Abridgment

Preference Elasticities of Transit Fare Increases and Decreases by Demographic Groups

Elene P. Donnelly, Planning and Research Bureau, New York State Department of Transportation

Although research has been conducted to develop demand elasticities for transit at different fares, the literature is notably lacking in drawing a distinction between forward elasticities (fare increases) and backward elasticities (fare decreases).

The Curtin rule suggests a 33 percent decrease in ridership for each 100 percent increase in fare. In the 1974 transit operating assistance study done by the New York State Department of Transportation (1), three forward elasticities are reported: -0.25 for the New York City bus and subway and Buffalo bus systems; -0.55 for other bus systems; and -0.70 for commuter rail (2).

Although it is widely believed that the elasticity of demand is not the same for fare increases as for decreases, there is little evidence to support this contention because fare decreases rarely occur, and so data are lacking. Only intuition indicates that when a transit rider has forsaken a mode, for whatever reason, he is less likely to ride it again if the former conditions return.

A logical argument supports this belief. When a rider leaves the transit mode because of increased fare or decreased service, he usually turns to the automobile for transportation. If fares or services return to the former level, there is nothing to force him to return to transit. On the contrary, having made an automobile purchase, he is likely to continue to use it. Habit favors retaining the current mode until an outside force (e.g., cost or inconvenience) causes a personal reevaluation. That the Curtin rule does not hold for backward elasticities is noted by Holland (3) who offers some evidence that the increase in ridership for a 10 percent fare decrease is in the range of 10 to 30 percent.

This study investigates the nature of forward and backward fare elasticities of transit demand by various socioeconomic strata.

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TRADE-OFF ANALYSIS

Although demand information is lacking on backward fare elasticities, the issue can be addressed from a preference point of view. Presumably, knowledge of how people say they would change their transit ridership habits is an indication of how they would actually behave. Estimates of people's preferences for different transit programs that vary only in fare level may be translated into preference elasticities, which in turn may result in a relationship between forward and backward preference elasticities and therefore backward and forward demand elasticities.

The trade-off technique, in which the respondent compares two items by trading off one for the other, was used to study this issue. The willingness of the respondent to make this trade is recorded in matrix form and is later translated to ratio-scaled data.

When presented with a matrix (Figure 1) that displays the possible trade-offs, each respondent orders them, rating the most attractive (or least unattractive) as 1, the next as 2, and so forth. Each respondent ranks the trade-offs according to his or her personal preferences.

An algorithm exists that transposes simple rank order preference data, acquired through specially designed survey questionnaires, to ratio scales. The value on the scale for each variable for each respondent may be combined with other values for like variables for different respondents, to arrive at preferences of the entire population or for certain stratifications of the population. More matrices may be developed to allow comparison of several more features being considered in the given research project.

In December 1974, the New York State Department of Transportation sponsored a statewide public opinion survey incorporating some questions to be used for trade-off analysis (4). The data and trade-off analyses have been used to determine the elasticities of people's strength of preference for alternative operating assistance programs, as influenced by changes in fare.

Given a choice between fares of 25 cents and 30 cents, a person would logically choose the lower, all things being equal. The same response would be expected if he were asked to choose between 25 cents and $1.00. However,

Figure 1. Sample trade-off matrix.

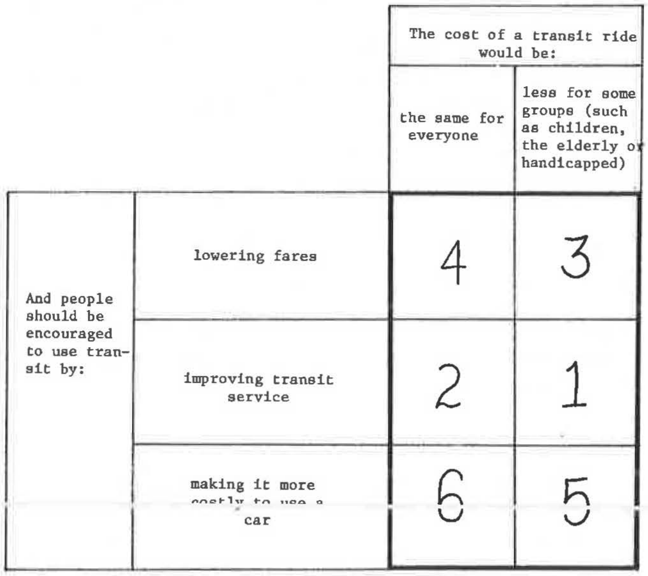


Figure 2. Preference elasticities.

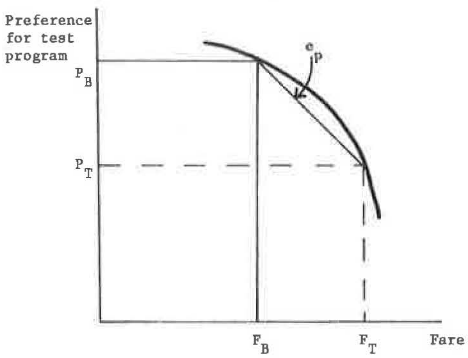
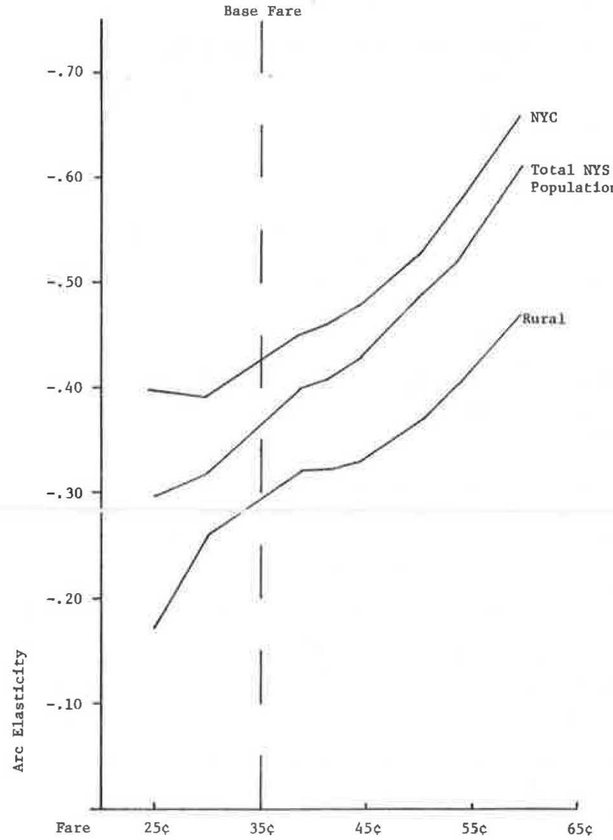


Table 1. Fare preference elasticities for fare decrease from 35 to 20 cents and fare increase from 35 to 50 cents.

Stratification	Lower Fare From 35 to 20 Cents	Raise Fare From 35 to 50 Cents	Ratio of Elasticities
Total population	-0.24	-0.49	2.04
Location			
New York City	-0.34	-0.53	1.56
Large metropolitan area	-0.18	-0.49	2.72
Small urban area	-0.14	-0.47	3.36
Rural	-0.12	-0.37	3.08
Age			
18 to 34	-0.22	-0.47	2.14
35 to 54	-0.16	-0.47	2.93
55 and older	-0.34	-0.53	1.56
Automobile ownership			
0	-0.44	-0.52	1.18
1	-0.16	-0.47	2.93
2 or more	-0.08	-0.47	5.88
Race			
Black	-0.26	-0.50	1.92
White	-0.23	-0.48	2.09
Other	-0.32	-0.52	1.63
Mode to work			
Automobile	-0.13	-0.39	3.00
Bus	-0.25	-0.62	2.48
Subway	-0.26	-0.44	1.69
Walk, other	-0.22	-0.49	2.23

Figure 3. Arc elasticities by fare.



that person's feelings toward a fare increase of 5 cents or 75 cents are not the same in both cases; the second increase would cause a much stronger reaction. It is this strength of reaction, not necessarily the direction, with which we are dealing here.

PREFERENCE ELASTICITY

The next step is, What is the difference in strength of reaction when the fare is increased 5 cents, 10 cents, and so on as opposed to decreasing the fare 5 cents, 10 cents, and so on? To answer this question, a preference comparison was made of the base transportation program against itself. As expected, the results in all stratifications indicated a 50-50 split in preference: Neither program was any better or worse than the other, so there was no difference in preference. A series of comparisons was then run of the base program and a second program that differed only in the average cost per ride (fare). In the comparisons, the base program was maintained while the fare in the new program was changed.

The preference scores from the trade-off runs were used to develop chord elasticities for fare decreases from 35 to 30, 25, and 20 cents and for fare increases from 35 to 40, 45, 50, 55, and 60 cents. These preference elasticities were computed by using the following method (Figure 2):

$$e_p = \frac{\text{\% change in preference}}{\text{\% change in fare}} = \frac{\Delta P/P_B}{\Delta F/F_B} = \frac{\Delta P}{P_B} \times \frac{(P_B - P_T)F_B}{(F_B - F_T)P_B}$$

where

e_p = preference elasticity,
ΔP = change in preference,

ΔF = change in fare,
P_B = preference for test program at base fare,
F_B = base fare (35 cents),
P_T = preference for test program at test fare, and
F_T = test fare.

GENERAL RESULTS

Table 1 gives the results for the New York State population as a whole and stratified by geographic area (New York City, large metropolitan areas of 500 000 population or more, small urban areas of 5000 to 500 000 population, and rural areas of less than 5000 population); age; automobile ownership or nonownership; race; and mode of transportation to work. For all stratifications, elasticity increases as fares are raised from about 35 cents (approximately the present rate). Likewise, elasticity decreases as fares are lowered from 35 cents (Figure 3).

The range of chord preference elasticities by stratifications for the 35 to 20-cent fare reduction is -0.08 to -0.44 and -0.24 for the total population. This is in striking contrast to a range of -0.39 to -0.62 for the 35 to 50-cent fare increase and -0.49 for the total population (Table 1).

Presumably, people react to a situation in accordance with their preferences. If people's preference for transit decreased, they would probably use transit less and vice versa. For example, if people's preference for a transit program decreased by about 14 percent when the fare is increased from the present level by 20 cents (in this case, from 35 to 55 cents), it can be assumed that transit ridership would decrease. When the fare is decreased by 20 cents from the present level (in this case, from 35 to 15 cents), people's preference increases by only 6 percent. Presumably, the percentage of change in ridership here would be less than that for a 20-cent increase, since the change of preference for the decrease is much less than the change in preference for the increase.

RESULTS BY STRATIFICATIONS

The change in preference elasticity is not the same for all groups of population (Table 1). For those who have no alternative to transit, the fare elasticity at low fare levels is much greater than for those with alternative modes available. A good example is New York City residents compared to residents of the other three geographic stratifications or those who do not own cars compared to both groups of car owners. Bus and subway riders react in the same way: Both groups are more sensitive to fare decreases than those who commute by automobile. Fare elasticity increases with fare. However, there is not a great difference among the three age groups, although automobile and bus users react in the extreme to fare increases (automobile users, the least of any group; bus users, the most of any group). In almost all of the stratifications, the differences appear in reactions to fares below the current rate; elasticities toward higher fares are nearly the same.

CONCLUSION

In all stratifications, the preference elasticity is significantly higher for fare increases from 35 to 50 cents than for fare decreases from 35 to 20 cents. Because these are preference elasticities, not demand elasticities, the results may not be directly applied to existing ridership and fare condition. However, the ratio of the forward preference elasticity to the backward preference does offer the opportunity to roughly estimate backward demand elasticities where the forward demand elasticities are known. Although this may produce only order-of-magnitude results, it is significant that these results will vary greatly from the known forward elasticities.

Backward elasticities not only are notably lower than forward elasticities but also differ more among various stratifications. Data given in Table 1 show that the preference responses by stratification for fare increases are much closer than are the responses for fare decreases, with the exception of the mode-to-work category.

All stratifications but one are almost equally sensitive to fare increase but have varying strengths of preference for fare decreases. Sensitivity to transit fare increases is significantly higher than sensitivity to transit fare decreases: People may become very unhappy about fare increases but may be only somewhat pleased about fare decreases.

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