of trips. Because the facility was withdrawn

TABLE 34 : MULTI-RIDE SCHEMES IN THE U.K. - SUMMARY OF EFFECTS

	DISCOUNT (%)	MARKET SHARE (% of trips)	EFFECT ON RIDERSHIP	EFFECT ON REVENUE	BOARDING SPEEDS	LEVEL OF FARE EVASION	PASSENGER ACCEPTANCE
MERSEYSIDE P.T.E.: "BUS ECONOMY TICKET" (1970-75)	25	15 (max.) (13% of revenue)		Implied loss		Poor	
WEST YORKSHIRE P.T.E. "SUPERSAVER"	30 (range 19-40)	17 (38% of eligible persons)	"Supersaver" users made 4.6% more trips		3.0 seconds	Overriders (% revenue) = 1.7 before = 3.7 after	Viewed as: - money saving - convenient - helps bulk travel - improves reliability
NOTTINGHAM CITY TRANSPORT (c.1970-1)	None	← Negligible →					
SOUTH YORKSHIRE P.T.E.	10	Less than 5%					
LONDON TRANSPORT HAVERING (1977-81)	50	75	7% rise in total trips		3.0 seconds	Overriders (%revenue) = 3.5 before = 5.7 after	
GREATER MANCHESTER P.T.E. "CLIPPERCARD" (1979-)	11 (range 10-20)	10% of revenue			Identified as a problem		

as a means of keeping down the level of a general fare increase, it is implied that it was a net loser of revenue for the undertaking. However, other factors also played a part - a major concern was its susceptability to fraudulent use (see section 2.2.2).

With careful design, multi-ride systems can form a valuable and permanent part of an undertaking's ticket range. Greater Manchester's P.T.E. is fairly pleased with the performance of its "Clippercard" range, which includes versions for Pensioners, teenagers, and off-peak users, in addition to the basic discount ticket. An average discount of 11% had produced an overall market share of 10% of revenue by the end of 1981. Effects upon revenue and patronage were not known, although some problems had been experienced with fraud, in the form of overriding.

A multi-ride scheme has operated in the Leeds area since 1967, introduced initially to help overcome staff resistance to the introduction of OPO. The system was not widely publicised, and was used by only 7% of passengers. Problems encountered were typical - inadequate protection against fraud, and unreliable equipment. Since 1979, when the decision was taken to transfer sales to just two off-vehicle sales points, market share has declined further.

Of greater interest is an experiment introduced by West Yorkshire P.T.E. in the late 1970's, in order to determine the extent to which pre-purchased tickets could help to create a situation whereby crew operation could be eliminated. Two trials were conducted, one on a Bradford service, and another on a route crossing Leeds. Using the slogan "Supersaver", tickets were sold through various retail agents and special kiosks. Monitoring of the scheme on a "before-and-after" basis found that additional patronage had been generated, but at the expense of a loss in revenue. Comparisons of ridership found that levels stood at 96% of the figure for eighteen months previously on the "Supersaver" routes, whilst on other routes it had fallen to 82%. It was estimated that of the passengers on the "Supersaver" routes, 10% had been newly attracted by the multi-ride facility.

South Yorkshire P.T.E., and the predecessor Sheffield City Council, have provided a limited multi-ride facility since the early 1970's on a limited number of routes. Cancellation is performed by the driver or conductor, and the discount is fixed at 10%. However, because of the very low general level of fares charged in South Yorkshire, such a discount is very small in absolute terms. This, together with a lack of promotion, has resulted in a negligible market share. In fact, because of their low fares policy, South Yorkshire has been reluctant to promote any form of discounted prepurchased ticket scheme.

This section has revealed nothing to contradict earlier conclusions regarding the performance of multi-ride tickets. Specifically, it is essential that sizeable discounts and widespread publicity are used if a significant market share is to be achieved. The introduction of these tickets tends to result in a net increase in overall ridership, but at the expense of a loss in revenue.

b) Season Tickets

All the undertakings visited, with the exception of South Yorkshire P.T.E. and Newport Borough Transport, offered some form of season ticket facility to their customers. Several of the undertakings have had the performance of their particular schemes presented in a formal report, and as such reference should be made to section 2.2.4 for consideration of the schemes operated by London Transport, West Midlands P.T.E., Greater Manchester P.T.E., and Greater Glasgow P.T.E.

Most concerns introduced season tickets primarily in order to stimulate patronage, although in the case of Greater Glasgow P.T.E.'s "Transcard" this was only a subsidiary consideration. It was the potential for enabling easier interchange which was of primary interest in this case, although several other P.T.E.'s also gave this as an additional motive. The potential for promoting off-vehicle sales and faster boarding times was also a common justification. West Yorkshire P.T.E., for example, is using the travelcard as a means of moving towards its ultimate objective of 80% of revenue from off-vehicle sales. Improving the convenience of users was also mentioned, particularly by operators using exact-fare farebox systems.

Reasons given by South Yorkshire P.T.E. and Newport Borough Transport for not offering season tickets were basically that their fare levels were already low, and the offer of further discounts was unneccesary. In the case of Newport, the flat fare structure also means that the operational and convenience attributes of travelcards would be far less noticeable in relative terms.

Market shares achieved by season tickets in the undertakings visited were generally low (see table 35). Only West Midlands and Tyne and Wear P.T.E.s reached the 30% mark in 1982. No fewer than seven undertakings operated season tickets which had market shares of less than 12% (of trips) in 1981. The system of zonal seasons introduced by Merseyside P.T.E. in 1978 had achieved a level of penetration of no less than 63% for rail commuting journeys, although the figure for all bus trips was just 7%.

TABLE 35 : SEASON TICKET SCHEMES IN THE U.K. - SUMMARY OF EFFECTS

	DISCOUNT (%)	MARKET SHARE (%)	EFFECT ON RIDERSHIP	EFFECT ON REVENUE	BOARDING SPEED	LEVEL OF EVASION	MOTIVES FOR INTRODUCTION
LONDON TRANSPORT "LONDON BUS PASS" (1972-1982)	12-14% (April 1981)	Less than 10% (6% April 1981)	10% generated (6% former car users)	Fluctuates Overall loss		Negligible	
WEST MIDLANDS P.T.E. "TRAVELCARD"		30% (1981)	+7.5% by 1979-80	+9.6% by 1979-80	Already Autofare	Negligible	
GREATER MANCHESTER P.T.E. "SAVER SEVEN" (1975-)	Breakeven point = 4½ mile trip	12% of revenue by 1981	Reduced rate of loss	Reduced rate of loss		Minimal (ID card needed to prevent illegal transfers)	1. To increase patronage. 2. To reduce on-bus transactions. 3. To boost customer convenience. 4. To facilitate interchange. Aimed at regular longer distance travelle
MERSEYSIDE P.T.E. ZONAL TRAVELCARD (1978-)	33% (approx.)	7% of bus revenue 63% of peak period rail users (1980-81)					1. To maximise passenger mileage. 2. To generate income from new passengers 3. To promote interchange. 4. To improve cash flow. 5. To reduce on-bus transactions.
WEST YORKSHIRE P.T.E. "METROCARD"	Breakeven point = 8 miles	8.6% of trips (1981)					1. To stimulate patronage. 2. To promote off-bus sales. 3. To reduce PTE/NBC fare differential. 4. To promote long distance commuting.
TYNE & WEAR P.T.E. "TRAVELTICKETS"		32% (1981)		Initial loss expected to be recouped over time	Appreciable acceleration	Negligible (main issue is alteration of expiry dates)	
GREATER GLASGOW P.T.E. "TRANSCARD"		24% (1982)	+2.6% by 1980-81	-6.5% by 1980-81	Already Autofare		Main objective to promote integration.
NOTTINGHAM CITY TRANSPORT "EASY RIDER" (1981-)		12% of revenue (1981)					1. To attract car users. 2. To boost convenience to passengers. 3. To promote off-bus sales. 4. To improve cash flow. 5. To enhance attractiveness of service.
HULL CITY TRANSPORT "CROWN CARD"		4.6% of trips (1981)	Overall 1% rise. Holders have made 25% more trips.	1% p.a. loss	Already Autofare		Main objective to halt decline in patro
LINCOLN CITY TRANSPORT "PHOTOFARE"	10-15%.	3% of revenue 5% of trips (1981)		Loss	Already Autofare	Very minor. Tendency to use expired cards.	1. To reduce cash transactions. 2. To accelerate boarding speeds. 3. To help preserve customer loyalty.

With regard to the crucial effect upon ridership, all undertakings reported a net increase. In many cases, the introduction of seasons served to reduce the rate of loss. Indeed, in some cases, a significant proportion of trips made using the ticket had been generated (10% for the London Bus Pass, and no less than 24.5% for the Hull "Crown Card"). However, because market penetration was limited, these generated trips made only a negligible contribution to overall patronage (1% in the case of Hull). For those undertakings which now employ performance criteria based on patronage rather than strictly financial issues, the positive contribution made by travelcards in generating additional custom (albeit mostly by existing passengers) is of considerable benefit.

Conversely, the influence of travelcards upon revenue is confirmed to have been less satisfactory. All undertakings except West Midlands P.T.E. reported that travelcards lost them revenue, primarily because it was existing customers rather than new ones who took advantage of the discount offered. West Midlands reported that initial revenue losses had been turned into revenue gains, whilst Tyne and Wear P.T.E. and Hull City Transport were trusting that this would occur in the near future. In the case of Nottingham, a revenue reduction of 1% during the first six months of travelcard operation was attributable more to the effects of general recession than to the new ticket. However, for the Lincoln "Photo-card" it was stated that pricing policy would have to be reviewed if market share rose appreciably (greater than 15% was quoted) in order to stem revenue losses. It was thus implied that losses were already being experienced, albeit at an "acceptable" level due to poor market penetration. Some operators reiterated the observation that to be successful in terms of revenue performance, season tickets must be able to attract a significant proportion of users who are totally new to public transport.

Most operators confirmed a beneficial effect in terms of boarding speeds, with season tickets facilitating a reduction in driver workload. Those employing the relatively fast farebox/no-change fare collection policy noticed only very slight improvements following the introduction of seasons. In their case, a reduction in the volume of coins handled was the main operational benefit.

Fraudulent use of season tickets was not regarded as a major problem, with the general level of abuse being perceived as minimal. It must be noted, however, that several operators found it necessary to introduce a system of photographic identity cards jointly with season tickets in order to prevent the transfer of tickets between persons. This precaution was found to be necessary following unfortunate experience in this area. The most prevalent abuse now encountered was the continued use of expired cards, although no undertakings were particularly concerned about the scale of this problem.

Hardly any undertakings had carried out formal studies to determine passenger attitudes towards season tickets, their reasons for purchase or non-purchase, and so on. One such excercise has been carried out by Hull City Transport (64). This confirmed the previous observation that people buy season tickets primarily because of the financial savings to be made. It was observed that the reasons given by passengers for "Crown Card" purchase are balanced between financial (49%) and convenience (51%) considerations. Comments given on the questionnaire showed a similar split between financial and other attributes of the scheme (particularly the elimination of the need to tender the exact fare, together with the capability for allowing interchange without paying extra). An opportunity to assess people's attitudes towards prepurchased tickets in more detail arose through the Plymouth City Transport "Easyfare" scheme (see part three).

iv - Through and Integrated Ticketing

Views amongst operators visited regarding the extent of demand for through ticketing were mixed. Some acknowledged that the need for such a facility is substantial, whilst others tend to be dismissive about such a market. In addition to Tyne and Wear P.T.E. (who already operate single journey through ticketing), three other operators recognised that there was a genuine identifiable demand for through travel using single tickets on their networks, although at present such demand was not encouraged. West Yorkshire P.T.E. stated that, at any one time, roughly 20% of passengers would benefit from such a facility. Lincoln City Transport stated that 10% of trips made constituted movements across the city, with most services terminating in the City Centre. Merseyside P.T.E., who are keen to realise the full potential of their recently improved rail network, have stated that single journey through ticketing is "......an essential prerequisite of an integrated transport system." (65). Particular reasons given were the need to eliminate the financial penalty associated with rebooking, and the need to remove restrictions concerning bus route rationalisation. On the other hand, representatives of Greater Manchester and South Yorkshire P.T.E.'s were less enthusiastic about the scope for full scale integration of services, in the case of the former because Manchester's rail network was supposedly unsuitable for full integration.

Indeed, all operators were fully aware of the inherent problems with any full-scale system of single journey through ticketing. Prominent amongst the difficulties mentioned were:

- susceptability to fraudulent use unless more sophisticated equipment is used;
- increased complexity creates an additional burden for the driver, resulting in slower boarding speeds and perhaps union objections;
- where different modes are involved, ticket issuing equipment is often incompatible;
- problems of revenue apportionment between operators, with an increase in administration;
- a probable loss of revenue due to the elimination of rebooking; and
- major shifts in modal split would occur with full integration, with possible adverse reaction from passengers and staff alike.

Table 36 shows that provision for through and integrated travel is very limited amongst the undertakings visited, apart from the multi-ride and travelcard facilities discussed earlier. In only one instance (Tyne and Wear P.T.E.) is through travel with a single ticket permitted on anything approaching a network-wide scale. Of the remaining operators, six allow single journey through ticketing only on a sporadic basis on selected services, whilst five make no provision whatsoever.

An example of one of the isolated schemes in operation is that provided by Greater Manchester P.T.E. for residents of Marple, offering them through ticketing between two bus services which represent the severed halves of a previously longer route. The system was introduced in order to mitigate the effects of having to change vehicles and re-book. The arrangement is not publicised, and usage is

TABLE 36 : ISSUES RELATING TO INTERCHANGE FOR U.K. OPERATORS INTERVIEWED

	MR	TC	ARRANGEMENTS FOR SINGLE JOURNEY THROUGH TICKETING	ESTIMATION OF NEED FOR THROUGH TICKETING	COMMENTS
LONDON TRANSPORT	YES	YES*	None, apart from limited Underground/British Rail facility	There is a genuine demand for bus/tube single journey through ticketing, but suppressed at present due to incompatible ticket systems.	Integration is awaiting development of compatible BR/LT a.f.c. systems. Possibility of Underground add-on facility for BR ticket holders + system of zonal travelcards.
MERSEYSIDE P.T.E.	NO	YES*	One isolated scheme.	".....an essential prerequisite of an integrated transport system." Needed to eliminate financial penalty and constraints on service rationalisation.	The absence of through ticketing was seen as a major impediment to development of a properly integrated and efficient system of public transport.
GREATER MANCHESTER P.T.E.	YES	YES*	Limited schemes to mitigate effects of route severance.		Schemes hardly ever used due to lack of publicity. "Fraught with difficulties".
WEST MIDLANDS P.T.E.	NO	YES*			
WEST YORKSHIRE P.T.E.	YES	YES*	Limited schemes to compensate for route severances.		Would like to see systemwide single journey through ticketing but: (i) need more sophisticated equipment (ii) susceptible to fraud; (iii) driver needs to know greater range of O/D combinations.
TYNE & WEAR P.T.E.	NO	YES*	"Transfare" bus/metro facility. (Available on metro feeder services only).	Essential for introduction of integrated system, due to: (i) elimination of need to rebook, and (ii) removal of financial penalty. Off-bus ticketing alone is insufficient.	Marginal loss of revenue anticipated. Very susceptible to abuse. May slow down boarding speeds.
GREATER GLASGOW P.T.E.	NO	YES*	None.		Major problems of revenue apportionment. Increased administrative burden coupled with lower revenue.
SOUTH YORKSHIRE P.T.E.	YES	NO	One isolated scheme.		Scheme unsuccessful because: (i) inconvenience of changing vehicles; (ii) parallel bus service costs 55% less.
NOTTINGHAM CITY TRANSPORT	NO	YES	None.		
LINCOLN CITY TRANSPORT	NO	YES	None.	Estimated 10% demand for cross-city trips.	Incentive to make through trips should be minimised, particularly as demand highest at peak periods when costs are greatest. Revenue would be damaged.
HULL CITY TRANSPORT	NO	YES	None.		No likelihood of introduction for several years. Would require additional equipment.
NEWPORT BOROUGH TRANSPORT	NO	YES	None.	Most people making cross-town movements are confirmed car users. Vast majority of bus users have town centre destinations.	

minimal. A similar motive was behind the introduction of limited through ticketing on certain services in the Calderdale area of West Yorkshire P.T.E.

Both Greater Manchester and South Yorkshire P.T.E.'s allow for single journey through ticketing between one of their own bus services and a rail link to the respective city centres. In the case of Manchester, it involves a bus feeder from a district of Hazel Grove to the local railway station, from where the ticket continues to be valid for the rail trip to Manchester Piccadilly. In the South Yorkshire example, residents of Dinnington can travel to Kiveton Park station on the bus and subsequently on the train to Sheffield on a single ticket. In both cases, tickets can be purchased either on the bus or at the City Centre railway station. Both schemes have a disappointing record, which in the case of South Yorkshire is hardly surprising since the fare on a parallel direct bus service is 55% cheaper. The inconvenience of having to change vehicles en route was also cited as a reason for poor results.

Whilst London Transport does not currently offer any through ticketing between their bus and Underground services (or between different bus services) using a single ticket, such a facility does exist between themselves and British Rail wherever cross-platform interchange or shared tracks occur. It is possible that the introduction of compatible automatic fare collection systems between the two operators on a large scale may be pre-empted in the interim by a flat rate add-on facility for B.R. customers in the suburbs wishing to continue their journey into Central London by tube (introduced in 1983).

Of greater interest, however, is the system of single journey through ticketing introduced by Tyne and Wear P.T.E. to coincide with the commissioning of the new Metro network in November 1981. Without such a facility, the remodelling of scores of bus services to act as feeders to the Metro would have been unacceptable, in the view of the Executive. Off-vehicle ticketing in the form of travelcards was, in itself, inadequate. Marketed as "Transfares", these tickets allow one trip on the Metro, and as many trips on designated bus routes as are required to complete the journey. Issue of "Transfare" tickets on the Metro is a simple matter of consulting a coloured map and requesting a ticket from a standard vending machine. Issue on buses (75 routes are involved) is from a pre-encoded ticket stock held in a dispenser, the ticket then being validated in a canceller by the passenger, recording zone, date and time of boarding. Because a destination is not stated on the ticket, a time limit is imposed which determines the latest time at which the final leg can be started. Nevertheless, worries remained about the susceptability of these tickets to abuse, particularly in so far as the date and other items are not actually magnetically encoded onto the ticket at present. Other operators are watching the performance of the "Transfare" innovation with considerable interest. Performance of the new integrated Tyne and Wear network is discussed briefly in section (i).

2.3.2. Findings from the Questionnaire Survey of Municipal Operators

Results from that part of the questionnaire dealing with basic details of fares and ticket systems employed by Municipal operators were described in section 2.1. In this section, the perceived effects of the various types of fare system will be dealt with. Replies were received from 35 of the 47 Municipal undertakings to whom the questionnaire was distributed in October 1981 (see appendix 1). A copy of the questionnaire is included as appendix 3.

i - Fare Structure

Very few experiments had been carried out in this area. The most radical scheme envisaged was the introduction of zonal fares and multi-ride tickets on three routes in Plymouth. This scheme and its performance is discussed in detail in part three. Four undertakings who replied were reported to be considering the introduction of flat fares on a limited basis (Brighton, Ipswich, Northampton and Merthyr). Portsmouth was planning to break away from its graduated scale, although no details were given.

Despite their predictability, the responses to a question asking for a ranking of factors considered when choosing a fares and ticketing system are of great interest. Eight considerations were listed on the questionnaire, whilst an opportunity was provided to list any additional factors that came to mind. The results show that the impact upon revenue and ridership is the prime consideration for the operator (see table 37). The impact upon levels of fraud is also given a high priority. The cost of equipment is also seen as ranking quite high in most operator's priorities, despite the fact that fare collection only accounts for a very small proportion of capital and operating costs. The ability to cope with through or integrated ticketing is accorded the lowest priority. The more common unprompted considerations offered by operators include the cost of maintenance, ease of staff comprehension and mechanical reliability.

ii - Fare Collection

Very few innovations in the field of fare collection were reported. Four operators were intending to update their ticketing equipment in the near future, whilst another four were proposing to introduce an automatic information and waybill processing system.

Operators were also asked their reasons for issuing tickets, and to what extent they would be prepared to forego ticket issue. Responses to the first question are contained in table 38. The role of the ticket is seen primarily as a means of checking against fraud by passengers, and to a lesser extent by staff. As such, in response to the second question, few operators were prepared to contemplate foregoing ticket issue. Three were prepared to do so if the new system offered appreciable advantages, whilst another three would do so if they could be sure that fraud could be kept at insignificant levels. One was prepared to do so if penalty fares were introduced.

iii - Ticket Range

A number of the operators surveyed were found to be contemplating limited extensions to off-bus ticketing. Multi-ride ticketing was intended for Plymouth, Taff Ely and Rossendale (acceptance of Greater Manchester P.T.E.'s "Clippercard" in the latter case). Colchester and Halton were considering the introduction of a travelcard facility, whilst Reading and Rhymney were proposing better validity conditions for their existing season tickets. Six operators were reported to be considering the introduction of off-peak only "Rover" tickets, two of which would be in the form of a family ticket.

Information was also given on motives for introducing travelcard schemes, and their effects. Seven operators quoted the desire to generate additional ridership and revenue as a reason for introduction, whilst three used them as a means of accelerating boarding speeds. The preservation of customer loyalty, facilitation of easier interchange and stabilisation of cash flow were given as a motive for introduction by two operators. The handful of undertakings which offered multi-ride schemes were not forthcoming as to their reasons for introduction.

TABLE 37 : MUNICIPAL OPERATOR'S QUESTIONNAIRE : RESPONSES TO QUESTION B4

- RELATIVE IMPORTANCE OF FACTORS IN CHOOSING THE FARE AND TICKET SYSTEM *

Rank	Factor	Score
1	Impact upon revenue	152
2	Impact upon patronage	143
3	Impact upon fraud	140
4	Cost of equipment	130
5	Ease of passenger comprehension	129
6	Impact upon boarding times	119
	Ability to provide management information	119
8	Ability to cope with through and/or integrated ticketing	78

* Note: Each respondent was asked to rate each factor on a scale of importance from 1 (low) to 5 (high). The score is simply an addition of the values given to the factor by each respondent.

TABLE 38 : MUNICIPAL OPERATOR'S QUESTIONNAIRE : RESPONSES TO QUESTION B1A

- REASONS FOR ISSUE OF TICKETS

Rank	Motive	Responses
1	To prevent passenger fraud/ To check the correct fare has been paid	35
2	(To prevent staff fraud	18
	(To provide management information	18
4	To act as a receipt	15

Note: Respondents were allowed to give more than one reason for issue of tickets.

Expectations of revenue losses figured prominently amongst reasons given by the sixteen operators in the sample who did not provide a prepurchase facility. Administrative and issuing costs were also common objections to both season and multi-ride ticket schemes. The cost of cancelling equipment and the existence of a season ticket facility also figured amongst reasons given for not adopting multi-ride tickets. Interestingly, susceptability to fraudulent use was only cited once as a reason for not offering prepurchased tickets.

With regard to the effects of prepurchased tickets, observations that they tend to increase ridership at the cost of an overall loss in revenue were reiterated by findings from the questionnaire. Market share achieved was in all cases small - ridership and revenue accounted for by prepurchased ticket users being under 10% in nearly all instances. Nine undertakings reported that their travelcards had either retained passengers (effectively a net gain), or produced some increase. Five reported negligible or neutral ridership effects, whilst none quoted a net loss. However, four reported a loss of revenue, two an initial loss followed by a gain, and only one a gain. Three cited a neutral effect, whilst two did not know the revenue impact of their particular schemes. Most operators reported that the introduction of travelcards had accelerated boarding times, although the extent varied. Furthermore, without exception each scheme had made interchange easier for holders of these tickets. Fraud was generally negligible, but the collection of management information was rendered more difficult or even impossible in many cases.

iv - <u>Through and Integrated Ticketing</u>

The survey found that many Municipal operators in the U.K. rely upon season tickets to provide an interchange facility. It has already been established that very few operators offer through ticketing for cash fare payers, even on a limited basis. Objections to single journey through ticketing included a potential loss of revenue (cited seven times), a perecived lack of demand (six), and susceptability to fraud (five). The popularity of using travelcards as a means of making interchange easier can be criticised because it makes no allowance for those categories of traveller who find a travelcard too expensive as a means of satisfying their interchange needs.

2.3.3. Analysis of information supplied by Continental Operators

i - Introduction

Following an initial request for information on fare systems sent to approximately 60 Continental European undertakings, follow ups were made to those who had changed their fare system within the last decade. Specifically, the effects of fare system changes were requested under the familiar headings of ridership, revenue, boarding speeds, and so on. A list of undertakings contacted is included as appendix 1.

The operators contacted in the second phase and details of their particular schemes are given in table 39. It will be apparent that there are considerable variations in the types of structure involved. No clear trend emerges amongst the undertakings studied apart from a move away from graduated (and to a lesser extent flat) structures towards simplified ones (zonal in particular). Obviously this makes systematic comparison of results obtained more difficult, although findings are still of considerable value if the special circumstances pertaining to each are borne in mind. Changes in ticket type have tended to feature moves towards automation or off-vehicle purchase, with season ticket innovations

TABLE 39 : SUMMARY OF INFORMATION FROM CONTINENTAL UNDERTAKINGS ON FARE STRUCTURE CHANGES

UNDEATAKING		SCHEME(S)	RIDERSHIP/REVENUE	BOARDING SPEEDS	FARE EVASION	PASSENGER ACCEPTANCE
HANNOVER	CHANGE TO ZONAL FARES	Promotion of travelcard; Change from flat (bus) and graduated (rail) to zonal fares. (1975)	Simultaneous increase in fare level obscured fare structure effects. Rise in trips temporarily halted.	A positive effect upon boarding speeds was universally reported amongst the operators contacted, in two cases enabling the elimination of conductors.	Extent of evasion held constant by increased inspection levels.	
FRANKFURT		Multi-ride tickets abandoned; zonal fares introduced.			Reduction; no longer any scope for travelling without valid ticket.	Overall satisfaction with fare system.
COPENHAGEN		Introduction of zonal fares and multi-ride facility (1975-9)	[illegible] increase in ridership 1975-80. Average trip length fell due to greater use of interchange.			Market research (1980) revealed 15-18% of travellers did not understand zonal system.
HAMBURG		Introduction of zonal fares (1967).	Revenue and ridership have both increased: Trips: 1967=558m/1980=602m Revenue: "236mDM/ " 413mDM			
STUTTGART		Change from coarsely graduated to zonal fares; Introduction of kerbside vendors.	Trips increased 5.4% in first year; revenue rose 3.1%.		Decrease, following doubling in penalty fare.	Positive.
BORDEAUX		Introduction of zonal fares (1976).	Rise in trips and passenger kilometres, with adaption of trip-making.			
BASLE		Introduction of zonal fares. Replacement of conductors by kerbside vending machines.	Minimal effect on revenue. Large savings in operating costs.		Evasion rate increased to 1%.	
S.N.C.V. (Belgium)		Change from graduated to zonal fares, with multi-ride tickets and free interchange (1976).	Revenue increased +14.8% in first seven months compared with same period in previous year.		No change.	Popular for simplicity, convenience; Impact upon individual fares also important.
HELSINKI	CHANGE TO FLAT FARES	Zonal fares replaced by flat; season ticket heavily promoted (1973).	Substantial increase in trips and revenue, helped by season ticket and fare increase respectively.		Remained constant throughout 1970's at 0.2%.	Flat fare popular due to simplicity, but people mainly concerned with effect on fare.
NANTES		Shift from graduated to flat fares (1976). Pre-purchased tickets phased in 1972-81.	45% rise in trips 1975-80; 86% rise in passenger kilometres; 75% rise in revenue.		Major problem arose due to lack of safeguards for "open" system. Evasion in 1980=10.9% of passengers.	Flat fares popular due to simplicity.
TRONDHEIM		Change from zonal to flat fares in August 1982.	Increase in passenger kilometres, but net 9% fall in trips and 2.5% rise in revenue in first 5 months with 13.9% rise in fare level.			

NOTE : In many cases the change in fare system was accompanied by changes in other factors, such as fare level. The observations summarised are therefore not necessarily attributable wholly to the change in fare structure.

featuring prominently. Throughout this section, reference should be made to table 39, which also provides a summary of the effects of each scheme studied.

ii - Changes in Fare Structure

In order to present the analysis in a coherent manner, fare structure changes involving the adoption of a zonal fare replacing graduated and flat fares will be dealt with first, followed by shifts from graduated and zonal to flat:

a) { Graduated ⟶ Zonal
   { Flat ⟶ Zonal

b) Graduated/Zonal ⟶ Flat

a) Changes from Graduated or Flat to Zonal Fares

Motives

In most cases zonal fares have been adopted as part of the setting up of "Transport Communities" or "Verkehrsverbund" as they are known in West Germany, where they now proliferate. The operators involved generally operated either flat (usually municipal bus and tram operations) or graduated fares (rail and private bus services). An excellent illustration of the issues involved at arriving at a zonal structure is provided by the Hannover Transport Community, instituted in 1975. Whilst the main bus operator had previously employed flat fares and was perfectly content to continue doing so, its main partner in the venture - the West German state railway (Deutsche Bundesbahn) - stipulated a fare structure better able to cover costs. Hence, zonal fares were a compromise - actually a three-zone concentric configuration was chosen (see fig. 11). No doubt similar considerations were applied in the case of Frankfurt, the Rhine-Ruhr area, Greater Copenhagen and the Netherlands. The large areas involved meant that some form of fare differentiation according to distance travelled was inevitable

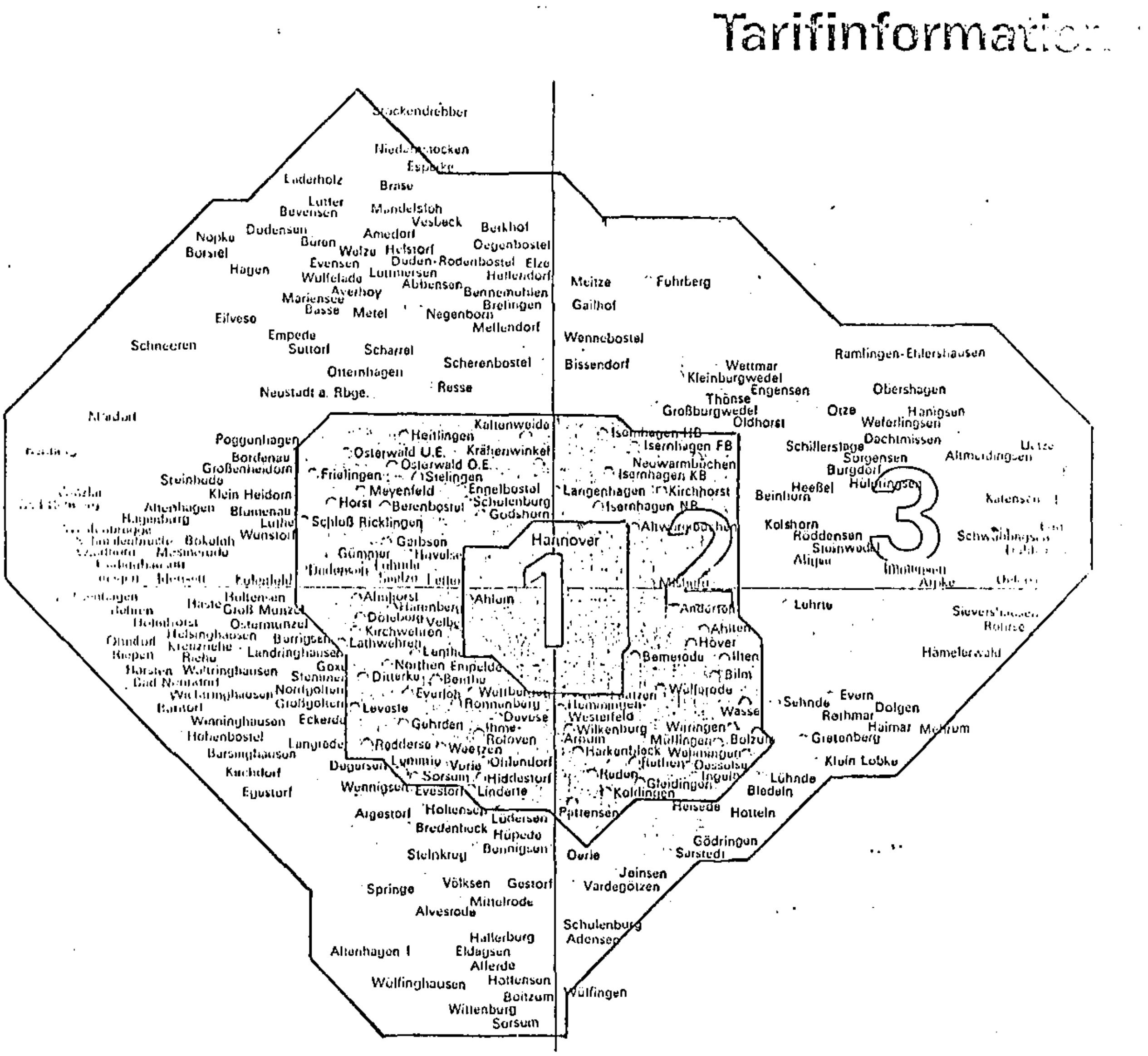


Figure 11 : Plan of zonal configuration used by the Hannover 'Verkehrsverbund' (extracted from publicity material).

if huge revenue (or patronage) losses were to be avoided. For example, in the case of Hamburg it was stated that:

> "The Association decided in principle to retain the system with prices graded according to distance (ie.zonal). This decision was determined not only by the considerable extension of the network to be included in the joint fare system, but also by recognition of the fact that the desired relationship between price, performance and costs could not be achieved with a uniform (ie.flat) fare." (66)

Stuttgart also adopted a zonal arrangement upon introduction of its "Verkehrsverbund" in 1978, although in this case a coarsely graduated structure had previously been used by the municipal undertaking. Of all the various fare structures, it is apparent that zonal fares are best suited to large-scale integrated operations. Whilst still enabling differentiated pricing according to distance travelled (thus improving revenue yield), the system is sufficiently simple to make it easy to use and operate for passengers and staff. Even where flat fares had been used beforehand, the new arrangements are not unduly complicated. As such, most zonal schemes allow considerable scope for automation and passenger self-service, which in itself also has important benefits. The undertakings in Frankfurt, Copenhagen, Stuttgart, Hamburg and the Netherlands all mentioned the need to keep their integrated systems as simple and easy to use as possible as the main motive for the introduction of zonal fares. Frankfurt specifically mentioned their role in permitting passenger self-service on "S-Bahn" and tram services, whilst Hamburg believed zonal fares to be an "essential prerequisite" for speeding up fare collection on its new unified system created in 1967.

To conclude, therefore, zonal fares appear to have been introduced primarily as a means of creating a reasonably simple fare system which would produce a good revenue yield by virtue of its distance-related element. It was the need for full network integration which resulted in the conversion of flat municipal fares to zonal, although the central zone in many cases is of such a size as to effectively retain flat fares for a large proportion of passengers.

Ridership and Revenue effects

Analysis of ridership and revenue effects is complicated not only by the variety of types of fare structure involved, but also changes in fare level. Indeed, observations of trends in basic patronage figures before and after the fare structure change is inadequate, unless inflation, changes in fare level, service levels, and even population size and distribution are all taken into account. Some operators were unable to offer any definitive results in this area (quantitative or otherwise), for these and other reasons.

Most of the undertakings which adopted zonal fares experienced a subsequent increase in trips made, although this can be attributed to other factors as well as the new fare structure. In some cases, an enhanced service, or lower fare level, are primarily responsible. For example, the Stuttgart municipal undertaking, who introduced their new fare system in 1978, stated:

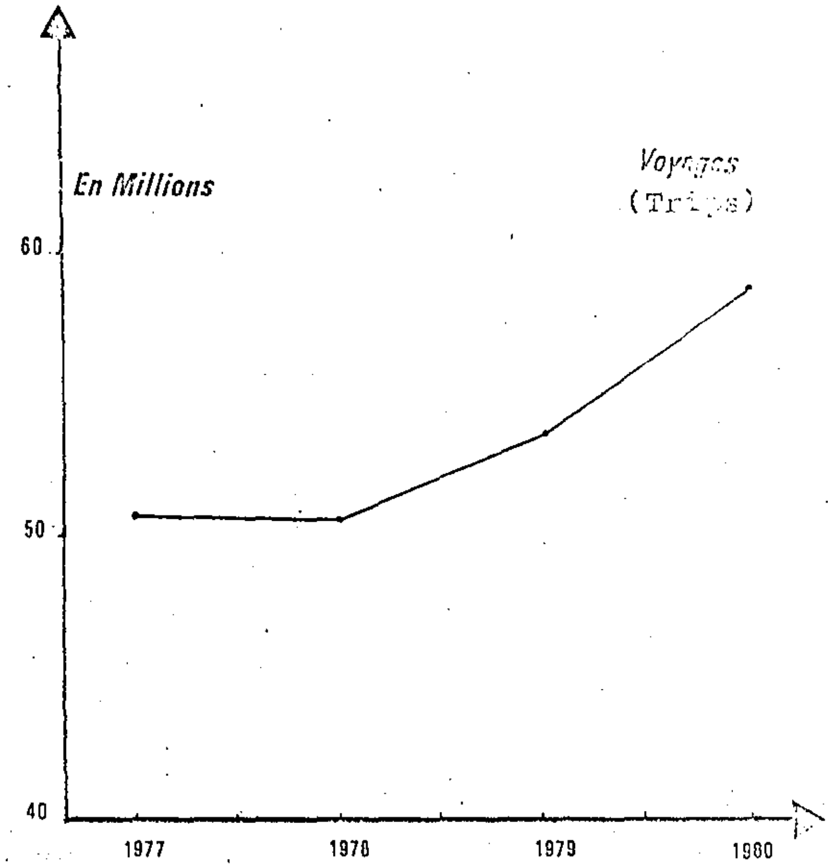
> "A detailed statement on the number of additional passengers attracted by the change in fare structure is not possible, because the supply of services was improved at the same time. However, it certainly afforded a greater freedom to travel on a variety of modes, and thus made an important contribution towards an increase in trips made." (67)

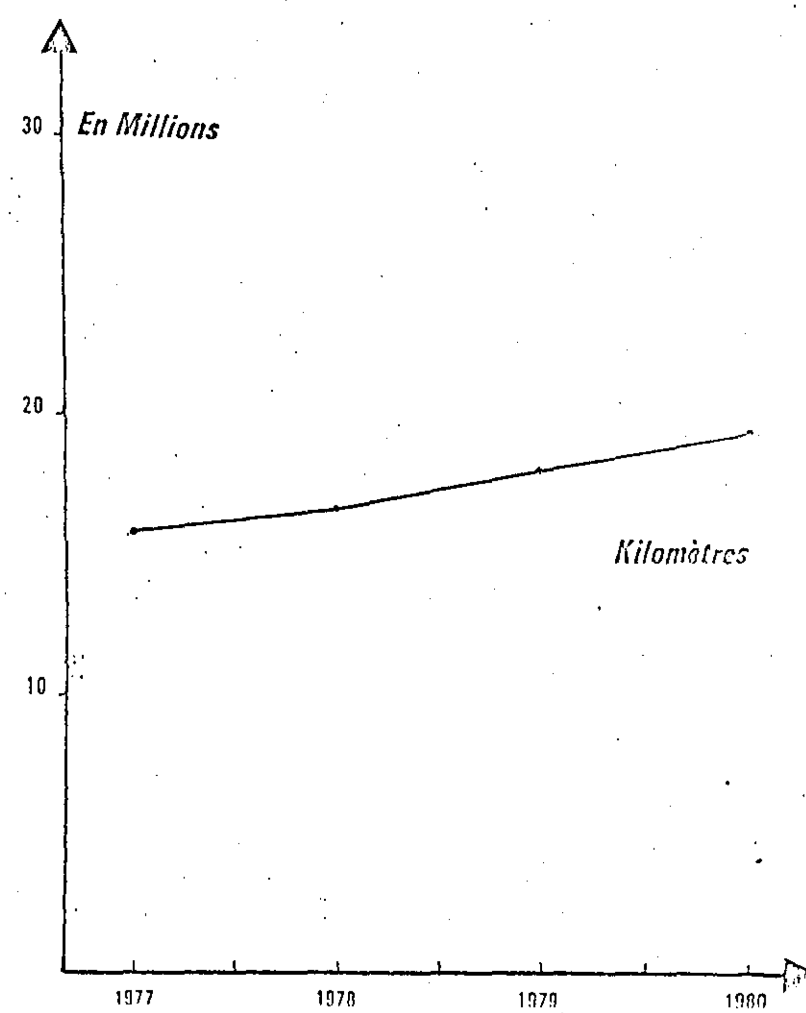
The actual rise in trips made was 5.4% in the year following the introduction of the new system, although it is pointed out that this can also be attributed to population increase, land-use changes and increases in car operating costs. Revenue only increased 3.1%, primarily because the average fare paid by each passenger fell by 2.3% (due in turn to higher penetration of season tickets).

The new arrangements in Copenhagen were also accompanied by an increase in ridership. Its two-phase introduction of a new integrated fare system (1975 for buses and certain rail services and 1979 for remaining rail services) produced a 25% increase in trips between 1975-80, with most of the rise being concentrated in the last year (68). Again, the importance of other factors cannot be over-emphasised. In this case, the number of bus kilometres operated rose by about 30% over the five year period, and the number of bus routes by 20%, in addition to improvements such as co-ordination of modes and electrification of rail services. Massive increases in petrol prices also occurred during this period. Interestingly, indications are that many of the new trips attracted were short ones, with the ease of interchange facilitated by the new system attracting people who previously walked for part of their journey. Because of this, together with a multi-ride ticket facility which was acknowledged to be underpriced, performance regarding revenue was less satisfactory, although no precise figures are to hand.

It is logical that where a zonal arrangement replaces flat fares, the number of trips made increases at a faster rate than passenger miles travelled. This is illustrated by the experience of the Bordeaux undertaking, where the new zonal system created in 1976 has produced distinct trends (see fig. 12) (69). The creation of fare boundaries has caused passengers to adapt their trip-making habits to avoid crossing such boundaries. Revenue performance of the Bordeaux undertaking is not known.

Fig. 12 : Travel on the Bordeaux network following the introduction of a zonal system (1977-80).





In Hannover, a similar increase in fare level served to obscure any impact of the fare structure change (1975). The flat fare was superceded by the introduction of a higher fare (up to 67% extra) for trips of more than a certain distance. The result was a temporary reduction in trips, against the background of a long term increase, which has continued at a similar rate to that before the changes. The contribution made by the new fare structure to this success is not known. Because of the size of the fare increase in 1975, most of the additional revenue generated must be attributable to the new fare level.

Evidence of the impact of fare structure changes made when the Hamburg Transport Community was introduced as early as 1967 is scanty. All that can be said is that ridership and revenue have both increased at a healthy rate under the new system, with 602 million trips being made on H.V.V. services in 1980, compared with 558 million in 1967. Revenue rose from 236 million DM to 413 million DM during the same period. Interestingly, the level of passenger kilometres travelled has remained wholly static during this time at 3,600 million, which tends to support the observations from Copenhagen that integrated systems tend to encourage relatively short trips.

No ridership or revenue figures are available for Frankfurt or the Netherlands. However, the main undertaking in Basle (Switzerland) reports that its change to a zonal structure had very little effect upon revenue, although it did permit appreciable savings in operating costs by enabling conductors to be replaced by vending machines. As such, the subsidy requirement was greatly reduced, thus creating a similar end result to that which an increase in revenue yield might have done.

The Belgian state railway (S.N.C.V.) also operates bus services in the provinces. It is in four such areas that in September 1981, the prevailing graduated fare structure was replaced by a zonal one. Instead of charging 16BF for trips up to 4 km in length, with an extra charge of 2BF for each kilometre beyond, a boarding charge of 8BF plus 8BF for each zone travelled through was introduced. Each zone is hexagonal in shape and has a maximum width of 4.5 km. A multi-ride facility, together with free interchange, was introduced simultaneously.

Analysis of the revenue results shows a creditable performance, particularly since the fare system change was supposedly designed so as not to represent a change in overall fare level. In the four areas involved, revenue rose by 14.8% in the first seven months of the venture, compared with the same period in the previous year (see table 40). This is somewhat surprising, especially when it is remembered that a multi-ride facility was introduced at a discount of 25% on single fares. It was pointed out that delays in the delivery of cancelling equipment has reduced the overall impact of the changes. Unfortunately, ridership figures are not available, and cannot be deduced from revenue figures because journey length distributions are not available.

To summarise, contact with continental operators regarding the ridership and revenue effects of fare structure changes to zonal fares reveals an uncertain picture, with specific effects being obscured by other factors. These include changes in fare level, land-use patterns, population, service levels and car operating costs. It would seem, however, that the new zonal arrangements helped to stimulate ridership as part of the overall package of improvements. Wherever flat fares previously existed, the new zones are sufficiently coarse so as not to damage ridership unduly. Interestingly, short trips in particular

TABLE 40 : REVENUE IN THE FOUR ZONAL FARE AREAS OF S.N.C.V. BEFORE AND AFTER THE INTRODUCTION OF THE NEW FARE STRUCTURE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
Total revenue ('000 BF):								
- Sep 1980-Mar 1981 ("Before")	42,734	44,194	39,362	34,845	41,428	35,128	41,287	278,978
- Sep 1981-Mar 1982 ("After")	49,500	47,765	45,964	43,741	46,174	41,735	45,394	320,274
Percentage change	+15.8	+8.1	+16.8	+23.5	+11.5	+18.8	+9.9	+14.8

Source: Personal communication with S.N.C.V. (1982).

seem to be encouraged under the new regime. Revenue effects are even less clear, although it is likely that additional sums from new passengers outweigh any losses caused by a coarser fare structure or pre-purchased tickets.

Boarding speeds

Operators contacted were much more confident in describing the effect of the change in fare system upon boarding and operating speeds, although here too they rarely provided quantified information. Each quoted a positive effect, although in many cases the acceleration in boarding speeds was attributable to other aspects of the fare system.

Fare evasion

A transfer from flat to zonal fares would, other things being equal, tend to increase the scope for fraudulent travel. This is because it introduces scope for overriding, which cannot exist under a flat fare regime. Such a hypothesis is to some extent confirmed by comments from continental operators contacted as part of this research. For example, the proportion of people found travelling without valid tickets on the Hannover system (0.2%) was only held constant with higher levels of inspection. In the case of Basle, the introduction of zonal fares under similar circumstances to that of Hannover produced a subsequent evasion rate of 1%, whilst before it had been practically non-existent.

The operators who furnished evidence in this area which previously employed graduated fares - S.N.C.V. and Stuttgart - reported respectively that there was no discernable change and a decrease in fraud (the latter after a doubling in the penalty fare).

Firm conclusions on changes in levels of fraud to be expected from a change to zonal fares cannot be made on the basis of such scanty evidence.

Passenger attitudes

Reactions to fare structure changes as opposed to other aspects of the fare system can be found mostly under the headings of simplicity, convenience or its impact upon fare level. Most people are primarily concerned with whether the change causes their particular fare to go up or down, with other considerations playing a secondary role. This was highlighted by the Belgian undertaking, who when asked to describe the popular and unpopular aspects of their new system listed the following:

- popular - simplicity
  - convenience
  - cheaper fare (for some)
- unpopular - increased fare (for some)

For those undertakings belonging to Transport Communities, the emphasis tends to be upon flexibility as an attribute perceived by passengers, referring primarily to the increased provision for interchange and the nature of the prepurchased tickets offered. Fare structure plays only a subsidiary role in achieving this flexibility.

It should not be taken for granted that the public will automatically find a zonal system simple to use, however, if the evidence from a market research survey undertaken in Copenhagen in 1980 is to be believed. Between 15-18% of travellers interviewed claimed they did not understand the zonal fare system (68). This proportion was held to be "acceptable" by the operators. Confusion may have been caused by factors other than fare structure.

The general impression seems to be that the public approve of zonal fare structures for a variety of reasons, although the impact upon their particular fare is of paramount importance.

b) Changes from Graduated or Zonal to Flat Fares

Motives

Of those undertakings which have switched from graduated or zonal to flat fare structures in recent years, three submitted more detailed information on the perceived effects. Helsinki abandoned its zonal arrangement in 1973, whilst Nantes replaced its graduated structure in 1976, and Trondheim (zonal) as recently as August 1982.

Reasons given for the switch (which goes against the trend of recent years) were to simplify fare collection for passengers and staff, and to increase the scope for self-service. Helsinki stated that:

> "The zone fare had proved to be inconvenient for drivers and passengers alike. We wanted a fare system which would eliminate these disadvantages and which would keep investment in fare collection equipment to a minimum."

Nantes was motivated by the need to eliminate crew operation without damaging the quality of service offered. Politics played a part in all three changes, with it being felt desirable that passengers should pay the same fare regardless of distance travelled. Indeed, for the Trondheim undertaking this was the main reason for the switch to flat fares.

Revenue and Ridership effects

Previous evidence suggests that flat fares cause an increase in passenger kilometres but a fall in trips. If the average fare level is held constant, a significant loss of revenue might also be expected. Experience in Trondheim appears to have confirmed this, but evidence from the other two undertakings is less conclusive.

Ridership and revenue figures from the Helsinki undertaking are shown in table 41. It will be seen that the introduction of flat fares in 1973 was accompanied by a substantial increase in both trips and revenue. Extraneous factors play a major part in this result, with a boost in sales of season tickets helping to explain the increase in trips, and an inbuilt fare increase serving to increase revenue. However, even allowing for these factors, the size of the increase in trips in 1973 is striking.

In Nantes, meaningful analysis is hampered by a number of factors:

- graduated fares were phased out over a long period (1969-76);
- a considerable change in the extent of the network;
- changes in ticket type; and
- increases in fare level.

Although fares in Nantes have failed to keep pace with inflation since 1975, the increase in ridership has nevertheless been impressive. Table 42 shows that trips increased by 45% between 1976-80, whilst passenger kilometres rose by no less than 86% in the same period. The most immediate effect of flat fares - to encourage longer trips at the expense of shorter ones - is again observed.

Revenue on the Nantes system increased by 75% between 1976-80, although this was insufficient to keep pace with increases in costs - the proportion of costs met from fares fell by 71% to 47%. Performance may well have been improved if some form of distance-based fare had been used, although a relatively short average trip length of 4.0 km (1980) militates in favour of flat fares.

TABLE 41 : RIDERSHIP AND R' VENUE ON HELSINKI CITY TRANSPORT (HKL) 1966-81

Year	Trips (Linked)	Trips (Unlinked)	% Change	Revenue (M FIM)	% Change	Fare increase
1966	142	-	-	63.0	-	December 1st
1967	134		-5.6	71.4	+13.3	
1968	131		-2.2	70.6	-1.1	
1969	129		-1.5	70.3	-0.4	
1970	131		+1.6	72.3	+2.8	
1971	132		+0.8	76.0	+5.1	May 1st
1972	136	(161)	+3.0	77.6	+2.1	
1973•	(158)	198	+19.6	94.5	+21.8	April 1st
1974		202	+2.0	110.8	+17.2	Feb 1st/June 1s
1975		204	+1.0	122.9	+10.9	September 1st
1976		207	+1.5	132.9	+8.1	
1977		209	+1.0	179.1	+25.8	January 1st
1978		211	+1.0	201.6	+12.6	January 1st
1979		208	-1.4	196.8	-2.4	
1980		217	+4.3	202.8	+3.0	January 1st
1981		219	+0.9	216.1	+6.6	January 1st

Source: Personnel Communication with HKL (1982)

Flat fares for single and multi-ride ticket holders have existed in Trondheim since August 1982. This replaced a three-zone (concentric) arrangement, with the new fare of 7 kroner representing an increase in inner zone prices of 16.6%, whilst the outer zone enjoyed a 22.2% decrease. Comparable figures for the multi-ride facility were +25.5% for the inner zone, +7.8% for the middle zone, and -16.2% for the outer zone. All monthly seasons increased by 10%. Overall, a 3.5% price increase occurred at the same time as the introduction of flat fares.

Noting a previous fare increase of 10% in January 1982, it has been found that the number of journeys fell by 18.5% in the first five months after the new structure, compared with the same period in 1981 (see table 43). Since the estimate of passenger loss between January and July 1982 inclusive is 9.6%, the August changes caused a further 9% decrease. Since under normal circumstances a 3.5% fare increase should have caused no more than a 1% patronage loss, the bulk of the second decrease can be directly attributed to the flat fare, which as has already been seen, serves to stifle short distance trip-making. The impact upon passenger kilometres travelled would probably have been less damaging (positive if experience elsewhere is to be heeded), although unfortunately no statistics were available to confirm this.

Table 43 shows that total revenue in the five months immediately after the introduction of flat fares was 28.4m kroner, compared with 27.7m in the same period in 1981 (a 2.5% increase). This is particularly disappointing, bearing in mind the fare level had increased 13.9% during the same period. Although ridership on the Trondheim undertaking has been showing a high degree of volatility in its reaction to fare increases in recent years, with high elasticities being observed, much of this poor performance

TABLE 42 : RIDERSHIP AND REVENUE ON THE NANTES UNDERTAKING (SEMITAN) 1966-80

Year	Trips (m)	% change	Psgr. kms. (m)	% change	Ave. trip length (km)	Revenue (mF)	% change	Ave. fare paid (F
1966	31.2	-	56.7	-	1.8	13.8	-.	0.44
1967	30.6	-1.9	60.2	+6.2	2.0	14.5	+5.1	0.47
1968	27.6	-9.8	59.0	-2.0	2.1	14.9	+2.8	0.54
1969	26.8	-2.9	62.3	+5.6	2.3	17.0	+14.1	0.63
1970	26.0	-3.0	62.2	-0.1	2.4	17.9	+5.3	0.69
1971	25.7	-1.2	62.7	+0.6	2.4	19.2	+7.3	0.75
1972	25.0	-2.7	62.9	+0.3	2.5	20.3	+5.7	0.81
1973	23.4	-6.4	63.1	+0.3	2.7	20.8	+2.5	0.89
1974	21.8	-6.8	64.2	+1.7	2.9	21.7	+4.3	1.00
1975	21.4	-1.8	67.4	+5.0	3.1	23.4	+7.8	1.09
1976	23.7	+10.7	74.7	+10.8	3.2	25.6	+9.4	1.08
1977	26.7	+12.7	95.0	+27.2	3.6	29.0	+13.3	1.09
1978	28.8	+7.9	113.4	+19.4	3.9	31.9	+10.0	1.11
1979	31.8	+10.4	127.4	+12.3	4.0	37.2	+16.6	1.17
1980	34.3	+7.9	138.7	+8.9	4.0	44.9	+20.7	1.31

Source: Personal communication *1982).

TABLE 43 : RIDERSHIP AND REVENUE ON THE TRONDHEIM UNDERTAKING 1980-82

	Passenger trips (000's)			Fares revenue (000 Kroner		
	1980	1981	1982	1980	1981	1982
August	732	579	523	3,375	3,643	4,186
September	872	912	727	3,927	5,299	5,336
October	1099	964	760	5,000	5,643	5,451
November	1057	1016	840	4,700	5,927	6,103
December	1294	1190	950	6,063	7,170	7,296
TOTAL	5055	4661	3800	23,065	27,682	28,372
% Change on previous year	-	-7.8	-18.5	-	+20.0	+2.5

Source: Personal Communication (1983)

must be attributed to the flat fare. Increases in trips over the longer distances have been insufficient to offset the revenue losses from trips lost within the inner area.

The Trondheim example, whilst making allowance for the high elasticities observed there in recent years, illustrates well the poor performance of flat fares regarding ridership and revenue which it has been more difficult to demonstrate from earlier examples. By failing to differentiate according to distance travelled, either ridership or revenue (depending upon the new fare level) are inevitably lost.

Boarding Speeds

Not surprisingly, the introduction of flat fares served to accelerate boarding and operating speeds. In Trondheim, the improvement was only negligible, because a coarse zonal system had previously operated, but in Nantes the improvement was sufficient to enable the elimination of conductors. A figure of 1.8 seconds per passenger quoted by Helsinki is very fast indeed for one-person operation.

Fare Evasion

In Helsinki detected fare evasion has remained constant throughout the 1970's at approximately 0.2%, an exceedingly low figure which helps to reiterate the strength of flat fares in this area. No figures are available for Trondheim, but in Nantes, a major problem arose concerning fraud, which in 1980 stood at 10.9% of passengers inspected. Since this has been attributed to the method of fare collection rather than the fare structure, it will be discussed further subsequently.

Passenger attitudes

Because the motivation for introducing flat fares is frequently political in nature, it can be assumed that, on balance, they are popular with transport users. Apart from the obvious benefits of low cost for people living in the outer suburbs, they are also attractive from the point of view of simplicity (confirmed by experience in both Helsinki and Nantes). However, people tend to be preoccupied with what happens to their particular fare, and as such, residents of inner city areas, who can be severely penalised unless a special short distance fare is incorporated, may react with hostility to a flat fare structure.

iii - Changes in Fare Collection methods

Introduction

Changes in fare structure were not always accompanied by simultaneous changes in the fare collection methods employed. As such, evidence on the effects of such changes is less widespread amongst the evidence supplied by operators. The most noticeable trends have been towards passenger self-service and a reduction in fare transactions aboard the vehicle. This has been achieved through promotion of pre-purchased tickets, and to a certain extent of kerb-side vending machines also.

Motives

All the operators contacted which belong to "Transport Communities" employ fare collection methods which rely to a large extent on prepurchased tickets. Indeed, many already did so before the new arrangements were introduced. Their motives for adopting such fare collection arrangements varied somewhat, but all were associated with a desire to minimise staff involvement and boarding times, whilst maintaining other aspects of the quality of service. In essence, they have striven to maintain boarding speeds previously achieved with crew operation, but with single manning and in many cases extensive provision for interchange.

In Nantes, the simultaneous introduction of flat fares and extensive off-vehicle sales in 1976 was basically intended to facilitate the elimination of crew operation without deleterious side effects. In the case of Basle, where all on-vehicle transactions were removed in favour of a switch to ticket vending machines at bus stops, the need for staffing economies was particularly pressing due to a shortage of labour.

Ridership and Revenue effects

The type of fare collection employed can play only a subsidiary role in influencing levels of ridership and revenue. As has already been determined, capital and administrative costs of equipment tend to figure more strongly in the minds of decision makers, although even these factors are held to be less important than questions of operational feasability and user perception.

Evidence supplied by operators suggests that fare collection methods generally exercise an indirect effect upon ridership and revenue, in as much that they influence the quality of the service offered through boarding speeds, convenience, and so on. Passengers will react accordingly.

Boarding Speeds

Since the overriding consideration amongst continental operators contacted in choosing their fare collection systems appears to have been its impact upon boarding and operating speeds, this area merits more detailed investigation. Several undertakings have reported that the predominantly off-vehicle form of fare collection introduced had facilitated significant reductions in boarding speeds. Stuttgart achieved this using kerbside ticket vending machines, whilst Copenhagen did so using multi-ride tickets purchased off-vehicle and cancelled on a self-service basis.

Both Basle and Nantes reported that the new fare collection arrangements (in conjunction with other changes) enabled them to phase out conductors without harming boarding speeds. In some cases, net improvements were observed. Such results are in stark contrast to those achieved with conventional OPO fare collection arrangements in the U.K., which produce a noticeable decline in boarding speeds following conversion.

Fare Evasion

Fare collection was also found to have an important influence upon the rate of fare evasion. However, little evidence was supplied in this respect, no doubt because they themselves are unsure of trends. A notable exception is Nantes, where the phasing out of conductors and the nature of the system which replaced them is put forward as part of the explanation for a dramatic worsening in the extent of fraud. In 1980, the rate stood at 10.9% of passengers checked, and it was admitted that significant volumes of revenue had been lost. It was pointed out that the individual amounts involved are small, so means of supressing losses are limited (penalty fares are already in force). Weaknesses are believed to be the "open" system employed, together with the fact that cancellers are used without a direct visual or audible link to the driver. Measures being taken to rectify the situation include modifications to cancellers, and the setting up of a register of defrauders to identify persistent offenders, with legal action in the worst cases.

It must be emphasised that, if official figures are to be believed, the situation in Nantes is quite exceptional. Other operators using similar fare collection arrangements produced rates of evasion of 2% or less of inspected passengers.

Passenger attitudes

Very few attitude surveys have been conducted amongst public transport users to ascertain their feelings on any aspect of the fare system, including fare collection. One gains the impression, however, from comments by operators contacted that public acceptance is one of the less favourable aspects of "continental style" fare collection. Many users find it difficult to become accustomed to using new equipment, particularly vending machines, which tend to be sophisticated and difficult to understand. This problem is pointed out by both the Frankfurt and Basle undertakings, although they emphasise that the familiarisation period was fairly short.

On the positive side, however, where it was reported that the fare system changes as a whole were viewed favourably by the travelling public, the role played by the innovative fare collection methods in accelerating boarding and operating speeds (thus improving quality of service) was undoubtedly a contributory factor in this overall impression.

iv- Changes in ticket range

Introduction

Discussion of trends in fare collection amongst foreign operations which supplied information revealed a move towards off-vehicle ticket purchase. Specifically it is the rise in use of season tickets which is most noticeable. Multi-ride tickets have been introduced by some undertakings, but interestingly, withdrawn by others. The market share achieved by the various ticket types, together with their effects upon the usual performance indices, are summarised in table 44.

TABLE 44 : SUMMARY OF INFORMATION FROM CONTINENTAL UNDERTAKINGS ON TICKET RANGE CHANGES

Undertaking	Market Share (% of trips)					Effect upon ridership	Effect upon revenue	Effect upon Boarding speeds	Fare evasion	Passenger acceptan
		Single	Multi-ride	Season	Other					
Nantes (France)	1972	22.9	28.9	22.4	25.8	Rise in season ticket share led to overall increase, plus longer average trip length.		Introduction of seasons has boosted boarding speeds.	Evasion has increased (10.9% in 1980).	
	1975	29.3	27.2	22.8	20.7					
	1978	15.4	35.8	48.7	0.1					
	1981	9.0	40.2	50.1	0.1					
S.N.C.V. (Belgium)	9/80-3/81	68.0	-	32.0	-	Insufficient information available				Flexibility of mult ride ticket popular, but resentment over lack of provision f on-bus purchase.
	9/81-3/82	53.4	7.3	39.3	-					
Frankfurt (W.Germany)	Multi-ride ticket abolished.								Reduction. No scope for travelling without a validated ticket.	Passenger survey ha demonstrated overal satisfaction with fare system.
Stuttgart (W.Germany)		Loss		Gain				Acceleration.	Negligible effect.	Positive.
Copenhagen (Denmark)	1980	20	40 (from 0)	40	-			Significantly improved.		
Helsinki (Finland)	1972	41.9	48.2	9.8	-					Relatively cheap sea found to be very pop
	1973	24.3	52.4	23.2	-					
	1976	8.2	39.7	52.0	-					
	1981	5.1	20.1	74.7						
Hannover (W.Germany)	(% revenue)									
	1970	21.0	71.4	7.6	-			Faster due to increased use of pre-purchased tickets		
	1974	18.2	63.1	18.7	-					
	1976	12.1	41.6	45.9	-					
	1981	5.0	33.4	61.9						

Market share

Changes in ticket range, together with the relative prices of ticket types, have produced enormous shifts in usage by ticket type in a number of instances. In Frankfurt,multi-ride tickets were abolished when its "Transport Community" was instituted in 1974, whilst in the new bus fare system operated in the Netherlands since 1980, single tickets have been eliminated. Market share of ticket types can also be dramatically altered by manipulation of relative prices. For example, in Helsinki where prices of season tickets have risen by 83% between 1973-81, compared with 250% for single and 300% for multi-ride tickets, the share of single tickets has fallen to just 5.1% of trips. The proportion of multi-ride trips has also fallen dramatically. Similar trends were reported in Hannover and Nantes.

Multi-ride tickets introduced by S.N.C.V. on its new zonal systems had achieved overall penetration of just 7.3% of trips after the first seven months of operation, despite a 25% dicount compared with single fares being offered. This disappointing performance was attributed to delays in delivery of cancelling machines, with some vehicles being left unequipped. In Copenhagen however, newly introduced multi-ride tickets had acheived a market share of 40% of trips by 1980.

Most apparent is the increasing dominance of season tickets in terms of trips undertaken. In Helsinki, Hannover and Nantes, this particular ticket type accounts for over half of all trips made, with 1981 shares of 75%, 62% and 50% respectively. This has been achieved from much lower levels of penetration in the early 1970's (10%, 8% and 22%).

Ridership and revenue

Generally speaking, it has been impossible to isolate the role played by changes in ticket range in affecting levels of ridership and revenue from information supplied by operators. Other factors, particularly fare level, play a more important role. Nevertheless, it is legitimate to make a connection between those undertakings which have promoted season tickets aggressively being also the ones which have tended to perform best in terms of ridership trends. Season tickets help to encourage trip making in a number of ways, including the facilitation of free interchange and of additional free trips over and above those regularly made.

Insufficient material has been provided to enable further evidence on ticket type elasticities to be obtained. However, in the case of Trondheim, a recent series of fare increases has enabled values to be derived. Results are shown in tables 45 and 46. These reiterate previous findings that prepurchased ticket users tend to exhibit lower elasticities than people using single tickets.

Table 45: Price elasticities exhibited by users of the Trondheim system

Time period	All traffic	Single tickets
1979-82	-0.70	-1.26
1979-80	-0.12	-0.22
1981-82	-1.00	-2.01

Table 46: Elasticities exhibited by users of the Trondheim system by zone and ticket type (July 1980 - July 1982)

Zone	All tickets	Single	Multi-ride	Season
Inner	-0.65	-1.40	-0.77	-0.93
Middle	-0.41	-2.14	-0.31	-0.59
Outer	-0.13	-0.48	-0.26	+0.61

In essence, users of multi-ride and season tickets are less likely to reduce their trip making habits following a fare increase than their cash-fare counterparts. The exceedingly high overall elasticities exhibited in Trondheim are attributable to the cumulative effect of a series of fare increases within a relatively short period following a long period of stability.

The revenue effect of alterations to ticket range is even harder to ascertain from the material obtained. With some undertakings having regarded prepurchased tickets as their standard ticket system for many years, the normal argument that offering a discount compared with single fares must lose revenue no longer applies. Indeed, the attractive aspects of prepurchased tickets may conceivably increase ridership and revenue, with marginal season ticket purchasers being finally persuaded by the scope for making additional trips which would otherwise not have been made. Conclusive evidence of this from continental operators is unfortunately not available.

Boarding speeds

Several operators were able to confirm that greater use of prepurchased tickets had helped to accelerate boarding and operating speeds. Indeed, where relatively simple fare structures had been in force for many years, these ticket range alterations were the major source of more recent improvements in this particular area.

Fare evasion

Although most operators made no comments that could be construed as inferring that increased use of multi-ride or season tickets had damaged revenue security, two undertakings were concerned about certain aspects. Nantes blamed its high fraud rate on operational aspects of its multi-ride facility, together with the abolition of conductors. Frankfurt reported that the scope for failing to validate tickets had been eliminated. The absence of any other such findings suggests that, generally speaking, the expansion of off-bus ticketing has caused only isolated problems of abuse.

Passenger attitudes

The absence of any formal attitude surveys by operators contacted makes conclusions difficult. The popularity of season tickets can only be inferred from the high levels of penetration often achieved - the relative importance of price and convenience in this cannot be ascertained here. Comments made usually related to the fare system as a whole, although these were favourable in most cases. The Belgian undertaking (S.N.C.V.) described the popular aspects of their new multi-ride tickets as being the scope for interchange, flexibility for use over varying journey lengths, and so on. The fact that they could not be purchased on board the vehicle was subject to criticism, however.

v- Through and integrated ticketing

Most urban public transport operations on the continent have offered free interchange between their own services with all their ticket types for many years (albeit with a time restriction). Identification of the effects of offering such a facility is, however, virtually impossible to establish.

All the continental undertakings which supplied general information on the effects of fare system changes provide free interchange for multi-ride and single ticket users, although Helsinki has only done so for the latter group since January 1982. Since most also belong to "Transport Communities", they also provide free interchange with services provided by neighbouring bodies. Unfortunately, no worthwhile data was obtained on the extent of interchange on these systems.

The direct effects of providing for free interchange upon ridership and revenue are not known with any certainty. Logically, an increase in ridership could be expected, since such a facility is effectively an improvement in the quality of service offered.

Trips made are likely to rise faster than passenger miles travelled, because integration in April 1979 helped to produce a marked increase in patronage of 20% during the following year (large increases in petrol prices also contributed). More specifically, bus-rail interchange also increased markedly, with people preferring to travel by bus to and from railway stations instead of walking (see table 47). This is demonstrated by surveys of the number of people boarding and alighting from buses at Central Copenhagen Norreport station. A 30% increase was reported between Autumn 1979 and Spring 1980.

Provision of free interchange on the Bordeaux network in 1976 appears to have contributed (together with the zonal fare structure) to a faster growth in trips made than kilometres travelled. The additional facility can thus be said to have had an important effect, because introduction of a simplified fare structure alone can be confidently expected to have the reverse effect (a greater increase in kilometres travelled than trips).

The revenue effect of introducing free interchange is virtually impossible to ascertain. Many appear to consider such a provision a vital aspect of being able to offer a good quality service, and as such any revenue losses have to be tolerated. The net revenue effect could, in any event, be positive if a sufficient proportion of the people taking advantage of the facility previously used another mode for all or part of their journey.

Because integrated ticketing represents a complication in the fare system, it is likely to have an adverse effect upon boarding speeds if the driver is required to perform an additional or different operation. Most systems allow for self-service, however, with the ticket merely requiring scrutiny by the driver on subsequent legs. As such, no operator reported that the introduction of through or integrated single

TABLE 47 : TRAVEL TO AND FROM RAILWAY STATIONS IN THE GREATER COPENHAGEN AREA

Question: How do you reach your local S-train station ?

Mode	14.4.79	20.9.79	8.11.79
Bus	21	24	26
Car	5	4	7
Cycle	12	14	15
Foot	60	52	45
Other	2	2	2
No response	3	5	5

(Figures in percentages)

Question: How do you reach your normal destination after leaving the S-train ?

Mode	14.4.79	20.9.79	8/11/79
Bus	23	30	33
Car	1	1	2
Cycle	5	6	7
Foot	69	63	57
Other	2	2	2
No response	2	1	2

Source: Ref. 68.

ticketing had handicapped boarding.

With regard to fraud, effects are impossible to ascertain. It is likely however that the introduction of free transfers contributed to the increase in evasion at Nantes. Any such system is open to abuse, although probably no more than a normal multi-ride ticket facility. The use of a time limit (usually 60 minutes) is sufficient to restrict most additional opportunities for fraud.

Passenger attitudes towards the provision of through and integrated ticketing are more easily discernable, and not surprisingly users tend to look upon such a facility favourably. The flexibility offered by such an arrangement was mentioned as a perceived attribute by the Belgian and Dutch undertakings, whilst Hamburg specifically mentioned the tendency for more boarding and alighting closer to origins and destinations. Again, through and integrated ticketing seemed to make an important contribution to popular regard for continental fare systems.

2.3.4 Summary of findings from communication with Operators regarding recent or proposed Fare System changes and their effects

This section has analysed original material obtained from operators regarding recent or proposed fare system changes and their effects (up to 1982). Findings from each of the three sources employed will be collectively summarised under the normal headings. Analysis was again hampered by the intrusion of other factors such as changes in fare levels, service levels, and so on.

Fare Structure

- Evidence on the effects of fare structure simplifications obtained from this analysis remains somewhat inconclusive. In nearly every example, the contribution made by fare structure changes is obscured by parallel changes in other factors. All three of the British undertakings examined which had adopted simplified structures performed well, but the influence of the zonal or flat fares employed was only a contributory factor.

- On the continent, the introduction of zonal systems seems to have stimulated ridership, but evidence indicates that flat fares perform relatively poorly in terms of their effect upon ridership and revenue by failing to differentiate according to distance travelled.

- Results from the questionnaire to Municipal operators show that impact upon revenue and patronage is the prime consideration for the operator when choosing a fare structure.

- Fare structure simplification exercises were found to be generally successful in reducing boarding times and in helping to facilitate OPO.

- Evidence on passenger attitudes to fare structure changes reiterates the importance of impact upon the fare paid, although simplicity and convenience also play a part.

Fare Collection

- Whilst there had been few important innovations amongst British operators up to 1982, on the continent there had been a noticeable trend towards passenger self-service and a reduction in on-vehicle transactions.

- Fare collection methods appear to play a largely indirect role in influencing ridership and revenue through their impact upon the quality of service, particularly boarding speeds.

- Experience with innovative systems regarding the impact upon fare evasion had been mixed. There were indications that unless safeguards are taken, use of the "open" system tends to encourage fraudulent travel.

- Whilst there is evidence of passenger resistance to automation of fare collection, when viewed as a whole with other changes to the fare system, public opinion tends to be more favourable.

Ticket Range

- Research revealed a general move towards provision of prepurchased tickets, although progress had been slower in Great Britain than in the rest of Western Europe. Only a few of the British Municipal operators who replied to the questionnaire were contemplating extensions to their range of off-bus tickets. Such tickets were generally introduced to stimulate patronage and/or reduce boarding times.

- Most operations reported a beneficial effect upon ridership for both main types of pre-purchased ticket, although the revenue effect was often negative. For a variety of reasons, these tickets often failed to attract sufficient new customers to public transport to offset the discount offered to existing users. Expectations of revenue losses figured prominently amongst reasons given by those municipal operators who did not provide a prepurchase facility.

- There was general evidence that prepurchased tickets help to improve boarding speeds.

- Fraud was shown to be a potential problem for a multi-ride facility unless safeguards were taken, although evasion using season tickets was found to be only an isolated problem.

- The limited evidence on passenger attitudes suggests reasons for use of prepurchased tickets are balanced between financial and convenience considerations.

<u>Through and Integrated ticketing</u>

- British operators were found to rely more upon season tickets as a way of offering a through ticketing facility, although the largest operators with significant rail networks tended to place more emphasis on single journey through ticketing as a prerequisite for full modal integration. Operators gave a range of anticipated difficulties associated with this facility.

- Despite long experience with comprehensive through ticketing on the continent, its effects are difficult to establish. There are strong indications that free interchange tends to produce a greater increase in trips than in passenger kilometres travelled, due to greater use being made of feeder services and interchange. Continental operators appear to view free interchange as essential for offering a good quality service, and hence any revenue losses have to be tolerated. The net effect could, in any event, be positive if people using the facility previously used another mode for all or part of their journeys.

- A potential susceptability to abuse is generally contained by introducing a time limit on interchange.

- Continental evidence is that through and integrated ticketing seems to make an important contribution to popular regard for continental fare systems by their users.

It has already been stated that whilst there is a substantial body of evidence tending towards a favourable overall effect for the simplification of fare systems, the influence of fare level and other factors tends to confuse the situation and make firm conclusions impossible. This suggests an in-depth study of one particular fare simplification exercise would be particularly useful in helping to clarify the picture. Such a study is contained in the next part of this thesis.

PART THREE : AN ANALYSIS OF THE PLYMOUTH "EASYFARE" EXPERIMENT

3.1. Introduction

A valuable opportunity to study in depth the performance of a simplified fares and ticketing scheme arose when it was learned from one of the questionnaires distributed in the autumn of 1981 to municipal undertakings (see section 2.3.2.) that Plymouth City Transport was about to adopt such a scheme on three of its routes on a experimental basis. Apart from enabling new evidence to be provided on the effects of simplified fare systems, detailed analysis also assisted the undertaking in deciding whether or not to extend such a system to the whole of its network. Because of the original nature of this study, and its worthwile findings, this section will deal in some depth with the scheme and the issues raised.

Plymouth City Transport, one of the largest municipal operators in the U.K., provides the majority of stage carriage bus services within Plymouth (population about 250,000). The basic objective has been to investigate the effects of the experiment with regard to the familiar indices of revenue, patronage and public acceptance.

The experiment with zonal fares and off-bus ticketing was introduced in February 1982, and ran for approximately three months. Marketed under the title "Easyfare", it was applied to three closely related routes (services 45, 46 and 47), which operated from the City Centre (and in the case of service 47 from the Dockyard area) to various north-eastern suburbs of the city (see fig.13). It should be pointed out, however, that over several sections of route the "Easyfare" services operated alongside other routes which

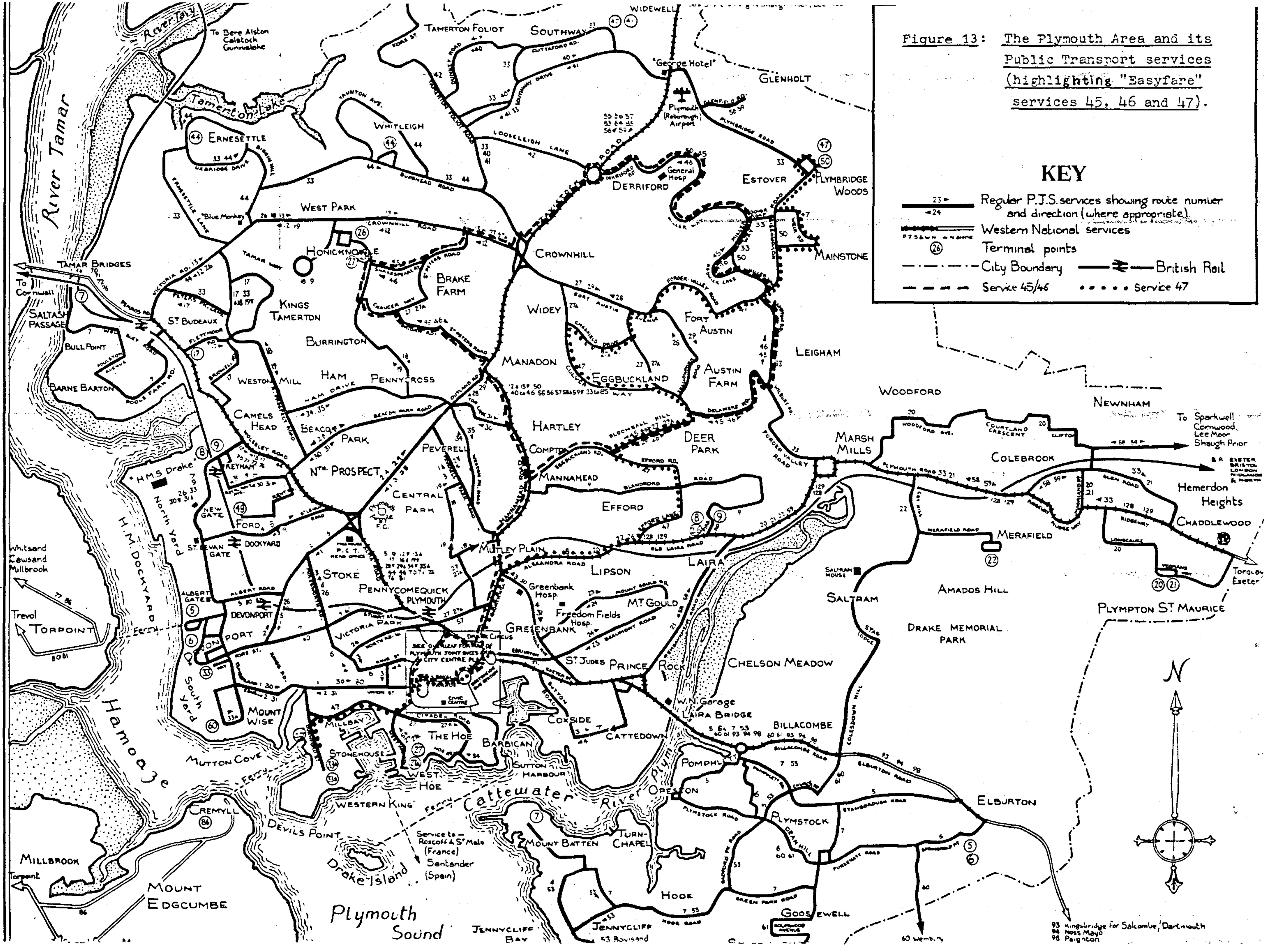


Figure 13: The Plymouth Area and its Public Transport services (highlighting "Easyfare" services 45, 46 and 47).

retained traditional graduated fare structures. Since this produced certain anomalies in as much that sometimes there were more than one fare to pay for the same journey on different services, a major complication was unfortunately added to the analysis.

The experimental fare structure involved the replacement of a graduated scale involving 14 stages on services 45/46 and 8 stages on the 47 by five roughly concentric zones, of which no more than four were relevant to each service (see fig. 14). The large outer zone was also divided radially into two separate parts. It will also be noted that services 45/46, after leaving the City Centre, become circular routes operating clockwise and anti-clockwise respectively round a loop.

The old graduated scale increased in the progression 15, 25, 35, 40 and 45 pence. This was superceded by a charge of 15p per zone, up to a maximum of 45 pence. Many users thus faced altered fares, involving either reductions or increases depending on the journey made. In order to alleviate the financial penalty otherwise incurred by people making very short trips across a zone boundary, a 'short hop' fare of 10p for journeys of up to two stops was included in the scheme.

Concurrent with the introduction of the zones, a multi-ride ticket was launched under the title of "Easyfare Discount Ticket" (fig. 15). Offering a discount of 16.7% compared with the equivalent single cash fare, each ticket had 12 segments, which had to be cancelled in groups of one, two or three, depending on the number of zones to be travelled in. Purchase could be made at any one of five locations, of which three were specially adapted stamp vending machines placed at three of

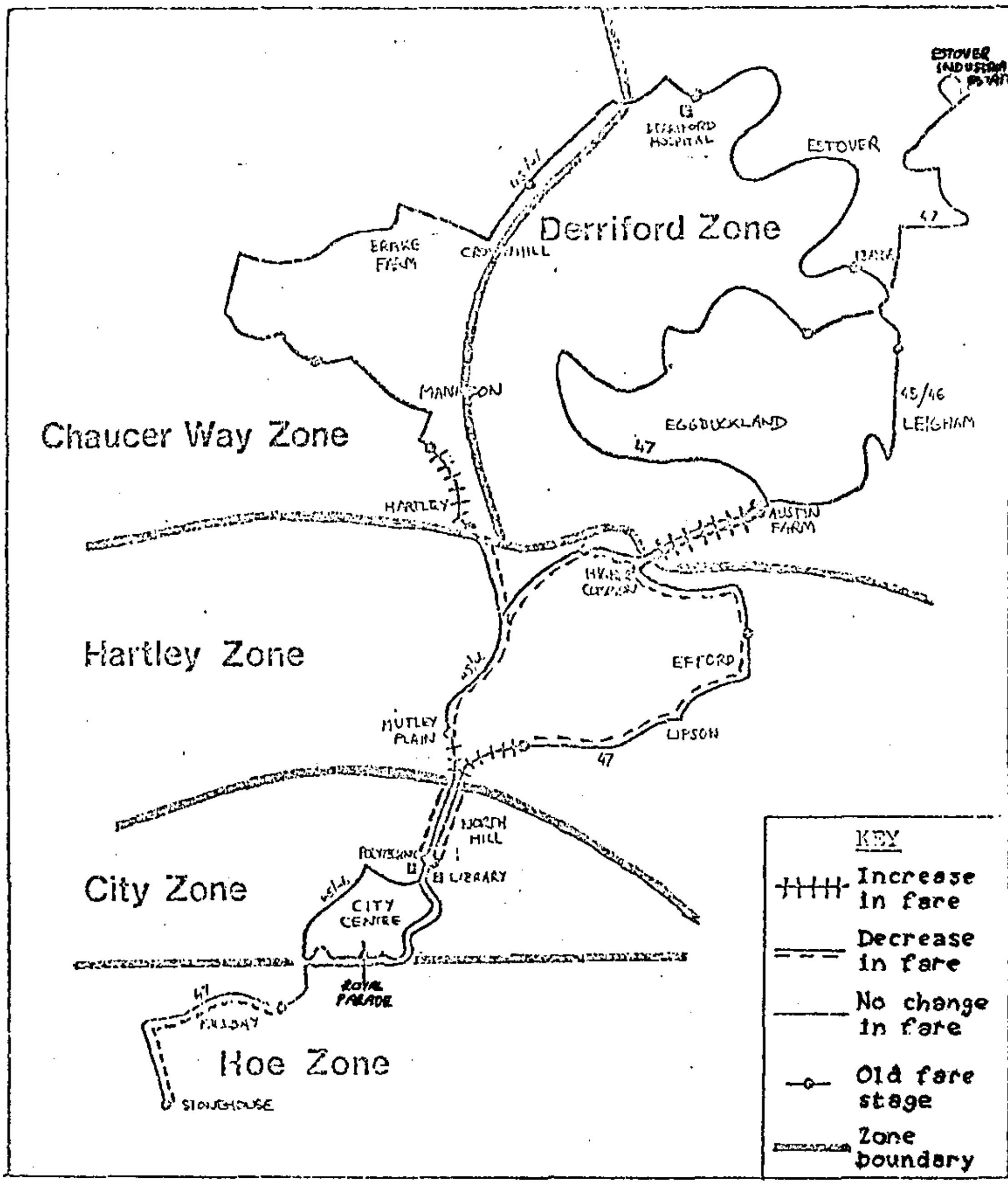


Figure 14 : Map showing effect of "Easyfare" experiment upon fare to Plymouth City Centre (Royal Parade).

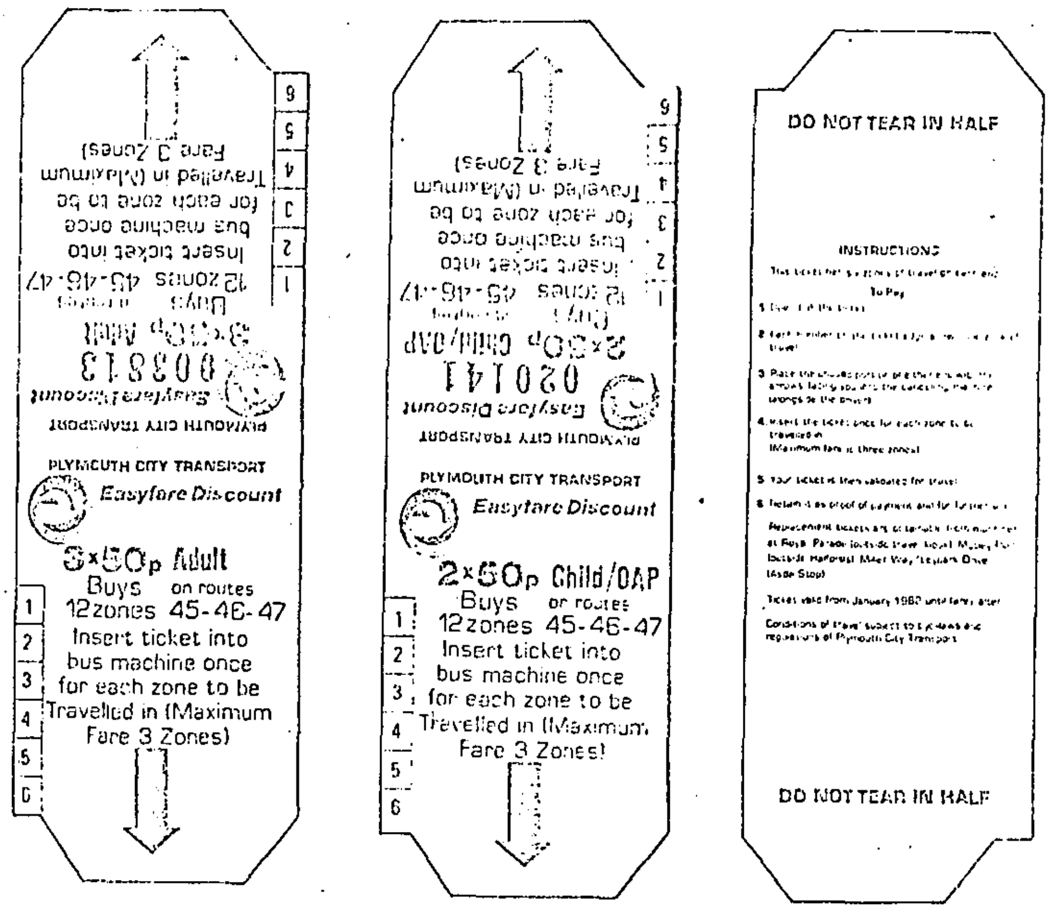


Figure 15 : Examples of adult and child/OAP "Easyfare" Discount Tickets on offer as part of the Plymouth City Transport fare system experiment.

the busiest bus stops. The other two outlets were a City Centre department store, and a suburban newsagent. Users of the multi-ride ticket made their cancellation in a conventional Almex 'M' machine situated next to the driver's fare collection equipment, under his supervision. As such, only single stream boarding was allowed.

Considerable publicity was given to the "Easyfare" scheme locally, using the press, radio and television. Some 18,000 leaflets (see appendix 4) were distributed to households along some sections of route.

3.2. Methodology

The study is based on three main areas of research:

1 - An on-bus survey of services 45, 46 and 47.

2 - Household interviews in selected areas served by the above services.

3 - Revenue and ridership information on various Plymouth City Transport routes derived from City Transport records.

3.2.1. The On-bus survey

This was undertaken over an eight-day period covering Saturday March 27th - Saturday April 3rd 1982. It was designed to reveal overall levels of patronage on the routes in the experiment, origins and destinations of travellers and type of ticket used. The latter, of course, would particularly focus on the Easyfare discount ticket. A further objective was to endeavour the establish changes in patronage as a result of the experiment. Neither time nor resources permitted a full 'before and after' study. However, these routes had been part of a major market analysis project (MAP) study, some 12 months previously. This principally involved major on-bus surveys.

It was therefore determined to align the new on-bus investigation with the MAP approach to facilitate comparison. Indeed, the survey form used was as designed for MAP, with the addition of a 'box' to record use of the new Easyfare Discount Ticket (appendix 5). The method of analysis was different, being specifically directed towards giving information on the previously mentioned requirements. Approximately 8,000 passenger journeys were surveyed during the eight-day period, with most weekday services being covered at least once. The response rate to the survey form was pleasingly high at 86.1%, particularly as this was the second such investigation within just over one year.

3.2.2. <u>The household interviews</u>

These were undertaken during the month of April 1982 and covered a sample of 260 households containing 467 persons. These were located in four specially selected areas along the routes of the Easyfare services (fig.16). Along with their reasons for selection the areas were as follows:

Area A : Estover (North) Routes 45/46

The furthest point from the City Centre, this area is reasonably free of 'competing' routes. The fare to the City Centre remains unchanged under the zonal fare, but a discount can be gained by using the pre-purchased ticket.

Area B : Estover (South) Routes 45/46

This is almost identical to area A but with one major difference. This is the presence of one of the discount ticket vending machines at the bus stop on Miller Way adjacent to the Asda Superstore. Comparison of areas A and B thus permits a view to be gained on the effectiveness of such a bus stop 'sales point'.

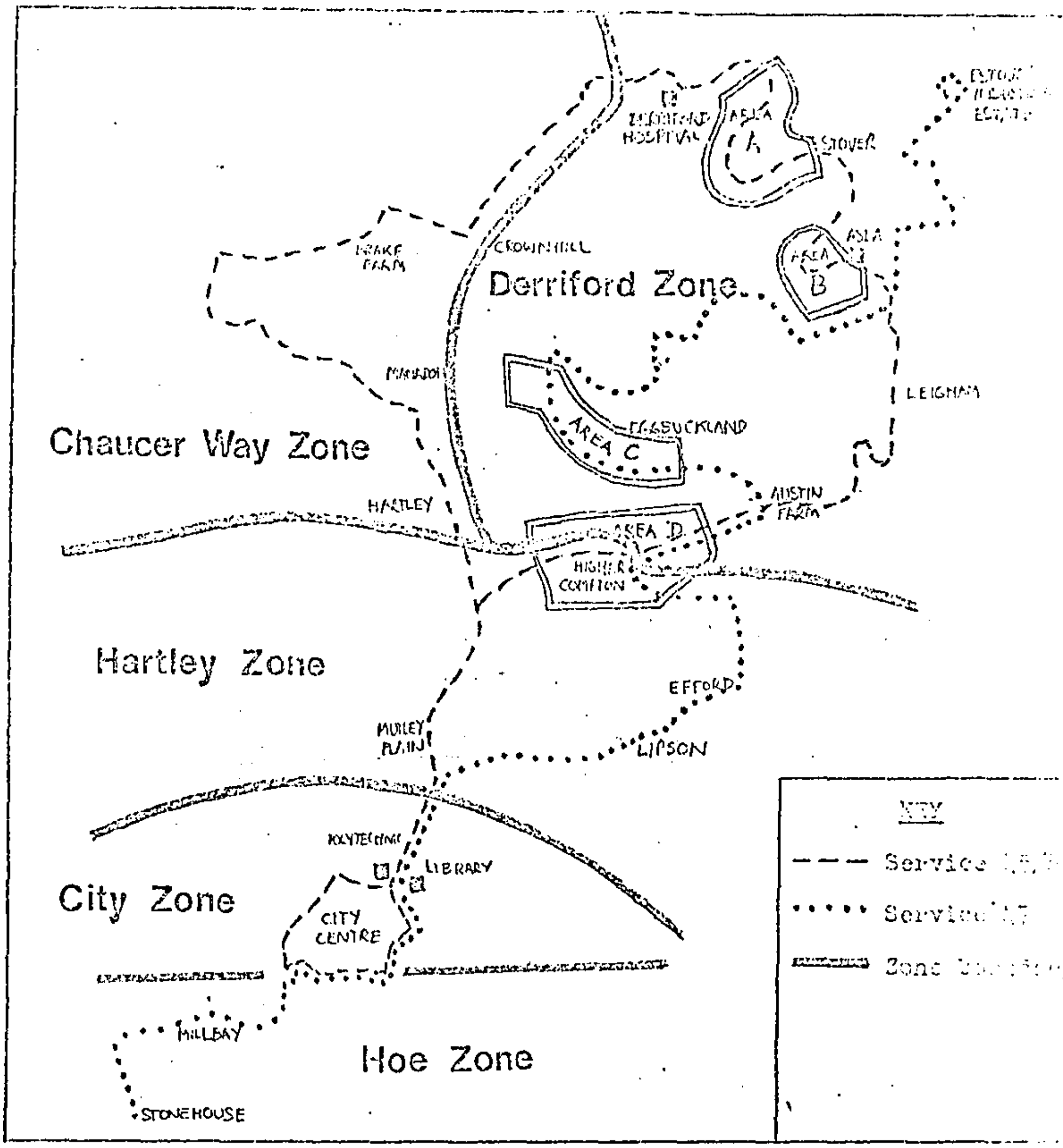


Figure 16: Location of the areas in which the household surv... was undertaken.

Area C : Culver Way Route 47

The area is served exclusively by route 47 and passengers are unable to use other buses without substantial walking trips. Although the fare to the main part of the City Centre was unchanged at 45 pence, the opportunity to save 5 pence by alighting early at the Polytechnic/Library former fare stage was removed. The discount ticket, however, offered a journey to any City Centre stop of 37½ pence.

Area D : Higher Compton Routes 45, 46 and 47

This was chosen deliberately as an area which straddled a new zone boundary. Moreover, a considerable number of alternative services were available on this section which remained on a graduated fare scale. The net result was a considerable opportunity for travellers to save money, in relative terms, by careful selection of services and/or modifying the bus stops they travelled to and from. Although this is a somewhat artificial situation concerning zonal fares per se it was hoped to reveal people's sensitivity to different fare levels and their overall comprehension of the situation.

The total number of surveys carried out in each area was broadly similar, comprising:

Area A :	115 persons
Area B :	123 persons
Area C :	101 persons
Area D :	128 persons

Within the overall total of 467, there were 339 persons defined as 'bus-users'. (The definition adopted for this purpose was 'persons travelling at least once per month on Plymouth City Transport'). Obviously, this represents a far greater number of users than would be found in a random sample of the population. This was the result of a deliberate policy designed to obtain as many different views as possible on the scheme. It was believed (rightly) that non-bus users would almost all view the scheme with no more than mild interest. The sample was constructed by each interviewer having a maximum 'quota' of non-bus users which were not to be exceeded and being given the requirement, if necessary, to find households containing bus users.

The completed questionnaires were edited and coded, with new data being filed on computer and retrieved as required. A copy of the questionnaire is included as appendix 6 .

3.2.3. Revenue and patronage

Revenue and patronage figures for the Easyfare routes, their 'competitors' and the Plymouth City Transport network as a whole were studied covering comparable periods over the last three years. Economic recession and other factors notwithstanding, this enabled some indication to be gained of the experiment's impact upon the above factors. Sales of Easyfare multi-ride tickets were also obtained, disaggregated in terms of each selling point.

3.2.4. A note of caution in interpreting the results

It should be reiterated that certain factors necessitate that caution be exercised in interpreting the results obtained. In addition to the normal complications concerning the influence of changes in fare level, service quality, land-use patterns, economic activity and other factors which combine to affect ridership trends, there is the problem represented by the existence of 'parallel' services* offering discount fares for ultimately identical destinations. This had a disruptive influence upon the ridership 'effect' one might have expected from a pure experiment. An example of the different fares

* See fig. 17.

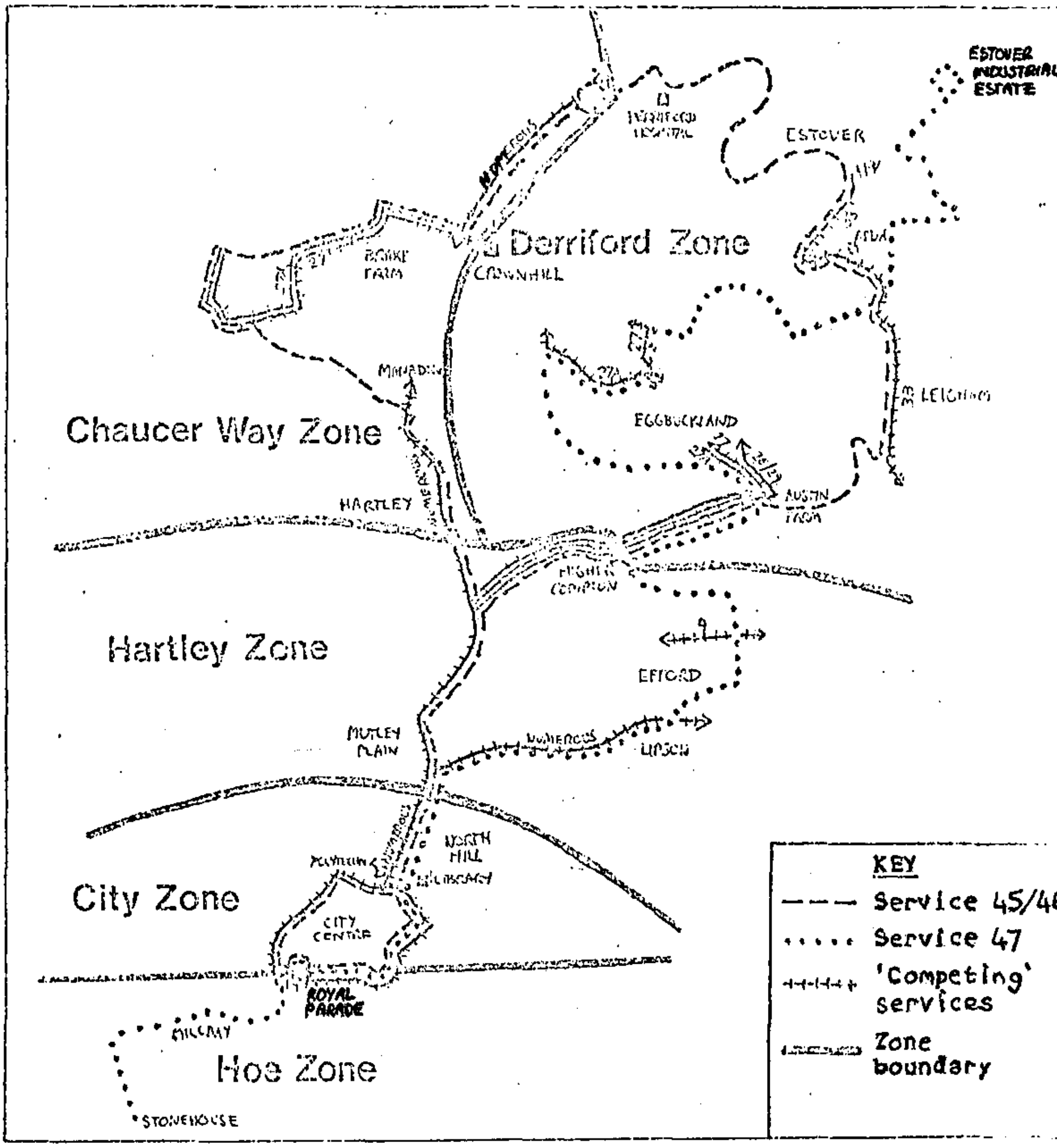


Figure 17 : Map showing the "Easyfare" routes (45/46/47) and their competitors.

that were created for essential y identical trips is given below:

From Austin Farm:			
To - Polytechnic	27/27A/28/29	35p[1]
- Poly or Royal Parade	45/46/47	37½p[2]
- Royal Parade	27/27A/28/29	40p[1]
- Poly or Royal Parade	45/46/47	45p[3]

Notes: 1 = Graduated fare structure
2 = Easyfare Discount Ticket
3 = Zonal fare

However, because the anomalies thus created can be isolated by considering changes to specific origins and destinations, the contention that reasonable and substantive conclusions can be drawn from analysis of this experiment is reaffirmed.

3.3. Revenue and patronage changes

3.3.1. Overall revenue

Data held by Plymouth City Transport permits an examination of changes in revenue over time. Table 48 compares changes in revenue for the same six-week period during the three years 1980-82. Taking the period 1981-82 it can be seen that the Easyfare routes have performed marginally better than the network as a whole. The major gain is, however, on the competing routes (+10.9%). The immediate inference is that a certain degree of transfer has taken place between 45/46/47 and its competitors. This is confirmed in section 3.3.2. To gain some overall impression of the experiment, it is thus equally appropriate to consider the results of these two groups of services together. Set against the PCT average, it can be seen that the result is favourable

Before too much is inferred from the above, it should also be noted that 1980-81 performance of the routes under scrutiny was not good in relation to the PCT network as a whole. No explanation can be given for this, since factors such as fare changes were common to all routes.

Such variations become even more acute when considering changes in the short term, for instance on a weekly basis. Factors such as weather, special events, holidays and school terms will all have a significant effect. Nonetheless, it is **obviously** instructive to compare revenues immediately before and after the experiment began. To ameliorate the problems just cited, table 49 presents the information in the form of index numbers and overall shares of PCT revenue. For each week relative performance can be assessed by checking the three index numbers, whilst changes in each group's share of revenue can be seen by scanning down each column.

The table shows quite clearly a readjustment in the revenue takings after the first week of the experiment. The most important points are:-

(a) Further evidence to suggest some transfer of riders from the experimental routes to other services.

(b) Considerable stability after the 'readjustment' of the first week.

(c) Virtually no change in the total percentage contribution of the experimental and competing routes to overall revenue.

Consideration of route figures therefore suggests that the experiment has in no way been financially calamitous. Tentative conclusions suggest that the scheme has been neutral or perhaps just mildly favourable in its effects.

TABLE 48 : TRENDS IN REVENUE

(Figures shown actual revenue. Percentage change on previous year in brackets).

Six week period ending	City Transport (All routes)	Services 45/46/47	'Competing' routes	45/46/47 and 'Competing' routes
29/3/80	516,903	65,757	88,740	154,497
28/3/81	579,334 (+12.1)	70,123 (+6.6)	93,231 (+5.1)	163,354 (+5.7)
27/3/82	604,998 (+4.4)	74,211* (+5.8)	103,397 (+10.9)	177,608* (+8.7)

Note: * Includes sales of Easyfare Discount Tickets.

'Competing Routes' are those where substantial sections run close to or parallel with the Easyfare routes. They do not however include all of the many services along the City Centre - North Hill - Mannamead Road corridor. Shown on figure 17, the competing routes are services 8/9, 26/27/27A, 28/29, 33 and 50.

TABLE 49

DETAILED REVENUE CHANGES BEFORE AND AFTER THE EXPERIMENT

Week ending	Revenue Index:			% share of revenue:		
	PCT (All routes)	45/46/47	Competing routes	45/46/47	Competing routes	Both groups
16/1/82	100	100	100	12.1	16.4	28.5
23/1/82	102	105	102	12.5	16.4	28.9
30/1/82	103	105	103	12.4	16.4	28.8
6/2/82	101	102	102	12.3	16.6	28.9
13/2/82	101	103	102	12.4	16.6	29.0
20/2/82	98	104	102	12.7	17.2	29.9
27/2/82	99	99	102	11.8	17.1	28.9
6/3/82	96	95	99	11.4	17.1	28.5
13/3/82	98	95	102	11.3	17.2	28.5
20/3/82	98	97	102	11.3	17.1	28.4
27/3/82	100	101	104	11.4	17.2	28.6

Note: The experiment commenced on Sunday 14th February 1982. Revenue from off-bus sales of the discount ticket is included in figures for 45/46/47.

3.3.2. Revenue over sections of route

The stability of overall revenue change masks considerable variations between the different sections of route. Unfortunately 'waybill' data showing revenue collected on each bus journey is inadequate for such detailed analysis. Reliance has therefore been placed on the on-bus surveys cited in section 3.2.1. Levels of patronage found in these studies for certain origins and destinations were multiplied by the respective former graduated fare scale and the new zonal system. However, since the MAP data relates to patronage in March 1981, it was decided that this should be factored down in order to try and remove the 'recession' effects of the period between the two surveys. The real effects of the experiment could then be isolated. Due to the inherent uncertainties, two 'recession factors' were used. Firstly, a postulated decline of 9.9% (ie. the average decline for PCT patronage as a whole during this period), and secondly 7.4%, the decline on the Easyfare routes and their competitors (see section 3.3.3.). Results are therefore presented as a range of values, representing a likely upper and lower limit. Finally, it should be noted that the analysis is restricted to trips to or from inner city stops, since these represent by far the largest proportion of journeys (70%) and also the main fare changes that have occurred.

Table 50 shows the astonishing variations in revenue changes on different section of route. Much is obviously attributable to changes in the fare structure. Above all, the presence of competing routes (which, of course, often offer different fares) is seen to have a marked effect. A further attributable change is the increase at the stops serving the newly opened Derriford Hospital (number 665 on route 45 and 682 on route 46).

TABLE 50 : REVENUE ANALYSIS OF TRIPS TO/FROM INNER CITY STOPS

(i.e. ROYAL PARADE - MUTLEY PLAIN INCLUSIVE)

	PERCENTAGE REVENUE EFFECT ASSUMING RECESSION FACTOR OF:- - 9.9%	-7.4%	'COMPETING' ROUTE	FARE INCREASE	FARE DECREASE
SERVICE 45					
OUT OF CITY TO STOPS: ↓					
653 - 656	-19.3	-22.8	✓	✓L/P	✓RP
657 - 658	+13.2	+ 5.3	✓	✓	
851 - 664	-13.0	-15.4	✓•	✓L/P	
665	+752	+608			
666 →	+ 6.9	+ 4.3			
Overall	- 2.7	- 5.6			
SERVICE 46					
INTO CITY FROM STOPS: ↑					
691 - 695	-32.9	-35.6	✓	✓L/P	✓RP
689 - 690	-41.2	-41.2	✓	✓	
879 - 681	-18.4	-20.6	✓•	✓	
682	+1989	+1989			
→ 681	- 84	-10.5			
Overall	-10.3	-12.6			
SERVICE 46					
OUT OF CITY TO STOPS: ↓					
653 - 781	-26.4	-28.4	✓	✓L/P	✓RP
782 - 783	+59.4	+59.4	✓		✓
587 - 591	-14.0	-16.4	✓	✓	
760 - 768	+ 7.6	+ 4.6		✓L/P	
769 →	+20.7	+17.1			
Overall	+ 7.6	+ 4.7			
SERVICE 45					
INTO CITY FROM STOPS: ↑					
695 - 786	-32.1	-33.3	✓	✓L/P	✓RP
785 - 784	-23.6	-25.5	✓		✓
1566 - 631	-27.6	-29.8	✓	✓	
779 - 771	-10.6	-13.2		✓L/P	
→ 770	- 5.9	- 8.3			
Overall	-12.7	-15.1			
SERVICE 47					
OUT OF CITY TO STOPS: ↓					
483 - 583	+ 8.7	+ 5.2	✓	✓L/P	✓RP
584 - 586	-12.5	-13.0	✓		✓
587 - 591	-26.7	-28.9	✓	✓	
592 - 600	-26.9	-29.1	✓•	✓ L/P	
601 - 612	- 8.8	-12.1			
Overall	-11.8	-14.4			
SERVICE 47					
INTO CITY FROM STOPS: ↑					
524 - 637	-21.3	-23.4	✓	✓L/P	✓RP
636 - 634	+ 0.1	+ 0.1	✓		✓
1566 - 631	-43.4	-43.5	✓	✓	
630 - 620	+ 2.4	- 0.6	✓•	✓L/P	
619 - 612	+ 7.7	+ 3.8			
Overall	-10.2	-12.4			
All Easyfare routes	- 6.2	- 8.7			

Notes

Arrows indicate direction of travel.

• At some stops only

RP To/from Royal Parade

L/P To/from Library/Polytechnic

For location of stops see tables 3.8a - f.

To make further sense of this result, table 51 summarises the information by simply comparing old and new fare values on routes 45/46/47. These are expressed in 'bands' of comparable fares. Two values occur in the old fare structure due to the presence of a fare stage within the central area at the Polytechnic/Library stop (see fig. 14).

Table 51: Revenue analysis of trips to/from inner city stops

	old fares	zonal fare	revenue effect assuming recession factor of: -9.9%	-7.4%
Band 1	25-35p	30p	-10.5%	-13.3%
Band 2	35-40p	30p	+10.6%	+8.8%
Band 3	35-40p	45p	-28.1%	-31.2%
Band 4	40-45p	45p	-1.0%	-3.6%
OVERALL CHANGE			-4.2%	-6.9%

Note: This table excludes Mutley Plain and North Hill stops (for which different fares applied) to maintain clarity.

Considerable changes can again be seen, thus indicating sensitivity to fare levels on the part of passengers. It must again be stressed that bands 1, 2 and 3 cover sections of route where competing services are abundant and transfer is possible to gain a cheaper fare. Services 45/46/47 have, not surprisingly, gained patronage in band 2, but lost heavily in band 3. The real revenue effect of the scheme in isolation is best studied in band 4. Here it can be seen that performance is only marginally worse than might have been expected without zonal fares. Taking into account the 16.7% discount of the new ticket and the approximations inherent in our technique, this would not seem to be an unfavourable result.

3.3.3. Overall patronage

City Transport data gives information on passengers using each bus route, with the exception of pass-holders and, in the case of 45/46/47, multi-ride ticket users. The on-bus survey of March-April 1982 however, recorded the multi-ride ticket enjoying a market share of 14.3% of all trips. Applying this figure to the data, table 52 can be constructed.

Passenger journeys are seen to decline by 10.5% compared to the equivalent period in 1981. This is slightly worse than the figure for the City Transport network as a whole (-9.9%). A contrast is again apparent in relation to competing routes, where ridership has fallen by only 5.1%. Combining the two groups of services (-7.4%) shows a result marginally better than the network as a whole. All the results have, not surprisingly, a considerable similarity with revenue changes discussed in section 3.3.1.

A similar picture emerges from a direct comparison of the on-bus surveys. The 1981 (MAP) figures were slightly adjusted so as to replicate (as far as possible, due to minor service changes) the 1982 study. Table 53 shows an overall decline of 12%, compared to 10.5% in table 52. The discrepancy may be due to the fact that the latter includes all revenue from the discount tickets at the time of purchase, rather than use. In any event, the survey is shown to be suitably representative. This table also reveals substantial variations between the Easyfare routes. This emphasises the point made in section 3.2.4 regarding the ever changing pattern of demand for local public transport. Some of the more detailed figures in section 3.3.4 must be considered in this light.

TABLE 52 : TRENDS IN PASSENGER TRIPS

(Percentage change from previous year in brackets)

Six week period ending	P.C.T. (All routes)	Services 45/46/47	Competing routes	45/46/47 and Competitors
29/3/80	2,710,894	357,399	475,101	832,500
28/3/81	2,281,289 (-15.8)	283,439 (-20.7)	385,574 (-18.8)	669,013 (-19.6)
27/3/82	2,055,957 (-9.9)	253,747* (-10.5)	365,921 (-5.1)	619,668* (-7.4)

Note: * Includes estimate of trips made using Easyfare Discount Ticket (derived from on-bus survey).

TABLE 53

CHANGES IN BOARDERS ON EASYFARE ROUTES 1981/82

(Numbers of passengers)

Route number	Before (1981)	After (1982)	% Change
45	2379	2024	- 14.9
46	2654	2475	- 6.7
47 (from city)	1163	939	- 19.3
47 (into city)	1340	1195	- 10.8
Total for Easyfare routes	7536	6633	- 12.0
All P.C.T. routes			- 9.9

Changes in overall patronage can also be examined immediately before and after the start of the experiment (see table 54). As in table 49 indexing of the statistics has been used. The table reveals a very similar pattern to that shown by revenue during the same period (table 49). Apart from the first week of the experiment, performance is very consistent, with routes 45/46/47 almost holding their own in terms of share of total PCT patronage, despite a significant transfer of passengers to the competing routes.

3.3.4. Patronage over sections of route

Changes in patronage between different origins and destinations have been appreciable. This can be seen in the series of tables contained in appendix 7 . For the purpose of clarity, trips to and from the City Centre have been analysed separately, in relation to each route, or part of route. Also shown separately are the main stops at Royal Parade and the Polytechnic/Library. Due to the very small numbers, trips wholly within the suburbs have again not been presented. Care has been taken to ensure the comparability of MAP data and the 1982 survey. It should be noted that the changes in patronage in these tables are absolute - there being no recession factor added as in section 3.3.2.

It will be immediately apparent that there are appreciable variations in patronage changes over the various sections of route. Generally, trips starting or finishing in locations nearer the City Centre tend to have suffered relatively large drops in patronage, whilst those to or from the outer suburbs are more stable. An important exception is around the area of Austin Farm, where a severe drop in patronage has occured. A further important change has been the reduction in use of the Polytechnic/

TABLE 54 : DETAILED CHANGES IN PATRONAGE BEFORE AND AFTER THE EXPERIMENT.

	WEEK ENDING	PCT(ALL ROUTES)	45/46/47	'COMPETING ROUTES'	PERCENTAGE SHARE OF PCT PATRONAGE 45/46/47	COMPETING ROUTES	BOTH GROUPS
BEFORE	16/1/82	100	100	100	12.3	17.2	29.5
	23/1/82	103	106	103	12.7	17.2	29.9
	30/1/82	103	105	104	12.5	17.3	29.8
	6/2/82	103	105	105	12.6	17.4	30.0
	13/2/82	103	105	104	12.6	17.3	29.9
AFTER	20/2/82	98	105	103	13.3	18.0	31.3
	27/2/82	100	100	104	12.2	17.7	29.9
	6/3/82	98	95	101	12.0	17.7	29.7
	13/3/82	100	99	103	12.1	17.8	29.9
	20/3/82	101	99	104	12.2	17.7	29.9
	27/3/82	102	100	106	12.2	17.9	30.1

Note: Trips made using the Easyfare Discount ticket (14.0% of total) are included in figures for 45/46/47.

Libary stop, part of which appears to have transferred to Royal Parade.

The two main factors determining the patterns outlined above are almost certainly the presence of competing routes and the change in fare level. To assist the reader, information on these factors is presented in appendix 7 . It can be seen that the largest drops in traffic have all occurred in sections where people who would otherwise pay a higher fare were able to transfer to competing routes charging the ordinary graduated fare. Austin Farm is an example, together with the "inner suburban sections along Mannamead Road and part of Eggbuckland Road where people would otherwise pay a higher fare to the Library/Polytechnic. Indeed, where competing services are available, people have obviously "shopped around" for the lowest fare. This also explains the gains in patronage in the sections of route on the city side of the Bluebird on 45,46 and 47, where the zonal services offered a cheaper fare. At the Rising Sun and Bluebird stops on 45/46 and Efford Cemetary, Dartmeet Avenue and Bluebird stops on 47, the saving is actually as much as ten pence for trips to Royal Parade, and patronage increases at these stops have been commensurately large in most cases.

The tables relating to this section, show the difficulties involved in making a judgement on this aspect of the experiment. The effect of zonal fares does appear to have either increased patronage, or at least stemmed decline, from the expected figure in those areas where anomalies do not exist. However, such a consideration confines us to the outer suburban areas, where the 45 pence fare predominated both before and after the experiment.

Under the circumstances, it is perhaps more pertinent to point out that the public will very quickly learn how best to "play the field", if offered a variety of fare options.

3.3.5 Changes in bus stop used

This section investigates the extent to which travellers have modified their travel behaviour at or near the old fare stages and new zone boundaries due to fare changes. Some important changes of this nature will already be clear to the reader who has studied appendix 7, especially where the fares on competing routes compound the issue. The point in question here, however, is to discuss the effects of replacing a complex system of fare stage "boundaries" with the simpler zonal system.

Fare stages are the undesirable "steps" in the price of a bus journey. For example, a fare may increase by ten pence if a journey is extended by no more than, say, 200 yards beyond such a fare stage point. This factor tends to inhibit a person's travel on the bus, in as much that they board later and/or alight earlier than they would ideally wish. Zonal fares do not eliminate the problem, although they reduce the occurrence of the "steps" significantly. If we are seeking to suggest that zonal fares are advantageous, we should expect many passengers whose journeys were previously "inhibited" to board and alight closer to their journeys ends.

To determine the extent to which travel patterns have been amended in this way, comparison has been made between the number of people boarding and alighting before and during the experiment. These are presented as appendix 8, which show changes at each stop. The before figures have been adjusted downwards so that their absolute total equals that of the after figure. This enables a direct comparison to be made between the distribution of boarders and alighters without the disrupting influence of changes in overall patronage.

Results show that at the old fare stage boundaries a positive effect of removal can be discerned in 23 out of a possible 75 cases. This means that evidence exists to suggest that travellers are taking advantage of the abolition of the fare stages by either boarding earlier or alighting later than previously. Elsewhere, there was either no change in patterns of bus stop usage or the small numbers of people involved made firm conclusions impossible. Moreover, in many instances, the presence of competing routes (especially due to their different fare scales) tends to invalidate any positive conclusion.

Having stated the above, the most important case where the positive effect has been noted, in terms of persons involved, has been the decline in use of the Polytechnic/Library stops in favour of those nearer the City Centre, despite the presence of competing routes retaining the old fare structure. This example is, however, noteworthy for another reason, since it illustrates how the positive effects may be seen as a mixed blessing. Abolishing the fare stage has meant that many passengers have forfeited the opportunity to save five pence by alighting earlier and/or boarding later at this stop (although the discount ticket would in most cases show a saving, even if travelling to Royal Parade). Indeed, the household interviews (Section 3.4) reveal some adverse comments on the situation.

A more typical example of a location with a positive effect is around the old fare stage at Shirley Gardens on routes 45/46.* It is shown that people are now travelling further, either by alighting after the fare stage or boarding before it.

The benefits of removing fare stages must, of

* See table 55.

course, be compared with the potential problems of zone boundaries, especially as these "steps" will, of course, probably be of greater (in terms of the fare increase payable) size. In 9 out of 26 possible locations we are able to perceive modifications to travel behaviour attributable to the desire to avoid crossing a zone boundary.

On balance, therefore, changes occur at approximately one third of both old and new boundaries. However, the number of boundaries with the zonal system are in themselves reduced to one third of the fare stages. Thus it is not surprising to find that the number of passengers benefiting from the removal of fare stages (i.e. "positive effects") is 570, whilst those adversely affected number only 90 persons; a ratio of over 6 to 1. On this basis the effect of the experiment upon the extent to which a person's travel is less "inhibited" by fare barriers can be said to be very favourable.

3.3.6. Changes in ticket purchasing behaviour

The 8,000 completed forms in the bus survey reveal information on the market share of various ticket types used. These are illustrated in the diagram shown on the following page (Figure 18).

The new multi-ride ticket can be seen to possess a market stare of 14.3%. Most of these trips appear to have been made previously using single tickets. This is hardly surprising given that such ticketing is normally aimed at the sector of the market which uses single tickets because their frequency of travel is insufficient to justify a season/monthly pass. Moreover, it should be noted that the Plymouth season tickets do not offer major discounts unless very considerable amounts of travel are undertaken.

The Easyfare discount ticket is, of course,

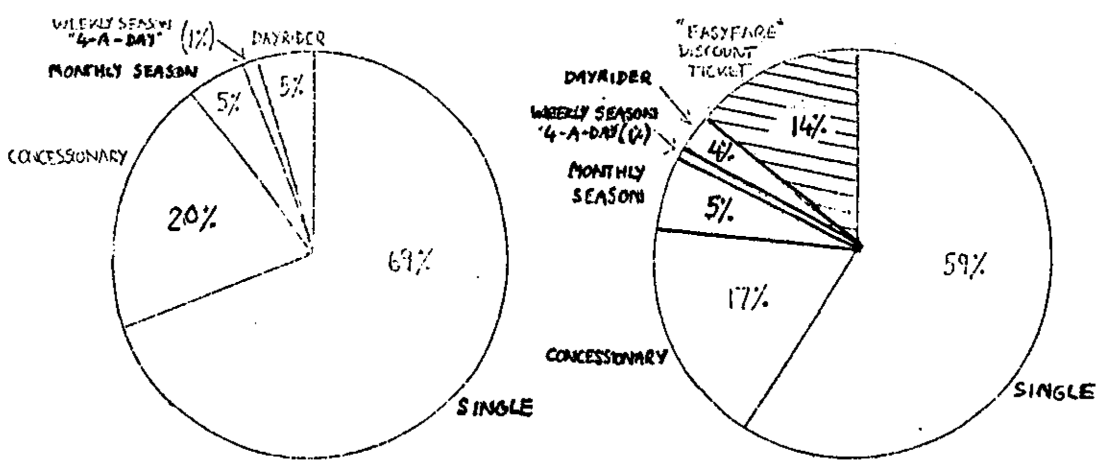
TABLE 55

EXAMPLE OF A "POSITIVE" CHANGE IN THE PATTERN OF BUS STOP USAGE AT AND NEAR AN OLD FARE STAGE

	ALIGHTERS FROM CITY	BOARDERS TO CITY	ALIGHTERS FROM SUBURBS	BOARDERS TO SUBURBS
853 SHERIDAN RD. JCT.			↑ +3	↓
854 BIG TREE			+4	+5
OLD FARE STAGE 855 SHIRLEY GARDENS	↓ -13	-27 ↑	-30	-2 ↓
856 CHAUCER WAY SCHOOL	+18	+11		
857 THACKERAY GARDENS	↓			

Note: Arrows indicate direction of travel.

FIGURE 18 : TICKET TYPES USED 'BEFORE' AND 'AFTER' THE EXPERIMENT



'BEFORE' (1981) 'AFTER' (1982)

purchased off-bus, and it is thus important to compare the effectiveness of sales points. Five locations were used, three of which were at or adjacent to bus stops, along with the City Centre Co-op store and a surban newsagent. The bus stops were served by specially adapted stamp machines which dispensed tickets in return for two or three 50 pence coins (£1.50 adult : £1.00 OAP/child). Table 56 compares performance of the outlets, from which two features are most obvious.

Firstly, it can be seen that total purchases of the ticket have remained broadly stable since the scheme's inception. Unless new people are tempted to try the ticket just as former users drop out, this clearly suggests a stable and specific market is being catered for (this is confirmed by the household interviews in Section 3.4).

Appreciable change can, however, be seen when looking at points of purchase. A significant shift away from the dispensers is apparent. This can probably be explained by the fact that the original publicity leaflet did not inform the public of the two retail outlets (agreement was only reached just before the scheme started) and hence they have only gradually become aware of them. This is again confirmed from the household surveys - indeed awareness of the Coop and Pascoes outlats was still limited at the time of the interviews (April). There would thus appear to be a growing preference for purchase of the ticket over the counter, rather than from machines- a point further explored in Section 3.4.

3.3.7. Use of the easyfare discount ticket

This section discusses various aspects of how the ticket is used; specifically the average length and journey purpose of trips undertaken. Other aspects, including frequency of use and motives

TABLE 56 : EASYFARE DISCOUNT TICKET SALES

(Number of tickets sold)

Week ending (1982)	Self-service Dispensers				Co-op*	Pascoes*	TOTAL
	Royal Parade	Mutley Plain	Estover	Sub Total			
13/2	345		30	375			375
20/2	1000	70	142	1212	180	26	1418
27/2	954	131	129	1214	236	26	1476
6/3	834	94	106	1034	533	35	1602
13/3	624	107	98	829	510	44	1383
20/3	668	106	81	855	550	50	1455
27/3	691	90	79	860	628	60	1548
3/4	639	68	95	802	630	67	1499
10/4	441	57	62	560	666	70	1296
17/4	509	76	67	652	687	78	1417

* Data from these sales points was not supplied on a weekly basis, but from periodic returns the upward trends are abundantly clear.

for purchase are discussed in Section 3.4.4.

Trips made using the ticket (14.3% of all trips on the Easyfare services). tend to be appreciably longer than average. Table 57 shows that 45.5% of multi-ride trips are over three zones compared to the norm of 38.6% for all other ticket types. Expressed another way, 16.2% of all three zone trips are made with the ticket compared with 12.9% of one zone and 12.4% of two zone journeys. Use over specific sections of route can be seen by reference back to appendix 7.

Table 57 : Easyfare discount ticket and trip length

	discount ticket	all other tickets	difference	discount ticket share of all trips
1 zone	19.4	21.4	-2.0	12.9
2 zone	30.5	35.3	-4.8	12.4
3 zone	45.5	38.6	+6.9	16.2
4 zone	4.6	4.7	-0.1	13.8
total	100	100		14.3

The average length of trip made with the multi-ride ticket is 2.45 zones. On this basis, the 12 zones of travel purchased will last on average for just under five journeys.

An examination of the journey purposes for which the discount ticket is used reveals its popularity for work trips, moreso than other types of journey.

The overall picture of trip length and journey purpose is slightly surprising. One might have expected the ticket to be catering for slightly less frequent and shorter journeys (e.g. one or two zone shopping/social) rather than the longer and more regular trips (e.g. three or four zone work). However, one must bear in mind two points already noted , namely the anomalies of competing routes for most one and two zone trips to and from the City Centre (this may have acted as a deterrent to the purchase of the ticket - see appendix 7).and the small discount offered by most season tickets which also, especially in the case of the monthly ticket, require a considerable outlay of cash.

Table 58 : Easyfare discount ticket and journey purpose

(Figures as Percentages)

	discount ticket	all trips	difference	discount ticket share of all trips
Work	46.0	30.5	+15.5	21.5
Shopping	25.7	27.1	- 1.4	13.6
Education	11.3	16.7	- 5.4	9.7
Social	9.7	15.2	- 5.5	9.[illegible]
Medical	2.9	3.5	- 0.6	11.8
Other	4.4	7.0	- 2.6	8.9
Total	100	100		14.3

3.3.8 Summary of section 3.3.

- The effects of the experiment on overall revenue has been neutral or mildly favourable.

- Considerable variations occur in revenue performance over certain sections of route. A major contribution to this is the presence of competing routes often offering different levels of fare to the passenger. Where these locations can be eliminated performance compared to the "no change" situation would not seem adverse.

- Changes in overall patronage behave in a very similar way to revenue. Taking into account transfers between 45/46/47 and competing routes, the net result again appears to be quite favourable. Such judgements are, however, extremely difficult to make.

- Patronage over longer journeys seems to have performed much better than might have been expected in a "no change" situation.

- Elimination of fare stage boundaries has had a beneficial effect on travel behaviour. Many passengers no longer walk further to/from their origins/destinations to avoid the financial penalty of the fare stage. Although the zone boundaries have themselves inhibited travel behaviour, the beneficiaries exceed those adversely affected by a ratio of over 6:1.

- The Easyfare Discount Ticket holds a market share of 14.3% of trips on Easyfare services. It tends to be used more for longer trips and is biased towards work journeys.

- Purchase of the new ticket has remained remarkably constant, with high initial awareness, but preferred means of purchase have shifted away from the self-service machines to "over the counter" retail outlets.

3.4. Household survey findings

3.4.1. Perceived impact of the scheme upon bus travel

(a) The overall number of trips made

Although it is unreasonable to expect any substantial increases, it is most important to check the extent to which the Easyfare experiment has encouraged more trips to be made by bus. Predictably, the overwhelming majority of bus users surveyed (85%) do not appear to have changed the number of trips made because of the scheme. Nevertheless, a significant proportion (11%) claimed to have increased their trips because of it, whilst only 4% thought they travelled less.

Those who travelled by bus approximately two to three times a week were most likely to have been influenced by the scheme - 17% of them had travelled more and 7% less. This finding concurs with the usual observation that bus users of this frequency (mostly shoppers) are more likely to change their travel habits than other less elastic groups (workers and children).

Almost three-quarters of those who claimed to have increased their bus trips used only the zonal services (45/46/47). However, the largest proportion of people expressing an increase (23%) lived in area D, which is well served by competing services. People here had taken advantage of the zone boundary which gives them a potentially reduced fare, and also apparently encouraged them to increase their travel by an appreciably greater extent than elsewhere.

The largest proportion of persons increasing their number of trips (20%)was found in the 40-59 age group, whilst the 25-39 age group showed an average tendency to increase their trip rate. However, no significant differences were found between males and females in this respect.

(b) The choice of service

In order to determine whether or not the general changes in bus travel were concentrated on use of the Easyfare services or on their competitors, people were also asked whether their use of the former group had changed because of the experiment. Whilst 11% of bus users claimed an overall increase in trips, 13% had increased their use of 45/46/47, suggesting a small net transfer to them in the areas surveyed (which, of course are not representative of the whole range of locations) 5% said they used the Easyfare routes less, a somewhat lower figure than the overall trend revealed by the above section (a). Again, Higher Compton (area D) accounted for a higher proportion of the change than the other areas, because of the presence there of more competing routes.

People who have increased their use of the Easyfare routes since the experiment do not lie predominantly within any particular age group, nor sex.

(c) The choice of bus stop

Section 3.3 endeavoured to establish whether changes in bus boarding and alighting had occurred due to the experiment. Interviewees in the household survey were also asked to give information on this subject. The results show very little change, with only 6% of bus users having walked to a stop further from home. More than half the persons in this group lived in Higher Compton (area D). However, it must be noted that in the other three areas it would be unlikely that any gains in terms of a lower fare could be achieved without a considerable walk. This is not the case in area D where people could walk relatively short distances to overcome the zone boundary and gain significant savings. Given that for trips into the city centre half the sample in area D would not need to modify the stops used in order to gain a cheaper fare, the findings that 12% of all passengers in the Higher Compton sample did modify their stop is highly significant. Taken together with the on-bus information, it emphasises the propensity of passengers to modify their travel behaviour in order to avoid incurring higher fares.

3.4.2. Attitudes towards the Easyfare scheme

Asked their views on the zonal fares scheme, the majority (81%) of bus users were not disapproving of the scheme (see table 59). 42% expressed positive approval of the scheme, whilst only 18% actually voiced disapproval. The characteristics of those who fall into the two groups, and their motives for doing so will now be examined in turn.

Table 59 : Bus-users views of the scheme (expressed as percentages)

	all bus users	area A	area B	area C	area D
Strongly approve	31	26	21	19	55
Mildly approve	11	20	10	10	8
Neutral	40	29	48	58	20
Mildly disapprove	9	6	11	12	2
Strongly disapprove	9	19	10	1	8

(a) Approval : the extent

It has not been found that the more frequent bus users show a higher degree of approval than less frequent ones (see table 60). Indeed, no clear patterns emerge whatsoever except a fairly consistent degree of approval regardless of frequency of bus use. However, if those persons with a car usually available for their use are removed, then we see that people captive to the bus are generally more enthusiastic (Table 61).

TABLE 60 : DEGREE OF APPROVAL OF SCHEME IN RELATION TO FREQUENCY OF BUS TRAVEL

(Expressed as percentages)

APPROVAL OF SCHEME / FREQUENCY OF BUS USE	STRONGLY APPROVE	MILDLY APPROVE	NEUTRAL/ DON'T KNOW	MILDLY DISAPPROVE	STRONGLY DISAPPROVE
DAILY	26	9	45	8	12
2 or 3 TIMES A WEEK	36	14	32	10	8
ONCE A WEEK	29	13	30	15	14
ONCE A FORTNIGHT	28	22	39	11	-
ONCE A MONTH	31	8	50	4	8
ALL BUS USERS	31	11	40	9	9

TABLE 61 : DEGREE OF APPROVAL IN RELATION TO CAR AVAILABILITY

(Expressed as percentages)

APPROVAL OF SCHEME / CAR AVAILABLE	STRONGLY APPROVE	MILDLY APPROVE	NEUTRAL/ DON'T KNOW	MILDLY DISAPPROVE	STRONGLY DISAPPROVE
ALWAYS	9	9	46	27	9
MOST OF THE TIME	13	13	53	8	13
SOME OF THE TIME	32	15	37	13	3
VERY RARELY	29	9	39	5	18
NEVER	41	12	29	9	9
ALL BUS USERS	31	11	40	9	9

TABLE 62 : DEGREE OF APPROVAL IN RELATION TO AGE

(Expressed as percentages)

	STRONGLY APPROVE	MILDLY APPROVE	NEUTRAL/ DON'T KNOW	MILDLY DISAPPROVE	STRONGLY DISAPPROVE
11 - 16	13	16	49	13	9
17 - 24	17	15	42	2	24
25 - 39	26	15	47	8	4
40 - 59	37	10	23	20	10
60+	61	4	22	4	9
ALL BUS USERS	31	11	40	9	9

Approval of the scheme does not vary appreciably between those who use just the zonal services and those who use others as well.

Interestingly, the tendency towards approval of the scheme increased with the age of the respondent (as can be seen from Table 62). Whilst only 29% in the 11-16 age group showed approval, the figure in the 60+ age group was no less than 65%. Many people in the younger groups were undecided rather than openly hostile to the scheme.

Location also plays a part in determining attitudes towards the scheme. Approval was highest in the Culver way area (29%). Over half the bus users interviewed in the latter were neutral or unable to express in opinion, emphasising the small impact made by the scheme in this area.

(b) Approval : the reasons

The most popular aspects of the scheme were the cheaper fare, mentioned by 33% of bus users (see Table 63), and the enhanced ease and convenience of use of the system (23%). Almost half the bus users surveyed could not find any particular aspect of the scheme they liked, although this does not, of course, necessarily mean they were hostile towards it.

People travelling about two or three times a week were more likely to praise the scheme, citing the cheaper fare, discount from the Easyfare ticket, and the convenience of the system more frequently than average. Other relationships between frequency of bus travel and favoured aspects of the scheme (see Table 64) are difficult to pick out. In area D, almost twice as many people as the average cited the cheaper fare and convenience as aspects of the scheme they liked (Table 65), with the presence of the zone boundary obviously playing a part here.

TABLE 63 : ASPECTS OF THE SCHEME LIKED BY BUS USERS
(Expressed as percentages)

	ALL BUS USERS
The cheaper fare	33
The ease and convenience of use	23
The discount offered by the multi-ride ticket	10
Easier to understand	8
Other	-
Don't know/No	48

Note: Respondents were able to give more than one answer to this question

TABLE 64 : ASPECTS OF SCHEME LIKED IN RELATION TO FREQUENCY OF BUS TRAVEL

(Expressed as percentages)

	CHEAPER FARE	DISCOUNT FROM EASYFARE TICKET	EASIER TO UNDERSTAND	EASIER TO USE/ CONVENIENCE	OTHER	DON'T KNOW/ NO
DAILY	29	6	6	21	2	52
2 or 3 TIMES A WEEK	40	14	13	30	-	43
ONCE A WEEK	29	12	34	20	-	39
ONCE A FORTNIGHT	35	10	-	15	-	45
ONCE A MONTH	21	3	7	10	-	55
ALL BUS USERS	33	10	8	23	-	48

Note: Respondents were able to give more than one answer to this question

TABLE 65 : ASPECTS OF THE SCHEME LIKED IN RELATION TO INTERVIEW AREA

(Expressed as percentages)

	CHEAPER FARE	DISCOUNT FROM EASYFARE TICKET	EASIER TO UNDERSTAND	EASIER TO USE/ CONVENIENCE	OTHER	DON'T KNOW/ NO
AREA A	29	19	10	12	1	54
AREA B	30	9	5	23	-	56
AREA C	25	-	5	20	-	62
AREA D	57	11	12	41	1	32
ALL BUS USERS	33	10	8	23	-	48

Note: Respondents were able to give more than one answer to this question

(c) Disapproval : the extent

As we have already seen, those who disapproved of the scheme comprised only 18% of bus users. Objectors were not particularly prevalent in any particular category of bus use frequency (Table 60), except perhaps those who travelled about once a week (29% disapproving). Car availability, sex, and interview area were all insignificant factors. Those in the 17-24 age group showed a marked tendency to show strong disapproval, with strong feelings in the 40-59 group being matched by a higher than average level of approval for the scheme.

(d) Disapproval : the reasons

Table 66 shows that the aspects of the scheme which were disliked most frequently were the more expensive fare (cited by 23% of bus users), and its unfairness (8%). Over half the bus users could not find any particular aspect of the scheme they disliked.

People travelling by bus once a week cited the higher fare more frequently as an aspect of the scheme they disliked, whilst the more occasional passengers found the scheme to be confusing more than other travellers (table 67). Apart from these points, there were no outstanding relationships between frequency of bus travel and aspects disliked. Area D again showed interesting results, accounting for a slightly higher than average level of people disliking the higher fare (table 68). Remembering that it was also outstanding for being the area with the largest number of people approving of the scheme because of the reduced fare, clearly the presence of the zone boundary has had an important impact in this respect.

TABLE 66 : ASPECTS OF THE SCHEME DISLIKED BY BUS USERS

(Expressed as percentages)

	ALL BUS USERS
The more expensive fare (for adults)	18
The more expensive fare (for children/OAPs)	5
Find it confusing	4
Find it inconvenient	5
Find it unfair	8
Other	8
Don't know/No	55

N.B. Respondents were able to give more than one answer to this question.

TABLE 67 : ASPECTS OF THE SCHEME DISLIKED IN RELATION TO FREQUENCY OF BUS TRAVEL

(Expressed as percentages)

	HIGHER FARE	CONFUSING	INCONVENIENT	UNFAIR	OTHER	DON'T KNOW/ NO
DAILY	21	3	6	9	6	57
2 or 3 TIMES A WEEK	23	5	7	9	9	54
ONCE A WEEK	32	5	4	9	5	52
ONCE A FORTNIGHT	15	10	-	5	15	55
ONCE A MONTH	19	-	4	3	7	59
ALL BUS USERS	23	4	5	8	8	55

N.B. Respondents were able to give more than one answer to this question.

TABLE 68 : ASPECTS OF THE SCHEME DISLIKED IN RELATION TO INTERVIEW AREA

(Expressed as percentages)

	HIGHER FARE	CONFUSING	INCONVENIENT	UNFAIR	OTHER	DON'T KNOW/ NO
AREA A (Estover North)	26	-	8	6	15	56
AREA B (Estover South)	16	10	7	11	10	49
AREA C (Culver Way)	25	3	4	9	4	62
AREA D (Higher Compton)	25	6	1	8	1	56
ALL BUS USERS	23	4	5	8	8	55

(e) Contributions from the zones and the Easyfare ticket towards overall attitudes

When asked what their views of the zonal fare scheme were, it is probable that many people included in their judgement both the zones and the Easyfare ticket (see section 3.4.4.). Because these two aspects are somewhat unrelated, it is necessary to try to separate out their respective contributions to the overall judgement of the scheme.

As can be seen from table 69 whilst only 29% of those who had not purchased an Easyfare ticket actually approved of the scheme. The equivalent figures for those who had bought between one and five tickets was 68%, and more than five tickets - 78%. Disapproval of the scheme was lower amongst those who purchased the ticket. Clearly, the ticket has had a significant impact on attitudes towards the scheme. Without its presence, the overall proportion of people approving of the scheme would have fallen from 42% to 29%.

Further corroboration of the favourable contribution made by the ticket is shown by the finding that of those people who cited the lower fare offered by the multi-ride ticket as an aspect of the scheme which they liked, 90% showed overall approval of the scheme.

Table 69 : Approval of the scheme in relation to Easyfare ticket purchase

(Expressed as percentages)

	Strongly approve	Mildly approve	Neutral/ don't know	Mildly dis-approve	Strongly dis-approve
None	19	10	46	15	10
1-5 tickets	48	20	16	-	16
More than 5 tickets	60	18	14	3	5
OVERALL	31	11	40	9	9

3.4.3. Comprehension of the scheme

The finding that only 23% of bus users found some aspects of the scheme complicated is good, bearing in mind the radical departure which the zones represent as a method of charging for local bus travel. Interestingly, those who use the bus on a daily basis show the greatest tendency to be confused by the scheme (29%). It is people in the lower age groups who are most likely to be confused by the scheme (30% of persons under 23) although a person's sex appears to make no difference whatsoever.

Sources of confusion are shown in Table 70. Understanding the zones themselves was the largest single source of confusion, mentioned by 83% of bus users who found certain aspects of the scheme complicated, and 20% of all bus users. This problem was spread fairly evenly throughout the various frequency categories for bus users, although younger people apparently had more difficulty than older ones. The other main source of confusion was buying the multi-ride ticket.

Almost certainly, a good deal of the confusion can be attributed to either a lack of experience of the scheme, or the anomalies created by its experimental nature.

Table 70 : Sources of confusion in the Easyfare scheme

(Expressed as percentages)

	Confused people	All bus users
The zones themselves	83	20
Buying the multi-ride ticket	28	7
Using the multi-ride ticket	8	2
Other	5	1

NB. Respondents were able to give more than one answer to this question.

3.4.4. Impact of the Easyfare multi-ride ticket

(a) Take-up of the ticket

Of those 280 respondents who were aware of the ticket, 16% had bought between one and five tickets since the experiment started, whilst a further 24% had bought more than five. The remaining 60% had bought none. 36% of daily bus users had bought the ticket at some stage, whilst for those who travel about two or three times a week the figure was even higher at 50%. Take-up is clearly highest in the over 60 age group, as Table 71 shows, with 57% of people aware of the ticket in that group having tried it, compared with an overall average of 40% of persons within the sample. Note, however, that these figures relate to persons of its use. As shown in section 3.3, work trips due obviously to the higher frequency, account for the greatest degree of usage on the bus.

A high proportion of purchasers (94%) have maintained their use of the ticket, whilst those who have decided not to buy any more are too small in number to draw any reliable deductions as to their behaviour. 78% of users of the ticket employ it for all or most of their trips on the Easyfare routes.

Table 71 : Take-up multi-ride ticket in relation to age

(expressed as percentages)

	None	1 -5 tickets	5 or more tickets
11 - 16	70	13	17
17 - 24	58	15	27
25 - 39	68	15	17
40 - 59	53	24	23
60+	43	9	48
All bus users (aware of the ticket)	60	16	24

(b) Factors determining take-up of the ticket

Table 72 reveals that the overwhelming majority (97%) of multi-ride ticket users cited the discount available as a reason for purchase, whilst 64% also mentioned the convenience they offered. Other attributes, such as the absence of a time limitation upon use, and the opportunity for them to be used by more than one person were unimportant as motives for purchasing the ticket.

The extent to which discount is cited as a reason for purchase is not determined by age or sex. Convenience is mentioned more often by persons in the age groups over 25.

The most prevalent reason given by people aware of the ticket for not purchasing it was that insufficient journeys were made to justify purchase (see Table 73). Objection to the relatively large outlay involved in buying the ticket, together with an insufficient level of discount were also significant factors.

Table 72 : Reasons given for buying the Easyfare multi-ride ticket

(expressed as percentages)

Offers a discount/cheaper	97
More convenient to use	64
Can be used by more than one person	16
No time limit on ticket	9
Just wanted to try it out	4
Other	6

N.B. Resondents were able to give more than one answer to this question.

Table 73 : Reasons given for not buying the Easyfare multi-ride ticket

(expressed as percentages)

Do not ride often enough to justify buying a ticket	38
Cost of ticket too much to pay in one go	15
Ticket does not offer enough saving	13
Location of ticket vending machines inconvenient	11
Dislike using the ticket vendors/ cancelling machines	9
Ticket would get used up too quickly	7
Other	18

N.B. Respondents were able to give more than one answer to this question.

(c) Issues relating to purchase points for the ticket

The availability of sufficient outlets of the right type (i.e. economical but popular with users) is of crucial importance to the success of any off-bus ticketing venture, as is a high level of awareness of their location.

Those people aware of the ticket were asked whether they would be more likely to purchase it if it were available from a range of outlets (Table 74). Whilst 50% of people thought the type of outlet would have no effect on the likelihood of their buying the ticket, 26% said they would be more likely to purchase it if it were available from shops , newsagents and post offices. The respective figures for self-service vending machines on the bus and at bus stops were 18% and 6%. As the table shows, older people showed a distinct preference for buying the ticket from shops, newsagents and post offices, whilst younger people showed a greater tendency to prefer to buy them from machines. Frequency of travel by bus was an insignificant influence upon the type of purchase place preferred.

With only 6% of people thinking a wider distribution of ticket machines at bus stops would encourage them to use the ticket more, the apparently poor reliability of the three bus-stop ticket vendors used in the experiment must have had an influence on this result. Indeed, many people who were otherwise in favour of the ticket were critical of the lack of sales points and/or the poor reliability of the "ticket trader" machines.

3.4.5. Findings from the non-bus users

One of the criteria by which the performance of any marketing experiment in public transport has to be assessed is the extent to which it attracts new users who previously travelled by other modes. In this connection, the respondents classified as non-bus users (128 in number) were asked whether the fare system had affected their likelihood of travel by local bus in the future. Although 66% of the non-bus users were aware of the scheme, only 5% claimed it had made them more likely to use the bus, with no impact whatsoever on the bulk of the sample. Whilst this appears to be a very low figure, it should be remembered that if applied across the whole of Plymouth, such an increase would represent an appreciable increase (in absolute terms) in both revenue and patronage.

Table 74 : Impact of Type of Purchase Point upon likelihood of increased Multi-ride sales.*

	From shops, newsagents, post offices.	From self-service machines on the bus.	From self-service machines at bus stops.	No more likely
All persons aware of the Easyfare ticket	26	18	6	50
Age 11 - 16	10	24	10	56
17 - 24	15	23	4	58
25 - 39	26	20	7	47
40 - 59	31	13	4	52
60+	34	15	5	46

* Expressed as percentages.

3.4.6 Summary of findings from the household survey

- Predictably, the overwhelming majority of bus users surveyed (85%) did not appear to have changed the overall number of trips made because of the scheme. Nevertheless, a significant proportion (11%) claimed to have increased their trips because of it, whilst a very small number (4%) thought they travelled less.

- The majority of bus users (81%) were not disapproving of the scheme. 42% were positively in favour, whilst only 18% expressed disapproval. The extent of approval varied somewhat between areas, age groups and bus use frequency categories.

- The change in fare was the most important factor determining people's attitudes towards the scheme, with 33% of bus users liking the lower fare and 23% disliking the higher fare. The enhanced convenience offered by the system was also significant as a popular aspect of the scheme, mentioned by 23% of bus users.

- The Easyfare multi-ride ticket made an important contribution to the overall level of popularity of the scheme, with the level of approval amongst ticket users being more than double that of non-ticket users.

- Of those bus users aware of the multi-ride ticket, 40% had purchased it at least once. A very high proportion of purchasers (94%) have maintained their use of the ticket, and 78% of people using the ticket employ it for all or most of their trips on the Easyfare routes. The discount offered was overwhelmingly important as a reason for purchase, although the convenience it offered was also significant. Awareness of the different purchase points for the ticket varied considerably, often with poor correlation to the volume of sales at each point. Of the various possible types of purchase point, shops, newsagents and post offices were most popular, especially amongst the older age groups.

- A high proportion of all respondents (86%) were aware of the new zonal fare system. The leaflet was the most important medium through which people first heard of the scheme, and it had an appreciable impact in those areas where it was delivered on a door-to-door basis.

- Only 23% of bus users found some aspects of the scheme complicated, usually citing the zones themselves (20% of bus users) as a source of confusion.

- Only in one of the areas surveyed was there any significant change in bus stops used by the inhabitants because of the scheme. Elsewhere, the distance that would have to be covered on foot in order to gain a cheaper fare was prohibitively great. (Compare with overall findings in Section 3.3.5).

- 5% of non-bus users claimed the scheme had increased their likelihood of travel by bus in the future, a significant figure in absolute terms if applied across the whole of Plymouth.

3.5. The "Easyfare" experiment: overall conclusions

The Plymouth Easyfare experiment has confirmed certain of the findings emerging from part two. A zonal fare structure and multi-ride ticket can replace a traditional graduated fare system without any deleterious overall effects. This can be confidently concluded, despite the somewhat artificial circumstances of some aspects of the experiment (notably the presence of competing routes with ordinary graduated fare scales).

Trends in revenue and patronage on Easyfare routes and their competitors were more favourable than the City Transport average, when considered over the previous 12 month period. When overall route statistics immediately before and after the start of the scheme are studied, this difference is hardly discernable. However, a transfer between Easyfare routes and their competitors was readily apparent. Wherever anomalies were absent, performance of revenue and patronage was **favourable on** routes 45/46/47.

In common with much of the evidence on this matter supplied by continental undertakings, public attitudes towards the new fare structure were generally favourable. 81% of persons interviewed were not hostile to the scheme and comprehension of it was generally good. Approval was primarily due to the potential for cheaper fares, and to a lesser extent, overall convenience.

Following the change in fare structure, those who benefited from an elimination of fare stage boundaries (by walking less to and from stops) greatly outweighed those who walked further to avoid crossing the new zone boundaries. Such "positive" effects were noted at approximately one third of all possible locations.

The Easyfare multi-ride ticket scheme in Plymouth made a significant impact, accounting for 15.9% of revenue and 14.3% of trips on the services for which they were available. This level of take-up is noteworthy, bearing in mind the availability of competing services at the same or lower fares for short and middle distance trips (the market at which the ticket is usually aimed). Nearly all users of the ticket cited the discount available (16.67%) as a reason for purchase, with the convenience offered being almost as important.

PART FOUR : ASSESSING THE EFFECTS OF VARIOUS FARE STRUCTURES - A SIMULATION APPROACH

4.1 Methodology

Whilst some clear patterns emerged from the analysis of actual experience of the effects of different fare structures contained in part two, and from the results of the Plymouth "Easyfare" experiment in part three, the diverse circumstances under which these results were obtained suggests an additional technique would be helpful in ascertaining effects under more controlled conditions.

Hence, the purpose of this exercise has been to test the effects upon ridership and revenue of replacing the traditional graduated fare scale with (a) flat and (b) zonal structures. Origin-destination information for six different urban bus services was used to obtain the "before" situation (a graduated fare scale was in force for all the services at the time data was collected). New flat and zonal fare structures were then designed, and a range of elasticities employed to assess the effect of the imposition of the new structures upon the travelling public. In essence, individual passenger responses are aggregated to derive the overall effect upon ridership and revenue.

The analysis has been confined to the consideration of alternative fare structures. The effects of using different types of fare collection, ticket type or through/integrated ticketing facilities have not been tested. The exercise is primarily concerned with the quantifiable effects of fare structure changes upon ridership and revenue. The other main factors in the overall assessment of fare structure effects (boarding speeds, levels of evasion, passenger acceptance, and the extent of 'generated' custom caused by a change in service quality) are also included, but in a non-quantified form. The likely effects in these areas have been estimated using the evidence obtained elsewhere in this thesis. By necessity, these additional effects could not be quantified to an acceptable level of accuracy, but when comparing the three fare structures, it was felt that the findings elsewhere enabled a relative order of magnitude to be placed upon them. This has been done in recognition of the importance of obtaining a fair overall picture of the effects of fare structure changes.

The main assumptions made in this exercise are:

i - that all passengers pay single cash fares;

ii - that the factors other than the fare which determine ridership levels (frequency, reliability, etc.) are held constant.

The use of elasticities raises problems regarding the choice of a suitable value (or values). Because of the importance of elasticity values in this analysis, a detailed discussion of elasticities and their derivation is included as appendix 9.

Care was taken to separate the effect of the fare structure change from the change in fare level. Thus scenarios 1 and 2 involve applying mean and median fare values respectively. The mean simply represents the mean fare previously paid by all passengers on a particular route, broken down by the new zones travelled through in the case of zonal fares. An identical approach was adopted for the median fare scales. This hypothetical technique has eliminated any effect from the change in fare level which is otherwise inevitable.

However, because in reality a uniform fare scale is generally applied to most if not all services in a network, and not individually tailored to any one route, the next stage was to design a range of "network" fare scenarios. These involve a low fare level, intermediate or "practical" scale, and a high fare scale. The term "practical" is used because this variant has rounded values to facilitate rapid fare collection and ease passenger perception. The fare scales employed for the six services are summarised in table 75.

The six bus services chosen (see table 75 for details of route lengths, frequencies and fares) represent a wide variety of routes operated by two very different undertakings. Plymouth City Transport operates in an urban area containing approximately 250,000 people, whilst the West Midlands P.T.E. serves a conurbation with a population in excess of two million. The Plymouth routes (fig.14) had the advantage of having patronage data readily available, following the "Easyfare" analysis. Two of the services were circular, and all three linked an outer suburb of Plymouth with the City Centre (for further details see section 3.1). The Birmingham routes (see fig.19) can be summarised as follows:

- Service 10 : A medium length route linking a western suburb of Birmingham with the City Centre. As part of the modelling exercise, the fare scale was changed from a graduated one of six values to a zonal one of three.
- Service 62 : A relatively long route linking an outer south-western suburb with the City Centre along a major radial corridor. In this case, seven graduated values were replaced by four zonal ones.
- Service 96 : A short inner city route, passing through four graduated stages or two zones.

TABLE 75 : BUS SERVICES AND FARE STRUCTURES EMPLOYED IN THE SIMULATION EXERCISE

No.	Route	Length (miles)	Frequency (per hour)	Journey time (mins.)	Fare structures: Mean (1) Flat	Mean (1) Zonal	Median (2) Flat	Median (2) Zonal	Network "Low" Flat	Network "Low" Zonal	Network "High" Flat	Network "High" Zonal	Network "Practical" Flat	Network "Practical" Zonal
Plymouth City Transport														
45	City-Crownhill-Estover-City *	12.0	3	72	32.1	19.6/28.9/37.7	35.0	21/29/39	26.0	17/25/35	35.0	21/29/39	30.0	19/28/37
46	City-Estover-Crownhill-City*	12.0	3	72	31.8	18.0/28.9/37.7	35.0	21/29/39	26.0	17/25/35	35.0	21/29/39	30.0	19/28/37
47	Stonehouse-City-Estover (2 Directions)	8.0	2	52	27.5 26.6	18.4/27.4/36.2 17.6/25.2/35.4	29.0 29.0	21/29/39 21/29/39	26.0 26.0	17/25/35 17/25/35	35.0 35.0	21/29/39 21/29/39	30.0 30.0	19/28/37 19/28/37
	*Circular route													
West Midlands P.T.E. (Birmingham area)														
10	City-Quinton Road	5.8	3	26	35.8	20.3/33.1/45.3	40.0	20/32/40	25.0	18/27/36	35.0	24/36/48	30.0	20/30/40
62	City-Rednal	8.0	4	47	33.1	23.8/31.7/42.8/54.4	32.0	20/32/40/50	25.0	18/27/36/45	35.0	24/36/48/60	30.0	20/30/40/50
96	City-Winson Green	2.8	4	16	25.0	19.4/30.1	25.0	20/32	25.0	18/27	35.0	24/36	30.0	20/30

Graduated ("before") fare scales:

Plymouth 12/21/29/35/39

West Midlands 12/20/25/32/40/50/60 (_ = not 96; = = not 10 or 96).

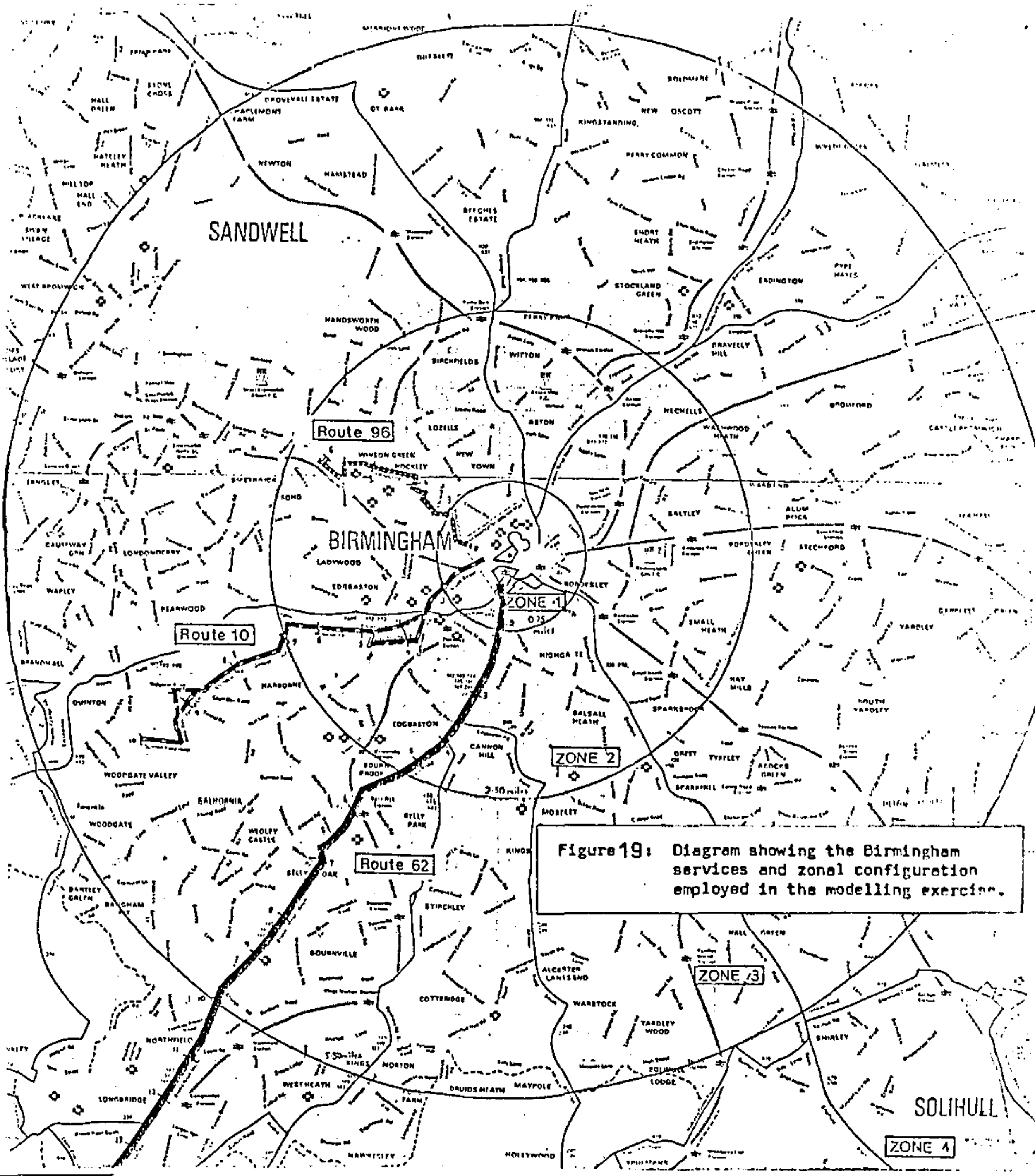


Figure 19: Diagram showing the Birmingham services and zonal configuration employed in the modelling exercise.

When designing the zones, the three routes in Plymouth were given the "Easyfare" zone boundaries (fig. 14), whilst those in Birmingham were designed as concentric circles of radii 0.75, 2.5 and 5.5 miles from the City Centre (fig. 19).

Each scenario was tested using five elasticity values:

- 0.0 (ie. revenue change only)
- -0.1
- -0.3
- -0.5
- -0.8 for the minimum value "old" fare passengers under the "worst" option (the remaining passengers were assumed to have a -0.5 elasticity, with no increases in ridership being allowed under this option).

The value generally used as an average elasticity is recognised to be -0.3, and it should be remembered that the "worst" situation is very unlikely to occur in reality.

4.2. Results from the Simulation Exercise

4.2.1. Introduction

The changes in patronage and revenue resulting from the imposition of zonal and flat fare structures on the six routes in question are summarised in table 76 (zonal) and 77 (flat). The full results are given on a route-by-route basis in appendix 10.

The findings will be analysed in detail under the following headings:

- the impact of zonal fares;
- the impact of flat fares;
- a comparison of zonal and flat fares;
- the effect of using different elasticity values.

Throughout the following discussion, it is crucial to bear in mind the other areas upon which changes in fare structure have an effect. The benefits of simplified fares for passenger and operator alike may be underestimated by concentrating solely on the ridership and revenue effects for existing customers for a number of reasons:

i - Additional custom may be generated through the enhanced convenience and attractiveness of the simpler fare structure.

ii - Additional traffic may also be generated by the enhanced scope for marketing initiatives (pre-purchased tickets in particular).

iii - There is potential for a reduction in operating costs for the undertaking due to simplified fares administration, reduced boarding times and faster journey schedules.

iv - Passengers may alter their travel habits to conform with the new structure. The presence of a graduated fare scale (the "before" situation) means that fare stages occur with greater frequency than in other fare structures Clearly, there is hence a greater opportunity for a passenger to make a short walk trip and thereby minimise his/her fare to the detriment of the operator. In the Plymouth experiment, it was possible to observe changes in behaviour at 23 bus stops out of a total of 75 affected by the elimination of fare stages. The number of passengers involved exceeded those who tried to avoid the effect of the new zone boundaries by a ratio of 6:1.

v - Finally, simplified fare scales reduce the scope for fraud in the form of over-riding. The more complex a fare system is, the more scope exists for this phenomenon. L.T. have demonstrated that, under a graduated structure, only 80% of people paying the minimum fare are travelling the correct distance.

The additional factors listed above are included in the analysis in the form of a non-quantified 'balance sheet' (see section 4.2.4).

4.2.2. The Impact of Zonal Fares

Taking the most representative elasticity value of -0.3, and the "practical" scenario, table 76 shows that the change in patronage varies between +1.3 and -2.4%. The range for the change in revenue is +0.2 to -7.9%. It will be noted that the route with the best performance in terms of patronage loses the most revenue, and vice versa. However, the overriding impression is that these figures are mostly very small in percentage terms. Variations in performance must therefore be attributed to incidental factors such as the occurance of fare boundaries, rather than to length of route or absolute levels of patronage.

TABLE 76: CHANGE IN PATRONAGE AND REVENUE RESULTING FROM ZONAL FARES UNDER THE "PRACTICAL" SCENARIO (-0.3 elasticity)

Route	Length (miles)	Ridership (one-way trips p.d.)	% change in ridership	% change in revenue
45	12.0	3888	-0.7	-2.8
46	12.0	4451	-0.7	-2.3
47	8.0	2062	-2.4	+0.2
10	5.8	653	+1.3	-7.9
62	8.0	1945	+1.0	-5.6
96	2.8	581	-1.6	0.0

Another observation which may be made is that under the "practical" scenario, the zonal fare structure performs consistently better in terms of patronage than revenue. This is attributable to a slight overall reduction in fare level in the interests of using simple fare values. Under the mean and median scenarios (where the overall fare level is held constant), this imbalance between patronage and revenue effects does not occur. As discussed previously, results from the mean and median fare scenarios are of particular academic interest because they show the net effect of the new fare structure. It will be noted that the changes are of a smaller magnitude than under the "practical" scenario. They could, in fact, be described as negligible. The "mean" patronage impact ranges from -0.8 to -2.9%, whilst the revenue effect lies between -0.7 and -2.4% with a -0.3 elasticity.

It may be concluded, therefore that in terms of patronage and revenue, a shift from graduated to zonal fares has a negligible (albeit negative) effect. However, when the additional factors such as boarding speeds are taken into account, the overall impact is likely to be positive (section 4.2.4).

4.2.3. The Impact of Flat Fares

Again using the "practical" scenario and a -0.3 elasticity value, table 77 shows that the change in patronage following a shift from graduated to flat fares ranges from +1.2 to -9.3% for the six routes studied. The respective figures for revenue are +8.7 to -15.3%. As with zonal fares, the route which performs worst in patronage terms has the best results for revenue and vice versa. Again, this must be attributed to incidental factors such as the variable impact of the "practical" fare values upon each route. Study of the mean and median scenarios gives a better impression of net impact of flat fares. The mean scenario produces a range of between -2.3% and -4.4% for patronage, and -2.3 and -4.6% for revenue. Again, the net effect is very small.

TABLE 77 : CHANGE IN PATRONAGE AND REVENUE RESULTING FROM FLAT FARES UNDER THE "PRACTICAL" SCENARIO (-0.3 elasticity)

Route	Length (miles)	Ridership (one-way trips p.d.)	% change in ridership	% change in revenue
45	12.0	3888	-0.8	-7.4
46	12.0	4451	-0.9	-6.9
47	8.0	2062	-7.1	+0.3
10	5.8	653	+1.2	-15.3
62	8.0	1945	-1.2	-10.4
96	2.8	581	-9.3	+8.7

It is noticeable that when a "practical" flat fare is introduced on a network basis, the fluctuations in performance are greater, with larger losses, and in certain cases significant gains. Even so, when the various advantages of flat fares in areas such as boarding speeds and protection against fraud are taken into account, the net effect of flat fares need not lead to a deterioration in financial performance. Furthermore, it must be remembered that patronage is measured here in terms of trips made, rather than total passenger miles/kilometres travelled. As such, study of trips made portrays an unrealistically pessimistic view of the impact of flat fares, because such a fare structure tends to suppress short trips and encourage long ones.

4.2.4. A Comparison of Zonal and Flat Fare Performance

It is immediately apparent from table 78 that zonal fares generally perform better than flat fares, as far as patronage and revenue are concerned. Under control conditions (the "mean" scenario) the albeit very small loss in patronage and revenue for the zonal option is about half that for flat fares. The gap widens if a more realistic fare scale ("practical" scenario) is adopted because of the

TABLE 78 : A SUMMARY COMPARISON OF THE VARIATION IN IMPACT BETWEEN ZONAL AND FLAT FARE STRUCTURES (-0.3 elasticity)

	Percentage change from graduated fare scale to:	
Scenario	Zonal	Flat
"Mean":		
- Ridership		
- Best	-0.8	-2.3
- Worst	-2.9	-4.4
- Average	-1.6	-3.6
- Revenue		
- Best	-0.7	-2.3
- Worst	-2.4	-4.6
- Average	-1.3	-3.6
"Practical":		
- Ridership		
- Best	+1.3	+1.2
- Worst	-2.4	-9.3
- Average	-0.5	-3.0
- Revenue		
- Best	+0.2	+8.7
- Worst	-7.9	-15.3
- Average	-3.1	-5.0
* BOARDING SPEEDS	+	++
* LEVELS OF EVASION	+	++
* PASSENGER ACCEPTANCE	+	(+)¶
* 'GENERATED' TRAVEL (Caused by changes to convenience/simplicity of services, or adjustments to travel habits.	+	+

* Likely performance compared with graduated fare structure, based on results obtained elsewhere in this thesis. See also section 4.1. for explanation of technique employed here.

¶ The popular aspects of flat fare structures - simplicity, convenience, and a relatively cheap fare for medium and longer distance travellers - may be offset by the adverse financial effect upon shorter distance users.

relative insensitivity of the network flat fare. These quantified results, which exclude any subsequent generation, are hardly surprising bearing in mind the total absence of fare differentiation within a flat fare structure.

Whilst this analysis has demonstrated that, in most of the situations tested, flat (and to a lesser extent) zonal fare structures lose small amounts of ridership and revenue, when the additional factors shown in table 78 are taken into account, the overall picture becomes more favourable. Most of these unquantified factors exert a positive influence, if experience revealed elsewhere in this thesis is to be believed. A better overall picture is thus obtained, since the potential for simplified fare structures being able to generate additional custom and reduce operating costs cannot be ignored. It is inevitable that these additional factors remain unquantified, since their influence will vary from scheme to scheme.

4.2.5. The effect of using different elasticity values

Results for the full range of elasticities tested are shown for each route in the tables contained in appendix 10. Ridership behaves in a predictable step-like fashion when the -0.1, -0.3 and -0.5 values are applied. The lowest elasticity generally has the least impact upon ridership. However, depending upon which way the fares are altered, the greatest change in revenue may occur under conditions of low or zero elasticity. This is because the low (-0.1) and zero elasticities give people little or no scope to respond to the new fares. If the fare level is raised, there is an increase in revenue which falls away or becomes negative as the elasticity value increases. Similarly, if the fare level falls, low elasticities offer the least scope for attracting new customers.

The "worst" elasticity scenario (see section 4.1 for definition) is an attempt to determine the behaviour of simplified fare structures under extremely rigorous conditions, which are very unlikely to occur in reality. It will be noted from table 78 that some significant losses in revenue and patronage occur under this option, particularly in the case of flat fares. The range for patronage changes under the "practical" fare scenario is -3.4 to -11.9% for zonal fares, and -8.9 to -17.6% for flat. The respective revenue changes are -3.6 to -11.9%, and -1.2 to -23.9%. It must be reiterated that these results are the worst that could possibly happen, and it is safe to assume they would not occur in reality.

4.2.6. Conclusions from the Simulation Exercise

Two general conclusions may be made. Firstly, the performance of the zonal option is consistently better than the flat fare with regard to patronage and revenue effects. Secondly, whilst it is apparent that most effects caused by the switch to simpler fares have a negative impact upon ridership and revenue, the extent of the change in generally very small. In fact, as a result of zonal fares only one route had a reduction in revenue in excess of 10% (this under the worst possible conditions), and none had a reduction in patronage greater than 8.2%. The impact of flat fares is also small, albeit somewhat worse than for flat fares.

It must be reiterated that the modelling exercise was preoccupied with the effect of simplified fares upon ridership and revenue. When the broader considerations discussed in section 4.2.1. are included in the analysis, the overall effect of simplified fare structures is likely to be positive, as has been shown. The extent will, of course, depend upon many factors, not least the individual details of each scheme.

PART FIVE: OVERALL CONCLUSIONS AND RECOMMENDATIONS

5.1. Overview

This study has employed a variety of approaches to investigate the effects of adopting simplified fare structures and fare systems in urban public transport. The review has been undertaken against the background of a fundamental variation in fare system policy between United Kingdom and continental undertakings.

It has been determined that the fare system involves four constituent aspects:

- the fare structure;
- fare collection arrangements;
- the ticket range;
- provision for through and integrated ticketin
- inspection methods.

These combine to play a crucial role in influencing the performance of the undertaking, both in commercial and public service terms.

Following a discussion of the nature of the various approaches which can be employed within the system, their application was investigated. A fundamental variation in fare system policy between British and continental operations was confirmed. The former tend to employ relatively complicated graduated fare scales with little or no scope for prepayment, whilst their continental counterparts use the simpler flat or zonal fares, often with a wide range of prepurchasable tickets.

In the light of this discrepancy, the bulk of the study has been devoted to determining to what extent the fears of British operators regarding the adoption of simplified fare systems are justifiable. The evidence obtained from various sources in order to assess the validity of this stance will now be collated and conclusions drawn for each of the four aspects of the fare system, before overall conclusions and recommendations are made.

5.2. Fare structure

At the outset it must be stated that conclusive evidence on the impact of simplified fare structures has been difficult to obtain. Even where information has been obtainable, it has often proved impossible to separate out the impact of the fare structure change from other influences upon performance.

Nevertheless, available evidence from various sources indicates that the move away from a graduated structure can be advantageous. Analysis of documented evidence, information supplied by continental operators for the purposes of this study, results from the Plymouth "Easyfare" experiment and the modelling exercise tends to show the positive effect of simplified fares upon levels of ridership. The situation for revenue, however, is less clear. There are indications that flat fares tend to perform badly in this respect, at least when compared with zonal and graduated structures. Nevertheless, the extent of the loss is generally small. There are strong indications that zonal fares tend to perform better than flat in terms of both ridership and revenue, a fact attributable to their ability to maintain a differential price in relation to distance travelled.

Simplified fares have the potential for recouping any initial revenue and patronage losses due to their enhanced attractiveness and convenience. There was evidence of this in the Plymouth experiment, from West Midlands P.T.E., London Transport, and a number of continental undertakings. There is also widespread evidence of an acceleration on boarding speeds, and of operating cost savings. Public reaction towards simplified fares is generally favourable, although opinions are strongly influenced by the effect upon the individual's own fare. People appreciate in particular the ease of understanding and convenience of such fare structures.

5.3. Fare collection

Similar problems of a lack of quantified information together with the presence of extaneous factors combined to hamper meaningful analysis in this area. The importance of the method of fare payment regarding the convenience and attractiveness of the public transport mode cannot be overemphasised, particularly when compared with the car. In discussing this part of the fare system, there arises an obvious overlap with ticket range (see section 4.4).

The dominant issues determining the choice of fare collection technique were vehicle operating speeds, costs, levels of fare evasion, and public acceptability. As far as cash payment is concerned there appears to be a discrepancy between the need to have a fast and efficient system and one which is popular with users. The review of documented evidence found that a recurrent theme was the serious impact of not having a fast and efficient fare collection system. The consequences were found to be increased operating costs, greater traffic congestion, and a poorer quality of service.

The British experience with automatic fare collection for buses has been sceptical, not least due to reliability problems. Continental operators have used highly automated systems to overcome the problem of having low operating costs whilst maintaining fast boarding speeds. They were often prepared to spend substantial amounts of capital in order to do this. These "open" systems, which rely strongly upon passenger self-service were not generally found to be particularly susceptible to fraud, provided that certain safeguards were incorporated into the system. Indeed, there was evidence of the trditional British methods of fare collection being more vulnerable than is generally admitted.

With regard to the crucial area of public acceptability, the review of documented material demonstrated that passenger resistance tends to be higher towards highly automated systems. In the Plymouth "Easyfare" scheme, people were found to prefer obtaining prepurchased tickets from retail outlets rather than machines. However, continental experience suggests that people find automated systems quite satisfactory after a short familiarisation period. A case may be made for considering ergonomic and marketing aspects in preference to costs when choosing a system, particularly since fare collection costs form such a small proportion of total operating costs.

5.4. Ticket range

One important area of investigation in this study has been the implications of offering prepurchased tickets as a means of prepayment for travel. Their impact is dependent upon the market share achieved, which is in turn critically influenced by the discount offered. The location and quantity of sales outlets, publicity and convenience also play and important part.

It has proved virtually impossible to isolate the influence of changes in ticket range upon ridership and revenue. A review of published material, together with information supplied by British operators, suggests the effect of multi-ride and travelcard tickets is to stimulate patronage, at the expense of a small loss in revenue. Returns from continental operators indicate that it is those undertakings which have promoted season tickets aggressively which appear to perform best in terms of ridership trends, although the level of discount offered obviously plays a part in influencing these trends.

There is widespread evidence of prepurchased ticket holders in general, and travelcard users in particular, having lower elasticities. It tends to be the most captive sections of the market which take most advantage of the discount. However, the corollary of this is that season ticket holders have been found to be less susceptible to price increases. Indeed, the Plymouth experiment indicated that there can also be a strong degree of loyalty towards multi-ride tickets - 94% of purchasers had maintained their use of it since its intrduction four months earlier.

All sources indicated the beneficial effects of prepurchase upon boarding speeds, with favourable repercussions for operating costs.

Public reaction towards prepurchased tickets is generally enthusiastic, provided the tickets are competitively priced, and are easily obtainable. The convenience of use they offer also plays an important part in their marketability. Prepayment has the advantage of placing payment for public transport on a similar footing to that for the private car, since the cost of each individual journey is no longer perceived.

5.5. Through and integrated ticketing

The need for interchange is a fact of life in urban transport, particularly in the larger cities, but nevertheless unpopular amongst users and potential users of the system. Prepayment generally provides an effective means of satisfying demand for through ticketing for frequent and regular users, but for other sections of the market, the issue is more problematical. It is imperative that a simplified fare scale be adopted if a facility for interchange on a single ticket is to be introduced.

There was found to be very few examples of widespread single journey through ticketing in the United Kingdom, although a few of the larger operators are moving tentatively towards it as part of comprehensive network integration schemes.

The available evidence suggests that, even allowing for the generation of additional trips, the provision of through and integrated ticketing results in a small revenue loss. Information supplied by two continental operators confirmed that an increase in the number of trips (as opposed to distance travelled) is caused. On the continent, any revenue losses appear to be viewed as a necessary price to be paid for offering a good quality service to the public, a fact which is reflected in passenger attitudes towards the system. The analyses of user preferences contained on published material suggest that money would be better spent on subsidising a system of integated fares and ticketing than on simply lowering fares.

5.6. Overall conclusions and recommendations

Notwithstanding certain problems of obtaining and interpreting information, this study can make useful and meaningful conclusions and recommendations on the scope for simplified fare systems in urban public transport. There is a strong interaction between the various elements of the fare system, and the nature of the fare structure has a key influence upon the other elements.

The most significant conclusion must be that with careful design and pricing simplified fare structures and ticketing need not cause appreciable financial loss. Indeed, there is much evidence that they can play an important role in enhancing the attractiveness of the public transport product. Furthermore, important advantages can be gained in terms of the potential for operating cost savings, reduction in scope for fraud, and enhanced comprehension and convenience for the user. When these factors are taken into consideration, the net effect of introducing simple fare structures, prepurchased tickets, and so on, is usually a positive one.

This potential should be exploited to the full if public transport is to retain or enhance its share of the market for urban transport. British operators should no longer avoid adopting simplified fare structures on the grounds of differences in the operating environments and subsidy levels between themselves and their continental counterparts.

APPENDIX 1 : LIST OF UNDERTAKINGS CONTACTED REGARDING FARE SYSTEMS

1. Interviews undertaken (see section 2.3.1)

A representative from each of the British Passenger Transport Executives (P.T.E.'s) (except Greater Glasgow P.T.E.), together with London Transport, was interviewed regarding their fare systems and the effects of any recent changes thereto. The full list is as follows:

London Transport
Greater Manchester P.T.E.
West Midlands P.T.E.
Merseyside P.T.E.
West Yorkshire P.T.E.
South Yorkshire P.T.E.
Tyne and Wear P.T.E.

Visits were also made to four British municipal undertakings which warranted special investigation by virtue of their experience with fare systems:

Newport Borough Transport
Nottingham City Transport
Lincoln City Transport
Kingston-upon-Hull City Transport

2. The Municipal Operator's Questionnaire (section 2.3.2)

All but seven of the British Municipal undertakings were sent a questionnaire concerning their fare systems in the Autumn of 1981. Those with a fleet size of less than 30 vehicles were excluded from the sample. Replies were received from 35 operators. In an effort to gain a complete picture, a less detailed questionnaire was sent to the 8 non-respondents, of which 7 subsequently replied. Questionnaires were not, of course, sent to those undertakings to which personal visits were made. A full list of operators contacted using the questionnaire is provided overleaf.

List of British Municipal Operators to whom a questionnaire was sent

England & Wales:

Barrow Corporation Transport Dept.
Borough of Blackburn Transport Dept.
Blackpool Corporation Transport Dept.
Bournemouth Transport
Borough of Brighton Transport Dept.
Burnley & Pendle Joint Transport Cttee.
City of Cardiff Transport (No response)
Chester City Transport
Chesterfield Transport Dept.
Cleveland Transit
Colchester Borough Transport
Cynon Valley Borough Council Transport Dept.
Borough of Darlington Transport Dept.
Derby City Transport
Eastbourne Borough Transport Dept.
East Staffordshire District Council Transport Dept.
Fylde Borough Council Transport
Grimsby and Cleethorpes Transport
Great Yarmouth Transport Dept.
Borough of Halton Transport
Hartlepool Borough Transport Dept.
Borough of Hyndburn Transport Dept.
Ipswich Borough Transport
Islwyn Borough Council Transport Dept.
Lancaster City Council Transport Dept.
Leicester City Transport
Maidstone Borough Council Transport Dept.
Merthyr Tydfil Borough Council Transport Dept.
Northampton Transport
Plymouth City Transport
City of Portsmouth Passenger Transport Dept.
Borough of Preston Transport Dept.
Reading Transport
Rossendale Transport
Rhymney Valley District Council Transport Dept.
Southampton City Transport
Southend Transport
Taff-Ely Borough Council Transport Dept.
Thamesdown Transport
Warrington Borough Council Transport Dept.

Scotland

Grampian Regional Council Dept. of Public Transportation
Lothian Regional Council Transport Dept
Tayside Regional Council Transport Dept

Barton Transport P.L.C., an important independent stage carriage operator in the Nottingham area was also sent a questionnaire.

3. Continental Undertakings contacted (section 2.3.3)

61 Continental European undertakings serving urban areas with populations in excess of 200,000 were contacted in the first instance, requesting details of their fare system, and of any important changes to their system in recent years. Following receipt of 36 replies, 12 of these undertakings were contacted again, asking for detailed information on the nature and effects of fare system changes they had reported in the first phase. Operators contacted in the second phase are denoted thus * .

France

Bordeaux * ✓
Lille
Lyon ✓
Marseille ✓
Nantes * ✓
Paris
Strasbourg ✓
Toulouse

Netherlands *

West Germany

Aachen ✓
Augsburg
West Berlin ✓
Bonn ✓
Braunschweig
Bremen ✓
Dortmund ✓
Duisberg ✓
Dusseldorf
Essen ✓
Frankfurt * ✓
Freiburg ✓
Hamburg * ✓
Hannover * ✓
Karlsruhe ✓
Kassel
Koln
Krefeld
Mannheim ✓
Munchen ✓
Nurnberg ✓
Stuttgart * ✓
Wiesbaden
Wuppertal ✓

List of Continental Operators contacted (continued)

Switzerland

- Basle * ✓
- Berne ✓
- Geneva
- Lausanne ✓
- Zurich ✓

Belgium

- Charleroi
- Antwerp
- Liege
- Ghent

(Charleroi, Antwerp, Liege, Ghent: S.N.C.V. * ✓)

Italy

- Bologna
- Genoa ✓
- Milan
- Naples
- Rome ✓
- Turin

Denmark

- Copenhagen * ✓

Norway

- Bergen ✓
- Oslo ✓
- Trondheim * ✓

Sweden

- Goteborg ✓
- Malmo
- Stockholm ✓

Finland

- Helsinki * ✓
- Tampere

Spain

- Barcelona
- Madrid

Appendix 2 (Page 1)

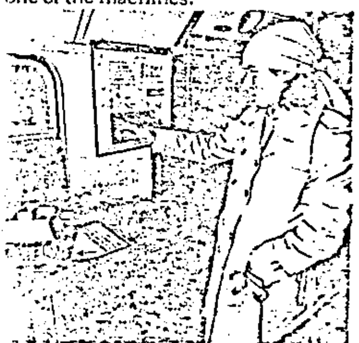
All you do is buy a ticket from the driver on one-man buses or from the conductor on other buses.

How do I use a Multi-Ride ticket?

We've made Multi-Ride tickets as simple to use as possible.

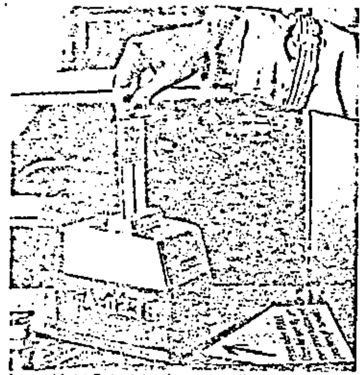
On routes where there is a conductor, tell him your destination, hand him your ticket and he will cancel the appropriate number of *units* for you.

On one-man buses you cancel the ticket yourself by inserting it in one of the machines.

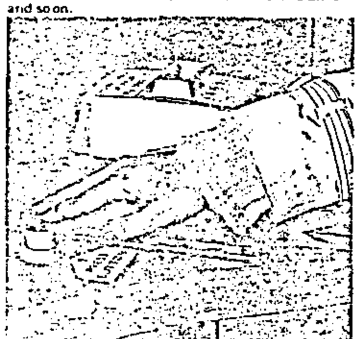


Decide how many *units of travel* to cancel for your journey.

If you intend travelling for what will be a 10p cash journey, then insert your ticket just once into the cancelling machine. If, however, you are travelling the 20p cash fare distance then insert your ticket twice, and if you are travelling the 25p or 30p cash fare distance then insert the ticket three times.



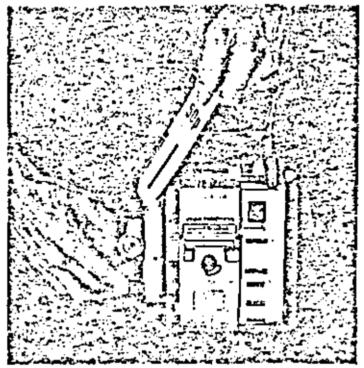
Insert Multi-Ride ticket into cancelling machine —once to cancel one *unit*; twice to cancel two *units* and so on.



Then press the button to release turnstile (double-deck one-man buses only).

Where can I use my Multi-Ride ticket?

You can use Multi-Ride tickets on any London Transport bus for any journey starting or finishing in the Borough of Havering (see map for boundaries).



On two-man buses hand the conductor your ticket, state your destination and he will cancel ticket for you.

The London Transport routes involved are: 66, 66B, 86, 87, 103, 165, 174, 175, 193, 246, 247, 247A, 247B, 248, 248A, 252, 294, N98.

Other routes (for local journeys) are:

London Country route 370 between Romford and Corbets Tey.

Eastern National route 26 between Romford and Cranham St. Mary's Lane, Front Lane.

Eastern National route 151 between Romford, Southern Way and Gallow's Corner.

Eastern National route 251 between Romford, Mawney Road and Gallow's Corner; and all points along this section and Gants Hill Station.

What more should I know about Multi-Ride tickets?

There is no time limit on their use, so they are worth buying whether you are a regular or occasional bus traveller.

If you make regular bus journeys you may find it convenient to buy more than one Multi-Ride ticket at a time. You can use up the remaining *units* on one ticket and start another.

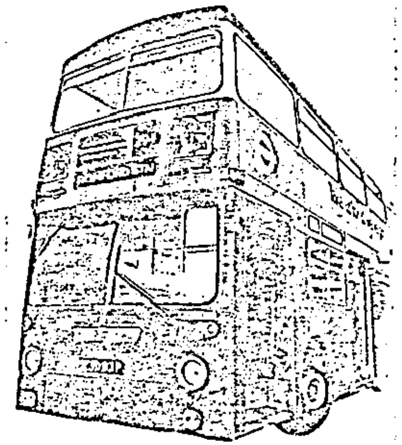
Even if it is fully cancelled you must keep your ticket until the end of the journey.

Each ticket may be used by only one passenger on the bus.

Tell us what you think about Multi-Ride by writing to:
Multi-Ride Experiment, Dept. 841/H, London Transport, 55 Broadway, London SW1 0BD.

1787000KP/200M Printed in England

Multi-Ride tickets save you time and money.

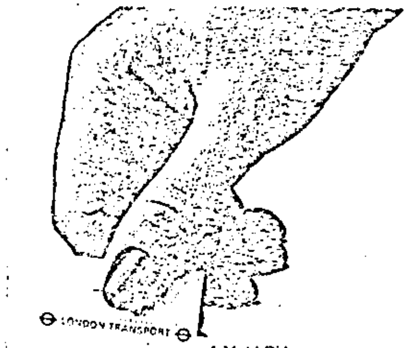


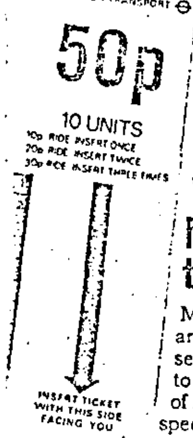
Starting in the Havering area from Sunday, 26 February 1978.

HAVERING AREA

APPENDIX 2 : LEAFLET EXPLAINING THE HAVERING MULTI-RIDE TICKET EXPERIMENT ADOPTED BY LONDON TRANSPORT 1978-80.

Appendix 2 (Page 2)





A Multi-Ride ticket costs 50p and is valid for 10 *units of travel.*

What is a Multi-Ride ticket?

Multi-Ride tickets are the latest in a series of experiments to test new methods of fare collection and speed up boarding times on one-man buses.

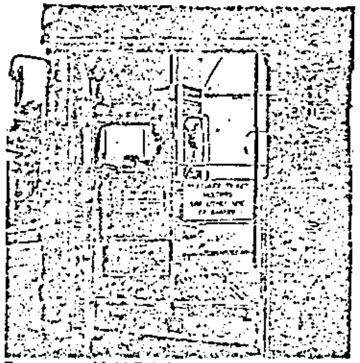
Instead of paying cash every time you get on a bus you will be able to buy one Multi-Ride ticket for 50p which is valid for several journeys, the number depending on the distance travelled.

When does it start?

You can start to use Multi-Ride tickets from Sunday, 26 February. But they will be on sale in buses from Sunday, 19 February. So buy early to avoid the first Monday morning rush.

Does it apply to me?

Yes, if you are an adult who travels in the Havering area and wants to save money on bus travel.



Entrance to a Multi-Ride bus.

How can Multi-Ride tickets save me money?

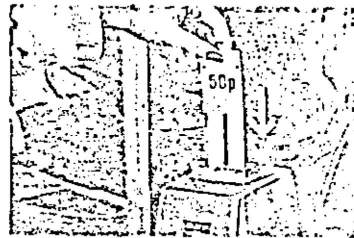
From 26 February there will only be three basic fares in the Havering area—10p, 20p and 30p (the off-peak maximum fare will remain at 25p)—*if you pay cash.* This means that the present 7p fare will become 10p, the 12p & 19p fares will become 20p and the 24p & 30p fares will become 30p.

But, if you use a Multi-Ride ticket, it will only cost you 5p, 10p and 15p respectively. That's because each Multi-Ride ticket costs 50p and gives you *10 units of travel*—equivalent to £1 in cash fares.

That's only *half* the new cash fares and even *less* than the present fares.

Red Bus Passes, Red Bus Rovers, Bus & Tube and Go-As-You-Please tickets and Elderly and Handicapped Persons' Travel Permits will, however, continue to be accepted, and child fares will remain unchanged.

Enter by left-hand side to buy Multi-Ride ticket from driver. Next time enter by either side.



Insert Multi-Ride ticket into cancelling machine next to driver—once to cancel one *unit,* twice to cancel two *units* and so on.

How much will I pay?

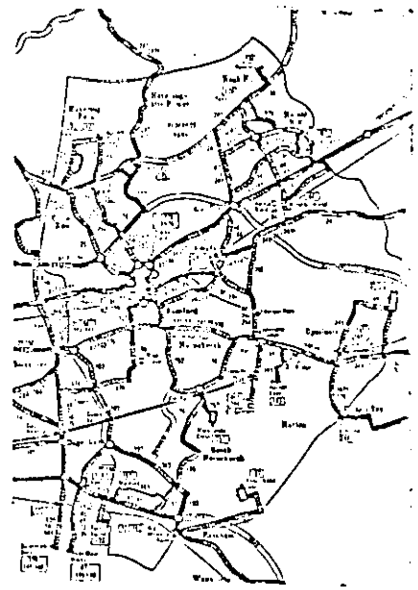
From 26 February fares in Havering will look like this:—

EXISTING FARES	NEW FARES Cash	Multi-Ride
7p	10p	1 unit (5p)
12p 19p	20p	2 units (10p)
24p 30p*	30p*	3 units (15p)
25p (off-peak maximum)	25p (off-peak maximum)	3 units (15p)

Additional fares on routes 247 and 247B into Essex will be:—

32p (off-peak maximum)	32p (off-peak maximum)	4 units (20p)
35p* 40p*	40p*	4 units (20p)

*peak hours only



Where can I get a Multi-Ride ticket?

You will be able to buy a Multi-Ride ticket on every London Transport bus operating on the routes covered by the experiment (see map).

APPENDIX 2 (Continued)

Appendix 3 : Copy of questionnaire distributed to British Municipal Undertakings

QUESTIONNAIRE

Name of undertaking ....

Please note: For the purposes of this questionnaire, disregard any concessionary fare schemes operated for senior citizens, disabled persons and/or children.

SECTION A

These questions seek factual details of your fare and ticket system(s).

A1. How many passenger carrying vehicles do you operate? ....

A2. What proportion of your fleet is one-man operated? ....%

A3. Please describe the following aspects of your current main fare collection system:

- It's structure (is it graduated, zonal or flat?):
- The driver's equipment (type of ticket issuing machine, cash handling arrangements, etc):
- Second stream arrangements (eg. self-service machines, ticket cancellors, etc.):
- Management information recorded by system (eg. passenger miles, number of tickets of different denominations, etc):
- Is change given?
- Provision for through* and/or integrated* ticketing (see definitions below):

* Through ticketing involves the use of just one ticket to cover two or more legs of a single journey, all of which are operated by your undertaking.
Integrated ticketing is similar, but allows the use of a single journey ticket on other operator's services, as well as your own.

A4. What percentage of current traffic is handled by your main fare collection system?

........% of ....

(Please specify measure used - eg. revenue, passenger miles, journeys).

If 100% go to A6.
If less than 100% go to A5.

A5 (a). Please describe the alternative(s) to your main fare collection system(s) (both present and past schemes), such as 'Travelcards' multi-journey tickets or flat fare schemes.

(Include the title, location and duration of scheme(s), together with market share achieved).

____

(b). This question relates to the observed effects of the alternative scheme(s) which you have described above.

Using the next page, use the appropriate space to describe the various effects of each scheme. If there are more than two schemes, please use a separate sheet or photocopy the original.

(A5 b) The impact of your alternative fare scheme(s). (See page 2).		
	ALTERNATIVE SCHEME (1)	ALTERNATIVE SCHEME (2)
<u>Effect upon:</u> Patronage		
Revenue		
Levels of fraud		
Boarding times		
Ability to provide management information		
Ease of interchange (Did it permit through and/or integrated ticketing)		
Ease of operation (Driver's workload and cash handling)		

A6. What future developments are planned or anticipated in the forseeable future as regards your fare and ticketing arrangements ?

SECTION B

These questions seek your opinion on certain matters relating to fare and ticket systems.

B1 (a). What are your reasons for issuing passengers with a ticket?

(b). To what extent would you be prepared to forego the attributes of ticket issue referred to above in order to use a different (possibly simpler) system?

B2. If any alternative fare and ticket schemes have been tried (see question A5), what were your undertaking's reasons for doing so?

B3. If your undertaking does not at present (or have plans to) employ any of the following fare and ticket systems, could you explain the obstacles involved in each case?

a). 'Travelcard' type tickets:

b). Multi-journey tickets:

c). Through and/or integrated ticket facilities (excluding 'Travelcard' type tickets):

B4 (a). Below is a list of factors arranged at random which may be considered when choosing a fare and ticket system. Bearing in mind the policy of your undertaking in this area, please indicate the importance you attach to each of them by ringing the appropriate number.

	High ←	Importance		→	Low
Impact upon revenue	5	4	3	2	1
Ability to cope with through and/or integrated tickets	5	4	3	2	1
Impact upon fraud	5	4	3	2	1
Cost of equipment	5	4	3	2	1
Impact upon boarding times (ie. speed of operation)	5	4	3	2	1
Impact upon patronage	5	4	3	2	1
Ease of passenger comprehension	5	4	3	2	1
Ability to provide management information	5	4	3	2	1

(b). Are there any factors missing from the above list which you regard as important when choosing a system ? Give them a numerical value using the scale above.

____

____

____

____

____

Signed ....

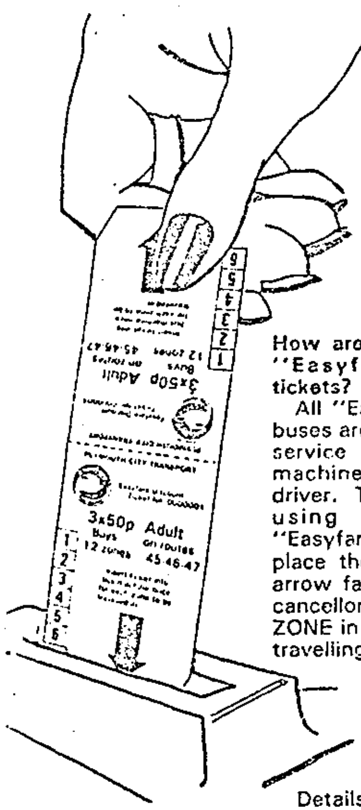
Position ....

Thank you very much indeed for your co-operation.

If you wish to make any further observations regarding fare and ticket systems, please attach a separate sheet of paper.

An S.A.E. is enclosed for your use.

Appendix 4 (Page 1)



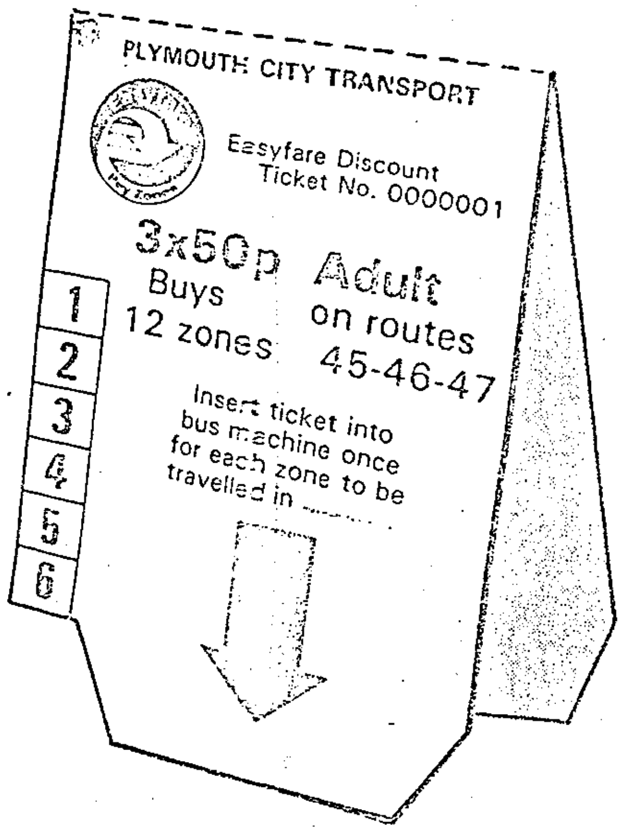
How are fares 'paid' with "Easyfare" Discount tickets?

All "Easyfare" pay zone buses are fitted with a self-service ticket cancelling machine along-side the driver. To pay your fare using a 12 zone "Easyfare" discount ticket place the ticket, with the arrow facing you, into the cancellor ONCE FOR EACH ZONE in which you will be travelling.

Details of your boarding zone, time of day and the date will be printed on the ticket to cancel the number of zones you use.

Remember to insert the ticket once for each zone. e.g. a three-zone journey will require three insertions into the cancellor to pay for your journey. The MAXIMUM fare is 3 zones.

To calculate your fare use our simple zone map overleaf.



APPENDIX 4: THE INFORMATION GIVEN BY THE LEAFLET PUBLICISING THE "EASYFARE" EXPERIMENT, WHICH WAS DELIVERED TO 18,000 HOUSEHOLDS IN AREAS AFFECTED.

(THE LEAFLET FOLDED NEATLY TO ONE-THIRD THE SIZE OF THIS PAGE)

PLYMOUTH CITY TRANSPORT

New Easyfare Pay Zones

APPENDIX 4.

On routes 45, 46, 47

The Simple Way to Pay Your Fare

☆ Britain's FIRST truly self service bus fare ☆

Begins on 14th February 1982

For: Brake Farm, Crownhill, Mainstone Leigham, Hartley & Mutley including DERRIFORD HOSPITAL

PLYMOUTH CITY TRANSPORT

new Easyfare Pay Zones

On routes 45, 46, 47

The Simple Way to Pay Your Fare

★ Britain's FIRST truly self service bus fare ★

Begins on 14th February 1982

For: Brake Farm, Crownhill, Mainstone, Leigham, Hartley & Mutley including DERRIFORD HOSPITAL

What are Easyfare Pay Zones?

They divide your bus route into areas making it easy to understand and calculate fares, therefore speeding up your journey.

Are Pay Zones cheaper than the old "stage" fares?

Most fares will be cheaper but a few could be slightly higher. This depends on where you live.

Remember — it is much cheaper to buy a multi-journey Easyfare ticket. Save 30p on 12 Adult zones.

How are Pay Zones charged?

On the simple zonal cash fares (see map) or by the NEW "Easyfare" Discount Ticket which you can buy in advance from one of our kerbside self service Ticket Traders.

What are the new cash fares?

15p per zone for Adults

10p per zone for Children & elderly people holding concession passes.

What is the Easyfare Discount Ticket?

A method of buying travel in advance from our kerbside Ticket Trader machines. It is a multi-journey ticket which can be bought and used at any time on routes 45, 46 and 47.

What do the 12 zone "Easyfare" Discount Tickets cost and are they cheaper?

You can save over 30p by purchasing "Easyfare" Discount Tickets which allow travel in 12 zones for ONLY:

£1.50 Adults (12½ pence per zone)

£1.00 Child/OAP (8⅓ pence per zone)

Where can "Easyfare" Discount Tickets be bought?

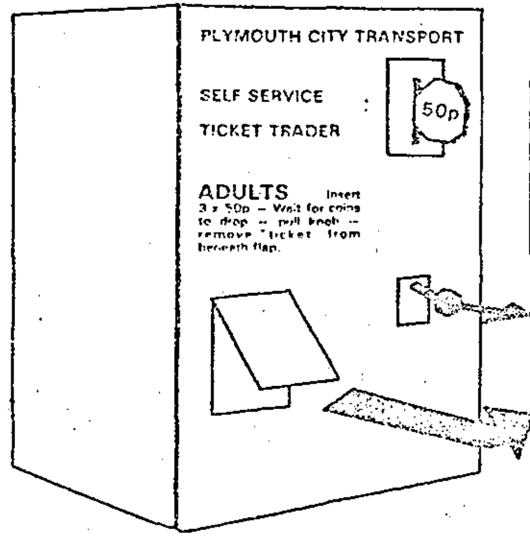
From our Self Service Ticket Trader machines situated at Royal Parade (Travel Kiosk), Mutley Plain (outside Halfords) and Miller Way (Leypark Drive — Asda stop)

Buying an Easyfare Discount Ticket

To buy a 12 zone "Easyfare" Discount Ticket from our self service Ticket Traders all you need are 50 pence pieces.

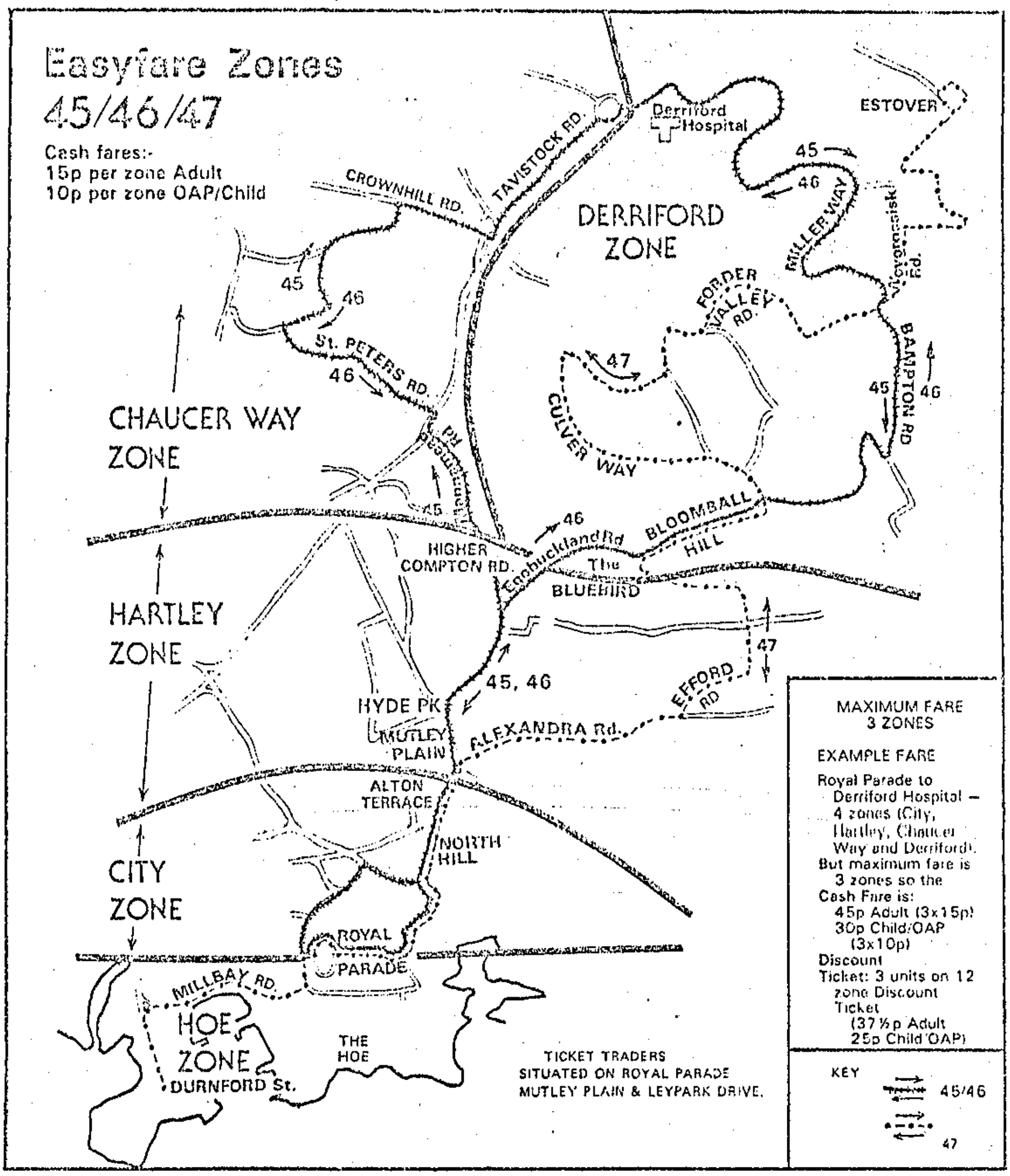
The ADULT 12 zone Ticket is obtained by inserting 3 x 50 pence pieces into a BROWN ticket trader.

The CHILD and Elderly Person Tickets are obtained by inserting 2 x 50 pence pieces into a YELLOW ticket trader.



Wait for the coins to drop, pull lever and take your 12 zone Discount Ticket from beneath the flap.

Please be sure to use the correct Ticket Trader — 12 zone "Easyfare" Discount Tickets are only available from a Ticket Trader and not obtainable on the bus.



N.B. Don't forget we also have on offer our **SPECIAL SHORT RIDE CASH FARE**: 2 Stops for only 10p Adult, 5p Child/OAP e.g. Board at stop 'A' alight at stop 'B' or 'C'.

and you can pay your fare with a 50p or £1 note e.g. if you tender £1 for a 45p fare (3 zones) a CASHCARD will be issued for your change (55p). You can either cash this immediately at our ROYAL PARADE KIOSK or use it towards your next fare.

FOR FURTHER DETAILS CONTACT
ROYAL PARADE KIOSK or BRETONSIDE ENQUIRY OFFICE — or telephone Plymouth 264816/7/8

Easyfare is the first system in Britain to use kerbside Ticket Traders. If you have any comments or ideas about this new system please write to:
PLYMOUTH CITY TRANSPORT, MILEHOUSE, PLYMOUTH.

CONFIDENTIAL

BUS PASSENGER SURVEY

This survey is designed to find out how well we are meeting your travel needs. Please answer all questions. Further comments on your bus services are welcomed and may be written on the back of the form.

036402

1. What is the MAIN PURPOSE of your journey? (Mark 1 box only)	To/From Work ☐	To/From Education ☐	To/From Shopping ☐	To/From Medical ☐	To/From Social ☐	To/From Other ☐				
2. What ADDRESS have you just come FROM?	....									
3. What ADDRESS are you now going TO?	....									
4. How did you get to the bus stop to catch THIS bus	Short Walk (1 or 2 mins) ☐	Longer walk ☐	Another Bus ☐ ⇨	Service number of PREVIOUS bus	Train ☐	Other ☐				
5. When you get off THIS bus, how will you get to your destination?	Short Walk (1 or 2 mins) ☐	Longer walk ☐	Another Bus ☐ ⇨	Service number of NEXT bus	Train ☐	Other ☐				
6. What type of TICKET have you got?	Monthly Ticket ☐	Weekly 4-a-day ☐	Dayrider ☐	Scholars free pass ☐	Scholar ½ pass ☐	Pensioner Disabled ☐	Employees ☐	Adult Single ☐	Child Single ☐	Easyfare Ticket ☐

Thank You For Your Help

OFFICE USE ONLY

P	FROM ADDRESS	TO ADDRESS	TS	LAST S	FS	NEXT S	T
☐	☐☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐	☐	☐☐☐☐	☐	☐☐☐☐	☐

APPENDIX 5 : SURVEY FORM USED IN THE ON-BUS SURVEY

Appendix 6 : The questionnaire used in the Household Survey.

PLYMOUTH CITY TRANSPORT/LOUGHBOROUGH UNIVERSITY

"EASYFARE" IMPACT SURVEY

Household Address ....

Introduction

Good evening. I'm from Plymouth City Transport. We're carrying out a study on the effects of the recently introduced "Easyfare" Zonal Fares Scheme. This household is one of those selected at random to take part in a survey, designed to give both bus users and non-bus users a chance to tell us how the new Fares Scheme has affected them, and what they feel about it. I wonder if you could spare me a few moments ?

(Ask if as many people in the household could be got together).

PART A - ALL RESPONDENTS	Person Number					
First of all, could I ask you/all of you some brief questions about yourself/yourselves, and your travel habits?						
Q1. How often do you use the local bus services in Plymouth? (Show Flashcard "A" and record response number). (For responses 1-5 go to Q.2) (For responses 6 or 7 go to Q.3)						
Q2. Could you tell me the route number (or numbers) of the local bus service (or services) you usually use?						
Q3. Which of these categories best describes how often you have the use of a car, either as a driver or a passenger ? (Show Flashcard "B" and record response number).						

Person Number

Q4. (a) Before this visit, were you aware of the new Zonal Fare System recently introduced on local bus routes 45, 46 and 47?

- YES
- NO

(If YES go to Q4b)
(If NO go to Q4c)

Q4. (b) How did you first learn of the new system?

- From the leaflet
- From the local press
- From friends/relations
- On local radio
- Other (specify)

Q4. (c) Do you remember receiving a leaflet about the new scheme through your letter box ?

- YES
- NO

(If YES go to Q4d)
(If NO go to Q5)

Q4. (d) Concerning this leaflet, did you,

- Read it in detail and understand it
- Read it in detail but found it confusing
- Just look at it quickly
- Not bother to read it

Person Number

Q5. Which of these age groups do you belong to ?

(Show Flashcard "C" and record response number)

Q6. (Record Sex - Male = M; Female = F)

(If there is a mixture of people who use the bus very rarely/never and who use it more frequently, say....)

The next group of questions is only for people who use the bus very rarely or never. Could I ask the rest of you to wait for a few moments before I come to you with questions?

(- FOR THOSE WHO USE BUSES VERY RARELY OR NEVER - i.e. NON BUS USERS - PROCEED OVERLEAF TO PART B;

- FOR BUS USERS, GO TO PART C - PAGE 6.)

		Non-bus user Person Number				
Q7. (a) Do you think the new fares system on your local bus services has altered the likelihood of your travelling by bus at any time in the future ?	YES - MORE LIKELY					
	YES - LESS LIKELY					
	NO					
(If YES - MORE/LESS LIKELY go to Q7b) (If NO go to Q7c)						
Q7. (b) What aspects of the new fares system have made you say this ?						
MULTI-CHOICE — - The increased simplicity of the system (such as fares easier to remember)						
- The convenience offered by the new multi-ride "Easyfare Discount Ticket"						
- Other (specify)						
Q7. (c) Are there any other changes that could be made to your local bus services that would make you more willing to use them ?						
(If YES go to Q7d) (If NO go to Q8)	YES					
	NO					
Q7. (d) What are these changes ?						
DO NOT PROMPT						

	Non-bus user Person Number					
Q8. Do you wish to make any further comments about the new Zonal fares scheme, the "Easyfare Discount Ticket", or local bus services in general?						

That is the end of the interview for the non-bus users.

Can I now ask the bus users some questions ?

	Bus-User Person Number				
Q9. (a) First of all, I'd like to get your views on the new Zonal Fares System on routes 45, 46 and 47. How do you feel aboutit ? (Use Flashcard "D" and record response number)					
Q9. (b) Are there any particular aspects of the new system that you like ?					
- Don't know/No					
- The cheaper fare					
- The discount offered by the "Easyfare Discount Ticket"					
- Easier to understand					
- Easier/more convenient to use					
- Other (specify)					
Q9. (c) Are there any particular aspects of the new system that you dislike?					
- Don't know/No					
- The more expensive fare (for adults)					
- The more expensive fare (for children/OAP)					
- Find it confusing					
- Find it inconvenient					
- Find it unfair					
- Other (specify)					

MULTI CHOICE (Q9. (b))

MULTI CHOICE (Q9. (c))

		Bus User Person Number				
Q.10 (a) Are there any aspects of the new Zonal System that you find complicated ? (If YES go to Q.10b) (If NO go to Q.12)	YES					
	NO					
Q.10 (b) Which aspects are these ?						
MULTI CHOICE	- Understanding the zones themselves					
	- Buying the "Easyfare Discount Ticket"					
	- Using the "Easyfare Discount Ticket"					
	- Other (specify)					
Q.11 Has the new Zonal System had any effect on the overall number of trips you make by bus ?	YES, INCREASE					
	NO CHANGE					
	YES, DECREASE					
Q.12 Has the new Zonal System affected your choice of bus service? In particular, of all your bus trips, do you make more, the same, or less trips using services 45, 46 and 47?	MORE					
	NO CHANGE					
	LESS					

	Bus User Person Number				
Q.13 Has the new Zonal System changed the bus stop you use?					
– No					
– Yes, walk to stop further from home					
– Yes, walk to stop closer to home					
– Yes, walk further to destination					
– Yes, walk less to destination					

NB. TWO ANSWERS POSSIBLE HERE

Q.14 (a) Are you aware of the "Easyfare Discount Ticket" which can be used on services 45, 46 and 47, and purchased in advance? (Show sample ticket)					
(If YES go to Q.14b) (If NO go to Q.15) YES					
NO					
Q.14 (b) How did you first find out about them ?					
– From the leaflet					
– From the local press					
– From friends/relations					
– From local radio					
– Other (specify)					

	Bus User Person Number					
Q.14 (c) Can you tell me where you can buy these tickets ?						
- Royal Parade						
- Mutley Plain						
- Asda/Miller Way						
- Co-op						
- Pascoes Newsagent (Crownhill)						
- Wrong Answer						
- Don't Know						
Q.14 (d) How many "Easyfare Discount Tickets" have you bought to date ? (Try to get an exact figure, but otherwise prompt with categories) (If NONE go to Q.14h) (Others go to Q.14e)						
NONE						
LESS THAN 5						
MORE THAN 5						
Q.14 (e) Over the last month, taking into account all your trips on routes 45,46 and 47, roughly what proportion involved the use of "Easyfare Discount Tickets" ?						
ALL						
MOST						
ABOUT HALF						
ONLY A FEW						

DO NOT PROMPT MULTI CHOICE

	Bus User Person Number					
Q.14 (f) What are your reasons for purchasing the "Easyfare Discount Ticket" ?						
- Offers a discount/cheaper						
- More convenient to use						
- Just wanted to try it out						
- Can be used by more than one person						
- There is no time limit on the ticket						
- Other (specify)						

MULTI CHOICE

Q.14 (g) If you have tried the "Easyfare Discount Ticket" but have decided not to continue doing so, why is this ?						
- Not applicable (will continue buying)						
- Does not offer enough saving						
- Cost of ticket is too much to pay at any one time						
- I do not ride often enough to justify buying the ticket						
- I found the ticket was used up too quickly						
- I found the location of the ticket vending machines inconvenient						
- I dislike using the ticket vending machines and/or the cancelling machines on the buses						
- Other (specify)						

MULTI CHOICE

	Bus User Person Number					
Q.14 (h) If you have heard about the "Easyfare Discount Ticket", but have not yet purchased any, why is this ?						
- Does not offer enough saving						
- Cost of ticket is too much to pay at one go						
- I do not ride often enough to justify buying the ticket						
- I think the ticket would get used up too quickly						
- I find the location of the ticket vending machines inconvenient						
- I dislike using the ticket vending machines and/or the cancelling machines on the buses						
- Other (specify)						

MULTI CHOICE

	Bus User Person Number				
Q. 14 (j) Would you be more likely to purchase the Easyfare Ticket if it were available,					
ONE ANSWER ONLY - From shops, newsagents and post offices.					
- From self-service machines on the bus					
- From self-service machines at bus stops					
- No more likely					
Q. 15 Do you wish to make any further comments about the new Zonal Fares Scheme, the "Easyfare Discount Ticket", or local bus services in general ?					

<u>That is the end of the interview. Thank you very much for your help.</u>

Appendix 7 (a) CHANGES IN ORIGIN/DESTINATION PAIRS FROM CITY CENTRE TO SUBURBS - WINTER SATURDAYS

- - - Old Fare Stage
—— Zone Boundary

Location	Stop number	Old fare from Royal Parade (001)	Old fare from Library/Polytechnic(479)	Zonal fare (ordinary)	Zonal fare with Discount Ticket	Increase in ordinary fare from Royal Parade(001)	Increase in ordinary fare from Library/Poly.(479)	Competing routes	% Change in trips from 6 Inner City stops(x)(1981-2)	% Change in trips from Royal Parade(001)(1981-2)	% Change in trips from Library/Poly.(479)(1981-2)	% Trips using Easyfare Discount Ticket
ROWANS	664											
DERRIFORD ROUNDABOUT	663		45p									0*
CHARLTON RD.	662											
CROWNHILL FORT	933											
FIRE STATION	865											
BRAKE RD.	864											
TOP ST. PETER'S RD.	863											
RUSKIN STORES	862											
S'PEARE RD/ST.PETER'S RD	861											
S'PEARE RD/COBBETT RD.	860	45p						27/27A	-15.6%	-18.0%	-33.5%	24.3%
VICTORY INN	859		40p	45p	37.5p							
COBBETT RD.	858											
THACKERAY GDNS.	857											
CHAUCER WAY SCHOOL	856											
SHIRLEY GARDENS	855											
BIG TREE	854											
SHERIDAN RD. JCT.	853											
BRONTE PL.	852											
HARDY CRES.	851											
GOLDEN HIND	658	40p	35p						-5.9	N/C	-100	0*
RUSSELL AVE.	657											
HARTLEY RESERVOIR	656											
VAPRON RD.	655	35p	25p	30p	25p				-31.3	+6.7	-84.6	9.4%
HENDERS CORNER	654											
SEYMOUR RD.	653											
MUTLEY PLAIN	651	25p						Numerous				
NORTH HILL	481		15p									
DEPTFORD PLACE	480			15p	12.5p							
POLYTECHNIC	479	15p										
CHARLES ST.	023											

*Small sample - figures somewhat spurious

(x) Stop Nos.: 001/023/479/480/481/651

Location	STOP NO.	Old fare to Royal Parade (001)	Old fare to Library/ Polytechnic (528)	Zonal fare (ordinary)	Zonal fare (with Discount Ticket)	Increase in ordinary fare to Royal Parade (001)	Increase in ord. fare to Library/Polytechnic (528)	Competing routes	%Change in trips to 9 inner city stops(x)1981-82	%Change in trips to Royal Parade (001) 1981-82	%Change in trips to Lib/ Polytechnic (528)1981-82	% of trips using Easyfare Discount Ticket
PATHWAY	666											
ROGATE DRIVE	667											
THORNBURY SCHOOL	668											
ROTHBURY GDNS.	669		45p									
BRENTWOOD GDNS.	670											
ESTOVER COMPREHENSIVE	671								-5.9	-6.8	-39.8	17.7
WASDALE GDNS.	648											
KESWICK CRESCENT	649											
LEYPARK DRIVE(PSDA)	672											
BAMPTON RD.	770											
COCKINGTON CLOSE	771											
SHEEPSTOR RD.	772	45p										
WINDMILL	773				37.5p							
BARNSTAPLE CLOSE	774											
WILBERT RD.(UPPER)	775		40p	45p					-19.5	+7.4	-30.1	16.1
WILBERT RD.(LOWER)	776											
DELAMERE RD/FORDER VAL.	777											
GRIZEDALE RD.	778											
DELAMERE SHOPS	779											
AUSTIN FARM SCHOOL	631											
DEER PARK	632											
DONNINGTON DRIVE	633	40p	35p						-46.4	-16.7	-62.5	10.5
WINDSOR RD.	1566											
BLUEBIRD	784							27/27A/28/29	N/C	+100	-45.8	24.4*
RISING SUN	785											
COLLINGS PARK	786											
PEARN HOME	787	35p	25p	30p	25p							
HENDERS CORNER	788											
EMMANUEL CHURCH	694								-45.3	+300	-74.3	2.9
SEYMOUR RD.	695											
MUTLEY PLAIN	697	25p	15p									
BRAIDWOOD TERRACE	526											
DEPTFORD PLACE	527							Numerous				
CENTRAL LIBRARY	528	15p		15p								
ALLEN'S GARAGE	025				12.5p							
NORTH CROSS	348											
COMET	349											

— · — Old Fare Stage

——— Zone Boundary

(x) STOP NOS: 697/526/527/528/025/848/849/850/001

*Small Sample - figures somewhat spurious

Appendix 7 (b): [illegible]

Location	Stop number	Old fare from Royal Parade (001)	Old fare from Library/Polytechnic (479)	Zonal fare (ordinary)	Zonal fare (with Discount Ticket)	Increase in ordinary fare from Royal Parade (001)	Increase in ord. fare from Library/Polytechnic (479)	Competing routes	Change in trips from 6 Inner City stops (x) 1981/2	% Change in trips from Royal Parade (001) 1981/82	% Change in trips from Library/Poly. (479) 1981/82	% of trips using Easyfare Discount Ticket
PATHWAY	681											
ROGATE DRIVE	680											
THORNBURY SCHOOL	679											
ROTHBURY GDNS.	678		[illegible]									
WENTWOOD GDNS.	677								+5.[illegible]	+5.[illegible]	[illegible]	[illegible]
ESTOVER COMPREHENSIVE	676											
YEWDALE GDNS/SHOPS	647											
KESWICK CRES. (BOTTOM)	646											
LEYPARK DRIVE (ASDA)	675											
BAMPTON RD.	769											
COCKINGTON CLOSE	768											
SHEEPSTOR RD.	767	45p										
WINDMILL	766			45p	37.5p							
BARNSTAPLE CLOSE	765								+0.9	+10.5	-0.5	[illegible]
WILBERT RD. (UPPER)	764		40p									
WILBERT RD. (BOTTOM)	763											
DELAMERE RD/FORDER VAL.	762											
GRIZEDALE RD.	761											
DELAMERE RD. SHOPS	760											
AUSTIN FARM SCHOOL	591											
DEER PARK	590											
DONNINGTON DRIVE	589							27/27A/28/29	-20.1	-17.[illegible]	-75.[illegible]	[illegible]
WINDSOR RD.	588	40p	35p									
BLOOMBALL HILL (TOP)	587											
BLUEBIRD	783											
RISING SUN	782								-47.[illegible]	-22.0	[illegible]	[illegible]
COLLINGS PARK	781											
PEARN HOME	780	35p	25p	30p	25p							
HENDERS CORNER	789								-31.7	-5.4	-56.[illegible]	[illegible]
SEYMOUR RD.	653											
MUTLEY PLAIN	651											
NORTH HILL	481	25p	15p									
DEPTFORD PLACE	480				12.5p			[illegible]				
POLYTECHNIC/LIBRARY	479			15p								
CHARLES ST.	023	15p										
ROYAL PARADE	001											

— — Old Fare Stage

—— Zone Boundary

(x) Stop nos.: 001/023/479/480/481/651.

[illegible] 21 people - figures [illegible]

Appendix 7 (c) CHANGES IN ORIGIN/DESTINATION PAIRS FROM CITY CENTRE TO SUBURBS - SERVICE 46 (WEEKDAYS)

Location	Stop No.	Old fare to Royal Parade (001)	Old fare to Library/ Polytechnic (528)	Zonal fare (ordinary)	Zonal fare with Discount Ticket	Increase in ordinary fare to Royal Parade (001)	Increase in ordinary fare to Library/Poly.(528)	Competing routes	Change in trips to 9 Inner City stops(x)(1981-2)	Change in trips to Royal Parade (001)(1981-2)	Change in trips to Library /Poly. (528)(1981-2)	% trips using Easyfare Discount Ticket
ROWANS	683		45p									*
DERRIFORD ROUNDABOUT	684											
CHARLTON RD.	685											
CROWNHILL (LOW LEVEL)	687											
CROWNHILL (HIGH LEVEL)	748											
FIRE STATION	866											
DRAKE RD.	867											
RUSKIN STORES	868											
S'PEARE RD/ST.PETERS RD	869	45p										
S'PEARE RD/COBBETT RD.	870		40p	45p	37.5p			27/27A	-24.7	+2.4	-47.6	19.6
VICTORY INN	871											
COBBETT RD.	872											
THACKERAY GDNS.	873											
CHAUCER WAY SCHOOL	874											
SHIRLEY GDNS.	875											
BIG TREE	876											
SHERIDAN RD. JCT.	877											
BRONTE PLACE	878											
HARDY CRESCENT	879											
GOLDEN HIND	689	40p	35p						-52.7	-27.3	-87.5	4.5*
RUSSELL AVE.	690											
HARTLEY RESERVOIR	691											
VAPRON RD.	692	35p	25p	30p	25p				-42.9	-20.0	-54.3	7.3
HENDERS CORNER	693											
EMMANUEL CHURCH	694							Numerous				
SEYMOUR RD.	695											
MUTLEY PLAIN	697											
BRAIDWOOD TERRACE	526	25p	15p									
DEPTFORD PLACE	527											
CENTRAL LIBRARY	528			15p	12.5p							
ALLEN'S GARAGE	025	15p										
NORTH CROSS	848											
COMET	849											
WESTERN APPROACH(BOTTOM)	850											

- - - - Old Fare Stage
——— Zone Boundary

* Small sample - figures somewhat spurious

(x) Stop Nos.:697/526/527/528/025/848/849/850/001

Appendix 7 (d) : CHANGES IN ORIGIN/DESTINATION PAIRS FROM SUBURBS TO CITY CENTRE - SERVICE 46 (WEEKDAYS)

Appendix 7 (e) :CHANGES IN ORIGIN/DESTINATION PAIRS FROM CITY CENTRE TO SUBURBS - SERVICE 47 (DIRECTION 1 - WEEKDAYS)

- - - Old Fare Stage
——— Zone Boundary

Location	Stop number	Old fare from Royal Parade (001)	Old fare from Library/Poly. (479)	Zonal fare (ordinary)	Zonal fare (with Discount Ticket)	Increase in ordinary fare from Royal Parade (001)	Increase in ord. fare from Library/Poly. (479)	Competing routes	Change in trips from 6 Inner City stops (x) 1981/2	Change in trips from Royal Parade (001) 1981/82	Change in trips from Library/Poly. (479) 1981/82	of trips using Easyfare Discount Ticket
VIADUCT	020	11p			12.5p			Numerous				
POLYTECHNIC	479			15p								
DEPTFORD PLACE	480											
NORTH HILL	481	21p	13p									
ALEXANDRA ROAD TOP	482							2?/23/22/25				
[illegible]	483											
ST. [illegible]'S CHURCH	484											
LIPSON VALE	485	35p	25p								-52.3	
EFFORD LANE (BOTTOM)	580			30p	25p				+0.9	+39.4		44.0
WEST [illegible] DRIVE	581											
[illegible] AVENUE	582											
ROYAL MARINE	583							9				
EFFORD CEMETERY	584								-4.1	+4.5	-54.0*	4[illegible]
DARTMEET AVENUE	585											
[illegible]	586											
[illegible] HILL	587	41p	35p					27/47A/28/29				
WINDSOR RD.	588								-44.4	+100	-71.[illegible]	13.1
DONNINGTON DRIVE	589											
DELL PARK	590											
AUSTIN FARM SCHOOL	591											
SHALLOWFORD RD.	592							27A				
SUMMERS CLOSE	593											
[illegible] CRESCENT	594			45p	37.5p				-30.7	+24.0	-18.7	12.0
[illegible] CLOSE	595		40p									
[illegible] GARDENS	596							27A				
[illegible] COURT	597											
[illegible] CLOSE	598	4[illegible]p										
[illegible]	599											
[illegible] RD.	600											
[illegible]	601											
[illegible]	602											
[illegible] DRIVE	603		45p									
[illegible]	604								-40.[illegible]	+4[illegible]	-[illegible]	[illegible]
[illegible] RD.	605											
[illegible] RD./CHELSON GDNS.	606											
[illegible] HILL RD.	607											
([illegible])	607-12											

x) Stop nos.: 001/020/479/480/481/482.

*[illegible]

Location	Stop number	Old fare to Royal Parade (001)	Old fare to Library/Poly. (479)	Zonal fare (ordinary)	Zonal fare with Discount Ticket	Increase in ordinary fare to Royal Parade (001)	Increase in ord. fare to Library/Poly. (479)	Competing routes	% change in trips to 6 inner City stops (x) 1981/2	% change in trips to Royal Parade (001) 1981/2	% change in trips to Library/Poly. (479) 1981/2	% of trips using Dayfare Discount Ticket
([illegible]R)	612/613											
[illegible] RD./CHELSON GDNS.	614											
[illegible]	615											
[illegible] DRIVE	616		[illegible]						[illegible]	[illegible]	[illegible]	[illegible]
[illegible] DRIVE	617		[illegible]						[illegible]	[illegible]	[illegible]	[illegible]
MILLER WAY	618											
[illegible]	619											
CHIL[illegible] WALK	620											
[illegible]	621											
[illegible] CLOSE	622											
[illegible] CLOSE	623	[illegible]										
[illegible] LANE/[illegible] LA	624							[illegible]				
[illegible] CLOSE	625								[illegible]	[illegible]	[illegible]	[illegible]
WESTCOTT CLOSE	626		40p	45p	[illegible]							
SPEEDWELL CRESCENT	627											
SUMMERS CLOSE	628							27/[illegible]				
CHURCH HILL	629											
SHALLOWFORD RD.	630							27/27A/28/29				
AUSTIN FARM SCHOOL	631											
DEER PARK	632								[illegible]	[illegible]	[illegible]	[illegible]
DONNINGTON DRIVE	633	45p	35p									
WINDSOR RD.	1536											
[illegible]	634								[illegible]	[illegible]	[illegible]	[illegible]
THE DAIRY	635								[illegible]	[illegible]	[illegible]	[illegible]
EFFORD CEMETERY	636											
ROYAL [illegible]	637							6				
DERWENT AVENUE	638											
WESTERN DRIVE	639			35p	25p				-19.0	-12.9	[illegible]	5.5
EFFORD LANE	544	55p	45p									
LIPSON VALE	522							22/2[illegible]				
ST. AUGUSTINE'S CHURCH	523											
[illegible]	524							[illegible]				
ALEXANDRA RD. TOP	525							[illegible]				
[illegible] TERRACE	526	2.5p	1.5p									
DEPTFORD PLACE	527							[illegible]				
CENTRAL LIBRARY	528	1.5p		15p	12.5p							
VIADUCT	021											

Key: — — — Old Fare Stage; ——— Zone Boundary

(x) Stop nos.: 522/526/527/[illegible]/[illegible]/001.

Appendix 7 (f): CHANGES IN ORIGIN/DESTINATION PAIRS FROM SUBURBS TO CITY CENTRE - SERVICE 47 (DIRECTION 2 - WEEKDAYS)

Appendix 8 (a) : Changes in bus stop use on P.C.T Route 45 1981-82

STOP NO. LOCATION	BOARDERS			ALIGHTERS		
	"BEFORE" (M.A.P.)	"AFTER" (EASYFARE)	CHANGE	"BEFORE" (M.A.P.)	"AFTER" (EASYFARE)	CHANGE
001 ROYAL PARADE	343	385	42•			
023 CHARLES STREET	60	77	17•		1	1
475 [illegible] ⊙	51	46	[illegible]•		[illegible]	[illegible]
480 DEPTFORD PLACE	14	9	[illegible]y	1	[illegible]	[illegible]
487 [illegible]	76	19	[illegible]	1	[illegible]	[illegible]
651 MUTLEY PLAIN ⊙	83	111	28	21	35	[illegible]
653 SEYMOUR ROAD	10	13	3	11	12	1
654 HENDERS CORNER	7	4	-3	15	8	-7
655 VAPRON ROAD		2	2	5		[illegible]
656 [illegible] RESERVOIR ⊙	9	7	-2	9	[illegible]	[illegible]
657 RUSSELL AVENUE	5	11	6•	3	6	3
658 GOLDEN HIND ⊙	25	16	-9•	13	10	-3•
851 HARDY CRES.	7	4	-3•	15	24	9•
852 BRONTE PL.	5	4	-1	26	22	-4
853 SHERIDAN RD. JCT.	2	1	-1	27	44	17
854 BIG TREE	1	6	5•	33	30	-3
855 SHIRLEY GARDENS ⊙	21	19	-2•	82	69	-13•
856 CHAUCER WAY SCHOOL	6	13	7	47	65	18•
857 THACKERAY GDNS.	29	10	-19	65	65	
858 COBBETT ROAD	34	22	-12	9	11	2
859 VICTORY INN	57	68	11	16	13	-3
860 SHAKESPEARE RD/COBBETT RD.	29	19	-10	25	25	
861 SHAKESPEARE RD/ST. PETERS RD	25	24	-1	39	39	
862 RUSKIN STORES	42	24	-18	27	24	-3
863 TOP ST. PETERS ROAD	12	12		20	9	-11
864 BRAKE ROAD	40	32	-8	10	8	-2
865 FIRE STATION	43	26	-17	13	18	5
933 CROWNHILL FORT	48	57	9•	11	11	
662 CHARLTON ROAD ⊙	32	4	-28•	3		-3•
663 DERRIFORD ROUNDABOUT	25	12	-13	12	27	15•
664 ROMANS	4	2	-2	3	14	11
665 DERRIFORD HOSPITAL ⊙	2	53	51	9	[illegible]	[illegible]
666 PATHWAY	14	12	-2	15	11	-4
667 ROGATE DRIVE	3	11	8	31	35	4
668 THORNBURY SCHOOL	22	36	14	91	59	-32
669 ROXBURY GARDENS	54	66	12	58	64	6
670 BENTWOOD GARDENS	20	27	7	33	19	-14
671 ESTOVER COMPREHENSIVE	6	11	5	13	11	-2
646 WASDALE GARDENS	58	70	12	50	43	-7
645 KESWICK CRESCENT	40	40		31	47	16
672 LEYPARK DRIVE (ASDA) ⊙	66	92	26	95	77	-18
770 HAMPTON ROAD	23	20	-3	17	8	-9
771 COCKINGTON CLOSE ⊙	35	66	31	19	29	10
772 SHEEPSTOR ROAD	120	115	-5	21	33	12
773 WINDMILL	67	56	-11	37	37	
774 BARNSTAPLE CLOSE	65	61	-4	21	28	7
775 WILBERT ROAD (UPPER)	2		-2	4	3	-1
776 WILBERT ROAD (LOWER)	2	3	1	7	11	[illegible]
777 [illegible] RD/FORDER VALLEY	4	8	4		1	[illegible]
778 GRIZEDALE ROAD	22	18	-4	9	10	1
779 DELAMERE SHOPS	10	3	-7	9	4	-5
630 AUSTIN FARM SCHOOL ⊙	86	59	-27	18	28	10
632 DEER PARK	29	14	-15	3	3	
633 DONNINGTON DRIVE	3	3		4	1	-3
1566 WINDSOR ROAD	4	3	-1	1	1	
784 BLUEBIRD	44	51	7	39	47	[illegible]
785 RISING SUN	3	6	3	5	3	-2y
786 COLLINGS PARK ⊙	21	5	-16	3	3	
787 PEARN HOME	3	10	7	7	5	-2
788 HENDERS CORNER	3	5	2	13	15	2
694 EMMANUEL CHURCH	13	10	-3	6	7	[illegible]
695 SEYMOUR ROAD	12	6	-6	15	8	-7
697 MUTLEY PLAIN ⊙	43	16	-27	133	119	-14•
526 BRAIDWOOD TERRACE	9	6	-3	19	31	[illegible]
527 DEPTFORD PLACE	3		-3	16	24	8
528 CENTRAL LIBRARY ⊙	3	1	-2	275	199	-76•
025 ALLEN'S GARAGE				13	27	14•
848 NORTH CROSS				36	26	-10•
849 COMET				59	76	17•
850 WESTERN APPROACH (BOTTOM)				44	51	7•
001 ROYAL PARADE				177	160	-17•

⊙ Old fare stage
526 Zone boundary (underlined)
• "Positive" effect at old fare stage
y "Positive" effect at zone boundary

Appendix 8 (b) : Changes in bus stop use on P.C.T. Route 46 1981-82

STOP NO. LOCATION	BOARDERS "BEFORE" (M.A.P.)	BOARDERS "AFTER" (EASYFARE)	BOARDERS CHANGE	ALIGHTERS "BEFORE" (M.A.P.)	ALIGHTERS "AFTER" (EASYFARE)	ALIGHTERS CHANGE
601 ROYAL PARADE	452	546	96 •			
[illegible]	[illegible]	100	[illegible] •			
[illegible] (O)	110	91	-19 •	2	1	-1
410 DEPTFORD PLACE	13	9	-4	4	[illegible]	[illegible]
[illegible]	21	20	-1	[illegible]	[illegible]	[illegible]
651 MUTLEY PLAIN (O)	148	159	11	30	16	-14y
653 SEYMOUR ROAD	8	15	7	20	8	-12
759 HENDERS CORNER	18	26	8	28	19	-9
760 PEARN HOME	4	1	-3	42	32	-10
761 COLLINGS PARK (O)				10	20	10
762 RISING SUN	2		-2y	9	24	15
[illegible]	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
587 BLOOMHALL HILL	4	2	-2	8	8	
588 WINDSOR ROAD	2	1	-1	9	9	
589 DONNINGTON DRIVE	3	4	1	10	14	4
590 DEER PARK	13	14	1	62	32	-30
591 AUSTIN FARM SCHOOL (O)	25	22	-3	58	51	-7
760 DELAMERE ROAD SHOPS	34	41	7	35	26	-9
761 GRIZEDALE ROAD	10	7	-3	25	23	-2
762 DELAMERE RD/FORDER VALLEY	4		-4		4	4
763 WILBERT ROAD (BOTTOM)		8	8		7	7
764 WILBERT ROAD (UPPER)		2	2	15		-15
765 BARNSTAPLE CLOSE	34	47	13	63	71	8
766 WINDHILL	46	40	-6	93	81	-12
767 SHEEPSTOR ROAD	47	43	-4	84	120	36
768 COCKINGTON CLOSE (O)	26	17	9	46	60	14
769 BAMPTON ROAD	8	3	-5	11	9	-2
675 LEYPARK DRIVE (ASDA) (O)	112	87	-25	108	114	6
646 KESWICK CRESCENT	46	48	2	29	39	10
647 YEWDALE GARDENS	35	45	10	45	60	15
676 ESTOVER COMPREHENSIVE	7	20	13	1	8	7
677 WENTWOOD GARDENS	11	25	14	32	41	9
678 ROTHBURY GARDENS	68	65	-3	51	56	5
679 THORNBURY SCHOOL	60	61	1	49	47	-2
680 ROGATE DRIVE	24	24		9	19	10
681 PATHWAY	25	9	16	37	13	-24
682 DERRIFORD HOSPITAL (O)	4	121	117	[illegible]	[illegible]	[illegible]
683 ROWANS	8	7	-1	10	16	6
684 DERRIFORD ROUNDABOUT	12	15	3	20	18	-2
685 CHARLTON ROAD (O)	6	8	2	22	32	10
687 CROWNHILL (LOW LEVEL)	17	5	-12	50	51	1
748 CROWNHILL (HIGH LEVEL)	50	38	-12	10	39	29
866 FIRE STATION	10	2	-8	19	23	4
867 BRAKE ROAD	52	15	-37	24	24	
868 RUSKIN STORES	34	47	13	26	20	-6
869 SHAKESPEARE RD/ST.PETERS RD.	44	29	-15	15	17	2
870 SHAKESPEARE RD/COBBETT RD.	26	29	3	29	12	-17
871 VICTORY INN	23	26	3	73	110	37
872 COBBETT ROAD	34	35	1	27	20	-7
873 THACKERAY GARDENS	63	43	-20	17	14	-3
874 CHAUCER WAY SCHOOL	61	72	11 •	24	19	-5
875 SHIRLEY GARDENS (O)	141	114	27 •	52	22	-30 •
876 BIG TREE	41	41		4	7	3 •
877 SHERIDAN ROAD JUNCTION	45	39	-6	1	5	4 •
878 BRONTE PLACE	33	17	-16	9	4	-5
879 HARDY CRESCENT	18	19	1	10	13	3
689 GOLDEN HIND (O)	47	21	-26	37	25	-12 •
690 RUSSELL AVENUE	1	5	4	6	8	2 •
691 HARTLEY RESERVOIR (O)	15	11	-4	19	12	-7
692 VAPRON ROAD	6		-6	2	1	-1
693 HENDERS CORNER	16	6	-10	10	6	-4
694 EMMANUEL CHURCH	24	23	-1	3	7	4
695 SEYMOUR ROAD	15	8	-7	21	15	-6
697 MUTLEY PLAIN (O)	43	11	-32y	114	108	-6
526 [illegible] TERRACE	4	10	6y	26	30	
527 DEPTFORD PLACE	5	2	-3	24	10	-11
528 CENTRAL LIBRARY (O)	3	4	1	297	183	-114 •
625 ALLEN'S GARAGE		1	1	4	17	13 •
648 NORTH CROSS				18	8	-10 •
649 COMET		1	1	75	78	3 •
650 WESTERN APPROACH (BOTTOM)				57	65	8 •
601 ROYAL PARADE				203	201	-2 •

(O) Old fare stage
526 (underlined) Zone boundary
• "Positive" effect at old fare stage
y "Positive" effect at zone boundary

Appendix 8 (c) : Changes in bus stop use on P.C.T. Route 47 (Direction 1) 1981-82

STOP NO.	LOCATION	BOARDERS "BEFORE" (M.A.P.)	BOARDERS "AFTER" (EASYFARE)	BOARDERS CHANGE	ALIGHTERS "BEFORE" (M.A.P.)	ALIGHTERS "AFTER" (EASYFARE)	ALIGHTERS CHANGE
570	DURNFORD STREET	157	123	-34			
571	ADMIRAL'S HARD	80	62	-18			
572	CAROLINE PLACE	12	12				
573	MILLBAY ROAD	5	9	4 •	1	1	
574	VOSPERS	6	8	2 •	3		-3
575	DUKE OF CORNWALL (O)	6	1	5 •	8	6	-2 •
576	HASKELL'S GARAGE	3	2	-1	5	13	8 •
1507	HALIFAX BUILDING SOCIETY	81	84	3	43	40	-3
001	ROYAL PARADE	265	269	4 •	69	82	13y
020	VIADUCT	88	56	-32 •	25	26	1y
479	POLYTECHNIC (O)	146	70	-76 •	24	8	-16y
480	DEPTFORD PLACE	8	5	-3	11	7	-4
481	NORTH HILL	39	39		18	12	-6
482	ALEXANDRA ROAD TOP (O)	87	84	-3	17	13	-4 •
483	BOWYERS		11	11	4	6	2 •
484	ST. AUGUSTINE'S CHURCH	10	23	13	6	8	2 •
485	LIPSON VALE	27	28	1	22	18	-4
580	EFFORD LANE (BOTTOM)	12	16	4	10	19	9
581	WESTERN DRIVE	4	12	8 •	32	38	6
582	DERWENT AVENUE	4	13	9 •	74	101	27
583	ROYAL MARINE (O)	44	35	-9 •	87	89	2
584	EFFORD CEMETERY	1	3	2	21	27	6
585	DARTMEET AVENUE	4	2	-2	20	28	8
586	[illegible]	16	15	-1	13	29	16
587	BLOOMBALL HILL	1	4	3	6	6	
588	WINDSOR ROAD	3	7	4	2	1	-1
589	DONNINGTON DRIVE	4	5	1	2	3	1
590	DEER PARK	5	5		13	14	1
591	AUSTIN FARM SCHOOL (O)	21	33	12	13	12	-1
592	SHALLOWFORD ROAD	12	15	3	17	25	8
593	SUMMERS CLOSE	6	9	3	20	24	4
594	SPEEDWELL CRESCENT	7	10	3	24	21	-3
595	WESTCOTT CLOSE	38	28	-10	70	32	-38
[illegible]	MARLOW GARDENS	2	14	12	39	8	-31
597	COOBAN COURT	12	20	8	27	53	26
598	HUXHAM CLOSE	4	15	11	19	8	-11
599	MILES MITCHELL	17	15	-2	24	15	-9
600	NOVOROSSISK ROAD (O)	4	5	1	15	10	-5 •
601	LANGDALE GARDENS				9	21	12 •
602	MILLER WAY JUNCTION		3	3	39	40	1
603	PATTINSON DRIVE		1	1	14	25	11
604	CRESSBROOK DRIVE				19	11	-8
605	WEIR ROAD				23	29	6
606	WEIR RD/CHELSON GDNS.		1	1	35	30	-5
607	COLWILL ROAD	2		-2	15	15	
608	ESTOVER ROUNDABOUT				29	5	-24
609	ESTOVER ROAD				39	19	-20
610	ESTOVER CLOSE	6		-6	9	33	24
611	COLD STORE				9	8	-1
612	WRIGLEYS				21	27	6

(O) Old fare stage
576 Zone boundary
• "Positive" effect at old fare stage
y "Positive" effect at zone boundary

Appendix 8 (d) : Changes in bus stop use on P.C.T. Route 47 (Direction 2) 1981-82.

STOP NO.	LOCATION	BOARDERS "BEFORE" (M.A.P.)	BOARDERS "AFTER" (EASYFARE)	BOARDERS CHANGE	ALIGHTERS "BEFORE" (M.A.P.)	ALIGHTERS "AFTER" (EASYFARE)	ALIGHTERS CHANGE
[illegible]	[illegible]	48	67	19			
613	COLWILL ROAD	29	18	-11			
614	WEIR RD/CHELSON GDNS.	22	23	1			
615	WEIR ROAD	15	22	7			
616	CRESSBROOK DRIVE	23	22	-1		1	1
617	PATTINSON DRIVE	16	12	-4			
618	MILLER WAY	32	40	8 *	3	1	-2
619	LANGDALE GARDENS	13	21	8	2		-2
620	CHILDREY WALK O	23	31	8			
621	MILES MITCHELL	15	18	3	6	9	3
622	HUXHAM CLOSE	11	13	2	31	11	-20
623	BELLAMY CLOSE	23	20	-3	18	12	-6
624	CULVER WAY/LINKETTY LANE	25	27	2	12	23	11
625	CULVER CLOSE	27	36	9	1		-1
626	WESTCOTT CLOSE	84	31	-53	36	41	5
627	SPEEDWELL CRESCENT	11	23	12	1	6	5
628	SUMMERS CLOSE	18	15	-3	4	4	0
629	CHURCH HILL	19	9	-10	16	1	-15
630	SHALLOWFORD ROAD	17	11	-6	24	10	-14
631	AUSTIN FARM SCHOOL O	55	45	-10	14	4	-10
632	DEER PARK	28	13	-15	9	10	1
633	DONNINGTON DRIVE	4	3	-1	5		-5
1566	WINDSOR ROAD	2	3	1	8	2	-6
634	BLUEBIRD	7	24	17	13	32	19y
635	THE DAIRY	23	23		10	3	-7y
636	EFFORD CEMETERY	4	7	3 *	3	11	8
637	ROYAL MARINE O	94	82	-12 *	28	31	3
638	DERWENT AVENUE	37	48	11	4	8	4
639	WESTERN DRIVE	11	17	6	2	8	6
541	EFFORD LANE	23	22	-1	3	6	3
522	LIPSON VALE	23	22	-1	16	21	5
523	ST. AUGUSTINE'S CHURCH	9	10	+1	4	12	8
524	BOWYERS	4	2	-2	4	5	1
525	ALEXANDRA ROAD TOP O	3	2	-1	56	75	19
526	BRAIDWOOD TERRACE	15	15		14	18	4y
527	DEPTFORD PLACE	4	3	-1	19	11	-8y
528	CENTRAL LIBRARY O	15	6	-9 *	215	153	-62 *
021	VIADUCT	8	3	-5 *	45	50	5 *
001	ROYAL PARADE	44	70	26 *	81	90	9 *y
012	DRAKE CINEMA	55	59	4	46	42	-4y
640	DUKE OF CORNWALL O		1	1	15	11	-4y
641	VOSPERS				9	7	-2
642	MILLBAY ROAD				9	12	3
643	CAROLINE PLACE				31	23	-8
644	ADMIRAL'S HARD				52	71	19
645	DURNFORD STREET				69	104	35

O Old fare stage

526 Zone boundary

* "Positive" effect at old fare stage

y "Positive" effect at zone boundary

APPENDIX 9

A DISCUSSION OF THE USE OF ELASTICITIES IN FORECASTING DEMAND FOR PUBLIC TRANSPORT

1. The meaning and derivation of elasticities

When the price or quality of public transport services changes, a change in the level of ridership inevitably follows. The factor which relates ridership to the user's fare (or more usefully to the generalised cost of travel which includes time as well as money costs) is called the price elasticity of demand. Elasticity is the key factor in any predictive model for studying the effects of alternative fare policy options.

There are four principal methods for computing the elasticity of demand, each producing a slightly different result. It is beyond the scope of this study to provide a detailed explanation of these methodologies, but their formulae can be summarised as follows:

Point elasticity: $$E_{pt} \approx \frac{dQ}{dF} \times \frac{F}{Q}$$

Shrinkage ratio: $$E_{sr} = \frac{Q_2 - Q_1}{Q_1} \div \frac{F_2 - F_1}{F_1} = \frac{\Delta Q / Q_1}{\Delta F / F_1}$$

Midpoint elasticity: $$E_{mid} = \frac{(Q_2 - Q_1)}{(Q_2 + Q_1)/2} \div \frac{F_2 - F_1}{(F_2 + F_1)/2} = \frac{(Q_2 - Q_1)\ (F_2 + F_1)}{(Q_2 + Q_1)\ (F_2 - F_1)}$$

Arc elasticity: $$E_{arc} = \frac{\log Q_2 - \log Q_1}{\log F_2 - \log F_1}$$

where Q_1 and F_1 represent the initial levels of ridership and fares respectively, and Q_2 and F_2 represent the new levels of ridership and fares (ref. 70).

The point elasticity is derived from the actual ridership demand curve and can be taken at any point along the curve. Although it is probably the most accurate of the four approaches, in many instances insufficient information is available to develop such functions, either for groups of passengers or the system as a whole. The shrinkage ratio (or loss ratio) is the most commonly used method, although the midpoint and arc definitions will yield more consistent results, especially for large fare changes. The shrinkage ratio is the approach has been used for the simulation exercise in part 4.

The choice of elasticity values used in the study has been based upon a review of findings elsewhere. Sufficient work has been done in this field for the choice of values to be made with some confidence. Most British urban operators customarily estimate a passenger resistance of about -0.3. That is to say, for each 10% rise in fares, 3% of ridership is lost. This "golden rule" is supported by a number of studies, the results of which are summarised in table A1.

However, it must be recognised that not only does the aggregate value tend to vary from place to place, but more importantly, the various categories of passenger who combine to make up the aggregate value have been proved to posess markedly different elasticities of demand. Hence it is desirable to break down the market in terms of length of journey, person type, journey purpose and mode of travel. Elasticities have been found to vary considerably within each of these areas, as the following discussion will show.

TABLE A1 : SUMMARY OF AGGREGATE PRICE ELASTICITY OF DEMAND VALUES FOR URBAN PUBLIC TRANSPORT

Lago/Mayworm/McEnroe (67 US cities)(1981)	-0.28 ± 0.16
Bly (1976)	-0.30
Oldfield (1974)	-0.20
Simpson & Curtin (1968)	-0.33
Goodwin	-0.40
Tulpule	-0.40
DoE (UK cities 1973-75)(1976)	-0.23
Bly (1976) - UK cities	-0.30
- USA cities	-0.41
- West German cities	-0.34
- Others	-0.32
Demand for Public Transport (TRRL 1980)	-0.30 ± 0.02
- UK	-0.33 ± 0.03
- USA	-0.23 ± 0.03
- West Germany	-0.34 ± 0.04
- Australia	-0.37 ± 0.06
- Others	-0.31 ± 0.07
Kindt (Time series analysis 1955-66)	-0.32
- Aachen	-0.32
- Bremen	-0.30
- Duisberg	-0.32
- Essen	-0.27
- Hamburg	-0.41
- Oldenburg	-0.33
- Wiesbaden	-0.30

2. Elasticity and length of trip

Evidence suggests that for urban public transport, very short trips (up to 1 mile) and relatively long ones (3 miles or more), are more elastic than trips of intermediate length. Empirical research by London Transport produced a value of -0.30 for trips up to 1.6km, -0.24 for those between 1.6 and 4.8km, but -0.33 for longer trips. Furthermore, following a rise in fares in 1975, LT found that the elasticity exhibited by those passengers paying the minimum fare was -0.50, compared with -0.35 for bus passengers as a whole. As White suggests (71), elasticity of demand is essentially the result of the degree to which the bus trip can be substituted. In the case of very short trips, relatively high elasticities can be explained by the tendency for many people to walk to avoid the rise in fare. Even with a graduated scale, the relatively high fare per unit distance travelled over short distances is a further source of volatility of demand in this sector of the market.

Variations in elasticities over longer distances are caused by the larger fare values involved making people more susceptible to a change of mode and/or change in trip frequency. With the exception of the work journey, most trips made over longer distances (such as shopping or entertainment) are of a nature that can be easily deferred (see section 3).

A further apect of elasticity by journey length is of particular relevance to the choice of fare structure. Investigation has shown that elasticities for passenger journeys are consistently lower than those for passenger kilometres travelled. A figure of -0.23 was found for passenger trips and -0.38 for passenger kilometres by Welsby et al (72), whilst work at LT produced elasticities of -0.3 and -0.4 respectively (73). When faced by a fare rise, people will board a stage later or alight a stage earlier to avoid its effects. Hence, the number of journeys made will not fall so quickly as the miles travelled. This effect, however, is less pronounced for coarse fare structures (and, of course, impossible for flat fare situations), and generally disappears over time.

3. Elasticity and journey purpose/time of day

The work journey is appreciably less elastic than most other journey purpose types. Lago et al produced an elasticity of -0.10 ± 0.04 for work trips, compared with -0.23 ± 0.06 for shopping trips (70). Wabe and Coles derived figures of -0.19 and -0.49 respectively (74), whilst a TRRL study found work trips to have elasticities in the range -0.05 to -0.35 compared with -0.28 to -0.70 for shopping and leisure trips (75). Evidence elsewhere (73)(76) supports these findings.

Journey purpose is, to a large extent, reflected in elasticities by time of day. With work trips being concentrated in the peak, elasticities at these times are lower than those during other periods. A summary of peak/off-peak elasticities is presented in table A2. Weekend elasticities are similar to those of weekday off-peak periods. It may be surmised that larger fare increases can be tolerated in the peak periods, thus strengthening the argument for time-differentiated fares.

TABLE A2 : SUMMARY OF DISAGGREGATE PEAK/OFF-PEAK ELASTICITIES

	Peak	Off-peak
Lago/Mayworm/McEnroe (US cities)	-0.17	-0.40
Smith & Mackintosh (Stevenage)	-0.32	-0.84
Demand for Public Transport (TRRL 1980)		
- London buses	-0.27	-0.37
- London Underground	-0.10	-0.25
Fairhurst/Morris (London buses)	-0.20	-0.40

4. Elasticity and city size

Indications are that, generally speaking, average elasticities increase as the size of the urban area decreases. Lago et al (70) found that from a sample of 44 US cities, those with a population greater than 1 million posessed an average value of -0.24 (±0.10), between ½-1 million -0.30 (±0.12), and smaller than ½ million -0.35 (±0.12). A review undertaken by the TRRL (75) produced elasticity ranges of -0.1 to -0.6 for "large", -0.1 to -0.5 for "medium", and -0.2 to -0.7 for "small" urban areas. These trends are supported by findings elsewhere (see, for example, 77 and 78).

The most likely explanation is that congestion, high parking charges and longer distances reduce the likelihood of people being able to use alternative modes. In smaller areas, walking, cycling or the private car are more viable as alternatives.

5. Elasticity and direction of fare change

Although the available evidence is by no means conclusive, indications are that passengers are less likely to react to a fare reduction than a fare increase. Kemp (79) states that on the basis of findings from the monitoring of ridership in Atlanta, fare reductions had a proportionately smaller effect on ridership (elasticity -0.18) than fare increases (elasticity -0.60). Simpson and Curtin found that whilst their widely circulated value of -0.33 held good for fare rises, reductions produced a figure of just -0.20 (80). These results are contradicted by Lago et al (70) who found from analysis of undertakings in 23 US cities a -0.34 value for fare increases, but a slightly higher figure of -0.37 for cuts in fare.

The most likely explanation for the lower elasticity values for fare decreases is that once people dissuaded from using public transport by fares increases have made alternative arrangements, they are reluctant to revert to using buses or trains even if fares are reduced.

6. Elasticity and mode of travel

Bus travellers tend to be more responsive to fares changes than rapid transit or rail users. Lago et al (70) produced a figure of -0.35 for buses, -0.17 for rapid transit, and -0.31 for long distance rail commuter services. Comparitive studies of London bus and Underground travel patterns have produced consistently lower elasticities for the latter mode. The ratio of bus to rail elasticity is given variously as -0.30/-0.07 and -0.35/-0.15 for London (73), -0.22/-0.13 for New York (81), and -0.20/-0.12 for Paris (82).

7. Elasticity and ticket type *

Fare elasticities for travelcards and, to a lesser extent, multi-ride tickets tend to be lower than those for single cash fares. This is primarily because prepurchased tickets tend to be used to a greater extent for work trips, although enhanced convenience also plays a part. Both Gutknecht (8) and Bly (83) mention the relatively low elasticities exhibited by travelcard holders, although no figure are provided. However, a study of bus usage in the West Midlands (84) produced figures of -0.10 and -0.32 for travelcard holders and conventional cash fare payers respectively. Observations in Paris (85) produced figures of -0.14 and -0.20 respectively, whilst investigation of fares increases in 12 areas of West Germany between 1974-76 produced the following elasticity ranges:

Single ticket	-0.50 to -0.80
Multi-journey ticket	-0.10 to -0.60
Season ticket	-0.10 to -0.30

(Source: ref. 86)

When attempting to assess the impact of relative changes in price between ticket types upon ridership and revenue, cross elasticities are most relevant. This represents the relationship between the proportionate change in demand for a particular ticket type and the proportionate change in the price of a rival variety. In most cases it would be acceptable to assume that elasticities are calculated in a way which makes implicit allowance for all cross elasticities embodied in the fare changes themselves, so that it is only the net impact upon demand which is being measured. However, if large differential price changes between different parts of the market are being contemplated, then the likelihood of significant transfers

* See also section 2.2.4.

of passengers makes it necessary to introduce explicit assumptions about cross-elasticity. It should be noted that cross-elasticities are unreliable unless the split of traffic between ticket types is taken into account. They tend to change rapidly as market shares alter. A better policy is to take the modal split modal as a base from which cross-elasticities may be deduced in a given situation. An example of how cross-elasticities might work is given below.

A review of previous experience led London Transport to incorporate the cross-elasticity values shown in table A3 into their Fares Model (87).

Table A3: Transfers of traffic resulting from a selective fares increase in ticket type
(% change in passenger miles)

	Bus cash fares	Bus passes	Rail cash fares	Rail seasons
Bus cash fares	-0.79	+0.54	+0.25	
Bus passes	+0.91	-1.52	+0.35	+0.26
Rail cash fares	+0.60	+0.18	-1.15	+0.37
Rail seasons		+0.25	+0.40	-0.65

Source: LT Technical Note 119.

The reduction in use of bus passes and ordinary rail cash fares is surprisingly high, although the behaviour of rail season ticket holders reflects the lower elasticity of that group in relative terms.

8. Use of elasticity values in the simulation exercise

Whilst having determined that, in reality, elasticities can vary considerably, both at aggregate and disaggregate levels, considerations of practicability meant that the number of individual values employed in the simulation exercise had to be kept to a minimum. It was decided to use a range of aggregate elasticity values in order to perform a sensitivity test The values chosen are listed in section 4.1.

APPENDIX 10A : PERCENTAGE CHANGE IN PATRONAGE AND REVENUE WITH ZONAL AND FLAT FARES

PLYMOUTH CITY TRANSPORT SERVICE NO.45

(See table 75 for details)

	ZONAL					FLAT				
ELASTICITY SCENARIO	0.0	-0.1	-0.3	-0.5	Worst	0.0	-0.1	-0.3	-0.5	Worst
PATRONAGE										
Mean		-0.4	-1.5	-2.6	-5.7		-1.0	-3.2	-5.3	-10.5
Median		-0.5	-1.9	-3.2	-6.2		-2.0	-6.2	-10.2	-12.5
Network "Low" Scale		+0.6	+1.9	+3.4	-3.4		+1.0	+3.1	+5.3	-6.9
Network "High" Scale		-0.5	-1.9	-3.2	-6.2		-2.0	-6.2	-10.2	-12.5
Network "Practical" Scale		-0.2	-0.7	-0.8	-5.1		-0.3	-0.8	-1.5	-8.9
REVENUE										
Mean		-0.3	-1.5	-2.2	-5.6		-0.1	-3.2	-5.3	-10.5
Median	+2.7	+2.2	+1.0	-0.8	-2.7	+9.0	+6.8	+2.2	-2.1	-4.6
Network "Low" Scale	-9.8	-9.2	-8.0	-6.7	-12.1	-19.0	-18.2	-16.5	-14.7	-24.6
Network "High" Scale	+2.7	+2.2	+1.0	-0.8	-2.7	+9.0	+6.8	+2.2	-2.1	-4.6
Network "Practical" Scale	-2.4	-2.5	-2.8	-2.8	-6.4	-6.6	-6.9	-7.4	-8.0	-14.9

APPENDIX 10B : PERCENTAGE CHANGE IN PATRONAGE AND REVENUE WITH ZONAL AND FLAT FARES

PLYMOUTH CITY TRANSPORT SERVICE NO.46
(see table 75 for details)

	ZONAL					FLAT				
ELASTICITY SCENARIO	0.0	-0.1	-0.3	-0.5	Worst	0.0	-0.1	-0.3	-0.5	Worst
PATRONAGE										
Mean		-0.6	-1.6	-2.8	-6.0		-1.3	-3.7	-6.5	-12.4
Median		-0.7	-2.5	-4.0	-7.5		-2.4	-7.2	-12.0	-14.5
Network "Low" Scale		+0.4	+1.8	+3.6	-3.7		+0.8	+2.8	+4.9	-7.0
Network "High" Scale		-0.7	-2.5	-4.0	-7.5		-2.4	-7.2	-12.0	-14.5
Network "Practical" Scale		-0.3	-0.7	-0.9	-5.5		-0.4	-0.9	-1.7	-9.6
REVENUE										
Mean		-0.5	-1.3	-2.2	-4.7		-1.3	-3.7	-6.5	-12.4
Median	+3.4	+2.9	+1.5	+0.2	-2.3	+10.1	+7.5	+2.2	-3.1	-5.8
Network "Low" Scale	-9.3	-8.7	-7.7	-6.1	-11.5	-18.1	-17.3	-15.6	-14.0	-23.2
Network "High" Scale	+3.4	+2.9	+1.5	+0.2	-2.3	+10.1	+7.5	+2.2	-3.1	-14.5
Network "Practical" Scale	-1.9	-1.9	-2.3	-2.4	-5.9	-6.0	-6.5	-6.9	-7.4	-14.3

APPENDIX 10C : PERCENTAGE CHANGE IN PATRONAGE AND REVENUE WITH ZONAL AND FLAT FARES

PLYMOUTH CITY TRANSPORT SERVICE NO.47*
(See table 75 for details)

	ZONAL					FLAT				
ELASTICITY SCENARIO	0.0	-0.1	-0.3	-0.5	Worst	0.0	-0.1	-0.3	-0.5	Worst
PATRONAGE										
Mean		-0.6	-1.4	-2.1	-7.3		-1.4	-3.9	-6.3	-15.2
Median		-1.4	-4.1	-6.6	-9.5		-2.0	-5.8	-9.7	-16.3
Network "Low" Scale		+0.2	+0.7	+1.4	-5.5		-0.7	-2.1	-3.3	-13.4
Network "High" Scale		-1.4	-4.1	-6.6	-9.5		-4.4	-12.8	-21.7	-23.0
Network "Practical" Scale		-0.8	-2.4	-4.0	-8.2		-2.4	-7.1	-11.7	-17.5
REVENUE										
Mean		-0.7	-1.3	-1.9	-8.1		-1.4	-3.9	-6.3	-15.2
Median	+8.2	+6.9	+4.4	+2.0	-0.4	+13.1	+11.0	+7.0	+2.8	+0.7
Network "Low" Scale	-6.3	-6.1	-5.5	-5.0	-10.5	-5.5	-6.1	-7.5	-8.6	-18.1
Network "High" Scale	+8.2	+6.9	+4.4	+2.0	-0.4	+27.3	+21.6	+11.0	-0.3	-2.0
Network "Practical" Scale	+2.3	+1.5	+0.2	-1.4	-4.9	+2.5	+1.6	+0.3	-1.0	-3.6

* One direction only.

APPENDIX 10D : PERCENTAGE CHANGE IN PATRONAGE AND REVENUE WITH ZONAL AND FLAT FARES

WEST MIDLANDS P.T.E. SERVICE NO.10
(see table 75 for details)

	ZONAL					FLAT				
ELASTICITY SCENARIO	0.0	-0.1	-0.3	-0.5	Worst	0.0	-0.1	-0.3	-0.5	Worst
PATRONAGE										
Mean		-1.6	-2.9	-4.3	-6.9		-1.5	-4.1	-7.0	-11.9
Median		-0.5	-2.0	-3.2	-6.1		-2.5	-8.0	-13.8	-16.4
Network "Low" Scale		+1.0	+4.2	+7.5	-1.7		+1.5	+5.5	+9.2	-5.5
Network "High" Scale		-0.9	-3.8	-6.7	-9.0		-1.4	-3.8	-5.8	-12.1
Network "Practical" Scale		0.0	+1.3	+2.6	-3.4		+0.5	+1.2	+1.4	-9.0
REVENUE										
Mean		-0.1	-0.7	-0.9	-4.7		-1.7	-4.6	-7.4	-13.0
Median	+5.2	+4.6	+2.7	+1.4	-0.8	+11.5	+8.8	+2.6	-3.9	-6.8
Network "Low" Scale	-18.7	-17.6	-14.8	-12.1	-19.6	-30.3	-29.2	-26.5	-23.9	-34.1
Network "High" Scale	+8.4	+7.4	+4.7	+2.1	0.0	-2.4	-3.8	-6.2	-8.1	-14.2
Network "Practical" Scale	-9.7	-9.1	-7.9	-6.6	-11.9	-16.4	-16.0	-15.3	-15.2	-23.9

APPENDIX 10E : PERCENTAGE CHANGE IN PATRONAGE AND REVENUE WITH ZONAL AND FLAT FARES

WEST MIDLANDS P.T.E. SERVICE NO.68
(See table 75 for details)

	ZONAL					FLAT				
ELASTICITY SCENARIO	0.0	-0.1	-0.3	-0.5	Worst	0.0	-0.1	-0.3	-0.5	Worst
PATRONAGE										
Mean		-1.6	-2.9	-4.3	-6.9		-1.5	-4.1	-7.0	-11.9
Median		-0.1	-0.1	-0.2	-4.2		-1.1	-3.1	-5.2	-10.9
Network "Low" Scale		+1.0	+3.6	+6.2	-2.3		+1.1	+4.1	+7.0	-5.0
Network "High" Scale		-1.6	-5.1	-8.6	-11.1		-2.0	-6.2	-10.5	-14.4
Network "Practical" Scale		+0.2	+1.0	+1.7	-3.6		-0.4	-1.2	-1.7	-9.3
REVENUE										
Mean		-0.9	-2.4	-3.4	-6.3		-1.5	-4.0	-7.0	-11.8
Median	-4.2	-4.3	-4.4	-4.5	-7.9	-3.3	-4.4	-6.3	-8.3	-13.8
Network "Low" Scale	-15.8	-14.9	-12.7	-10.5	-17.4	-24.4	-23.6	-21.4	-19.2	-28.2
Network "High" Scale	+12.3	+10.5	+6.6	+2.6	+0.7	+5.8	+3.7	-0.8	-5.3	-9.5
Network "Practical" Scale	-6.4	-6.3	-5.6	-4.8	-9.3	-9.3	-9.7	-10.4	-10.9	-17.7

APPENDIX 10(F) : PERCENTAGE CHANGE IN PATRONAGE AND REVENUE WITH ZONAL AND FLAT FARES

WEST MIDLANDS P.T.E. SERVICE NO.96
(See table 75 for details)

	ZONAL					FLAT				
ELASTICITY SCENARIO	0.0	-0.1	-0.3	-0.5	Worst	0.0	-0.1	-0.3	-0.5	Worst
PATRONAGE										
Mean		-0.4	-1.2	-1.9	-4.7		-0.7	-2.3	-3.8	-8.7
Median		-0.5	-2.1	-3.8	-5.5		-0.7	-2.3	-3.8	-8.7
Network "Low" Scale		+0.7	+2.2	+3.8	-2.8		-0.7	-2.3	-3.8	-8.7
Network "High" Scale		-2.5	-6.4	-12.3	-14.4		-4.8	-15.1	-25.4	-25.6
Network "Practical" Scale		0.0	-1.6	-3.3	-5.0		-3.1	-9.3	-14.8	-17.6
REVENUE										
Mean		-0.2	-0.9	-1.4	-4.1		-0.7	-2.3	-3.8	-8.7
Median	+5.3	+4.8	+3.0	+1.3	-0.1		-0.7	-2.3	-3.8	-8.7
Network "Low" Scale	-9.1	-8.4	-6.8	-5.3	-11.1		-0.7	-2.3	-3.8	-8.7
Network "High" Scale	+21.2	+18.2	+12.4	+6.6	+4.7	+39.8	+33.0	+18.6	+4.2	+3.9
Network "Practical" Scale	+1.0	+0.7	0.0	-0.7	-3.6	+19.8	+16.1	+8.7	+2.1	-1.2

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