# REPORT TO CONGRESS CONCERNING THE DEMONSTRATION OF FARE-FREE MASS TRANSPORTATION

DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION



JULY 1975

THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

July 21, 1975

Honorable Nelson Rockefeller
President of the Senate
Washington, D. C. 20510

Dear Mr. President:

I am pleased to submit to the Congress herewith the first Annual Report on Fare-Free Mass Transportation. This report has been prepared by the Department as part of the ongoing Service and Methods Demonstration Program activity in the Urban Mass Transportation Administration and is intended to provide information consistent with that required in Sections 204 and 205 of Title II of the National Mass Transportation Assistance Act of 1974.

Currently available funds will be used by the Urban Mass Transportation Administration to commence work on the design of fare-free transit experiments within the general framework of the Title II program objectives.

I believe that this Annual Report will be useful to the Congress in reviewing this subject of interest in the transportation field.

Sincerely,

William T. Coleman, Jr.

Enclosure

THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

July 21, 1975

Honorable Carl Albert
Speaker of the House
of Representatives
Washington, D. C. 20515

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# INTRODUCTION

Title II of the National Mass Transportation Assistance Act of 1974 provides authority to appropriate a total of $40 million dollars to fund the "research and the development, establishment and operation of demonstration projects to determine the feasibility of fare-free urban mass transportation systems." The Title also calls for the Secretary of Transportation to make annual reports to the Congress on the information gathered by the projects.

This report which was prepared as part of the ongoing research effort of the Service and Methods Demonstration Program is intended to provide information consistent with that required in Sections 204 and 205 of Title II of the National Mass Transportation Assistance Act of 1974. It surveys briefly the current state of knowledge with regard to the benefits and costs of fare-free transit, and describes the essential elements of a demonstration program to enhance understanding of the subject.

Technical assistance in the preparation of the report was received in particular from Michael A. Kemp of The Urban Institute.

## SUMMARY OF KEY POINTS

- This report concerns the demonstration of fare-free urban public transport services. It surveys very briefly the current state of knowledge with regard to the benefits and costs of abolishing transit fares, and describes the essential elements of an appropriate demonstration program.

### The current state of knowledge

- Advocates of fare-free transit claim that it would improve the efficiency of the transportation system as a whole, would help transit systems (in particular) operate more efficiently, and would assist certain groups within the population.

- Because of what is currently known about the relative importance of transit fare levels in influencing urban travel behavior, many observers are skeptical about the ability of across-the-board fare subsidies alone to encourage people to forsake private automobiles in favor of public transit. The magnitude of potential transit system efficiency gains and the relative effectiveness of low fares in assisting certain population groups are also the subjects of some doubt.

- However, there are many open questions on this issue which a well-designed program of experimentation would help to resolve.

### Plans for a demonstration program

- The overriding objective of publicly-funded demonstrations of transit fare abolition should be to learn; that is, to provide definitive answers about the costs and the efficacy of fare cuts in achieving their objectives, such as increased ridership. This can only be achieved if a strong emphasis is placed on matters of experimental design.

- A demonstration program contemplated under provisions of the 1974 Act and placing a major part of its emphasis on the detailed evaluation of system-wide fare abolition might select up to three experiments involving bus systems. For example:

-- one city with an existing transit ridership of between 15 and 20 million passengers per year; or

-- two transit systems, one with existing ridership on the order of 5 to 7 million per year and the second on the order of 10 to 13 million per year; or

-- three transit systems with current patronage levels at around 9 million, 6 million, and 3 million, in differing urban environments.

- One or more system-wide fare elimination experiments could be supplemented by more selective (and less costly) projects which would abolish fares at specific times, for specific groups of people, or for specific services.

- System-wide elimination of fares on a rail rapid transit system would be prohibitively expensive. It might be possible and useful to experiment with fare elimination on selected rail transit services, but this would provide only a limited indication of the potential cost savings which rail systems might make if fares were to be abolished system-wide.

- For system-wide demonstrations, an appropriate duration from inception to completion would be between 3 and 5 years, during which period fares would be abolished for about 2 years.

- The objectives of Title II, as set out in Section 204, are embraced almost completely by the type of demonstration program envisaged in this report. However, such a program would be at variance with some of the criteria for site selection specified in Section 203 (e.g., number of projects, financial viability of systems, innovative service requirements). The Department would expect to comment on such matters in subsequent reports pursuant to Section 205.

- During Fiscal Year 1976, work will commence on the design of an appropriate program of fare-free transit experiments, under funding provided by UMTA's Service and Methods Demonstration Program.

## THE OBJECTIVES OF LOW FARE TRANSIT

### Benefits claimed from free-fare service

The advocates of low fare or fare-free transit services usually point to a number of potential benefits which they claim would accrue from reducing or abolishing fares. In broad overview, the arguments in support of fare-free transit can be summarized into three categories: 1/

- the "transportation system efficiency" argument: "low fares help divert people out of private cars and onto transit"

  Each passenger-mile on a transit vehicle typically consumes less energy, causes less air pollution, requires less parking space provision, and (under congested conditions) contributes less to traffic congestion than does a passenger-mile by private automobile. It is consequently argued that, given a fixed capacity transportation system and a pattern of travel demands to be satisfied, the higher the proportion of journeys made by transit in preference to the private car, the lower will be the total costs to the community and the greater will be the net benefits. And, it is claimed, low or no transit fares encourage this diversion. In other words, fare-free transit would help the urban transportation system as a whole to function more efficiently.

  A corollary to this claim is a further assertion that, over the longer term, diversion of travelers from cars to transit will reduce "the need for" urban highway construction and will moderate the continued growth in automobile ownership.

  It is especially felt that in the central city, transit service at low or no fare may be used in conjunction with other measures such as a parking tax to reduce auto use.

- the "transit efficiency"argument: "fare-free service will help transit systems operate more efficiently"

  Abolition of fares would abrogate the costs (currently borne by transit agencies) which are involved in collecting, handling

1/ The detailed case for abolishing transit fares has been articulated by, inter-alia, Abrams (1971), Aleshire (1971), Amalgamated Transit Union (1975), Greenspan (1975), and Scheiner & Starling (1974).

counting, and guarding farebox revenues. With no longer any need to collect money from boarding passengers, boarding times would be reduced leading to faster average vehicle speeds and perhaps more frequent and reliable service. Transit industry productivity could increase. Vehicles and stations could be redesigned to permit more efficient passenger movement. The likelihood of theft by transit personnel would diminish. There is also some possibility that transit liability insurance costs could fall. Overall, it is argued, fare abolition should lead to lower total costs to society in providing the same, or even an enhanced, level of transit service.

A related argument suggests that alternative forms of transit financing, say by means of payroll, per capita, or sales taxes, would provide a more assured and predictable income to transit systems, encouraging better long-term planning and investment decisions.

It is also argued that by lowering off-peak fares, unnecessary trips would be diverted from the peak-period, thereby easing the amount of transit resources needed to serve peak-period demand.

- the "welfare role of transit" argument:
  "low transit fares can help groups of the population which it is felt socially desirable to assist"

  It is claimed that low transit fares can achieve or reinforce other, non-transportation objectives felt to be socially desirable. In particular, assistance to two groups of the population is usually mentioned in this regard. The first group comprises the poor (particularly residents of poverty areas) and the unemployed. The second group is the downtown business community--it is argued that fare-free transit service will help revitalize deteriorating central city areas.

## The current level of understanding about these issues

These three broad arguments underlie most of the advocacy of fare reduction and abolition. They have been summarized without endorsement or discussion. Many of the above statements about benefits are, in fact, open to considerable contention.

For example, with respect to the transportation system efficiency argument, there are some strong reasons to question whether across-the-board fare subsidies alone are a very cost effective means of encouraging people to forsake private automobiles in favor of public transit. These doubts derive in large measure from the fact that,

relatively speaking, the travel behavior of the public at large is not really very sensitive to the level of transit fares. Empirical evidence from a wide range of different sources supports this observation. For instance, some studies have analyzed the transit patronage response following fare increases or reductions; some past transit demonstration projects have specifically experimented with variations in the fare level or structure; other analysts have studied how travel behavior(that is, choices about where to travel, and which route or mode to take) varies among people who face different travel prices; and yet other studies have used marketing and psychometric research techniques to understand how people make travel decisions. 2/ By and large, the evidence from all of these different approaches confirms that, relative to their sensitivity to the prices of many goods or services, consumers respond less markedly to changes in transit fares and the other prices of local travel (parking charges, gasoline prices, or highway tolls, for example). In economics jargon, the price elasticities of demand for both private automobile and transit travel are usually quite small. 3/

This low sensitivity of patronage to the level of the fare has led many analysts to question the efficacy of using the farebox alone as a means of diverting car users onto transit. Their argument is reinforced by a second empirical observation--that a given percentage reduction in the door-to-door journey times by transit is likely to have a larger effect on ridership than is the same percentage reduction in fares. In other words, more people are likely to be lured onto transit by improved service than by lowered fares. It may well be true that for many transit systems the funding necessary to abolish fares would have a greater impact on patronage were the same amount of money to be spent on well-planned service improvements aimed at reducing average travel times. These are, however, matters about which there is some uncertainty, and on-going research under UMTA's Service and Methods Demonstration Program is currently addressing these questions.

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2/. Appendix A summarizes the available evidence about the factors influencing travel behavior in greater depth.

3/ The price elasticity is a measure of the sensitivity of demand to changes in prices. A direct price elasticity for a travel mode represents the sensitivity of demand to a change in the price of that mode; a cross-elasticity, on the other hand, represents the sensitivity of demand for one mode to changes in the price of another (competing or complementary) mode. Thus, for example, the cross-elasticity of automobile demand with respect to transit fare is a measure of the level of diversion from private car following a change in transit fares.

There is also considerable uncertainty about the validity of the claims that fare abolition would enhance the efficiency of the transit system itself. For example, the extent to which average bus speeds may increase following fare elimination will depend partly on the degree to which private automobile travel has been diverted onto transit. Further, the potential magnitudes of any operating cost savings and productivity increases are very difficult to gauge from anything short of experimentation with actual fare elimination over a complete transit system. One analysis has suggested that the cost savings which might accrue from the elimination of fare collection expense "probably range from zero to something less than five percent of current costs, and are small enough to be regarded as negligible for the Nation as a whole." 4/ Others have estimated the total operating cost savings at anything between five and 30 percent on a per-vehicle-mile basis. 5/

The welfare role argument, too, is something of an open question. It appears that for many (although certainly not all) transit services, fare abolition would indeed help the poor to a greater extent than it would help the more affluent--but the overall incidence of the program will depend both on the income circumstances of the people who ride the transit system and also on the source of financing. What few analyses have been carried out for specific fare subsidies 6/ suggest that, particularly when sales tax revenues are used to pay for transit, the subsidy can represent an income transfer from low income non-transit users in favor of low income transit users. Further, the efficacy of low fare transit in aiding downtown business is also largely undetermined, though there are indications of a positive impact associated with limited applications such as a free-fare zone for the central business district or special low fare or free-fare shuttles in these downtown areas.

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4/ Domencich & Kraft (1970).

5/ Scheiner & Starling (1974); Greenspan (1975).

6/ For example, Getz (1973) has investigated the net incidence of the benefits and costs from investment in transit services in Atlanta (Georgia). Frankena (1973) has studied the net incidence of transit subsidy programs in Canada.

The "conventional wisdom"

Considerations like these, and particularly the low sensitivity of transit patronage to fare changes, has led many transportation analysts to be somewhat skeptical of the value of abolishing fares across a complete transit system. In large part, this skepticism derives from a study commissioned by the Department of Transportation in 1967, 7/ which concluded that, while system-wide fare-free service could indeed help achieve many of the benefits claimed by its proponents, it would do so only at a relatively high cost. In particular, selective service improvements would probably achieve many of the same benefits at a much lower level of costs.

While the 1967 study contained a number of questionable assumptions and problems, 8/ the methodology used was as good as the current state-of-the-art, and its conclusions have, by and large, not been negated by the increased experience and further research accrued since it was published. Transportation analysts tend to be less skeptical about the efficacy of specifically-targeted fare cuts (that is to say, reductions provided for specific transit services, or times of day, or segments of the market) than they are of system-wide fare elimination.

However, it is apparent that there remains a great deal of uncertainty about many aspects of the impacts of fare abolition--the ridership response, the transit system efficiency implications, and over a longer term, the ways in which households and firms will adjust their travel, budgetary, employment, and location decisions.

Some of these areas of uncertainty are, in fact, being researched. For example, UMTA's Service and Methods Demonstration Program has supported a limited experiment into fare-free service on and around the campus of the University of Massachusetts at Amherst. The project linked the campus, the city of Amherst, and several apartment complexes with new and expanded service. The bus fleet, the service provision,

7/ Domencich & Kraft (1970).

8/ For example, the city chosen for the study's main focus--Boston, Mass.--is atypical in several ways; in particular, the operating costs of the Boston transit system are significantly higher than transit industry norms. Another major assumption is inherent in the way in which the patronage increase following fare elimination had to be projected. This involved an extrapolation far outside the range of prices and behavior encompassed in the study's data base. While this is often the only practicable procedure for forecasting the outcome of events of which there exists no practical experience, the validity of the forecasts must remain open to doubt.

and the ridership level have all grown markedly since the project's inception in January 1973. Evaluation of the data collected in the demonstration is nearing completion, but it has been hampered by some important external effects such as changes in local parking policies and the 1973/74 fuel shortages.

Also under investigation is the cost-effectiveness of various transit agency actions, including fare reductions, in their ability to increase ridership. Operating data from the San Diego bus transit system are being analyzed in an attempt to explain variations in patronage among routes and over time.

It remains true, however, that a program of carefully designed and monitored experiments with fare-free services for the general public could significantly enhance our understanding of many of the issues currently in doubt.

## THE IMPLICATIONS FOR THE DESIGN OF A FARE-FREE DEMONSTRATION PROGRAM

### The need for an experimental viewpoint

The current state of understanding about the benefits and costs of fare-free public transport services, reviewed briefly in the preceding section and in Appendix A, has some important implications for the manner in which a demonstration program should be designed.

The first implication concerns the experimental content of such a program. Demonstrations of public policy ideas have been used to serve two distinctly different purposes. The first is exemplary in nature: an idea or technology of proven high promise is implemented in a number of different operational environments with the objective of displaying its effectiveness and thereby encouraging its wider adoption. The second purpose is experimental: in this case, an idea or technology of largely unknown value is implemented or tested selectively with the objective of learning more about its suitability as public policy.

The gaps in current understanding about the costs and benefits of fare-free public transport services (coupled with the skepticism derived from desk analysis of the idea) argue strongly that any demonstrations of the concept should be regarded as experimental rather than exemplary--one is trying to learn rather than to promote an idea of proven value. In particular, demonstrations of fare-free services should not be concerned solely with the feasibility of financing transit through means other than the farebox; they must address a much wider range of concerns, including such questions as:

- what is the patronage response to fare elimination? How much of that response can be ascribed to the fare change, and how much to other concomitant changes on the transit system (which might otherwise have been made in their own right without removing the fares)?
- how does fare abolition impact on the transportation system as a whole? What happens to vehicle speeds, and to levels of highway congestion, automotive emissions, and fuel consumption?
- what groups of the population benefit from fare-free service, and to what degree?

- what is the impact on transit vehicle speeds and reliability? What are the savings in transit operating costs?

- What are the impacts on local employment levels? On retail trade in the area? How are local firms affected?

Secondly, given the current skepticism about the cost-effectiveness of fare-free service, it follows that the experiments should be designed so as to test the concept under those circumstances in which it is thought to stand its greatest chance of "success." In other words, the demonstrations should not be left open to the criticism that the particular implementations chosen were not the most appropriate ones for revealing the full benefits of fare-free service. Rather, care must be taken to test the concept under those conditions in which, a priori, one has reason to believe that most of the potential benefits will be exhibited.

The streets of a city, however, represent far from ideal laboratory conditions, and social experimentation--if it is to produce definitive information--requires very careful experimental design. The third guiding principle to observe is that, ideally, all of the objectives and claimed benefits of free-fare service should be spelled out explicitly, the projects must be designed in such a way that cause and effect can be identified in a logically-watertight fashion, and the appropriate performance measures must be carefully monitored throughout the experiment. The broad implications of these experimental design considerations on the type of demonstration which appears most worthwhile are summarized later in this section.

As a corollary to this last principle, sound experimentation requires that the responsibility for the design of a project and (more importantly) its monitoring and evaluation should rest with the Federal Government rather than with the local transit agency or with the representatives of local governments. In other words the evaluation should be freed from any vested interest in showing the project to be either a "success" or a "failure". 1/

1/ Currently, UMTA assumes responsibility for the evaluation of each demonstration it finances. However, prior to FY 1975 it was common for assessments of transit innovations to be made by the very local agency which had been responsible for planning, promoting, and implementing the innovation in the first place. The quality of the information under this earlier approach was often poor.

A publicly-funded demonstration program which--in accordance with the three principles set out above--attempts to learn about the costs and benefits of the most promising applications of fare-free public transport services (using research methods which are capable of producing definitive answers) should provide strong guidance to policy-makers who are considering using the transit farebox to pursue transportation or other social goals. It is more difficult to justify public expenditure on any less ambitious program than this, for the specific findings are likely to be of questionable generalizability and less capable of providing policy guidance.

General recommendations for demonstration design

In order to be compatible with the points which have already been made, the demonstration program should include, as its cornerstone, at least one system-wide fare elimination experiment which conforms with the following considerations:

- it should be planned and put into operation over an adequate time-frame;
- it should be mounted in a metropolitan area with an existing reasonably healthy transit system which has a route structure pervading most sections of the central city, and probably currently has a relatively high fare level;
- service changes on the system following fare elimination should be carefully controlled and monitored; and
- the impacts of the change should be observed by monitoring over time the budgetary, travel, employment, and location decisions of a suitably selected sample of households and (less importantly) firms.

All of these criteria can be justified on the grounds of experimental design--that is, if followed they create a situation from which one has a high probability of making useful advances in understanding. For example, it has been observed earlier that system-wide fare cuts appear to have less promise as good public policy than fare cuts targeted specifically at certain population sub-groups or selected transit services. However, in an experimental context one stands to learn most (per dollar expended) from system-wide abolition. Only if fares are eliminated across a complete system, for instance, can some of the claimed benefits--particularly cost savings to the transit operator--be properly tested. A system-wide

test may also illuminate the benefits of implementing fare cuts on a more selective basis, since the experiment can be designed in such a way that the ridership and cost impacts for specific groups of people, or times of day, or types of transit service can be individually examined in detail.

## Some problems in learning from transit experiments

It should be stressed that there are features of local public transport service which make the measurement and evaluation of the impacts of fare and service changes particularly difficult. In one respect, transit service is inherently dissimilar from most other goods and services with which economists are used to dealing. Transit service is a product for which changes in the level of supply bring about changes in the quality of the product itself.

For example, extra supply can be added to an existing bus line in one (or both) of two ways--by adding more vehicles, or by increasing the average size of vehicles (say, by introducing articulated or double-deck buses). In both cases, these changes will affect the quality of service experienced by the typical passenger. If more vehicles are added, it is likely that on average waiting times for buses will decrease. On the other hand, providing larger vehicles on the same frequency as before will probably imply a deterioration in service--passenger loading times may be expected to increase, thus lengthening the duration of the average journey.

Because of this, fare reductions--particularly large ones--are invariably accompanied by a change in the level of service. As patronage increases in response to the reduced fare, the transit operator will usually increase supply, thereby affecting service. On the other hand, if capacity is not expanded, in-vehicle crowding and boarding times will increase--thereby again influencing the quality of service. Since research has shown that ridership levels are usually more sensitive to service changes than they are to fare changes, 2/ a key question to be answered from experimentation with fare-free transit must be

2/ See Appendix A for a brief survey of the empirical evidence.

> "How much of the observed patronage response is due to the elimination of fares, and how much is due to the concurrent service changes? In other words, what size of ridership gain might have occurred had the fares been kept constant, but had service levels been adjusted in the same way as they were accompanying (or following) fare abolition?"

The implementation of fare and service level adjustments at the same time makes the problem of correctly identifying the ridership response attributable to the different types of change a difficult, but not an impossible, task. The problem will be ameliorated, if the existing level of service on the system is reasonably good. It is essential, also, that whatever service changes are made following fare elimination should be both tightly controlled and closely monitored. For example, one possible way of proceeding would be to maintain one (carefully selected) block of routes on which no extra capacity is added, a second block of routes on which extra vehicles are added to allow load factors 3/ to stay constant, and a third set of routes on which service provision is upgraded more markedly.

In order to provide definitive information about several of the benefits claimed for fare elimination, it is important to monitor the public response at the level of the individual household to see how decisions about traveling and about budget allocation are affected 4/--studying the changes at a more aggregate level (for example, by monitoring transit patronage statistics or highway traffic volumes) will not alone provide very strong information. Even at this level of detail, however, it is as well to realize that the experimental nature of the project will mean that some of the possible long-term impacts of fare abolition will be only partially manifest. The fact that fares could be re-introduced in (say) two years' time when the experiment is over will probably inhibit households from allowing transit fare levels to influence strongly their decisions about, for example, where to live and work, or how many automobiles to own. The experiment could be expected, however, to reveal partially some changes of this nature, and to afford information about the potential magnitude of long-run impacts.

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3/ Broadly speaking, the load factor is a measure of the average occupancy of the vehicle: it is the ratio of passenger-miles to seat-miles.

4/ To a lesser extent, it is also important to watch how firms in the metropolitan area react to the change.

On the supply side, too, it should be recognized that some of the potential benefits of fare elimination are likely to be only partially revealed by an experiment. New vehicle designs (with wider entry doors to capitalize on the removal of any need to control passenger entry) are unlikely to be achieved. The system-wide experiment can be expected, however, to produce information relevant to assessing the potential magnitudes of these effects.

## Other possible types of experiment

Were the demonstration program resources to permit, one or more system-wide fare elimination experiments could be supplemented by more selective projects at a number of sites which would abolish fares at specific times, for specific groups of people, or for specific services.

Four ideas appear to have particular merit:

- The abolition of fares in the weekday midday off-peak period

  This is likely to encourage transit use at times when spare capacity is most available and when transportation can be provided at lowest cost. It is also in line with pricing the service in a way which should encourage a more economically efficient use of resources. However, it would do comparatively little to help travel to and from work.

- Abolish fares for specific population sub-groups

  The elderly and handicapped are probably the easiest and most visible groups, but not necessarily the most needy. It may be possible to discriminate by income, particularly if the demonstration were to be tied in with some of the other Service and Methods Demonstration Program work on socially deserving target groups.

- Abolish fares for particular areas or services

  Where there are well-defined low income residential areas, or transit services to concentrations of predominantly low income employment, it may be possible to abolish fares selectively on an areawide basis or for specific services. Fare abolition for central business district distribution (as in Seattle) also justifies further experimentation.

- Temporary fare abolition used for promotional purposes

  Transit systems are increasingly using "get acquainted" fare-free days or weeks as a means of promotion. The returns to this type of marketing activity--as measured by a sustained increase in patronage--merit further investigation.

## CURRENT PLANS FOR A DEMONSTRATION PROGRAM

### Comparison with the provisions of the 1974 Act

The previous sections of this report have argued that a program of experiments with fare-free transit service would indeed be worthwhile if it were carefully designed to increase the current understanding about the benefits and costs of fare abolition. Some experimental design considerations have been briefly discussed. Now, it is necessary to compare the type of demonstration program which has been outlined here with the provisions of Title II of the 1974 National Mass Transportation Assistance Act.

The objectives of Title II, as set out in Section 204 of the Act, 1/ are embraced almost completely by the demonstration program envisaged in this report. 2/ But, while the content of Title II appears to indicate a Congressional concern for careful experimental design so that the information yield from the experiment may be maximized, there are a number of points at which provisions of the Act differ from the concerns which have been discussed here.

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1/ Section 204. The Secretary shall study fare-free systems... for the purpose of determining the following:

> (1) the effects of such systems on (i) vehicle traffic and attendant air pollution, congestion, and noise, (ii) the mobility of urban residents, and (iii) the economic viability of central city business;
> (2) the mode of mass transportation that can best meet the desired objectives;
> (3) the extent to which frivolous ridership increases as a result of reduced fare or fare-free systems;
> (4) the extent to which the need for urban highways might be reduced as a result of reduced fare or fare-free systems; and
> (5) the best means of financing reduced fare or fare-free transportation on a continuing basis.

2/ The fifth objective of Section 204 ("determining .... the best means of financing .... on a continuing basis") will be only partially illuminated by an experimental program. The experiments will, however, provide a clearer indication about the net incidence of the costs and benefits of fare-free services financed through various forms of local, state, and national taxation.

In particular this report's recommendations are partly at variance with the provisions of Section 203. 3/ For reasons which have already been touched on briefly, it does not appear wise to accompany fare elimination with major changes in the level of transit service. Thus, it is not advisable to choose an experimental site on the grounds of its having "a failing or nonexistent ... transit system," nor to introduce simultaneously "a high level of innovative service." Similarly, the requirements of "a decaying central city, automobile-caused air pollution problems, and an immobile central city population" should be secondary considerations in site selection to finding a service and fare environment where cause-and-effect can be identified in a logically rigorous fashion. When all such criteria are not satisfied in a project, the reasons would be addressed in the reporting process.

The scale of the program

The 1974 Act (in Section 203) calls for "several projects ... selected from cities or metropolitan areas of differing sizes and populations." Of course, heterogeneity of the environments in which fare-free public transport is tested will increase the extent to which the experimental findings can be generalized. However, the number of experiments to be conducted will obviously be constrained by the total funding available for the program. The superior information which could be obtained from a system-wide fare elimination experiment beyond that produced by more limited projects argues strongly that, if resources are limited, it would be better to attempt just one system-wide experiment rather than several smaller tests. If the city chosen for such a single project were fairly heterogeneous (in terms of population characteristics, types of neighborhood, and transit service provision levels), then some of the advantages of funding several experiments would be diminished.

3/ Section 203. The Secretary shall select cities or metropolitan areas for such projects in accordance with the following:

(1) to the extent practicable, such cities or metropolitan areas shall have a failing or nonexistent or marginally profitable transit system, a decaying central city, automobile-caused air pollution problem, and an immobile central city population;
(2) several projects should be selected from cities or metropolitan areas of differing sizes and populations;
(3) a high level of innovative service must be provided including the provision of crosstown and other transportation service to the extent necessary for central city residents and others to reach employment, shopping, and recreation; and
(4) to the extent practicable, projects utilizing different modes of mass transportation shall be approved.

With this concern in mind, it is useful to examine what types of projects might be contemplated under provisions of the 1974 Act--that is, a total of $40 million. For the type of experiment which has been outlined in the earlier sections of this report, requiring detailed monitoring of the response over time for a sample of households and firms, the experimental costs (as distinct from the operational costs involved in actually paying for the fare free service) are likely to be high. As a a very approximate first estimate, it can be assumed that roughly 5 to 10 percent of the costs would be related to monitoring activity.

If transit services for the experimental sites were being subsidized before the experiment, and if that existing level of financial effort were to be maintained quite independently of both Federal and local funding for the free-fare demonstrations, then the scale of the program could be correspondingly larger. Similarly, some local willingness to provide higher than the minimum matching requirement of 20 percent under this program would also allow an increase in scale. 4/

Assuming, however, that no other funding will be available from local sources to cover part of the operating expenses, that the cost savings following fare abolition will be small, 5/ and making some very tentative assumptions about the likely magnitude

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4/ However, it should be noted that the requirements of Section 203 of the 1974 Act are again not very helpful here. The specification of "a failing, or non-existent ....transit system" does not augur either an existing high level of local effort or even perhaps a local willingness to cost-share beyond the minimum legal requirement.

5/ As has been already stated, the likely magnitudes of savings in operating costs are far from clear; a major objective of experimentation is, in fact, to learn about these cost reductions. While the advocates of fare abolition tend to estimate large savings in expenses, it seems wise in planning the early phases of the experimental program to adopt a conservative assumption about their magnitude. To the extent that cost savings occur, the scale of the later stages of the demonstration program can be correspondingly increased.

of the patronage increase following fare abolition, this implies that under provisions of the Act it would be possible to pay for all rides for two years on services which, before the elimination of fares, were carrying an annual total of between 15 and 20 million revenue passengers.

Thus, based on these assumptions, a demonstration program contemplated under the 1975 Act and placing the major part of its emphasis on the detailed evaluation of system-wide abolition might select up to 3 experiments, for example:

- one city with an existing transit ridership of between 15 and 20 million passengers per year; or

- two transit systems, one with existing ridership on the order of 5 to 7 million per year and the second on the order of 10 to 13 million per year; or

- three transit systems with current patronage levels at around, say, 9 million, 6 million, and 3 million, in differing urban environments.

The actual choice of the number of sites, as well as the sites themselves, should be based solely on experimental design criteria; these alternatives are mentioned here only to give a qualitative indication of the range of possibilities. At the current stage of planning, a choice of two or, at most, three sites for system-wide fare-free service would appear the most appropriate. In order to illustrate further the size of the city which these ridership figures imply, listed below are the 1973 patronage volumes for a number of bus transit systems falling within the ranges specified. 6/

6/ The cities listed in this table have been chosen for illustrative purposes only. The mention of a transit system in the table does not imply that the city has any particular merit as a site for an experiment.

| | Revenue passengers 1973 (millions) |
|---|---|
| San Diego, California | 21.4 |
| Cincinnati, Ohio | 19.2 |
| Portland, Oregon | 18.4 |
| Denver, Colorado | 18.2 |
| Memphis, Tennessee | 16.5 |
| Richmond, Virginia | 12.2 |
| Indianapolis, Indiana | 11.8 |
| Omaha, Nebraska | 8.3 |
| Charlotte, North Carolina | 6.7 |
| Fort Worth, Texas | 4.5 |
| Greensboro, North Carolina | 2.0 |

The costs of experiments in larger cities

It will be obvious that the scale of effort discussed above precludes system-wide experimentation in any of the Nation's largest cities, and in particular, in any of the cities which have rapid rail systems. It may be possible and useful to experiment with fare elimination on selected rail transit services, but this would provide only a limited indication of the potential cost savings which rail systems might make if fares were to be abolished system-wide.

On the other hand, an experiment which entailed system-wide fare abolition on a rapid rail system is likely to be prohibitively expensive. For a medium-sized system with existing annual ridership volumes of between 100 and 200 million revenue passengers, for example, the costs of a single experiment can be conservatively anticipated to exceed $75 million per year at current prices.

The time-frame for a demonstration program

The time-frame specified by Section 207 and 205 of the 1974 Act 7/ is not conducive to sound experimentation. In order to ensure that each individual experiment is well designed and executed, that

7/ Section 207. There are hereby authorized to be appropriated not to exceed $20,000 for each of the fiscal years ending on June 30, 1975 and June 30, 1976, respectively, to carry out the provisions of this title.

Section 205. The Secretary shall make annual reports to the Congress on the information gathered pursuant to Section 204 of this title and shall make a final report of his findings, including any recommendations he might have to implement such findings, not later than June 30, 1975 (sic).

appropriate performance measures can be monitored in a statistically valid way, and that both the general public and the transit system have an adequate time in which to adapt their behavior following system-wide fare abolition, the total duration of a major experiment (between initiation at that site and completion) would probably be between three and five years, broken down as follows:

| | |
|---|---|
| Detailed experimental design, and transit planning activity | 6 to 12 months |
| Monitoring of household behavior and travel conditions before fares are eliminated 8/ | 6 to 9 months |
| Experimental period of fare-free service | 18 to 24 months |
| Post-experiment evaluation phase 8/ | |

In setting out a time-frame for the program as a whole, there would appear to be some advantages in staggering the commencement of individual experiments. This would ensure that some of the lessons learned in mounting the first experiment--both pragmatic methodological matters and early experimental findings--could be used in planning later experiments. For example, if a total of three demonstrations were under consideration, the second and third could be profitably timed to commence some nine to eighteen months after the initiation of the first experiment.

An appropriation has not been requested for this program for Fiscal Year 1976. It is currently intended that during FY 1976 a portion of the appropriated funding of the UMTA Service and Methods Demonstration Program should be used for developing the design of a program of fare-free transit demonstration, along the lines suggested in this report. It is envisaged that this FY 1976 development work will include at least the following elements:

- a clear statement of experimental objectives, and of the performance measure to be quantified;
- the development of one or more appropriate experimental designs;
- the development of experimental site selection criteria;
- determination of the allocation of financial resources between experimental objectives and between sites;

8/ To a certain extent, work on these activities can be carried out concurrently with the phases itemized above them. A total duration of 36 months from inception to completion, however, probably represents the minimum timeframe for a sound experiment with system-wide fare abolition.

- developing broad administrative and management criteria for both the transit service provision and experiment evaluation;

- some measure of interaction and discussion on the above matters with interested State and local government authorities, transit management personnel, employee representatives, and transit patrons, as mandated by Section 206 of the 1974 Act;

- the development and (where necessary) the pilot testing of appropriate measurement instruments--for example, interview questionnaire schedules, self-completion diaries, criteria for the collection of good quality aggregate data, and so on.

## A BRIEF SURVEY OF RESEARCH INTO TRAVEL BEHAVIOR

### Different research approaches

Information about the way in which prices and other aspects of transportation service influence the travel behavior of the general public has been drawn from two different types of research. One approach examines what may be called "revealed behavior", and the second uses "non-behavioral survey research."

The"revealed behavior" approach draws inferences about motivations from the differences in the behavior (either observed directly or reported through questionnaire survey responses) of groups of people who experience varying levels and types of transportation service. The main problem involved in doing this is in drawing valid conclusions about cause and effect--that is, in deciding how far the observed differences in behavior are really attributable to the variations in transportation prices or service. The problem usually implies the necessity of very painstaking analysis.

There are basically three types of evidence which rely on revealed behavior and which have been used to investigate the influence of transportation price and service attributes on demand. Undoubtedly the most common is the investigation of cross-sectional data bases. Analysts have looked at how, at one point in time, different people or groups of people (i.e., cross-sections of the public) with different travel options available to them make different traveling decisions. For example, high income people travel more than low income people and are less likely to use transit for any of their trips. Much of this work has focused on identifying the factors which influence people's choice of mode of travel, or choice of route, or choice destination. The theoretical study of fare-free transit initiated by the Department in 1967 used this approach. 1/

A second form of evidence based on revealed behavior comes from the public reaction to experimental transportation services. Since 1964 a large number of demonstrations have been carried out with financial support provided under Section 6 of the 1964 Urban Mass Transportation Act. Several of the demonstrations (the Shirley Highway Bus-on-freeway demonstration, 2/ to cite but one recent example) have added to the general understanding of the response

1/ Domencich & Kraft (1970).

2/ McQueen et al. (1973).

of various market segments to particular aspects of service. The UMTA Office of Transit Planning is currently sifting through and summarizing the generalizable evidence from past experiments with transit fare and service changes.

The third source of evidence based on revealed behavior involves monitoring over time the impacts and costs of specific price or service changes in public transportation. To be able to establish cause and effect under these circumstances is a complex problem, but if good data are available showing (for example) how transit fares, service levels, and patronage have changed over time, it is possible to test hypotheses about causality.

Studies based on "non-behavioral survey research" have used a wide range of survey and psychometric techniques which examine how samples of people say (or imply) that they value different attributes of transportation service, and how they trade-off variations in these attributes. There have been many studies of this nature, and although some critics of this approach question how far responses to fairly abstract survey questions are capable of tapping motivations, credence is enhanced by the similarity of conclusions from the studies with the findings of revealed behavior evidence.

Some concensus in findings

Research studies, using methods as diverse as these, have produced something of a concensus, at least as far as in ranking various factors in the order of their importance in influencing decisions about local travel. Table 1 attempts to illustrate this concensus by presenting--in a much simplified fashion--the ranking of factors obtained by fourteen different studies. 3/

3/ Because the research methods used are so diverse, an exact comparison between the findings of the fourteen studies is impossible--the compilation of Table 1 has consequently required extensive simplification. The categorization of service attributes used in the Table is not necessarily that of the original research, and in some cases (particularly the studies based on non-behavioral survey research methods) it has been necessary to make subjective judgements about how best to classify the actual wording used by the original study into the very broad categories adopted in the Table. For example, survey responses relating to "arriving at the destination on time" have been classified as a statement about the "reliability" of the transportation option.

The fourteen studies chosen are far from an exhaustive survey of relevant research, but they are reasonably representative. They were selected primarily on the basis of the relative ease with which the study findings could be condensed into the format of Table 1.

Table 1: The rank order of importance of various aspects of urban transportation service in influencing travel behavior

| Attribute of service | non-behavioral survey methods | | | | | | | | revealed behavior methods | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | J | K | L | M | N | P |
| money price | 4 | 5 | 5 | 3 | 3 | - | 3 | - | - | 3 | 2 | 1 | 2 | 2 |
| time spent: | | | | | | | | | | | | | | |
| in the vehicle | 3 | 6 | 6 | 2 | 2 | - | 2 | 4 | 2 | 2 | 1 | 2 | 1 | 1 |
| walking & waiting | 2 | 4 | 4 | 1 | | 3 | 1 | 2 | 1 | 1 | | 3 | | 3 |
| convenience | 5 | 3 | 1 | | - | - | - | 1 | - | - | - | - | - | - |
| reliability | 1 | 1 | 2 | - | 1 | 1 | - | - | - | - | - | - | - | - |
| level of comfort | 6 | 2 | 3 | - | 4 | 2 | - | 3 | - | - | - | - | - | - |

Generally speaking, "importance" in this table means either the relative importance which survey respondents implied that each service attribute has in influencing their travel behavior, or else the relative magnitude of changes in behavior which might be expected following a given percentage change in each of the service attributes. Blanks (-) in the table relate to aspects of service which were not appraised in that particular study.

In most cases, the particular travel behavior studied comprised either all journeys or only journeys made between the home and the place of work. The people studied were generally meant to be representative of the population at large.

The studies cited are:

A Aslaksen (1973)
B Golob et al. (1972)
C Hoinville & Johnson (1972) [British data]
D Levinson & Gersten (1974)
E Paine et al. (1967)
F Saks et al. (1973)
G Shinn (1972)
H Tani & Miyatake (1975) [Japanese data]
J Algers et al. (1974) [Swedish data]
K Domencich & Kraft (1970)
L Lave (1968)
M McFadden (1974)
N Wigner (1973)
P Gaudry (1974) [Canadian data]

Despite the many differences between the findings from these research efforts, some significant consistencies are apparent. For example, many studies have shown the relatively strong importance which people appear to attach to "reliability" as an attribute of transportation service, and this holds particularly true when public transport services are being considered. People want to be sure that, whatever mode of traveling they choose, they will reach their destination consistently on time.

There are several other congruities in the research findings exemplified by the studies cited in Table 1. For instance, the time taken up by traveling appears to be important -- in particular, it is usually held to be more important than the money paid out for the journey. This generalization relates not only to the time which the passenger spends in the vehicle itself, but also to the total time it takes to travel from the origin of the journey to the ultimate destination -- the so-called "door-to-door" duration of the trip. Indeed, many studies have found that the time which has to be spent in getting to and from vehicles, or in waiting for vehicles to arrive, is counted by most people as being more onerous for them than the time actually spent traveling inside the vehicle.

As for the relative importance which the public attaches to other aspects of transportation service, Table 1 suggests that the research findings--at least as far as convenience and the level of comfort are concerned--are rather more mixed. There are several reasons for this. The concepts of "comfort" and "convenience" are more abstract, less easy to quantify, than (say) money and time outlays which can be measured in units of dollars or minutes. For this reason, these more abstract facets of service have rarely been incorporated in the quantitative research studies, and the evidence about their importance comes almost entirely from qualitative, non-behavioral survey methods. What a survey reveals about the relative significance of comfort and convenience could well be critically dependent upon the particular phrases or images which are used to communicate these concepts to the respondents of the survey.

There is, however, one aspect of "convenience" which is relatively easy to describe in unambigous terms and to measure, and that is the number of transfers between vehicles which it is necessary to make in the course of the journey. It is known that people find transferring particularly onerous. It is probably significant that those studies which have shown convenience to be an important determinant of travel behavior have defined the concept fairly rigidly in terms of the amount of transferring necessary.

There are, of course, still other aspects of service which are important to people when they make travel decisions. One such factor is personal safety. Another is "flexibility"--the ability of the traveler to make his or her journey just when and to where he or she decides to do so, and possibly on very short notice. In general, this is a characteristic of the private automobile which no currently available public transport system is able to match.

The sensitivity of patronage to changes in transit fare

There is consistency, also, in the findings about the sensitivity of transit patronage to fare levels. 4/ Fully consistent with the findings described above about the low relative weight with which the public appraises money prices in making urban travel choices, the evidence strongly suggests that for typical urban public transport services the demand is fairly inelastic with respect to price. In broad terms, short-run direct fare elasticities are characteristically observed to lie within the range -0.1 to -0.7 -- that is to say, for each ten percent drop in fare, the ridership can be expected to grow by between one and seven percent. 5/ A more precise value in a particular instance will depend on a variety of factors -- for example, transit ridership tends to be least sensitive to fare levels in very large cities, in central city areas, at peak hours, and in other circumstances where the prices of alternative modes are high.

The accumulated evidence also shows that ridership is usually more responsive to changes in the level of service (particularly door-to-door journey times) than to changes in fare, although the sensitivity to service changes is also quite small. One other piece of evidence has recurred from study to study and from city to city. It appears that people are less concerned about the "in-vehicle" times and costs of their traveling than they are about the "access" parts of their journeys -- the time spent in getting to and from the vehicle, the number of changes, and the lengths of the waits. Both of these observations are again fully consistent with the earlier generalizations about the relative importance of various service attributes in influencing travel behavior.

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4/ Kemp (1973, 1974) provides a survey of this evidence.

5/ This implies that gross fare revenues will fall by between three and nine percent for a ten percent decrease in fare.

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