Are Transit Riders Becoming Less Sensitive to Fare Increases?

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ABSTRACT

The Simpson-Curtin formula for measuring ridership changes resulting from fare increases, first published in 1968, has recently been confirmed in a study by Ecosometrics, Inc. However, in the wake of the 1979 energy crisis, some observers noted that the impact of fare increases on ridership was less than expected. Examined in this paper is the hypothesis that transit riders have become less sensitive to fare increases in the post-energy crisis period. One hundred seventy-nine instances of fare changes between 1979 and 1982 are analyzed. Several measures of elasticity are calculated, and results are broken down by region, Standard Metropolitan Statistical Area (SMSA) size, year, level of original fare, bus and rail systems, and type of fare change. Results indicate that the hypothesis must be rejected. This conclusion supports the assumption implicit in transportation planning that measures of travel behavior are stable over time and have positive implications for current work on disaggregate elasticities.

Transit companies have long had a natural interest in the reaction of their riders to fare increases. Historically, the demand for transit has been inelastic with respect to price. As a practical matter, this meant that a fare increase would cause some loss in ridership but would bring an increase in revenue. In 1968 Simpson and Curtin measured the elasticity of transit ridership with respect to price as -0.3 (1). This measure has gained widespread acceptance as a rule-of-thumb in the transit industry and has continued to provide an accurate gauge of the aggregate effect of increasing transit fares on ridership.

Recent work on fare elasticity has focused on disaggregate elasticities, or the sensitivity of various groupings of transit riders to fare changes. The most comprehensive work on disaggregate elasticities was performed by Mayworm et al. (2). These authors found interesting differences in response to fare changes among ridership segments. In terms of the aggregate reaction to fare changes, they confirmed the continuing validity of the Simpson-Curtin formula.

Scattered fare increases in the immediate wake of the 1979 energy crisis did not have the expected impact on transit ridership. Mayworm et al. examined fare changes that occurred before 1979, and so there was the possibility that transit riders had become less responsive to fare increases as a result of gasoline supply problems and price increases in 1979 (2). In this paper the hypothesis that transit riders have become less sensitive to fare increases in the post-energy-crisis period is explored. If this hypothesis is correct, the elasticity of ridership with respect to price would be closer to zero.

METHODOLOGY

To test this hypothesis, various American Public Transit Association (APTA) reports were reviewed to identify all fare increases that have taken place between 1979 and 1982 (3,4). A total of 227 instances of fare changes was identified for this 4-year period. APTA monthly ridership reports were then examined to determine ridership changes (5). In 48 cases, ridership data were not available, leaving a usable sample of 179 fare changes.

There are several pitfalls and issues to be considered in calculating changes in ridership in response to fare increases. Seasonal variation, existing ridership trends, and time frame for the effects of the fare change are all addressed here. In order to control for seasonal or month-to-month variation in transit use, changes in ridership were computed by comparing the ridership of the month in question to that of the same month in the previous year. For a given fare change, the change in ridership is measured in this way for the month following the fare change (or the month of the fare change if it took effect in the first 5 days). However, this method of calculating ridership changes requires that existing ridership trends be taken into account. If this is not done, changes in ridership resulting from fare changes (and thus, elasticities) would be overestimated in periods of declining ridership and underestimated in periods of increasing ridership. The existing trend is measured by calculating the change in ridership for the month preceding the fare change (compared to the same month in the preceding year). The third consideration is the possible long-term effects of fare changes; these are examined by calculating the ridership change for the sixth month after the fare change (compared to the same month in the previous year). Thus, three measures of change in ridership are available for each of the 179 fare changes. These three measures provide information on ridership trends before the fare change, immediate impact, and long-term impact.

Four elasticity numbers were calculated from these three measures of change in ridership. Short-term and long-term elasticities, with and without existing trends, were derived using the following equations:

Short term, no trend: $e = R_1/F$
Long term, no trend: $e = R_6/F$
Short term, trend: $e = (R_1 - R_o)/F$
Long term, trend: $e = (R_6 - R_o)/F$

where

- e = the elasticity of ridership with respect to fare,
- R_1 = percentage change in ridership in the first month after the fare change (compared to the same month in the previous year),
- R_6 = percentage change in ridership in the sixth month after the fare change (compared to the same month in the previous year),
- R_0 = percentage change in ridership in the month preceding the fare change (compared to the same month in the previous year), and
- F = percentage change in fare.

A common criticism of fare elasticity measures is that they assume that ridership changes occur only in response to fare changes. The trend equations are intended to control for existing ridership trends, which reflect changes in service levels and other extraneous factors. Because it measures immediate impact, the short-term trend equation is best in terms of controlling for the effects of nonfare-related changes in ridership.

RESULTS

Mean elasticities calculated by each method are given in Table 1. As may be observed, these are presented along with the standard error of the mean for all systems, and broken down by region, by SMSA size, by year, and by level of original fare. These are also shown separately for bus and rail systems, and for systems with fare increases and with fare reductions.

As noted in the preceding paragraph, elasticities measured without regard for existing ridership trends overestimate the effect of fare changes in periods of declining ridership and underestimate the effect of fare changes in periods of increasing ridership. In approximately two-thirds of the instances of fare changes, the ridership trend was positive in the previous month; thus, the elasticities calculated without regard for ridership trends are generally closer to zero. Short-term elasticities are also closer to zero than long-term elasticities. This may indicate that the full effects of fare changes are not immediately obvious because it takes time for riders to find suitable alternatives. However, there are likely to be many other factors that also affect ridership during the 6-month period, and so the reliability of long-term elasticities for measuring the impact solely of the fare change is reduced.

The breakdowns in Table 1 reveal some differences. Transit riders in the Northeast and the South appear most sensitive to fare changes in the period 1979 to 1982. The elasticity of riders with respect to fare is surprisingly high in very large SMSAs and unexpectedly low in very small SMSAs. The level of original fare may be confounding the SMSA size breakdowns because systems in small SMSAs tend to have low fares. When existing ridership trends are taken into account, bus riders are more sensitive to fare changes than rail riders (commuter rail is not included). The difference between elasticities for bus and rail systems is not as great as expected; Mayworm et al. found that bus elasticities were twice as large as rail elasticities (2). It is interesting that on rail systems, long-term elasticities are lower than short-term elasticities. This suggests that rail transit riders may be attracted back to the system within a few months of a fare increase more readily than bus riders, although as noted earlier there may be many other factors affecting ridership in the intervening months. Most of the fare changes in this 4-year period were increases; there are too few cases of fare reductions to make valid generalizations.

Two points of particular significance stand out in Table 1. The major conclusion concerns the central hypothesis of this paper, that transit ridership has become less elastic with respect to fare. Although the overall elasticities initially appear to support the hypothesis, the yearly breakdown shows that this may have been true only in the immediate wake of the energy crisis, that is, in 1979 and 1980. By 1982 the short-term, no-trend elasticity had returned to the level predicted by Simpson and Curtin. In addition, the short-term trend elasticity has remained relatively constant at a level within range of the

TABLE 1 Mean Elasticities ± Standard Error of the Mean Derived from 179 Cases of Fare Changes Between 1979 and 1982

	N	1 Month No Trend	N	6 Months No Trend	N	1 Month Trend	N	6 Months Trend
All systems	164	−0.05 ± 0.04	169	−0.18 ± 0.03	157	−0.21 ± 0.04	154	−0.32 ± 0.04
Region								
Northeast	37	−0.16 ± 0.08	42	−0.16 ± 0.05	36	−0.28 ± 0.07	37	−0.24 ± 0.09
South	40	−0.08 ± 0.10	42	−0.25 ± 0.10	36	−0.35 ± 0.10	36	−0.57 ± 0.11
North Central	50	−0.08 ± 0.07	46	−0.17 ± 0.06	49	−0.13 ± 0.06	44	−0.22 ± 0.06
West	37	+0.14 ± 0.08	39	−0.12 ± 0.05	36	−0.10 ± 0.07	37	−0.30 ± 0.06
SMSA size								
1 million +	57	−0.14 ± 0.06	57	−0.21 ± 0.05	56	−0.20 ± 0.07	53	−0.26 ± 0.08
500,000-1,000,000	22	−0.07 ± 0.11	21	−0.21 ± 0.07	20	−0.11 ± 0.09	19	−0.28 ± 0.06
250,000-500,000	23	−0.00 ± 0.09	27	−0.24 ± 0.08	21	−0.29 ± 0.09	24	−0.44 ± 0.10
100,000-250,000	37	−0.04 ± 0.09	41	−0.08 ± 0.07	36	−0.21 ± 0.07	36	−0.26 ± 0.05
50,000-100,000	11	+0.06 ± 0.13	11	−0.14 ± 0.06	10	−0.13 ± 0.12	10	−0.31 ± 0.11
Year								
1979	13	+0.30 ± 0.12	15	+0.24 ± 0.12	13	−0.23 ± 0.16	13	−0.33 ± 0.18
1980	59	+0.13 ± 0.06	60	−0.06 ± 0.05	57	−0.21 ± 0.07	57	−0.39 ± 0.07
1981	61	−0.14 ± 0.06	62	−0.21 ± 0.04	58	−0.19 ± 0.06	55	−0.21 ± 0.07
1982	31	−0.35 ± 0.10	32	−0.53 ± 0.08	29	−0.24 ± 0.08	29	−0.42 ± 0.08
Original fare ($)								
30 and below	30	+0.09 ± 0.06	30	−0.05 ± 0.06	30	−0.12 ± 0.08	27	−0.31 ± 0.10
31-40	59	+0.04 ± 0.06	62	−0.10 ± 0.05	57	−0.19 ± 0.05	57	−0.30 ± 0.06
41-50	41	−0.02 ± 0.09	42	−0.21 ± 0.07	38	−0.28 ± 0.09	38	−0.42 ± 0.07
51-60	21	−0.43 ± 0.14	23	−0.41 ± 0.13	20	−0.34 ± 0.13	21	−0.33 ± 0.12
Above 60	13	−0.25 ± 0.19	12	−0.31 ± 0.07	12	−0.03 ± 0.14	11	−0.13 ± 0.23
Bus systems	160	−0.05 ± 0.04	164	−0.18 ± 0.03	153	−0.20 ± 0.04	150	−0.32 ± 0.04
Rail systems	11	−0.26 ± 0.16	11	−0.12 ± 0.10	10	−0.15 ± 0.16	9	−0.01 ± 0.03
Fare increases	161	−0.06 ± 0.04	165	−0.18 ± 0.03	154	−0.20 ± 0.04	150	−0.32 ± 0.04
Fare reductions	3	+0.26 ± 0.20	4	−0.14 ± 0.25	3	−0.31 ± 0.15	4	−0.40 ± 0.44

Simpson-Curtin elasticity. This indicates that fluctuations in the no-trend elasticities are likely due to external events affecting ridership trends. The short-term trend elasticity is the preferable measure: it controls for month-to-month variation and for existing ridership trends, and it measures the immediate impact of a fare change. Taking the annual breakdowns and existing ridership trends into account, then, the hypothesis that the elasticity of ridership with respect to fare has moved closer to zero must be rejected. Although increasing fares may have had little apparent impact on ridership in the energy-conscious years of 1979 and 1980, this appears to have been only a temporary, and perhaps illusory, phenomenon.

A second interesting point concerns the concept of a fare threshold. This concept postulates that as fares rise beyond a certain threshold level, ridership behavior changes significantly. Behavior can change in one of two ways: either a large number of riders will balk at a fare beyond a certain threshold, or they will be relatively immune to fare increases beyond that threshold. The former version is analogous to the situation with gasoline prices. A price of $1.00/gal had been considered a threshold; at this price or beyond, it was thought that automobile users would be seriously motivated to investigate alternative means of travel. This has not happened, nor is there any evidence of a fare threshold of this type in transit. However, the latter version of the threshold concept is supported to some extent by Table 1. Elasticities are increasingly negative at higher levels of the original fare up to the "above $0.60" category. In this category, ridership response becomes less elastic than in the "$0.51 to $0.60" category. The explanation driving this version would be that by the time a relatively high fare level is reached, most of the choice riders have already abandoned transit for another mode, and so further increases have less impact on ridership. Although the data in Table 1 does not provide conclusive proof that a fare threshold of this nature actually exists, further research into this concept would be useful.

SUMMARY

The hypothesis that transit ridership has become or is becoming less elastic with respect to fares must be rejected. In 1979 and 1980, when transit ridership experienced gains due in large part to the effects of the energy crisis, there appeared to be a greater tolerance among riders for fare increases. If this willingness did in fact exist, it was short-lived; by 1982, the short term, no-trend elasticity had returned to the level of the Simpson-Curtin rule. An examination of the short-term trend elasticity, which is the most reliable measure of ridership response, suggests that the response of riders to fare increases was constant between 1979 and 1982 at a level within range of the Simpson-Curtin elasticity. The willingness of riders to tolerate fare increases in 1979 and 1980 was an illusion caused by the dramatic ridership increases occurring before a fare change. These pre-fare-change ridership trends were reduced but were not reversed by the fare increase, thus leaving the impression when raw numbers were examined that ridership was impervious to fare changes. This illusion highlights the importance of considering existing ridership trends when calculating elasticities.

The conclusion that the Simpson-Curtin formula for measuring ridership response to fare changes has remained valid has significance beyond the scope of this study. Transportation planning, particularly in the modeling area, rests on an implicit assumption that measures describing travel behavior are stable over time. This assumption is being examined in various areas. The report by Mayworm et al. (2) is one example; a previous New York State Department of Transportation (NYSDOT) study on the stability of trip rates is another (6). In both examples, the assumption was confirmed. The findings of this paper extend the findings by Mayworm et al. through the 1979 energy crisis, a period in which travel behavior underwent major disruption, and thus provide additional support for the validity of the assumption. Also, the conclusion that the aggregate fare elasticity has remained stable provides a foundation from which important work on disaggregate elasticities may proceed confidently.

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