# FARE BOX AND PUBLIC REVENUE:

# HOW TO FINANCE PUBLIC TRANSPORTATION

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16. Abstract

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Based on rider surveys in four Texas cities, a reassessment of fare reductions for specific population segments is warranted, with fare subsidies geared more specifically to local opinion and local population characteristics. A differential fare structure was found to be acceptable to current transit patrons, based on market segments, type of transit service, and other features. These options for a discriminatory fare structure suggest that minor fare alterations would prove beneficial to local systems.

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# FARE BOX AND PUBLIC REVENUE: HOW TO FINANCE PUBLIC TRANSPORTATION

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# ABSTRACT

To be effective, governmental funds for public transit services must be based on sound approaches for providing and distributing subsidies. This report provides a review of the impacts of current capital and operating grants programs. Recommendations are made for a combination of provider-side subsidies and user-side subsidies. This funding option would emphasize the strengths of both subsidies, that is, funding to transportation providers as well as direct assistance to individual users who are able to choose among competing providers.

Based on rider surveys in four Texas cities, a reassessment of fare reductions for specific population segments is warranted, with fare subsidies geared more specifically to local opinion and local population characteristics. A differential fare structure was found to be acceptable to current transit patrons, based on market segments, type of transit service, and other features. These options for a discriminatory fare structure suggest that minor fare alterations would prove beneficial to local systems.

# SUMMARY OF FINDINGS

This study describes alternative subsidy options and fare structures as a means to improve the financial base of public transportation. An overview of fare elasticities for transit facilities and optimum subsidy techniques is presented below.

## Fare Elasticities for Public Transportation Facilities

Conventional Transit. Fare elasticity studies of regular route transit services suggest that demand for transit services is relatively inelastic. Thus, transit planners seeking to increase ridership with low fares will find that reduced fares will not cause many people to shift from cars to buses. Fare cuts will bring substantial revenue losses. On the other hand, increased fares will increase total revenue while causing a relatively small decline in ridership.

Elasticity studies offer transit planners some guidance in the design of service and pricing structures since the public is clearly more responsive to changes in the level of service than to changes in fare. Patrons are quite interested in door-to-door journey times. In choosing a travel mode, the consumer finds trip time and access costs more important than fare levels. Also, patrons using transit are less sensitive to fare changes than are riders taking non-work trips, such as shoppers.

The relative demand intensities of market segments offers guidance in the design of fare structures and service provision. Discriminatory pricing can be implemented to charge different prices to individual market segments based on relative demand differentials. The following fare differentials are generally applicable:

- Peak patrons may be charged more than off-peak patrons.
- Long rides may be priced higher than short rides.
- Trips to work may be priced higher than non-work trips.
- Blue collar females, white collar females, and the elderly may be charged more than housewives and blue and white collar males (although the social costs may prohibit acting on this opportunity).

In summary, blanket fare changes or systemwide service changes often dissipate possible benefits.

Para-Transit. There are several strong markets for para-transit for the following purposes:

1. High density home-to-work travel;
2. Low density travel demand (suburban and small town areas); including limited mobility groups such as the young, old, unemployed, poor, and the handicapped;
3. Feeder to line-haul transit; and
4. Mobility in business and commercial districts.

Currently, taxicabs are the predominant form of para-transit. As a flexible conveyance, taxicabs are highly demand responsive. A disproportionate amount of taxi patronage comes from the extremes of the income distribution: white collar patrons and low income riders with no personal form of transportation.

Elasticity studies indicate that the price (fare) elasticity of demand for taxi services is roughly unit elastic. Thus, a one dollar fare increase would bring about a corresponding decrease in revenue.

## Ridership Response to Options for Altered Fare Subsidies

On-board surveys were undertaken in four Texas cities--Waco, Beaumont, Fort Worth, and Houston. The surveys revealed that passengers were more supportive of fare subsidies for rider segments who are regular patrons, i.e. are highly visible users of the system. In Beaumont where a large proportion of the riders were school children, for example, reduced fares for this segment were strongly supported. Fare reductions for individual segments of the population, such as older persons, the handicapped, the poor, and children, thus received differential support among the transit systems surveyed, based on existing characteristics of the market in each city. In sum, fare subsidies should be more specifically geared to local population characteristics, rather than attempting to establish standard guidelines across systems.

The majority of patrons using regular route services were willing to incur a 10¢ to 28¢ increase in fare before they would no longer ride the bus. However, elasticity of demand for bus transportation was shown to vary by system, by route, and by type of service. Fare increases were viewed as more acceptable by express bus riders in Houston than by subscription bus patrons in Fort Worth. Nevertheless, these commuters--both subscription and express bus riders--were willing to pay more per trip than were riders using regular route services in both cities. In sum, a potential was shown to exist for fare increases among commuter segments. These riders tend to travel longer distances by bus and often pay less per mile than do lower income, central city passengers.

Those willing to pay the greatest percent increase in fare were older persons, who would allow a 112 percent increase, according to survey analyses. Least willing to tolerate fare increases were white collar males, with an average 21 percent increase deemed allowable. As noted earlier, older persons, students, the unemployed, and the poor are often captive riders for whom choice of transportation mode is not possible, whereas white collar workers have a greater range of transportation choices.

When requested to choose between two options--one with fare constant and improved service levels and the second with fare reductions and current service levels--70 percent of passengers surveyed in the four cities favored service improvements at the current fare. Most riders, when queried, suggested that current fares are very reasonable relative to costs for other transportation modes.

## Basic Subsidy Techniques in Public Transit

There are two fundamental techniques used in the distribution of subsidies to transit systems. The first approach is a provider-side subsidy whereby the transit provider receives funding to subsidize the cost of service not covered by fares. Texas systems make almost exclusive use of provider-side subsidies. The average fare is priced less than the average cost of producing the service, in that 40 percent of the net operating costs in Texas are subsidized.

Provider-side subsidies tend to have the following impacts:

1. Competition among transit providers is minimized.
2. Incentives for inefficient capital use and excessive wage bills are fostered.
3. Providers receiving such subsidies may be over-utilized while unsubsidized providers may be under-utilized, providing a basis for economic inefficiency.
4. Publicly owned transit providers are less responsive to public transportation needs at the local level than are privately owned systems without provider-side subsidies.

The second approach for subsidizing transit systems is the user-side subsidy. With this tecnhique the patron is given a voucher equivalent to the transit fare, but he retains the option to choose among transportation providers and thus among competing transportation modes. The user-side subsidy reduces economic inefficiency incurred with subsidization by minimizing the distortion of individual economic decisions. Because patrons can choose among competing transportation modes, efficiency in the allocation of transportation resources is the chief advantage of this subsidy. In sum, user-side subsidies tend to have the following impacts:

1. Transit providers will have an incentive to operate their services efficiently.
2. The various public transportation modes will be used efficiently; there is an appropriate mix of transportation facilities, based on consumer demand.
3. Transit patrons will obtain a high quality of services from the transit providers because of competition among providers.
4. Certain administrative problems may be encountered in distributing "vouchers."

User subsidies can be quite flexible. These subsidies can be differentiated by age, income, and other characteristics of the population, time-of-day transportation mode, or class of service.

A promising policy option is the disbursement of subsidy funds through some combination of provider-side and user-side subsidies. A careful mixture would emphasize the strengths of both methods and minimize the inefficiencies of both methods. Some hypotheses concerning the potential for combined subsidy programs can be made:

1. Transit providers receiving provider-side subsidies still lose some of their incentives for efficient operation.
2. Many more providers can be involved conveniently than is the case under a program exclusively using a provider-side program.
3. Transit patrons, whether they receive user-side subsidies or not, may overutilize those providers favored by the provider-side subsidy program and underutilize other providers.
4. Administration of user-side subsidy funds may be difficult.

A combined subsidy program which emphasizes user-side subsidies would be economically optimal. Transit planners should give careful consideration to the potentials for economic efficiency and public service provided by combined subsidy techniques.

## IMPLEMENTATION STATEMENT

To be most effective, decisions regarding the funding of public transit services must be based on sound approaches for providing and distributing subsidies to local systems. This technical report furnishes an analytical framework for economic decisions regarding conventional public transit options, as well as for para-transit.

The Urban Mass Transportation Administration (UMTA) distributes federal funds to subsidize capital and operating expenses of eligible transportation systems. This study evaluated the economic ramifications of the incentives established by UMTA. The capital grants program tends to provide public transit with incentives to replace buses earlier than is economically efficient. Incentives to neglect maintenance, accelerate depreciation, and to apply capital to other economically inefficient areas are provided with this program. In addition, the operating grants program also has a tendency to set up some inefficient incentives. Because no well-defined profit incentive exists, the worker productivity of transit facilities tends to be somewhat lower when operating grants are utilized. Recommendations for combined provider and user subsidies are presented. This combined funding option would emphasize the strengths of both subsidies, that is, subsidies to transportation providers as well as subsidies to individual users who are able to choose among competing providers.

Based on rider surveys in four Texas cities, differential fare reductions for specific population segments are warranted, with fare subsidies geared more specifically to local opinion and local population characteristics. Further, differential fares were found to be acceptable to current transit patrons, based on market segments, type of transit service, and other features. These options for a discriminatory fare structure suggest that minor fare alterations would prove beneficial to local systems.

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# CHAPTER I

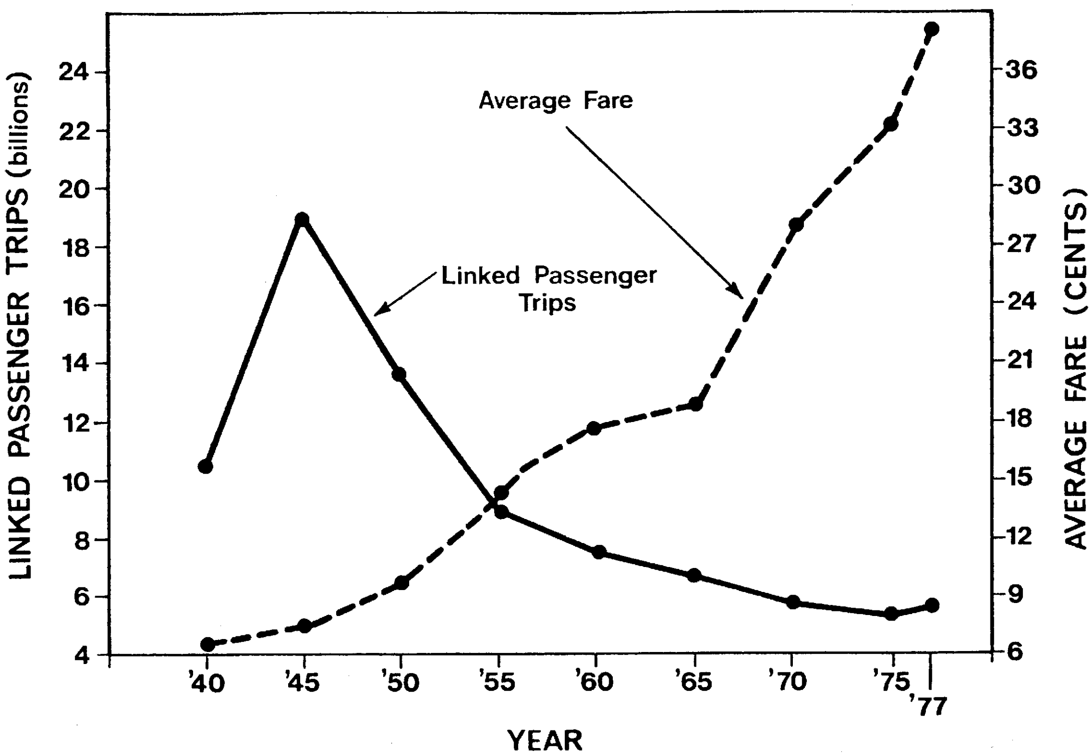
# INTRODUCTION

In recent years there has been a dynamic reawakening in the U.S. transit industry. Transit analysts have witnessed a resurgence of research and experimentation with fare reductions and dispensations for special population groups. Much of this innovation has stemmed from the increased availability of federal subsidy funds from the Urban Mass Transportation Administration (UMTA). The capital grant program provided the initial stimulus for subsidizations while expansion to the operating grant program provided momentum for further change. Thus, the existing trend is to price fares below operating cost requirements across the board. In this manner, it is not only the special population groups that have reduced fares, but also the ridership-at-large.

A significant innovation in the transit field is the growing emphasis upon marketing. Transit systems are now doing more research into the nature of transit demand. The place of advertising is also being defined more clearly. Marketing and marketing research have emphasized the level of transit service provided. Thus, transit service is increasingly becoming demand responsive.

As dynamic as these innovations are, it must not be forgotten that the precursor of these alterations was the near-destruction of the transit industry. Innovation has been precipitated by declining ridership and increasing fares. Following World War II there has been a persistent decline in demand for transit services. Since the 1940's ridership has declined by over 65 percent, while fares have increased over 360 percent from an average fare of 6.68¢ to 31.32¢ [3, Caruolo, 1974, p. 4]. Figure 1 shows the dual trends of increasing fares

Figure 1. Transit Trends in Fares and Ridership




Source: [1]American Public Transit Association, 77-78 Transit Fact Book, 1978, pp. 24, 32.

and decreasing ridership in the U.S. The transit industry, while more heavily subsidized, has continued to be plagued by substantial deficits.

## Why Subsidize Public Transit

The subsidization of public transit is based on two arguments. The first argument is that resource scarcity demands subsidization. It is asserted that a significant shift from automobiles to urban transit as the primary transportation mode would conserve energy, minimize environmental pollution, and decrease the congestion of transportation routes (especially in the central business districts). Such factors all suggest that the social costs imposed by transportation facilities would be minimized by increased patronage of relatively low operating cost, high occupancy urban transit modes. The second argument advanced for subsidization concerns social welfare. It has been asserted that transit should be offered as a public service. In this sense, it is the government's responsibility to assist the transit dependent (the young, old, handicapped, and poor) and to increase the mobility of these groups.

## A Perspective on Public Transit

This report seeks to provide both the transit analyst and the transit manager with an analytical framework for decisions concerning the economic dimensions of public transit. It is hoped that the analyst will gain insight into optimal approaches for providing and distributing subsidies to public transit systems. Care is taken to familiarize the analyst with para-transit options as well as with conventional public transit options. The transit manager is hopefully provided some insight into the best manner in which to structure fare and to provide transit services to the public while minimizing deficits.

# CHAPTER II

# SEGMENTATION OF THE TRANSIT MARKET

The optimal financing of public transportation is a complex policy issue which makes substantial demands upon Texas transportation planners. In order to meet these demands, policy makers must be provided with a firm analytical perspective of the relevant issues. The segmentation of travel demand is pivotal to such an analytical base. Awareness of specific population segments with varying propensities to use transit services allows the targeting of policy necessary for more optimal provision of public transportation. However, mere identification of various sources of market demand is somewhat incomplete at this time. The full advantage of market segmentation is realized through a study of the elasticity characteristics of the identified market segments. These elasticity estimates provide the policy analyst with some insight into the impact of various pricing and subsidy techiques on different segments. Information concerning the impact on the financial and operating status of public transit then can be estimated for different pricing and subsidy policies. However, before undertaking elasticity analysis, the concept of market segmentation must be developed as an analytical base.

## The Significance of Market Segmentation

Market segmentation, as used in this report, consists of dividing a market into distinct sources of demand for transportation services which are thought to respond similarly to pricing changes for specific transportation services. Identifying such clusters of demand facilitates formulation of predictive statements concerning the behavior of market segments. A primary advantage of segmentation is the identification of an important market component which can be termed the "modal shift margin." The modal shift margin is composed of all those people who are on the margin of choice between transportation modes. These individuals are especially significant to the transportation policy analyst because the effects of transit policy changes are often first reflected in the decisions of the modal shift margin. In designing policies which encourage a significant modal shift to urban public transportation, transit planners can gain a strategic advantage by identifying market segments, particularly by identifying the modal shift margin.

It is obvious that people travel for different reasons and with different limitations. We assert that people demand transportation services in a manner consistent with their preferences, subject to financial, physical, and self-imposed constraints. It is precisely because population groupings share common preferences or constraints that market segments can be logically grouped in a manner affording the analyst predictive ability. The primary justification of market segmentation is to help the transportation planner catalog those factors influencing the consumer's decision to patronize public transportation. Market segmentation provides an analytical framework which facilitates this need. It is the position of this study that transit service is most efficient when policies are directed at specific market segments rather than at the public in general.

## Methodological Considerations

Market segments may be delineated using a variety of criteria. Although geographic distribution of the population is an often used criterion, it should not be the only basis for segmentation. Socioeconomic characteristics of potential riders provide a second basis for segmentation, such as the income, education, age, and sex of consumers. Further, automobile availability is often viewed as a primary criteria for segmentation of the target market from non-users. Finally, the perceptions and preferences of consumers may be used as a basis for forming market segments. Research suggests that there is a relatively high correlation between what people say they will do and what they actually do with respect to transit behavior. However, this correlation is not perfect. It is because of possible discrepancies that this study measures consumer preferences by empirically estimated price elasticities of demand.

## CHAPTER III

## THE ECONOMIC CONCEPT OF ELASTICITY AND MEASURES OF ELASTICITY FOR CONVENTIONAL TRANSIT

Price elasticity of demand measures the responsiveness of demand to a change in price. The standard determinants of individual consumer demand are:

1. Income of the consumer,
2. Relative prices of substitute commodities or services,
3. Preferences of the consumer,
4. Price of the commodity or service concerned,[1] and
5. Characteristics of competing commodities or services.

There are three general types of elasticity. Direct price elasticity measures the change in quantity demanded with respect to a change in the price of an item. In transit studies this is often used to evaluate the sensitivity of transit ridership to changes in transit fares. Cross-elasticity is a measure of the degree to which consumers' demand for one item is affected by a change in the price of another item, e.g., how readily consumers switch to public transit when taxi fares rise. The third type, income elasticity, measures the responsiveness of demand to a change in consumer income.

### Computational Forms of Elasticity

For any type of elasticity measure there are three widely used computational forms. The point elasticity of demand is a measure of elasticity at one particular point on the demand curve. Thus, it is a measure of the (instantaneous) proportional rate of change between quantity demanded and a demand variable at the specified point on the demand curve. It may be defined mathematically at an initial price, $p_1$, and quantity, $q_1$, as:

[1]See Appendix A for a discussion of public transit pricing issues.

$$\varepsilon_{pt} = \left(\frac{\partial q_1}{\partial p_1}\right) \cdot \frac{p_1}{q_1}$$

The shrinkage ratio relates changes in quantity demanded and the demand variable to their initial (i.e., pre-change) values. It is thus a measure of the percentage change in quantity demanded resulting from a one percent change in the demand variable. Two points on the demand curve, $(x_1, q_1)$ and $(x_2, q_2)$, denoting time periods 1 and 2 respectively, are involved in this measurement technique. The shrinkage ratio may be defined mathematically as:

$$\varepsilon_{sr} = \frac{\dfrac{q_2 - q_1}{q_1}}{\dfrac{p_2 - p_1}{p_1}} = \frac{\Delta q/q_1}{\Delta p/p_1} = \frac{\Delta q}{\Delta p} \cdot \frac{p_1}{q_1}$$

The shrinkage ratio is the computational form most often used by transit analysts in the U.S.

The final computational form is that of arc elasticity. This form also involves reference to two points on the demand curve under consideration. However, the data points are not considered to be linear. That is, a straight-line straight-line plotting of the data points is not possible, as is the case with the shrinkage ratio. Arc elasticity may be defined mathematically as:

$$\varepsilon_{sr} = \frac{q_2 - q_1}{(q_1 + q_2)/2} \div \frac{p_2 - p_1}{(q_1 + q_2)/2}$$

In agreement with the law of demand, an increase in price will bring about a reduction in quantity demanded. It is conventional to make elasticity coefficients positive, so a "minus" sign is generally introduced into all of the computational forms. (Thus, an elasticity of demand reported as 0.2 actually would be -0.2.)

It should be noted that these computational forms will yield identical elasticity estimates only in the special case in which the change in the x-variable is infinitesimal (i.e., at the limit where $x \rightarrow 0$). Since this case is rare, the relative merits of the forms and their implications for transit revenues bear some study.

## Revenue Implications of Elasticity

The significance of elasticity is in appraising the impact of policy changes upon transit revenues. Thus, it is imperative that the planner learn how to interpret this measurement tool and be conscious of its limitations.

Demand is considered to be elastic if the elasticity coefficient is greater than one and inelastic if the coefficient is less than one. Since transit planners are most often interested in the revenue consequences of a fare change, Table 1 presents the relationship between elasticity coefficients and total revenue (TR). Table 1 provides the transit planner with a general interpretive framework for the elasticity coefficient.

Table 1

Fare Elasticity and Total Revenue (TR)

| | Fare Increase | Fare Decrease |
|---|---|---|
| Unitary Elasticity | TR constant | TR constant |
| Elastic Demand | TR decrease | TR increase |
| Inelastic Demand | TR increase | TR decrease |

The total revenue implications of elasticity estimates naturally lead to a consideration of the implications of elasticity for marginal revenue, (i.e., the expected added fare box revenue of a fare change). Economic theory posits that total revenue is at a maximum when marginal revenue is zero. Given this proposition and the results of Table 1, mathematical manipulation yields an interesting relationship between marginal revenue (MR), price ($P_1$), and elasticity ($\varepsilon$):

$$MR = \frac{\Delta TR}{\Delta q} = P_1 \left(1 - \frac{1}{\varepsilon}\right)$$

Note that the focus is on the effect of a fare change from $P_2$ to $P_1$. Given the equation for marginal revenue, the relationship between marginal revenue and elasticity can be explored. This relationship is presented in Table 2.

Table 2

Fare Elasticity and Marginal Revenue

| MR = 0 | MR > 0 | MR < 0 |
|---|---|---|
| Unitary Elasticity | Elastic Demand | Inelastic Demand |

In interpreting the various computational forms of elasticity the analyst should be aware of certain mathematical nuances. For both point and arc elasticities the previous revenue reference point of one is operational. However, this reference point does not hold with the shrinkage ratio unless the change in the x-variable is infinitesimal. Thus, a shrinkage ratio coefficient of 1.5 does not necessarily allow one to expect revenue to increase with a fare decrease. It is for this reason that the analyst should be particularly careful in interpreting the revenue implications of the shrinkage ratio.

In all work using elasticity measures, the transit planner should be forewarned that elasticity coefficients are abstract estimates of tendencies which hold under special circumstances. They give the transit planner a rough approximation of the consequences of policy changes. The planner should beware of comparing elasticities computed by different methods and/or at different times and under different circumstances. Empirical studies indicate that elasticity measures are consistent in differentiating between high and low elastic entities and also that patterns are discernible. (Recognizing the limitations of elasticity the transit planner is in a position to fully exploit it as an analytical tool.)

## General Characteristics of Conventional Transit

A nationwide survey of thirty-two urban transit systems by the Texas Transportation Institute [6, Guseman, Hall, and Hatfield, 1977, p. 46] delineated six market segments:

1. Persons 60+ years of age,
2. Persons with less than $5,000 annual income,
3. White collar workers,
4. Blue collar workers,
5. The young (ages 6 to 16), and
6. Housewives.

An examination of Table 3 reveals that these market segments are not mutually exclusive; for example, older persons may also fall within the category of "persons with less than $5,000 annual income." Because the survey is nationwide, these segments are thought to be relatively representative of many U.S. transit markets. However, complete extrapolation from this survey to any and every transit system is not valid.

Table 3. Percent of Each Population Segment As a Proportion of the Total Ridership for Transit Systems Nationwide (n=32 Systems)

| Population Segment | Mean Percentage | Standard Deviation |
|---|---|---|
| Persons 60+ | 13.79 | 6.11 |
| Persons with < $5,000 income | 42.61 | 20.17 |
| White collar workers | 23.22 | 9.94 |
| Blue collar workers | 27.87 | 19.80 |
| The young (6 to 16) | 15.59 | 15.41 |
| Housewives | 15.40 | 12.53 |

Source: [6 , Guseman, Hatfield, and Hall, 1977, p. 47].

## Factors Influencing Transit Behavior

A review of current transit research by Michael A. Kemp [11, 1977] cites four basic determinants of travel demand:

1. Reliability of travel alternatives,
2. "Door-to-door" duration of journey by travel mode,
3. "Access time" (i.e., time required to gain access to travel mode), and
4. Difficulty of transfer between vehicles if required.

These four determinants of travel demand may be thought of as basic parameters of demand. When seeking to determine the short run effects of a fare change, it is not unrealistic to assume that these parameters remain constant. A change in transit fares will bring a change in the quantity of transit services demanded, i.e., a change in the level of demand. In contrast, a parameter change will bring about a change in the overall characteristics of demand for transit services, i.e., a change in the nature of the demand function proper. The transit analyst must carefully differentiate between a change in demand and a change in quantity demanded. Some demand parameters may be thought of as policy variables which the transit planner may alter in order to manipulate the transit market.

## Intuitive Elasticity Expectations

Realistic interpretation of elasticity estimates require that we first gain an intuitive grasp of what kind of magnitudes to expect. This intuitive assessment may be gained through a study of transit price elasticities for differing trip purposes.[2] Analysis starts from the assumption that transit service demand is basically dependent upon two factors:

1. Strength of desire to make a journey, and
2. Strength of desire to travel by transit.

These factors may be influenced by the purpose of a planned journey. However, the demand for transit services is primarily derived from the amount of satisfaction the traveler anticipates from the trip itself and/or the destination.

Kemp [13, 1973] asserts that the price elasticity of demand is dependent on the "weaker" of the two influencing factors. Thus, if both wishes are strong, elasticity is low. However, if either wish is weak the elasticity will be somewhat higher. Table 4 presents Kemp's various elasticity expectations.

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[2]See Kemp [13, 1973, especially pages 28-30] for a more elaborate study of transit demand elasticities.

Table 4. Expectations of the Magnitude of Transit Price Elasticities for Differing Trip Purposes

| | strength of desire to travel at all in the central area | strength of desire to use transit, given a decision to travel | expectation of transit price elasticities |
|---|---|---|---|
| to and from work | strong | strong | low |
| employer's business | strong | medium | medium |
| personal business | medium | medium | medium |
| entertainment | medium | medium | medium |
| "hard goods" shopping | medium | medium | medium |
| school | medium | strong | medium |
| sport and social | medium | weak | high |
| "convenience" shopping | weak | medium | high |
| non-home-based journeys | weak | weak | high |

Derived from London Traffic Survey data, following Thomson (1967).

Source: [13, Kemp, 1973, p. 29].

In addition to the journey purpose variable there are several other general expectations concerning transit elasticities [13, Kemp, 1973]:

1. Short rides are generally more elastic than long rides.
2. When bus traffic and rail transit coexist, bus traffic is the more elastic transit mode.
3. In all probability, long-run fare elasticities will be greater than short-run elasticities.
4. Off-peak traffic is generally more elastic than peak traffic.
5. Sizable cities having congested central business districts tend to have relatively inelastic fare elasticities.

## Estimates of Price Elasticities of Demand

For many years, transit planners utilized the "Simpson and Curtin Formula" which estimates a shrinkage ratio elasticity of approximately -0.33. This estimate was based on 77 urban bus fare changes which occurred over a twenty year period. The estimate implies that policy makers could expect a 33 percent decrease in ridership for each 100 percent increase in fare. Although this estimate is still widely used, other empirical estimates are available. Table 5 indicates average elasticity changes between 1947 and 1967 according to city size.

Table 5. Average Fare Elasticities Observed for Fare Increases on U.S. Transit Systems, 1947-1967

| Population of Principal City Served | 1947-1952 | | 1950-1961 | | 1961-1967 | |
|---|---|---|---|---|---|---|
| | no. of cases | average elasticity | no. of cases | average elasticity | no. of cases | average elasticity |
| Less than 100,000 | 44 | -0.33 | 68 | -0.36 | 39 | -0.43 |
| 100,000 to 500,000 | 91 | -0.36 | 88 | -0.33 | 35 | -0.32 |
| More than 500,000 | 60 | -0.34 | 51 | -0.28 | 15 | -0.22 |
| Total | 195 | -0.35 | 207 | -0.32 | 89 | -0.35 |

Source: [11, Kemp, 1977, p. 23], from U.S. Department of Transportation (1974); based on data collated by the American Transit Association. These estimates indicate that for cities with populations less than 100,000 the demand is becoming less inelastic over time, and, for cities with populations greater than 500,000, demand is becoming more inelastic over time.]

Table 6 provides current elasticity estimates with respect to vehicle-miles and fare. This information indicates that the typical price elasticity of demand for transit services is highly inelastic.

Inelastic demand is of importance to the transit planner because it suggests that reducing fares is relatively ineffective in stimulating increased ridership. (i.e. causing people to shift from cars to buses). In addition to bringing only slight ridership gains, inelastic demand means that fare cuts will bring substantial revenue losses. Existence of inelastic demand indicates that increased fares will increase total revenue while causing a relatively small decline in ridership.

## General Conclusions of Elasticity Studies

The analysis of elasticity has important revenue implications for the transit planner considering fare structure changes. Certain elasticities also yield important information for the evaluation of service changes in the transit market. Elasticity studies offer several pivotal conclusions concerning the transit market:

1. Reducing fares can increase ridership somewhat, but impose a relatively high revenue loss.
2. The level of service elasticities are ordinarily inelastic. Thus, the public is more responsive to changes in the level of service than to changes in fare. This is evidenced most clearly in patron responses to changes in door-to-door journey times.
3. In choosing a travel mode, the consumer finds trip and "access" costs more important than fare levels. (Access costs are the money and time expended in traveling to and from transit pick-up points, the waiting time for transit, and the number of vehicle changes necessitated by transit travel).

Table 6. Estimates of Demand Elasticities with Respect to Vehicle-Miles and Fare

| Transit System | Demand Elasticity with Respect to vehicle-miles | fares | Source |
|---|---|---|---|
| Atlanta (Ga.) | +0.3 | -0.2 | Kemp (1974a) |
| San Diego (Cal.) | +0.7 | -0.4 | Kemp (1974b) |
| New York State systems: | | | |
| NYC private bus | +0.5 | -0.2 | Hartgen & Howe (1974) |
| NYC Mabstoa bus | +0.6 | -0.2 | |
| NYC other bus | +1.3 | -0.3 | |
| NYC subway | +0.5 | -0.2 | |
| Nassau County | +0.9 | -0.6 | |
| Buffalo | +0.5 | -0.2 | |
| Rochester | +0.9 | -0.5 | |
| Syracuse | +0.6 | -0.6 | |
| Albany and environs | +0.7 | -0.5 | |
| 13 small Iowa cities | +1.3 | -0.9 | Cartsens & Csanyi (1968) |
| 51 U.S. bus systems | +1.3 | -0.7 | Nelson (1972) |
| 17 U.S. bus systems | +0.8 | -0.6 | Boyd & Nelson (1973) |
| British bus systems: | | | Smith & McIntosh (1974) |
| Birmingham | +0.3 | -0.3 | |
| Bolton | +1.0 | -0.1 | |
| Coventry | +0.4 | -0.3 | |
| Edinburgh | +0.6 | -0.2 | |
| Leeds | +1.1 | -0.4 | |
| Rochdale | +0.6 | -0.2 | |
| Salford | +1.0 | -0.4 | |
| Sheffield | +0.2 | -0.2 | |
| Stockport | +0.9 | -0.3 | |
| West Bromwich | +0.8 | -0.6 | |
| British bus systems: | | | Mullen (1975) |
| Bradford | +0.4 | -0.4 | |
| Cardiff | +1.0 | -0.3 | |
| Coventry | +0.8 | -0.3 | |
| Derby | +0.5 | -0.4 | |
| Glasgow | +0.2 | -0.3 | |
| Leeds | +1.0 | -0.3 | |
| Leicester | +0.3 | -0.2 | |
| Northampton | +0.7 | -0.4 | |
| Plymouth | +1.2 | -0.3 | |
| Portsmouth | +0.6 | -0.2 | |
| Sheffield | +0.3 | -0.2 | |
| Southampton | +0.3 | -0.3 | |

Source: [12, Kemp, 1974, p. 29].

4. People are more sensitive to "access" costs than to in-vehicle time and amenity costs.
5. Transit trips to work are less sensitive to fare changes than are trips for shopping.
6. Given a particular fare structure, ridership can be increased through service improvements. However, the marginal costs of such improvements are seldom recaptured.

More specific conclusions can be made concerning the relative demand intensities of our defined market segments. Research in Texas [6, Guseman, Hall, and Hatfield, 1977] indicates that blue collar females, the elderly, and white collar females evidence more intense demand for a higher level of transit service than do housewives or blue and white collar males. Because these market segments manifest concentrated demand they are potential targets for modal shifting policies. Closer analysis reveals that these target segments require certain service characteristics of transit [6, Guseman, Hall, and Hatfield, 1977, p. 18]:

1. Reliability: Buses should maintain strictly consistent schedules.
2. Routing: Scheduled routes should be closer to the relevant destinations of the concerned market segments.
3. Amenities: Highly used bus stops should have bus shelters.

## Complications In Policy Formulation

Although policy formulation is fraught with complications, one problem bears special attention. This problem concerns the inherent difficulties involved in measuring the effect of transit improvements on ridership. The measurement problems may be visualized through a conceptual model of the triangular relationship between fare changes, service changes, and ridership.

Research [11, Kemp, 1977] indicates that one of the primary factors clouding the effect of service improvements in the transit market is that a change in the level of supply precipitates a change in the quality of transit services. For example, a growth in the supply of transit services could conceivably decrease average waiting time for public transit. Accordingly, a major fare change could, through its effect on ridership, also significantly change the quality of service. Figure 2 portrays the dynamic relationship between service quality, ridership, and fare changes. This conceptual model emphasizes the circular stimulus-response system set into motion by a policy change. Let

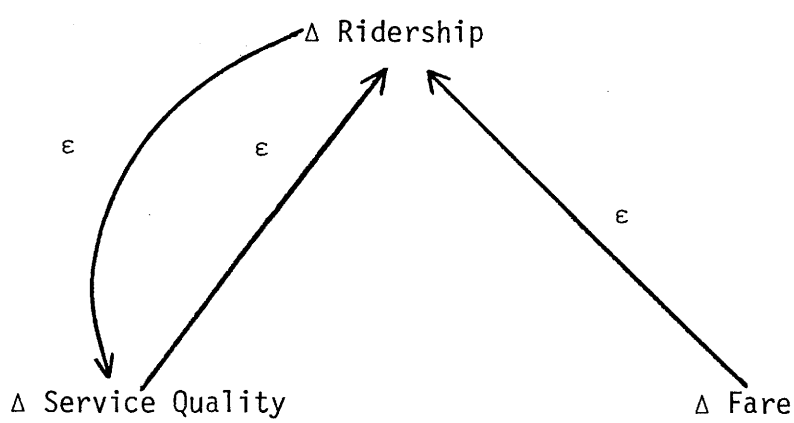


Figure 2. A Dynamic Model of Service Changes

us assume that a transit policymaker decides to reduce fares overall by amount X. The fare change will alter the ridership level, the magnitude of the change being determined by the elasticity coefficient. In addition, if the fare decrease causes an increase in ridership, the level of service quality may fall. For example, the increased ridership might result in very crowded buses, thereby discouraging patronage. In this manner, the change in ridership brought about by a fare alteration affects the level of service quality and in turn once more alters the ridership level. These changes interact and produce feedback effects. The magnitude of the respective changes in this dynamic matrix are determined by the relevant elasticity coefficients. The result is a dynamic system in which effects of a fare change or service improvement are difficult to measure.

Policy formulation is also complicated by the need to isolate the many factors influencing the transit market. Within the economy as a whole, there are changes in disposable income, seasonal variations, weather changes, and secular trends at work. To complicate matters even further, service improvements are often made at the same time as fare changes. ( As a result, it is quite difficult to isolate the "pure" effects of a fare change from the effects of other variables.

Elasticity interpretation is also complicated by the fact that there is some uncertainty as to whether elasticities are the same for both fare increases ("foreward" elasticities) and fare decreases ("backward" elasticities). Although the empirical evidence is scant, some [4, Donnelly, 1975] believe that backward elasticities are significantly lower than foreward elasticities.

## General Policy Implications

Perhaps of greatest importance to the transit planner is the fact that service improvements will probably bring greater ridership increases per dollar spent than will decreased fares. Research also indicates that social welfare and economic efficiency will be best served if fare structures are differentiated so as to focus on special population groups. Blanket fare changes or systemwide service improvements (or changes) are not as beneficial. Policies formed with these factors in mind are consistent with the goal of maximizing the ridership gain per dollar spent. The transit planner must be sensitive to consumer expectations, demand, and to what the consumer considers to be an acceptable fare structure. The transit manager must seek to increase ridership while generating acceptable revenues for public transit. Policies which increase peak-period fares and decrease off-peak-period fares under a differentiated fare structure regime may be consistent with these goals.

# CHAPTER IV

# PARA-TRANSIT OPTIONS

In recent years transportation planners have expressed increased interest in the options offered by para-transit modes. This interest has been stimulated by the realization that travelers are less concerned with fares than with the level of service provided. Such an emphasis on the need for improved services naturally leads the transit planner to an evaluation of the role of para-transit.

## Definition and Classification of Para-Transit

The following formal definition of para-transit may be offered:

> Para-transit services are those forms of intraurban passenger transportation which are available to the public, are distinct from conventional transit (scheduled bus and rail), and can operate over the highway and street system [15, Kirby et al., 1975, p. 9].

Para-transit options are, in effect, all modes of public transportation in - between the private automobile and conventional transit. Analysts classify para-transit modes into three basic types:

1. Hire and drive services,
2. Hail or phone services, or
3. Prearranged ride-sharing.

These categories are based on a careful study of the general service characteristics of the transportation modes presented in Table 7.

Table 7. General Service Characteristics by Mode

| | | PARA-TRANSIT MODES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | HIRE AND DRIVE SERVICES | HAIL OR PHONE SERVICES | | | PREARRANGED RIDE-SHARING SERVICES | | |
| | Private auto | Daily and short-term rental car | Taxi | Dial-a-ride | Jitney | Car pool | Subscription bus | Conventional transit |
| Direct route (DR) or route deviations (RD)? | DR | DR | DR → | RD | RD | RD | RD | RD |
| Door-to-door? | Yes → | Maybe → | Yes | Yes → | No → | Yes → | Maybe → | No |
| Travel time spent as passenger (P) or driver (D)? | D | D → | P | P | P → | P/D → | P | P |
| Ride shared (S), or personal (P)? | P | P → | P/S → | S | S | S | S | S |
| System routes fixed (F), semi-fixed (S), or variable (V)? | V | V | V | V → | S | S | S → | F |
| Access determined by prior arrangement (A), fixed schedule (F), phone (P), street hailing (H), or at user's discretion (U)? | U | U → | H/P → | P → | H → | A | A → | F |
| Vehicle parking required (PR) or not (NP)? | PR | PR → | NP | NP | NP → | PR → | PR/NP → | NP |
| Convenient for baggage? | Yes | Yes | Yes → | Maybe | Maybe | Maybe | Maybe → | No |

Source: [15, Kirby et al, 1975, p. 9]

Thus, the classification of para-transit is primarily based upon distinctive service characteristics and secondarily upon the specific vehicle (and accompanying technology) used in the provision of the relevant service.

## The Significance of Para-Transit

The sensitivity of transit patrons to the level of service they receive provides a motive for analyzing para-transit options. The value of para-transit is its ability to provide transportation alternatives to private autos and conventional public transit. Statistics reveal that some 20 percent of American households do not own autos, and in Texas approximately 12 percent have no automobile available.

Kirby et al., [15, 1975, p. 38-43], cite several potential markets for para-transit:

1. High density home-to-work travel,
2. Low density travel demand (suburban and small town areas) including limited mobility groups such as the young, old, unemployed, poor, and the handicapped,
3. Feeder service to line-haul transit, and
4. Mobility in business and commercial districts.

These potential markets are areas in which para-transit could make a significant contribution to improved transit service. As Table 7 reveals, the most common para-transit modes are the taxi, dial-a-ride services, the jitney, the car pool, and the subscription bus. All of these modes are potentially useful public transportation modes.

It is not the purpose of this study to review the relative merits of each para-transit mode. However, an attempt will be made to overview the potential usefulness of expanded taxi services. Perhaps because of its private ownership status, this para-transit mode seems to be frequently underestimated as a policy option.

## The Role of Taxi Services

### The Nature of Taxi Demand

Taxi service is that form of transportation whereby the patron may contract transportation services from a point of origin to a point of destination. As such, taxi services are demand responsive. The fare for taxi services is predominately based upon the distance traveled but may also be based upon trip duration. The most prominent service characteristics are:[3]

1. Relatively high average travel speed from point-to-point on urban journeys of five miles or less,
2. High route and time flexibility,
3. Relatively high fare,
4. Freedom from parking, and
5. Relatively high level of comfort and convenience provided.

Because shared-ride service is generally prohibited by city ordinances the majority of taxi trips are made by single passengers. The taxi may be thought of as a composite transportation mode which combines the advantages of the private automobile with those of public transit.

The market for taxi services may be divided into six general market segments [15, Kirby et al., pp. 113-114]:

1. Professional and managerial workers,
2. Persons from high income households,
3. Non-residents of local area,
4. People traveling to and from interurban transportation terminals,
5. Economically inactive people (housewives, students, the elderly, etc.), particularly those without drivers' licenses, and
6. Low income residents of poverty areas.

Research generally indicates that women and non-whites use taxi services more intensely than other patron groups. This is especially true for trips outside the central business district. Persons in white collar occupations use taxi

[3][15, Kirby et al., 1975, p. 59].

services most frequently for trips within the central business district for business or recreational purposes. Lower income groups are often intensive users of taxi services, especially in small to medium size urban areas. High income groups also may use taxi services intensely. Thus, a disproportionate amount of taxi patronage comes from the extremes of the income scale.

Most elasticity studies have concluded that the price (fare) elasticity of demand for taxi services is roughly unit elastic or perhaps slightly elastic. A one percent fare increase would be expected to bring a one percent decrease in the quantity of taxi trips demanded. There would be no significant change in revenues.

The demand for taxi services primarily is in the central business district of most cities. It is interesting to note that there is no significant increase in taxi usage during the traditional "rush" hours of the morning and evening hours. There are two possible explanations for this. First, the supply of taxis is fully employed during the rush hours and consequently cannot respond to any peak demand. Second, regulation of the supply of taxis restricts the ability of the industry to meet increases in demand. Rush hour usage of taxis is particularly useful to consumers because of the short headways common to taxi service. The vast majority of trips are between three and five miles in length.

## Policy Implications For Taxi Service

The reason for this presentation of taxi services is to expose to the transit planner the role the taxi industry currently plays. Many of the current reform proposals for urban transit, whether they be flexible or adaptive routing systems, are currently accomplished by taxi services.

Baytown, a Texas city without conventional transit, has successfully subsidized taxis at an average program cost of $1.96 per trip. The service has been available to the elderly who would have no other transportation options. Taxi services are provided within the context of a money-making concern. Based on economic efficiency criteria, it may prove feasible to investigate an expanded and perhaps low cost taxi system as a public transit policy option. North Central Texas Council of Governments has recently investigated four possible fare and/or subsidy options to increase utilization of taxicabs in the Dallas-Fort Worth area. One of the four options with anticipated usefulness was an equipment subsidy (equivalent to the capital improvements subsidy for conventional transit) paid directly to cab companies for equipment purchases. Other options were direct fare subsidies, shared-ride taxis, and fare increases for those not qualifying for subsidization. In evaluating the various methods of financing urban transit, the transit planner would do well to remember the potential of taxi services.

# CHAPTER V

# SUBSIDY ISSUES IN PUBLIC TRANSIT

The transit analyst evaluating the financing of public transit must be acquainted with some basic subsidy issues. Such an acquaintance involves a knowledge of the Urban Mass Transportation Administration (UMTA) capital and operating grant program. This chapter emphasizes the economic incentives established by UMTA and evaluates the economic efficiency of this program in financing public transit. The following analysis should provide a framework for the evaluation of various subsidy techniques in Chapter IX.

## UMTA Capital Grant Program

The Urban Transportation Act of 1964 empowered UMTA to distribute federal-local matching funds for transit financing capital. These capital grants required local transit companies to supply one-third of their required capital from 1964 to 1973 and one-fifth of their funds since 1973. In 1975 more than 85 percent of UMTA's expenditures went to capital grants. By 1973 UMTA had purchased some 12,725 buses. It is estimated that 80 percent of all buses sold are bought through the UMTA program. The size of these expenditures certainly fosters the growth of a healthy interest in the economic efficiency of these capital grants.

Tye [22, 1971, pp. 796-826] has analyzed the economic efficiency of UMTA's capital grant program as a subsidy device, primarily through a study of the Chicago Transit Authority and the Cleveland Transit System using 1960 data. These systems were chosen because they followed the traditional practice of using the newest buses for all day or off-peak use and using older buses for peak-hour use. Using 5.3 percent as the cost of capital, Tye estimated the optimal replacement age of buses used at rates of 22,000 and 50,000 miles per year.[4] He estimated that the Cleveland Transit System replaced their buses earlier than was economically optimal. His computations showed that buses of a given age were underutilized by approximately 24.5 percent. Chicago Transit Authority replaced its buses somewhat early but still approximated the optimal replacement rate.

Given these computations, Tye computed the cost of producing 50,000 miles of transportation service with and without grants. His computations suggested that federal subsidies were wasted by 23.8 percent in Cleveland and by 22.5 percent in Chicago. This waste is thought to have resulted from the substitution of depreciation for variable expenses.

Tye's basic conclusion is that capital grants provide public transit companies with an incentive to replace buses earlier than is economically efficient. The grant program provides an incentive to neglect maintenance, accelerate depreciation, and to apply capital to areas of dubious efficiency.

## UMTA Operating Grant Program

Research concerning the efficiency of operating grant subsidies is currently somewhat sparse and inconclusive. However, research by Gomez-Ibanez indicates that there are two possible sources of inefficiency present in the operating grant program [5, 1975, p. 293]. The first source is the tendency for public transit firms to pay their employees more than the common rate for comparable work in other areas of application. This tendency results from the lack of a well defined profit incentive in the public transit industry. Operating

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[4]A summary of Tye's findings is provided in [19, Miller, ed., 1975, p. 138-139].

employee wages are estimated to constitute around two-thirds of the total operating costs of a public transit firm. Because these firms are essentially isolated from the rigors of competition, transit managers' incentive to resist wage demands is obviated. The second possible source of inefficiency is low employee productivity. The transit manager receiving an operating grant has a low incentive to minimize the operating cost of his agency. Thus, there is not as much of an incentive to monitor worker productivity as there is in a competitive context. The reasoning here is analogous to the case of the over-remuneration of public transit labor.

Research suggests that UMTA programs establish incentives to waste economic resources in the areas of capital and operating grants. By pointing out that these disincentives exist and are potentially damaging, the adverse effects of subsidization under current federal legislation becomes more evident.

# CHAPTER VI

## BASIC SUBSIDY TECHNIQUES IN PUBLIC TRANSIT

Subsidies for public transit can be distributed by two fundamental techniques. The first is referred to as the "provider-side subsidy" technique. This technique consists of paying a subsidy directly to the provider of public transit service. The second subsidy method is known as the "user-side subsidy" technique. In this form the subsidy is paid directly to the users of public transportation. The patron is usually provided with some form of transportation voucher which is sold at a discount. For example, a patron could be provided with a set of tokens or a monthly bus pass at a 50 percent discount with the remaining costs incurred directly by the governmental entities providing the subsidy. The transportation provider would not receive any financial support until the rider opted to use the service. A worthwhile consideration is the possibility of combining these two subsidy techniques. In many situations the optimal subsidy method could incorporate both the provider-side and the user-side subsidy techniques.

The most common subsidy method currently in use is the provider-side subsidy. A primary example is the capital grant program administered by UMTA. Operating subsidies provided by local authorities are also common examples of provider-side subsidies. Examples of user-side subsidies are not prevalent. As noted in the previous chapter, Baytown, Texas, provides a user-side subsidy for elderly riders of taxicabs. Eligible patrons request taxi service as desired, reimbursing the taxicab company after verification of the service provided. Other notable experiments with user-side subsidies have been made in Los Gatos, California, and Derby, Connecticut. In Los Gatos the elderly and disabled are given the opportunity to buy 50¢ taxicab tickets for travel within the city limits. These patrons can buy a maximum of 10 tickets per month. The taxicab driver redeems each ticket for $2.10 through the city. In Derby a credit card system has been developed to bill large dial-a-ride patrons. Each month patrons are charged a percentage of their total transit bill. The residual cost of their transit bill is defrayed by the City of Derby.

In this chapter, we shall describe the basic characteristics of the subsidy techniques. We shall further evaluate the economic effectiveness of these techniques by identifying the incentives established under various alternatives.

## Provider-side Subsidies

The vast majority of current U.S. transit subsidy programs rely upon the provider-side subsidy technique. As discussed, provider-side subsidization presumes that transit is a valuable public service even though it cannot generate sufficient revenues to cover necessary capital and/or operating expenses. The average patron fare is priced less than the average cost of producing the public transit service, as shown for Texas systems in Table 8 wherein an average of 40 percent of net operating costs are subsidized. Given that subsidization is necessary, evaluation of the efficacy of providing the subsidy exclusively through the provider-side technique is warranted.

As stated earlier, research [22, Tye, 1971] indicates that provider-side subsidies limited to capital grants provide transit companies with an incentive to replace buses earlier than is efficient. Furthermore, such grants provide an incentive to neglect maintenance and accelerate actual depreciation. It has also been suggested [15, Kirby, et al., 1975] that the exclusion of private firms from the capital grants program has encouraged the economically inordinate use of public transit. The public transit firms are effectively enlarged in a manner which encourages their use. It is quite possible that private transit

Table 8. Net Operating Loss Per Passenger, Vehicle Mile and Vehicle Hour for Texas, 1977.

| | |
|---|---|
| PER PASSENGER | |
| Total Operating Revenue Per Passenger | $ .33 |
| Total Operating Expenses Per Passenger | .55 |
| Net Public Operating Cost Per Passenger | (.22) |
| PER VEHICLE MILE | |
| Total Operating Revenue Per Vehicle Mile | $ .77 |
| Total Operating Expenses Per Vehicle Mile | 1.30 |
| Net Public Operating Cost Per Vehicle Mile | (.53) |
| PER VEHICLE HOUR | |
| Total Operating Revenue Per Vehicle Hour | $ 9.88 |
| Total Operating Expenses Per Vehicle Hour | 16.70 |
| Net Public Operating Cost Per Vehicle Hour | (6.82) |

Source: State Department of Highways and Public Transportation, Transportation Planning Division, p. 13-18, "1977 Texas Transit Statistics." Austin: October 1978.

firms could provide transportation services more efficiently if they were subsidized to the extent that public firms are. It has also been suggested [5, Gomez-Ibanez, 1975] that provider-side subsidies encourage public transit to incur excessively high wage bills.

Provider-side subsidies also foster a reduction of worker productivity in the public transit firm. The provider-side subsidy is often attacked for undermining competition within the economy. By its very nature, the provider-side subsidy reduces the amount of competition among providers. As such, this subsidization method often leaves the public dependent upon one transit provider. Even in the face of strong regulatory constraints, one is reminded of the obvious analogy to monopoly.

Current research and experience yields several basic hypotheses concerning provider-side subsidies:[5]

1. Competition among transit providers is minimized.
2. Incentives for inefficient capital use and excessive wage bills are fostered.
3. Providers receiving such subsidies may be over-utilized while unsubsidized providers may be under-utilized. This provides a significant opportunity for economic inefficiency.
4. Publicly owned transit providers are less responsive to public transportation needs at the local level than are privately owned systems without provider-side subsidies.
5. Administration of such subsidy funds is relatively straightforward.

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[5][16, Kirby and McGillivray, 1975, p. 11]. This entire chapter draws upon this study of alternative subsidy techniques.

It should be noted that there is evidence suggesting the validity of each of these hypotheses. However, it is because further empirical verification is required that they retain "hypothetical" status. It should also be noted that there is indeed an unambiguous positive characteristic of provider-side subsidies. This is the relatively straightforward nature of provider-side subsidy administration. Such a virtue should not be overlooked in the design of an optimal subsidy method.

## User-Side Subsidies

In any subsidy program, one of the primary concerns of the policy analyst is to minimize economic inefficiency imposed by subsidization. The most salient feature of user-side subsidization is its tendency to encourage the efficient allocation of transportation resources.

Since the patron is given a voucher which replaces transit fares, he retains the option to choose among transit providers and thus possibly among competing transportation modes. The transit patron's free choice encourages competition among transit providers for patrons. The transit providers are furnished with an incentive to be responsive to the needs and desires of transit patrons. Furthermore, since transit providers are not unequivocally assured of some patronage level there is an incentive for them to minimize their costs. Through the user-side subsidies the transit patron uses a voucher to pay a price less than the average fare (which is equal to the average production cost of the transit provider). The distortion of economic decisions and incentives is generally minimized and the efficient allocation of transportation resources is encouraged.

One of the principal advantages of user-side subsidies is that they encourage competition in the public transit sector. Under this subsidy technique it would be possible to allow transit providers to set their own fares and level of service. This would reduce some of the monitoring costs of the government. Such provider freedom would encourage the most efficient allocation of transportation resources by assuring that patrons would choose those transportation modes which provide the best service at the lowest cost. There would be no bias towards using buses when another mode (e.g., the taxicab) could provide better service at lower cost. Transit providers would be forced into a competitive, although modified, environment wherein they would plan fares and service quality in a manner which is responsive to demand like other competitive firms.

The brokerage concept of coordinating several public transportation modes through a central administrative office meshes well with the provision of user-side subsidies. The "broker" organization normally furnishes information on conventional transit services, specialized facilities of human service agencies, and taxicab operations, as well as other salient transportation facilities. The patron can opt for a specific service among these alternatives based on eligibility for discounts, availability of vehicles for desired destinations and time slots, and other related choice criteria. The brokerage office has the potential to accept requests for demand-responsive vans or to dispatch taxicabs to patrons as needed, as well as the overall coordination of public transportation facilities. Thus, the patron has the ability to choose among facilities with the provider receiving reimbursement based on the number of patrons served or based on a fixed fee. However, for most brokerage programs, such as the coordinated transportation services program planned for implementation in Houston, a guaranteed rate will be assured providers with options for additional service at a fixed cost per hour. Nevertheless, the potential for a user-side subsidy with the brokerage program appears to be a highly feasible option which should be carefully assessed by transportation planners.

Although user-side subsidies have many advantages, administrative complexity presents one practical drawback. The voucher system usually consists of tickets, tokens, or credit cards. The distribution of these "vouchers" to target patrons and the reimbursement of providers would require detailed planning.

Kirby and McGillivray [16, 1975, p. 10] have formulated several hypotheses concerning user-side subsidy programs:

1. Transit providers will have an incentive to operate their services efficiently.
2. The various public transit modes will be used efficiently.
3. Transit patrons will obtain high quality services from the transit providers.
4. Certain administrative problems may be encountered in distributing "vouchers" and in guarding against fraud.

The problem of administrative complexity cannot be over-emphasized. Careful planning and experimentation has proven user-side subsidy administration manageable. Transit analysts seeking to use a differentiated pricing structure and to reach target market segments would find user-side subsidies quite flexible. They can be differentiated by age, mode, income, time-of-day, class of service, and so forth [16, Kirby and McGillivray, 1975, p. 6].

## Combined Subsidy Techniques

A promising policy option for transit analysts is the disbursement of subsidy funds through some combination of provider-side and user-side subsidies. Such a combination will aggregate the advantages and disadvantages of both methods. The administrative simplicity of provider-side subsidies will be balanced by the administrative difficulties common to user-side subsidies. The allocative efficiency of user-side subsidies will be played against the inefficient incentives established by provider-side subsidies. Through a careful mixture it may be possible to emphasize the strengths of both methods while minimizing their inefficiencies.

Kirby and McGillivray [16, 1975, pp. 10-11] cite the Transportation Remuneration Incentive Program (TRIP) in West Virginia as an excellent example of the combined method strategy. The program planned to spend $21.9 million between 1974 and 1977. Of the total, $8.8 million was to be used to cover the cost of providing transportation tickets to eligible patrons at 45 percent of face value. Approximately $7.7 million was intended to defray operating and capital costs for selected transit providers.

While a combined subsidy program offers many advantages, certain inherent tendencies must be watched carefully. The policy maker must be careful not to grant any providers a competitive advantage when initially distributing provider-side subsidies. It would be easy to grant a single transit provider the ability to offer inordinately low fares. This would cause transit patrons, whether they receive user-side subsidies or not, to over-utilize this particular transit provider.

Several general hypotheses concerning the potential for combined subsidy programs may be offered [16, Kirby and McGillivray, 1975, p. 1972]:

1. Transit providers receiving provider-side subsidies will lose some of their incentives for efficient operation.
2. Many more providers can be conveniently involved under an exclusively provider-side program.
3. Transit patrons, whether they receive user-side subsidies or not, may over-utilize those providers favored by the provider-side subsidy program.
4. Administration of user-side subsidy funds may be difficult.

The design of the optimal subsidy technique is a detailed project. In the designing process, the transit analyst should give careful consideration to the potentials for economic efficiency and the service of public need provided by combined subsidy techniques.

# CHAPTER VII

## RIDER RESPONSES TO ALTERED FARE SUBSIDIES IN FOUR TEXAS CITIES

Transit service provision in Texas has been greatly altered in the past 25 years, with operations moving from a large number of private, profit-making companies to a few public, subsidized transit services. Transit systems are being treated as a public service similar to the provision of streets and major roadways. Most policy makers agree that elements of transportation will always require subsidy; however, other functions of transit are serving, or could serve, groups of people that are capable of paying the full cost of their transportation.

This chapter examines:

- Differential fares for rider segments;
- Maximum allowable increases in fare among rider segments;
- Potential fare increases for express bus services;
- Trade-offs between service improvements and fare increases; and
- Satisfaction with bus systems relative to riders' fares.

As a means of assessing differential fare options and potential alterations in fare structure, on-board surveys were undertaken in conjunction with a marketing study, a cooperative DHT-TTI research project. In Waco, Beaumont, Fort Worth, and Houston on-board surveys were utilized on 12 routes, for both peak and off-peak periods.[6] The four systems differed in terms of service levels,

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[6]One route selected in Houston provided express bus service for which only a peak period bus was utilized in the survey. Therefore, twenty-three buses were included in the on-board surveys.

as shown in Table 9. The following discussion portrays selected characteristics of the 550 riders surveyed on the 12 routes.

Age. In examining rider characteristics across cities, age composition differed in the four sites. Almost 50 percent of the Houston ridership sample was under 25 years of age, as shown in Table 10. In Waco, however, 50 percent of the patrons surveyed were 55 or older.

Sex. Overall, riders averaged 61 percent female. However, the sample was biased by two subscription service routes in Fort Worth which were utilized primarily by male patrons. Beaumont, Waco, and Houston had, respectively, 81 percent, 71 percent and 62 percent female riders (see Table 10).

Education. Beaumont and Waco riders evidenced the lowest educational levels, with 46 and 37 percent, respectively having less than a twelfth grade education (see Table 10). In both Houston and Fort Worth, on the other hand, 30 percent of the riders in the sample were college graduates.

Occupational Ranking. Although the income of the rider or the rider's family was not requested, occupational categories were obtained, as shown in Table 10. Waco had a larger proportion of the retired population and of housewives than did other cities. Fifty-two percent of the Waco riders surveyed were either retired, unemployed, housewives, or students. Seventeen percent of the riders in Fort Worth, 19 percent in Houston, and 41 percent in Beaumont were not in the labor force. Fort Worth and Houston had the greatest number of white collar workers. Thirty-four and 40 percent, respectively, of Waco and Beaumont riders had jobs as private household or service workers in the blue collar category.

Ride Frequency. Waco showed the lowest usage of any system of repetitive riders, with 61 percent classifying themselves as regular patrons (Table 11).

Table 9. Transit System Characteristics and Population Characteristics for Waco, Beaumont, Fort Worth and Houston, Texas

| | Waco | Beaumont | Fort Worth | Houston |
|---|---|---|---|---|
| I. Transit System Characteristics: | | | | |
| Total Passengers (1977) | 660,580 | 1,010,996 | 4,145,841 | 39,863,600 |
| Buses in Regular Service | 15 | 13 | 88 | 360 |
| Number of Routes | 11 | 5 | 42[a] | 66[b] |
| Average Peak Headways (minutes) | 45 | 30 | 15 | 7 |
| Average Off-Peak Headways (minutes) | 60 | 42 | 38 | 20 |
| Percent of Population Within 1/4 Mile of a Route | 80 (est.) | 68 | 78 | 43[c] |
| Base Fare (cents) | 35 | 30 | 40 | 40 |
| II. Population Characteristics (1970): | | | | |
| Population Size | 95,326 | 115,965 | 393,463 | 1,232,407 |
| Population Density of Incorporated Area (persons per square mile) | 1,624 | 1,642 | 1.919 | 2,841 |
| Percent of Adult Population 65+ | 12.8 | 9.3 | 9.6 | 6.5 |
| Percent of Adult Population in Blue Collar Occupations | 47.3 | 51.3 | 49.6 | 45.6 |
| Percent of Households with Automobiles Available | 85.8 | 84.5 | --- | 88.4 |

[a]There are 26 conventional routes with 16 subscription service routes.
[b]There are 66 split routes and 33 through-routes.
[c]43 percent in City of Houston service area.

Table 10. Background Characteristics of Riders in Sample (in percentages)

| Characteristic | Waco | Beaumont | Fort Worth | Houston |
|---|---|---|---|---|
| Age Group | (N=56) | (N=104) | (N=147) | (N=192) |
| 6-17 | 0 | 14 | 7 | 6 |
| 18-24 | 14 | 19 | 14 | 41 |
| 25-34 | 18 | 11 | 10 | 27 |
| 35-44 | 7 | 10 | 16 | 7 |
| 45-54 | 11 | 23 | 33 | 11 |
| 55-64 | 27 | 8 | 11 | 8 |
| 65+ | 23 | 15 | 9 | 2 |
| Sex | (N=56) | (N-103) | (N=144) | (N=192) |
| Male | 29 | 19 | 57 | 38 |
| Female | 71 | 81 | 43 | 62 |
| Education | (N=54) | (N=103) | (N=145) | (N=192) |
| 9th grade or less | 26 | 24 | 13 | 12 |
| 10th or 11th grade | 11 | 22 | 7 | 15 |
| High school graduate | 28 | 41 | 23 | 19 |
| Some college | 20 | 11 | 27 | 24 |
| College graduate | 9 | 1 | 14 | 21 |
| Some graduate school | 6 | 1 | 16 | 9 |
| Occupation | (N-52) | (N-67) | (N=138) | (N=167) |
| Not in Labor Force (retired, unemployed, housewives, students) | 52 | 41 | 17 | 19 |
| Blue Collar workers | 36 | 47 | 21 | 27 |
| White Collar workers | 9 | 7 | 62 | 54 |

Table 11. Ridership Characteristics of Bus Patrons in Sample (in percentages)

| Characteristic | Waco | Beaumont | Fort Worth | Houston |
|---|---|---|---|---|
| Ride Frequency | (N=59) | (N=101) | (N=154) | (N=193) |
| Regularly | 61 | 81 | 77 | 80 |
| Frequently | 22 | 17 | 16 | 9 |
| Occasionally | 12 | 1 | 5 | 8 |
| Seldom | 5 | 1 | 1 | 3 |
| Years As A Rider | (N=54) | (N=92) | (N=144) | (N=183) |
| 0-4 years | 33 | 24 | 67 | 61 |
| 5-9 years | 6 | 9 | 6 | 12 |
| 10-14 years | 13 | 15 | 7 | 9 |
| 15-19 years | 13 | 4 | 2 | 2 |
| 20-24 years | 9 | 9 | 3 | 5 |
| 25-29 years | 4 | 5 | 3 | 4 |
| 30-34 years | 4 | 13 | 5 | 3 |
| 35-39 years | 7 | 4 | 3 | 0 |
| 40+ years | 11 | 16 | 5 | 4 |
| Trip Purpose | (N=55) | (N=80) | (N=153) | (N=178) |
| Work | 37 | 65 | 71 | 81 |
| School | 4 | 6 | 9 | 5 |
| Shopping | 28 | 17 | 8 | 7 |
| Medical | 19 | 0 | 3 | 0 |
| Other | 10 | 11 | 8 | 7 |
| Fare Paid | (N-57) | (N=96) | (N=77) | (N=186) |
| .00 | 7 | 1 | 5 | .5 |
| .05 | | 1 | | |
| .10 | | 5 | | .5 |
| .15 | | 17 | | |
| .20 | 14 | | 14 | 4 |
| .25 | 3 | | | |
| .30 | | 38 | 1 | |
| .35 | | 34 | | .5 |
| .40 | 42 | 1 | 79 | 18 |
| .45 | 33 | | | .1 |
| .50 | | | | 51 |
| .55 | | | | .5 |
| .60 | | 1 | | 24 |
| .65 | | 1 | | |

Beaumont and Houston had 81 and 80 percent, respectively, riding the transit systems on a regular basis.

Time Span as a Rider. Pronounced differences were found among riders sampled in the four cities regarding the number of years these individuals had been using the bus system (see Table 11). In Fort Worth and Houston, 67 and 61 percent, respectively, had been riding the bus for four years or less, pointing to the impact of improved transit services in these two cities. In the two smaller cities, patrons had consistently used the system over a long time span in many cases, with 47 percent in Beaumont having patronized the bus service for 20 years or longer. Thirty-five percent in Waco had ridden buses for at least two decades.

Trip Purpose. Houston and Fort Worth riders in the sample showed a higher utilization of the bus for work trips, at 81 percent and 71 percent, respectively (Table 11). Waco evidenced fewer journeys to work by transit, but shopping and medical trip purposes received a higher ranking than in other cities, purposes normally considered as promoting off-peak transit use.

Fares Paid. The distribution of fares paid by riders responding to the on-board surveys is depicted in Table 11. Until recently, Waco and Fort Worth provided free passes for the handicapped, thus explaining the proportion of riders paying no fare for the trip during which the survey was taken. Zone structures also aid in explaining the distribution of fares; however, fare zones per se were not appraised in this particular study.

Mean fare paid on the study routes differed in the four cities with Houston riders evidencing the highest fares and Beaumont having the lowest mean fares. Distances traveled in Houston provide one rationale for explaining the fare differentials, since long rides normally can be priced higher than short rides, as noted in Chapter IV. Also, the pronounced congestion problems in Houston bolster the demand for buses and, therefore, the potential for higher fares.

## Fare Structures for Disadvantaged Rider Segments

Four population groupings are currently receiving special discounts when riding transit vehicles--older persons, the handicapped, children, and poor persons. While these individuals do not qualify for such discounts across all bus systems, special consideration is federally mandated for the elderly and physically disabled. The principal advantages of a user-side subsidy as an approach to providing discounts was discussed in the previous chapter.

To assess the acceptability of a differentiated pricing structure, the on-board surveys addressed the topic of support for disadvantaged segments. As noted in Table 12, acceptance of subsidies in the form of special reduced fares pointed to fairly consistent support for the elderly and handicapped portions of the population, most notably among Houston riders. In cities evidencing the largest proportions of elderly riders, Waco and Beaumont, support was high but no pronounced differences among cities occurred.

Waco and Beaumont also evidence the highest proportions of passengers below the poverty level. Again, support was greater among riders in Waco and Beaumont for special fare reductions for "poor people."

Discounts for children received the lowest ranking in Waco and Beaumont, while lowest priority in Fort Worth and Houston had been the "poor people" category. It appears that riders are more supportive of fare reduction where they or others with whom they ride the bus are in visible need of such discounts. Thus, fare reductions for special segments received differential support by riders based on the existing characteristics of the market in each city.

Table 12. Acceptance of Subsidies in the Form of Fare Reductions for Disadvantaged Rider Segments in Four Texas Cities.
(n=425, percentages in parentheses)

| Support of Reduced Fares for: | City | | | | |
|---|---|---|---|---|---|
| | Waco | Beaumont | Fort Worth | Houston | Totals |
| Poor People | 34(60) | 55(56) | 42(52) | 85(45) | 216 |
| Elderly | 40(70) | 62(63) | 52(64) | 133(70) | 287 |
| Physically Handicapped | 35(61) | 56(57) | 55(68) | 132(70) | 278 |
| Children | 23(40) | 29(30) | 46(57) | 92(49) | 190 |
| None of These | 7(12) | 6 ( 6) | 8(10) | 14 ( 7) | 35 |

## Increases in Fare Among Rider Segments

Fare structure for the four cities under consideration has varied only by small increments in recent years. In order to classify the instances in which fare increases are allowable for specific rider segments, passengers were asked, "What is the highest price you would pay for this bus trip?" The modal response varied by city, as shown in Table 13. Such a decision on the part of the respondent required consideration of alternative modes available, costs of the alternative, value of time constraints, and other salient factors. It was difficult for riders to respond to the question, with several replying, "I'd pay whatever I'd have to, since I have no other means of transportation." Others provided cursory answers that reflected little awareness of the factors involved in fare consideration. Nevertheless, the distribution of highest allowable fares was analyzed, pointing to a much greater fare increase acceptable to Fort Worth patrons. It should be stressed that a categorized fare item was included in the Fort Worth survey, with the smallest category being a 5¢ increase in current fare and the largest category listed as $1.60 above current fare. This fixed choice item was not used for the other three cities; rather, an open ended question was asked in Houston, Beaumont, and Waco.[7] Thus, with the exception of Fort Worth, the vast majority fell in the 26¢ to 50¢ range in suggesting highest allowable fares. The highest mean fares acceptable differed in the four cities but generally showed a 10¢ to 28¢ increase for the non-subscription

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[7]The fixed choice categories were utilized in Fort Worth because two routes were comprised of subscription riders, who are excluded from Table 7, and compatibility among Fort Worth respondents was needed. The category (ranging from 5¢ to $1.60 selected by each respondent for a maximum additional amount to pay for the bus trip) was added to their actual fare paid to get categories shown in Table 9.

riders. Elasticity of demand for bus transportation is shown to vary by system and by routes within systems. Generally, the patron finds reliability and access considerations more salient than cost concerns.

Table 13. Maximum Acceptable Fare in Four Texas Cities

| | Waco | Beaumont | Fort Worth | Houston |
|---|---|---|---|---|
| Highest Fare Rider Would Pay | (N=49) | (N=79) | (N=77)[a] | (N=166) |
| 0 - .25 | 12 | 11 | 2 | 4 |
| .26 - .50 | 79 | 80 | 18 | 57 |
| .51 - .75 | 2 | 7 | 9 | 37 |
| .76 - 1.00 | 4 | | 20 | 3 |
| 1.01 - 1.25 | | | 11 | |
| 1.26 - 1.50 | | | | |
| 1.51 - 1.75 | 2 | | 1 | |
| 1.76 - 2.00 | | | 15 | |
| 2.01 - 2.50 | | | | |
| 2.51 - 2.75 | | | | |
| 2.76 - 3.00 | | | 1 | |

[a]Sample in Fort Worth excludes subscription riders.

A previous household survey undertaken by TTI in Beaumont and Waco revealed six major rider segments, based on a discriminant analysis of attitudes toward transit and service requirements sought[8]:

1. Older Persons (population 65+);
2. Blue Collar Males (those who were craftsmen, operatives, laborers, and service workers);
3. Blue Collar Females (primarily private household or other service workers);
4. White Collar Males (those in professional, managerial,; clerical, or sales positions);
5. White Collar Females (primarily clerical and sales workers); and
6. Housewives.

Because these segments were significantly dissimilar in terms of transit requirements, evaluation of local systems, and demand for service, analysis of maximum acceptable fare increases was undertaken for these six segments. An additional residual segment containing the unemployed and students who responded to the on-board survey was also included in the analysis.

Table 14 displays the sample sizes for each of the segments across the four cities included in the study. The sample sizes are small; thus, generalization regarding fare increases will be constrained by these data. Nevertheless, interesting differences do emerge in maximum fares deemed acceptable by riders. White collar females and males are willing to pay the largest fares per one-way trip; those respondents in these two segments are almost exclusively riders of

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[8]Discriminant analysis is a procedure for constructing a spatial model of the distinctiveness of segments. First, it finds the combination of attributes which discriminates among segments, maximizing an F-ratio of between-segment to within-segment variance. Where overlapping does exist among segments, these incorrectly placed individuals (a) may be small in number and diffused throughout all other segments, or (b) may readily cluster with only one other segment. In the latter case, the two similar population groupings would be combined (see 18, Massy, 1971).

Table 14. Maximum Acceptable Fare Increases by Rider Segments in Four Texas Cities (n = 484)

| Rider Segments | Sample Size | Current Fare (Mean) | Maximum Fare (Mean) | Mean Difference in Fare | Percent Increase in Fare |
|---|---|---|---|---|---|
| Older Persons | 46 | 25 | 53 | 28 | 112 |
| Blue Collar Males | 44 | 39 | 55 | 16 | 41 |
| Blue Collar Females | 69 | 40 | 55 | 15 | 37 |
| White Collar Males | 85 | 51 | 62 | 11 | 21 |
| White Collar Females | 96 | 48 | 67 | 19 | 39 |
| Housewives | 8 | 32 | 44 | 12 | 37 |
| Students, Unemployed | 136 | 37 | 57 | 20 | 54 |

HOUTRAN and CITRAN in Houston and Fort Worth. Those least willing to tolerate large fares were housewives and older persons, with both groups generally having constraints on personal incomes.

Examination of mean differences in current fare and maximum acceptable fare increases points to older persons as most amenable to fare increases. Based on previous TTI surveys, however, it is well known that the elderly are more often captive riders, willing to accept many disbenefits in regard to bus service if required. Additionally, assessment of percent increases in fare (shown in Table 14) clearly points to older persons as tolerating the greatest increases in fare.

Thus, white collar passengers are willing to pay the highest fares, with mean fares of 67¢ for females in clerical, sales, and similar occupations. White collar males consider a 62¢ maximum fare acceptable, again primarily in Houston and Fort Worth. Older persons, followed by students and the unemployed are willing to tolerate the greatest percent change from their current fares; how ever, these individuals tend to be captive riders, for whom choice of mode is not possible.

## Potential Fare Increases for Express Bus Services

As noted earlier, differential subsidies for various population segments have been assayed as a feasible approach to transit service provision. Many groups are able to pay the full costs of their transportation, particularly white collar and upper blue collar commuters utilizing express bus service. Three types of express bus services are currently provided: (1) park and ride facilities; (2) express buses having limited destinations; and (3) subscription service buses. The latter two forms of express service provision were examined through on-board surveys to assess acceptance of fare increases.

Houston's Express Bus Service. HOUTRAN is providing express buses which stop a limited number of times (2-7 stops) along the 82 bus routes in the transit service area. The Gulfton Express riders' responses were compared with passengers on conventional buses to assess differences in acceptable fare increases. Table 15 depicts the maximum fares allowable before riders would discontinue ridership. As can be noted, riders of conventional buses are less willing to pay large fares; these respondents suggested they would pay a maximum of 51¢, while express bus riders conceded a 61¢ fare as acceptable.[9] Ninety percent of the Gulfton Express riders were willing to pay between 59¢ and 96¢ per one-way trip, while only 25 percent of conventional passengers fell into this category.

While it is difficult to generalize from a small sample, it can be hypothesized that express bus riders are more willing to tolerate greater fares than are conventional bus riders.

Table 15. Maximum Acceptable Fare Delineated by Express Bus and Conventional Bus Passengers (percentages in parentheses)

| | Maximum Acceptable Fares[a] | | | | Totals |
|---|---|---|---|---|---|
| | 0-20¢ | 21-58 | 59-96 | 97+ | |
| Gulfton Express Riders | 0(0) | 3(7.5) | 36(90) | 1(2.5) | 40(100) |
| Houston Riders on Conventional Buses | 3(2.5) | 95(75) | 25(25) | 3(2.5) | 126(100) |

$\chi^2$ = 65.332, d.f. = 3, probability Type I error = 0.0001

[a]20¢ represents one standard deviation below the mean fare stated, while 58¢ represents the mean, and 96¢ is one standard deviation above the mean maximum fare supplied by respondents.

[9]Gulfton Express riders currently pay a 40¢ base fare with 10¢ added for a zone change. Passengers on conventional bus routes also pay a 40¢ base fare, with 10¢ per zone transition.

Fort Worth's Subscription Services. Subscription bus service at peak periods to two high employment centers in Fort Worth -- Bell Helicopter and General Dynamics -- has provided an alternative transportation mode for approximately 660 employees, primarily engineers, clerks, and technicians. The subscription buses have been operating for four years and pick up riders at an average of 4.5 locations on each mini-route. There are six routes to Bell and 12 routes to General Dynamics which reach these industrial sites one time in the morning and return at one fixed time in the evening. Two routes, one to each of the plants, were selected for on-board surveys. Each route originates in the same residential sector of southwest Fort Worth. The time span encompassed in picking up riders on the mini-route is approximately 20 minutes, with the remaining non-stop trip to the industrial sites taking almost 15 minutes.

Two conventional routes at both peak and off-peak periods also were selected for on-board surveys in Fort Worth. One of these routes covered the same residential area as did the two subscription routes, while the second originated in a lower socioeconomic section of the city.

Maximum acceptable fare for conventional and subscription bus riders differed markedly, with subscription patrons prescribing a 30¢ allowable increase and conventional riders a 75¢ maximum increase (see Table 16). Riders on conventional routes have a willingness to pay approximately double the current base fare. Passengers on conventional routes, however, evidenced a much greater dependency on transit than did subscription riders. The vast majority of those utilizing the subscription service had automobiles available to them for the work trip.

No significant differences were observed between subscription and conventional bus patrons in the maximum acceptable time increase before these riders would discontinue using the bus (see Table 16). The mean time increase tolerated by the two rider groupings was 14 and 15 minutes, respectively.

Based on this analysis, passengers on conventional routes are more willing than subscription passengers to incur fare increases. While capable of paying actual costs of such a service, subscription riders have alternatives to which they can readily turn if fare increases are higher than tolerated limits. It should be emphasized, however, that subscription riders in Fort Worth were nevertheless willing to pay more per trip than were express bus riders in Houston. A potential may thus exist for future fare increase among commuter segments. These riders have bus trips of longer duration and currently tend to pay less per mile than do lower income, central city passengers.

Table 16. Perceptions of Fare and Value of Time Factors for Subscription and Conventional Bus Patrons

| | Maximum Acceptable Increase in Fare (Mean Response) | Maximum Acceptable Increase in Time Spent on Bus (Mean) |
|---|---|---|
| Subscription Riders | 29.6¢ | 14 minutes |
| Conventional Riders | 74.8¢ | 15 minutes |

## Relevance of Service Improvements to Potential Fare Increases

Assessment of the desire for increased service, such as shorter headways, was juxtaposed against fare increases to determine willingness to pay for higher service levels. With the on-board respondents providing the data base, the question was asked:

"Which would you prefer?"

____The same fare as now, but faster and more frequent buses (in other words, better bus service).

____The same bus service as now, but a lower fare."

As can be observed in Table 17, 70 percent of the passengers favored service improvements at a constant fare rather than a fare reduction with the current service. While only eight housewives in the sample responded to this question, one-half were in favor of reduced fares and lower service levels. White and blue collar females, as well as students and the unemployed evidenced the greatest interest in maintaining current fares with an increase in service levels provided. In summary, no significant differences across segments were observed, except in the case of housewives. Most riders, when queried, suggest that current fares are very reasonable relative to costs for other transportation modes.

## Rider Satisfaction and Fares

The degree of satisfaction among riders with regard to transit usage may be viewed as dependent on a wide variety of dimensions, including the cost of such a service. Overall, passengers evidenced a high degree of satisfaction with transit services in Fort Worth and Waco receiving the greatest proportions eliciting approval, each with 93 percent (see Table 18). The lowest levels of satisfaction were found in Houston, with only 57 percent suggesting they were either "Satisfied" or "Very Satisfied" with the bus service for the particular trip on which the survey was taken.

Table 17. Preferences for Service Improvements Juxtaposed Against Fare Reductions (percentages in parentheses)

| | Preference Patterns | | Totals |
|---|---|---|---|
| | Same Fare, Better Service | Same Service, Lower Fare | |
| All Segments | 322(70) | 137(30) | 459(100) |
| Older Persons | 24(70) | 10(30) | 34(100) |
| White Collar Males | 27(64) | 15(36) | 42(100) |
| White Collar Females | 46(75) | 15(25) | 61(100) |
| Blue Collar Males | 51(62) | 31(38) | 82(100) |
| Blue Collar Females | 70(73) | 26(27) | 96(100) |
| Housewives | 4(50) | 4(50) | 8(100) |
| Students, Unemployed | 100(73) | 37(27) | 136(100) |

Table 18. Rider Satisfaction in Four Texas Cities (in percentages)

| Characteristic | Waco | | Beaumont | | Ft. Worth | | Houston | |
|---|---|---|---|---|---|---|---|---|
| Satisfaction | N=54 | | N=91 | | N=144 | | N=178 | |
| Very Satisfied | 26 | 93 | 41 | 92 | 38 | 93 | 14 | 57 |
| Satisfied | 67 | | 41 | | 55 | | 43 | |
| Neutral | 4 | | 8 | | 5 | | 24 | |
| Unsatisfied | 2 | 4 | 4 | 11 | 1 | 2 | 13 | 19 |
| Very Unsatisfied | 2 | | 7 | | 1 | | 6 | |

Satisfaction levels were related to fares paid for the trip during which theon-board survey was made. As noted on Table 19, a significant association between fares charged and rider satisfaction is observed. However, in the two lowest fare categories (0-29¢ and 30-39¢) a curvilinear relationship can be evidenced in that almost equal proportions (see parentheses) are dissatisfied with the bus service as are favorable toward the bus trip. In the 40¢-49¢ category, which represents the modal fare, only two riders out of 132 stated dissatisfaction with the transient ride. In the highest fare category (50¢ or greater), 71 percent who rated the bus trip as unsatisfactory were paying this maximum fare. Further, 55 percent of those "very dissatisfied" were also paying a fare of 50¢ or greater.

Table 19. Overall Satisfaction with Bus Trip by Fare Paid (n=377, percentages in parentheses)

| Fare (cents) | Very Satisfactory | Satisfactory | Neutral | Unsatis-factory | Very Unsatis-factory | Totals |
|---|---|---|---|---|---|---|
| 0-29 | 19(19) | 20(11) | 4(7) | 3(11) | 3(17) | 49 |
| 30-39 | 24(24) | 26(15) | 5(9) | 4(14) | 4(22) | 63 |
| 40-49 | 38(39) | 79(44) | 13(24) | 1(04) | 1(06) | 132 |
| 50+ | 18(18) | 53(30) | 32(59) | 20(71) | 10(55) | 133 |
| TOTALS | 99(100) | 178(100) | 54(100) | 28(100) | 18(100) | 377 |

System characteristics other than fares affect rider satisfaction. Table 20 points to the relative importance of fares in an unstructured question regarding needed system improvements. Specific features of bus operations elicited the greater percentage of comments. In summarizing rider recommendations for individual cities, the following characteristics were particularly salient:

- Waco -- operational characteristics, information needs, driver qualities, and amenities received top priority.
- Beaumont -- operational characteristics, driver qualities, and comfort features were the three primary concerns.
- Fort Worth -- operational characteristics, amenities, and physical maintenance were accorded the top rankings.
- Houston -- operational characteristics including more dependable, faster service, and physical maintenance and amenities received top ranking.

Table 20. Rider Recommendations for Bus System Improvements (in percentages)

| Suggestions for Improvement | Waco<br>N=271 | Beaumont<br>N=63 | Fort Worth<br>N=56 | Houston<br>N=151 |
|---|---|---|---|---|
| Comments Concerning: | | | | |
| Drivers | 6 | 2 | 5 | 4 |
| Fare | 3 | 0 | 2 | 2 |
| Amenities | 8 | 3 | 5 | 17 |
| Crowding | 10 | 5 | 0 | 5 |
| Physical Maintenance | 7 | 0 | 0 | 5 |
| Information Dissemination | 1 | 0 | 7 | 1 |
| Operations | 63 | 56 | 61 | 44 |
| Comments Expressing Satisfaction: | 1 | 35 | 20 | 22 |

# CHAPTER VIII

# SUMMARY AND RECOMMENDATIONS

This report emphasizes the economic dimension of policy analysis in the public transit field. As such, primary emphasis is placed on predicting the consequences of alternative policy and organizational options in public transit. This focus is predicated on the conviction that we must be able to predict the consequences of various policies before viable policy recommendations can be made. All predictions are made on the assumption that the opportunities for changing detailed individual behavior are limited. However, it is asserted that there is significant latitude for influencing general behavior in an aggregate sense.

The policy analyst studying the economics of public transit must keep the economist's perspective in mind. The distinction between "normative" and "positive" economic analysis must be recognized. Positive economics concerns the study of the most efficient means by which to attain some desired end. Normative economic analysis concerns the specification of which goals are to be pursued. The economist concerns himself with the study of positive economic phenomena and leaves normative considerations to the legislator and the body politic. Thus, the policy analyst considering the following recommendations should keep the economist's "positive" perspective in mind.

## Market Segmentation

Serious study of any transit system requires that the concerned market be divided into distinct sources of demand for transportation services. The identification of such clusters of demand facilitates the formulation of predictive statements concerning the behavior of market segments. This study cited research which delineated five market segments thought to generally represent many transit system markets:

1. Elderly persons;
2. White collar workers;
3. Blue collar workers;
4. The young (ages 6 to 16); and
5. Housewives.

The transit analyst would need to do specific market studies of local areas in order to ensure the greatest accuracy of predictive statements.

## Conventional Public Transit

Fare elasticity studies of conventional public transit suggest that demand for transit services is inelastic. This means that the fare box is a relatively ineffective stimulus to increase ridership. Thus, transit planners seeking to increase ridership with low fares will find that low fares will not cause many people to shift from cars to buses. Fare cuts will bring substantial revenue losses. On the other hand, increased fares will increase total revenue while causing a relatively small decline in ridership.

Elasticity studies offer transit planners some guidance in the design of service and pricing structures. The analyst should remember that the public is more responsive to changes in the level of service than to changes in fare. Patrons are clearly quite interested in door-to-door journey times. In choosing a travel mode, the consumer finds trips and access costs more important than fare levels. Patrons using transit to travel to work are less sensitive to fare changes than are patrons on shopping excursions.

The relative demand intensities of our defined market segments offer the transit planner some guidance in the design of fare structures and level of service. Blue collar females, the elderly, and white collar females evidence more intense demand for a higher level of transit service than do housewives or blue and white collar males.

Let us draw out the more salient policy implications of research on the transit market. Of great import to the transit planner is the fact that service improvements will probably bring greater ridership increases per dollar spent than will decreased fares. General research also indicates that social welfare and economic efficiency will be best served if fare structures are differentiated so as to focus on target population groups. Blanket fare changes or systemwide service changes dissipate possible benefits. The transit planner may well find that a policy option which increases peak-period fare and decreases off-peak-period fares under a differentiated fare structure is quite efficient.

## Pricing Structures in Public Transit

Economic theory posits that marginal cost pricing is the most efficient manner in which to price economic entities. However, there is evidence to suggest that the public transit industry is a decreasing average cost industry. We have shown that this implies that revenues will not cover costs under a marginal cost pricing regime. Given that society values public transit, there is some argument for subsidizing the losses incurred by public transit systems. Research specifically suggests that deficits are most prominent when transit uses some specialized right-of-way system. Where there is no specialized right-of-way but long headways exist, deficits are also quite pronounced.

Given that marginal cost pricing incurs deficits, the transit analyst should investigate the possibility of employing multipart and discriminatory pricing techniques. Multipart pricing could possibly be applied through some form of differentiated transit pass system. A billing system could be devised wherein the patron would be charged a price above marginal cost for his first few rides. The remainder of the rides in a defined time period would be priced at marginal cost. Discriminatory pricing essentially involves charging different prices to specific market segments on the basis of relative elasticity differentials. Price differentials may be designed using the various distinguishing characteristics of the market segments and their observed transit behavior. Several observations which may guide the transit analyst are:

1. Peak patrons may be charged more than off-peak patrons.
2. Long rides may be priced higher than short rides.
3. Trips to work may be priced higher than non-work trips.
4. Blue collar females, white collar females, and the elderly may be charged more than housewives and blue and white collar males (although it is recognized that welfare considerations may prohibit acting on this opportunity).

As we have previously noted, these general observations merely point to opportunities for charging more than marginal cost when the price rise will induce a relatively minimal distortion of observed economic behavior. As such, they indicate possible ways in which to minimize or avoid transit deficits.

## The Potential Role of Para-Transit

Para-transit may be thought of as all of those public transportation modes in-between the private automobile and conventional transit. It is para-transit's ability to span the "no man's land" between the private auto and conventional transit that gives it special significance. There is a manifest need for some form of service improvement in the transit market. Research indicates that there are several potential markets for para-transit:

1. High density home-to-work travel;
2. Low density travel demand (suburban and small town areas); including limited mobility groups such as the young, old, unemployed, poor, and the handicapped;
3. Feeder to line-haul transit; and
4. Mobility in business and commercial districts.

These potential markets are areas in which para-transit could make a significant contribution to improved transit service.

The transit analyst should pay particular attention to the potential role of taxicab services. Currently, taxicab services predominately owned and operated by the private sector are quite demand responsive. The taxicab has a relatively high average travel speed, high route and time flexibility, a relatively high level of comfort and convenience, and is free from parking difficulties. Research indicates that women and non-whites use taxi services more intensely than other patron groups. People in white collar occupations use taxi services most intensely for trips in the central business district. Thus, a disproportionate amount of taxi patronage comes from the extremes of the income distribution.

Most elasticity research indicates that the price (fare) elasticity of demand for taxi services is roughly unit elastic. Thus, a small percentage fare increase would bring no significant change in revenues. The transit planner plagued by deficits will find this fact important.

Transit analysts should give careful consideration to the possibility of using taxicabs in providing public transportation. The significance of taxi services as a policy option is that many of the current reform proposals for urban transit, whether they be flexible or adaptive routing systems, are currently accomplished by taxi services. Of particular importance is the fact that taxicabs are a money-making concern.

## UMTA Grant Programs

The Urban Mass Transportation Administration (UMTA) distributes federal funds to subsidize the capital and operating expenses of eligible urban transportation systems. This report evaluated the economic ramifications of the incentives established by UMTA. Research suggests that UMTA's capital grant program provides public transit systems with an incentive to replace buses earlier than is economically efficient. Incentives to neglect maintenance, accelerate depreciation, and to apply capital to areas of dubious efficiency are also provided. Research indicates that UMTA's operating grant program also has a tendency to set up some inefficient incentives. Because no well defined profit incentive exists, there is a tendency for public transit systems to pay their employees more than the rate common for comparable work in other areas of the economy. There is not as much of an incentive to monitor worker productivity as there would be in a competitive context. Consequently, there is a tendency for worker productivity to be somewhat lower under an operating grant than in a free-enterprise transit system.

## Options for Altered Fare Subsidies Based on Rider Response

The on-board surveys in four Texas cities revealed that passengers are more supportive of fare subsidies for specific rider segments if these groups are frequent patrons of the bus system. Fare reductions for individual segments, such as older persons, the handicapped, the poor, and children, thus received differential support among the transit systems surveyed, based on existing characteristics of the market in each city. In sum, fare subsidies need to be more specifically geared to local population characteristics, rather than attempting to establish standard guidelines across systems.

The majority of riders fell into the 25¢-58¢ fare range in response to the maximum fare tolerated before they would choose not to make the bus trip. This represented a 10¢ to 28¢ increase for non-subscription bus patrons. Elasticity of demand for bus transportation was shown to vary by system, by route, and by type of service. Generally, reliability, access, and comfort features were more salient than cost considerations.

Fare increases were viewed as more acceptable by express bus riders than riders of conventional buses, based on a Houston rider sample. In Fort Worth, on the other hand, riders using subscription bus service were less willing to incur a fare increase than were passengers on conventional routes. Nevertheless, the subscription riders in Fort Worth were willing to pay more per trip than were express bus riders in Houston or riders on conventional bus routes in both cities. Thus, a potential may exist for fare increases among commuter segments. These riders tend to travel longer distances by bus and often pay less per mile than do lower income, central city passengers.

The maximum fare that passengers were willing to pay differed among rider segments. Those willing to pay the greatest percent increase were older persons, suggesting an average 112 percent increase from a mean current fare of 25¢ to mean maximum fare of 53¢ across cities. Those least willing to tolerate fare increases were white collar males, with a 21¢ mean increase from an average of 51¢ to 62¢ deemed allowable. Older persons, followed by students and the unemployed, are often captive riders for whom choice of transportation mode is not possible.

When requested to choose between two options--one with fare constant and improved service levels and the second option with fare reductions and current service levels, 70 percent of passengers surveyed in the four cities favored service improvements at the current fare. Most riders, when queried, suggested that current fares are very reasonable relative to costs for other transportation modes.

The degree of satisfaction among riders regarding transit usage was found to be dependent on a number of bus features, with cost a relatively unimportant concern for survey respondents. Operational characteristics had far greater saliency for current patrons, suggesting that minor alterations in fare structure may have a negligible impact on passenger levels and ridership responses to the bus system.

## Basic Subsidy Techniques in Public Transit

There are two fundamental techniques used in the distribution of subsidies to urban transit systems. The most common technique is the provider-side subsidy. This technique consists of paying a subsidy directly to the provider of public transit. The second technique is the user-side subsidy. This method consists of paying subsidy funds directly to public transit patrons. The transit patron usually receives some form of transit service voucher at a discount.

Current research suggests several hypotheses concerning provider-side subsidies:

1. Competition among transit providers is minimized.
2. Incentives for inefficient captial use and excessive wage bills are fostered.
3. Providers receiving such subsidies may be over-utilized while

unsubsidized providers may be under-utilized. This provides a significant opportunity for economic inefficiency.

4. Publicly owned transit providers are less responsive to public transportation needs at the local level than are privately owned systems without provider-side subsidies.

5. Administration of such subsidy funds is relatively straightforward.

The policy analyst has as one of his primary goals the minimization of any economic inefficiency imposed by subsidization. The user-side subsidy accomplishes this goal by minimizing the distortion of individual economic decisions. Since the patron is given a voucher equivalent to transit fares, he retains the option to choose among transit providers and thus among competing transportation modes. These factors encourage the efficient allocation of transportation resources. Research suggests several hypotheses concerning user-side subsidies:

1. Transit providers will have an incentive to operate their services efficiently.

2. The various public transportation modes will be used efficiently.

3. Transit patrons will obtain high quality services from the transit providers.

4. Certain administrative problems may be encountered in distributing "vouchers" and in guarding against fraud.

One of the principal advantages of user-side subsidies is that they encourage competition in the public transit sector. Providers are forced to compete for the "vouchers" of the public. Transit analysts seeking to use a differentiated pricing structure and to reach target market segments would find user-side subsidies quite flexible. They can be differentiated by age, mode, income, time-of-day, class of service, and so forth.

A promising policy option is the disbursement of subsidy funds through some combination of provider-side and user-side subsidies. A careful mixture would emphasize the strengths of both methods and minimize the inefficiencies of both methods. Some hypotheses concerning the potential for combined subsidy programs may be made:

1. Transit providers receiving provider-side subsidies still lose some of their incentives for efficient operation.
2. Many more providers can be involved conveniently than is the case under a program exclusively using a provider-side program.
3. Transit patrons, whether they receive user-side subsidies or not, may overutilize those providers favored by the provider-side subsidy program and underutilize other providers.
4. Administration of user-side subsidy funds may be difficult.

It is the position of this report that a combined subsidy program which emphasizes user-side subsidies would be economically optimal. The transit analyst should give careful consideration to the potentials for economic efficiency and public service provided by combined subsidy techniques.

# APPENDIX A

## ISSUES IN PUBLIC TRANSIT PRICING

Economists almost universally advocate marginal cost pricing as the most efficient manner in which to price economic entities. This concept is quite straightforward and easily understood. The marginal cost of a good is the change in total costs resulting from the production of one more good. As such, it may be thought of as the incremental cost of production. The economist argues that all buyers should pay a price equal to the incremental cost of supplying one more unit. In order to fully understand this concept, we must investigate the economist's conception of cost.

The purpose of economic analysis is to determine the most efficient allocation of limited productive resources. The decision to produce more of one good in a system of limited resources amounts to a decision to produce less of all other goods (in an aggregate sense). Individual choices are assumed to be based upon the preferences and opportunities of the decision maker. The fact that more production of one good implies lower production levels of others is the economic concept of "opportunity cost." The opportunity cost of producing any good is the amount of other goods which must be forgone in order to produce the good in question. Efficient utilization of productive resources requires that the price of a good reflects its opportunity cost, i.e., its true resource cost to society. It is assumed that the demand for the good in question is responsive to price changes. Marginal cost pricing allows consumers' decisions whether to buy more or less of a commodity consistent with the incremental opportunity cost of supplying more or less of the commodity. Because the consumer deals in marginal decisions, average cost pricing would not adequately reflect the opportunity cost of production. The equivalence of price and marginal cost encourages the production of an optimal quantity of various goods.

In order to illustrate the efficiency of marginal cost pricing, assume that the price is greater than marginal cost. Because the price is higher, consumers will buy less than the optimal quantity where price equals marginal cost. Consumers who would prefer the commodity will not allocate their resources to its production as much as if P=MC. This is because the inflated price requires consumers to sacrifice an inordinate amount of consumption. Thus, less than the optimal quantity will be purchased. The argument is the same but with opposite results when the price is less than marginal cost. It is apparent that prices which deviate from marginal cost ordinarily lead resources to be less than their optimal economic allocation.

In studying marginal cost pricing it is necessary to specify the assumptions upon which this argument rests. The efficiency of marginal cost pricing rests upon two fundamental assumptions [10, Kahn, 1970, pp. 67-69]. The first is the assumption that the optimal economic system is one in which consumers get what they want, i.e., what they effectively demand. The second assumption is that income is already optimally distributed. Both of these assumptions are essentially ethical or "normative" in nature and not "positive." The marginal cost pricing concept has two corollaries. The first corollary is that prices must reflect all marginal costs of consumption and production if marginal cost pricing is to be efficient. In practice this implies that if externalities such as pollution are not reflected in prices, then marginal cost pricing will not necessarily be optimal. The second corollary is generally known in economics as "the theory of second best." This corollary asserts that marginal cost pricing in individual firms or markets may not be optimal if marginal cost pricing is not followed throughout the economy. The transit analyst must evaluate these issues and the problem of decreasing average costs of production in deciding whether marginal cost pricing is indeed optimal in public transit.

## Pricing and Average Costs of Production

The pricing issue is complicated by the fact that marginal cost pricing does not always guarantee that revenues will cover the total costs of providing public transit. Whether costs will be covered depends upon the relative sizes of marginal and average cost. If average cost remains constant as output changes, marginal cost and average cost are equal. Consequently, revenues are exactly equal to costs. If average cost increases with increases in output, marginal cost is greater than average cost. This implies that revenues will be sufficient to defray production costs. If average cost decreases as output increases, marginal cost will be less than average cost. Thus, marginal cost pricing will generate insufficient funds to cover production costs. The case of declining average costs requires careful elaboration.

A great deal of transit research suggests that the marginal cost of providing public transit is less than the average cost of providing transit. Thus, the public transit industry must receive assistance in order to continue operation with marginal cost pricing. Since public transit is a public service, there is some basis for an argument for governmental subsidization. Figure 3 graphically illustrates the problem introduced by marginal cost pricing in a declining average cost industry. Marginal cost pricing will yield a price of $P_A$ and a quantity produced of $Q*$. Total revenue generated is equal to the area of the rectangle $0Q*BP_A$. Total costs are equal to the rectangle $0Q*CP_B$. Thus, total cost exceeds total revenue by the area $P_ABCP_B$. Marginal cost pricing implies that the public transit industry requires subsidization in order to cover its deficit.

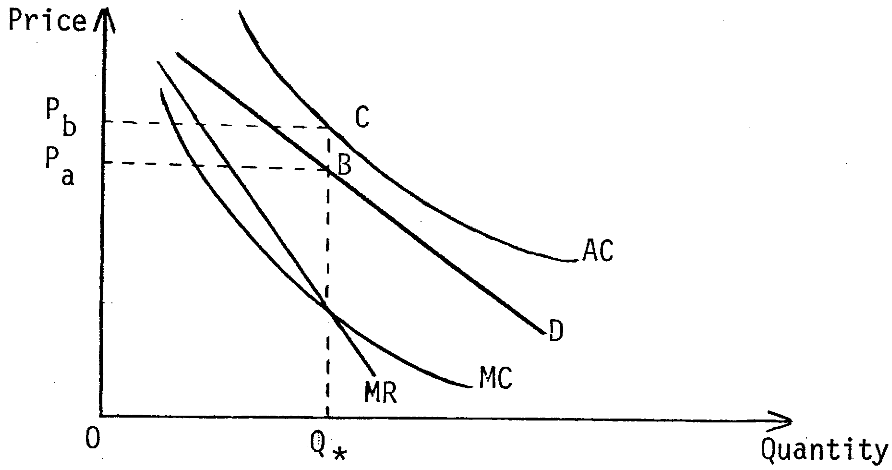


Figure 3. Declining Average Production Costs

Gomez-Ibanez [5, 1975] found that marginal cost pricing implies that revenues will be insufficient to cover all public transit costs when transit uses some specialized right-of-way system (e.g., rail transit). He asserts that revenue can conceivably cover all costs with the exception of those capital costs associated with the specialized right-of-way. In cases where there is no specialized right-of-way but where there are long headways, it is asserted that revenue will not meet all of the operating and capital costs.

## Differentiated Pricing Structures

Given that marginal cost pricing incurs deficits, the transit analyst must investigate alternative pricing strategies by which the deficits resulting from marginal cost pricing may be minimized or eliminated. We will investigate two pricing options: multipart and discriminatory pricing techniques. The general goal is to minimize deficits in a manner which does not disturb consumer decisions and thus leaves the quantity of transit services consumed at the same level marginal cost pricing would foster.

Multipart pricing in public transit would be applied to frequent transit riders. It involves charging the patron a price above marginal cost for his first ride (or first few rides). The remainder of the rides in a defined period would be priced at marginal cost. Multipart pricing could possibly be applied through some form of differentiated transit pass system. The problem is that it would be necessary for almost all transit users to use these passes for the system to be efficient. However, the pass system would be relatively adaptable to a discriminatory pricing structure, or differential costs for specific rider segments. The combination of a multipart and discriminatory pricing system might be especially effective.

Discriminatory pricing may take many forms, but all forms rely upon charging different prices to specific market segments. Prices above marginal cost are charged to those segments which have relatively inelastic fare elasticities of demand. Previous research at the Texas Transportation Institute indicates that all market segments are somewhat inelastic. However, comparisons of relative magnitudes of inelasticity give us a basis for constructing a discriminatory pricing schedule. Price differentials may be designed using the various distinguishing characteristics of the market segments and their observed transit behavior. We may make several general observations:

1. Peak patrons may be charged more than off-peak patrons;
2. Long rides may be priced higher than short rides;
3. Trips to work may be priced higher than non-work trips; and
4. Blue collar females, white collar, and the elderly may be charged more than housewives and blue and white collar males (although it is noted that welfare considerations may prohibit such policies).

These general observations merely point to opportunities for charging more than marginal cost wherein the price rise will induce a relatively minimal distortion of observed economic behavior. Thus, these observations indicate possible opportunities to minimize transit deficits while also minimizing the tendency for the quantity of transit services consumed to deviate from the marginal cost pricing level.

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