Elasticity of Transit Demand With Respect to Price: A Case Study in Northern Virginia

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The objectives of this research were (a) to observe and report the elasticity of transit demand with respect to price (fare), (b) to identify and quantify the impact of a peak-period transit fare increase on automobile use in general and on car pools in particular, (c) to determine whether a peak-period transit fare increase caused any measurable shift in passenger travel from peak to off-peak times, and (d) to compare the point elasticities observed on the Shirley Highway express buses with those observed on traditional bus service in the same metropolitan area, as well as to determine whether elasticities observed for two qualities of transit service were significantly different.

In addition, the observed elasticities of transit demand with respect to price will subsequently be compared with elasticities calculated from mode-choice models calibrated within the same environment. The comparison will serve as one validation procedure for the mode-choice models and, it is hoped, will provide useful insights into the question of model transferability.

This report presents those preliminary and partial results that are currently available. The forthcoming final report will address the four objectives in greater detail.

METHODOLOGY AND RESEARCH PLANS

The board of directors of the Washington Metropolitan Area Transit Authority (Metro), after holding a number of public hearings, raised peak-period bus fares on September 1, 1975. These fare increases applied only to the peak-period operations (6:30 a.m. to 9:00 a.m. and 3:30 p.m. to 6:00 p.m. on weekdays); off-peak fares were not changed. Prior to this fare increase, bus fares had been stable for a relatively long period of time.

The Shirley Highway corridor bus service (routes 6, 7, 8, 17, 18, 20, 27, and 28 in this research) was originally operated by the A. B. and W. Bus Company. This company last increased fares on July 11, 1970. The Lee Highway corridor bus service (Routes 2 and 3 in this research) was originally operated by the W. V. and M. Bus Company. This company last increased fares on October 26, 1969. All privately owned Washington, D.C., metropolitan area commuter bus companies were consolidated under public ownership within Metro in January 1973. Metro analyses indicated that A. B. and W. bus fares were higher than W. V. and M. bus fares, and in July 1973 Metro effectively reduced A. B. and W. fares to make them compatible with W. V. and M. fares.

This pricing change provided an excellent research opportunity to study travelers' reactions and to observe price elasticity in the real world.

The date selected for the fare increase to become effective (September 1, 1975) was by no means ideal from the standpoint of studying price elasticity: Significant changes in travel patterns normally occur at the end of the summer when people return from vacations and the autumn school terms begin. Thus it was necessary to carefully adjust observed modal travel demands for monthly (seasonal) variation prior to studying the interrelationship of price and patronage.

In retrospect, it appears difficult if not totally impossible to select an ideal time to perform before-and-after behavioral studies. Initially it was thought that a much more suitable time—from the standpoint of observing price elasticity—could have been selected to institute a fare increase. Notwithstanding the many other important considerations for selecting the date on which to raise fares, there are many other phenomena that can becloud a cause-and-effect relationship (1, 2). Some of these are known to the researcher and some are not. Even if they are known, the researcher can do little to isolate the contributions of these extraneous phenomena from those he wishes to study and quantify.

The basic study procedure was to observe and record bus patronage on selected bus routes before the fare increase and sufficiently long after the fare increase had been in effect for patronage patterns to have stabilized. During the same observation periods, motor vehicles and automobile occupancy were observed and counted (at a previously established location) on Shirley Highway. This highway is a reconstructed radial urban freeway connecting the southwestern parts of northern Virginia suburbs with employment centers at the Pentagon, Crystal City, and downtown Washington. During the peak commuter travel periods, the directional exclusive lanes serve bus vehicles as well as car pools of four or more persons. Three regular lanes (in each direction) are available to serve the needs of other traffic.

Field Observations

Field data were collected on August 19 (Tuesday) and August 20 (Wednesday), before the fare increase, and on October 7 (Tuesday) and October 8 (Wednesday), after the fare increase had been in effect for approximately 6 weeks.

Use of Shirley Highway was observed near 20th Street in Arlington, Virginia. Metropolitan Washington Council of Governments field crews observed numbers of vehicles by type, by lane, and by passenger occupancy from 6:00 a.m. to 9:30 a.m. on each of the 4 days. Metro field crews recorded the numbers of passengers by bus (block number) on all Shirley Highway buses as they entered the trunk-line portion of their trip between 6:00 a.m. and 7:00 p.m. In addition, patronage on the route 2 and 3 lines serving North Arlington and Falls Church was observed from 6:00 a.m. to 7:00 p.m. at the intersections of Broad and Washington streets (in Falls Church) and of Lee Highway and Quinn Street (in North Arlington). Observing patronage on these lines permits comparison of observed elasticities on two levels of bus service—the express service operated on Shirley Highway and the more traditional services operated as the route 2 and 3 lines on Lee Highway serving North

Arlington and Falls Church.

Data from 1974 required for adjusting for seasonal variation in travel demand were obtained from the D.C. Department of Highways and Traffic. Fare-change data were obtained from published schedules and tariffs provided by Metro.

Method of Analysis

The field observations of modal patronage by time period were tabulated in a systematic form in which before-and-after data could be readily compared. These observations were then adjusted to remove seasonal variation. Patronage changes on selected bus routes were related to estimates of average passenger-fare changes, and point estimates of the elasticity of transit patronage with respect to price were made. On Shirley Highway, observed changes in bus patronage were related to observed changes in transit fares. This systematic tabulation of transit patronage was examined for any perceptible shift in patronage from peak period to off-peak period.

These procedures yield estimates of price elasticity of transit demands that are only approximations, since (a) changes in demand over the observation periods can be affected by phenomena other than changes in price (e.g., changes in population at the origin end of the trip and changes in employment at the destination end) and (b) passengers boarding prior to the observation locations may have paid different boarding fares depending on where they board. Thus average fares and, more importantly, mean (before versus after) differences in these fares had to be estimated.

Better data for determining the price elasticity of transit demand might have been obtained by interviewing individual bus travelers, obtaining data on actual fares paid as well as other useful traveler-decision information. This would not necessarily have obviated all problems related to the first reason above, and it would have been extremely costly compared with the approach actually selected.

PRELIMINARY RESULTS AND CONCLUSIONS

Elasticity of Peak-Period Bus Travel Demand

Route 3 offers traditional bus service over the major arterial street system commingled with other vehicular traffic. Bus passenger patronage was observed at Lee Highway and Quinn Street in Arlington, for short (8-km or 5-mile) trips to the Washington central business district (CBD), and at Broad and Washington streets in Falls Church, for longer (19-km or 12-mile) trips.

After seasonal adjustment of observed patronage at the Arlington locations (before = 2959; after = 2752), the patronage change (drop) after the fare increase was found to be a 6.92 percent decrease. The estimated composite fare increase at this location was 52 percent. The resulting observed elasticity of transit patronage with respect to price was therefore 6.92 divided by 25, or 0.28.

Using seasonally adjusted observed patronage at the Falls Church location (before = 806; after = 738), the patronage change (drop) after the fare increase was found to be an 8.4 percent decrease. The estimated composite fare increase at this location was 31 percent. The resulting observed elasticity of transit patronage with respect to price was therefore 8.4 divided by 31, or 0.27.

These values (0.28, 0.27) are reasonably close to the rule of thumb commonly used by the transit industry—a 0.34 to 0.5 percent decrease in patronage per percentage of increase in the transit fare.

Route 18 offers premium service on exclusive freeway lanes between residential areas in the southern part of the Shirley Highway corridor and destinations at the Pentagon and the Washington CBD. It is a relatively long route, 26 km (16 miles). The percentage change (drop) after the fare increase (before = 2463; after = 2437), in patronage observed at the ramp where the buses enter the express lanes, was a 1.05 percent decrease. The estimated composite fare increase on this line was 40 percent. The resulting observed elasticity of transit patronage with respect to price was therefore 1.03 divided by 40, or 0.3.

Route 6 offers premium service on exclusive freeway lanes between Alexandria, the Pentagon, and the Washington CBD. This route is approximately 14 km (9 miles) long and is somewhat indirect for passengers boarding near the end of the line. The percentage change (increase) after the fare increase (before = 810; after = 955), in patronage observed at the ramp where the buses enter the express lanes, was an 18 percent increase. The estimated composite fare increase on this line was 36 percent. Obviously, some unidentified phenomena are significantly influencing patronage on this line; the elasticity was therefore not computed for this case.

The premium express bus service appears to be less sensitive to fare increases (i.e., exhibits a lower elasticity of demand with respect to price) than the more traditional service. This suggests that the premium service affords travelers a larger consumer surplus than does the traditional service.

Readers should note that, between 1971 and 1974, fuel costs alone have increased by approximately 44 percent. The rise in bus fares was smaller than the increase in automobile fuel costs, which results in an enhanced economic attractiveness of bus travel vis-à-vis private automobile.

Further Research and Analyses

Further research and analyses will explore the issue of elasticity in transit patronage in more detail, will study the impact of the fare increase on automobile use, and will investigate possible shifts of bus patrons to off-peak periods, in which fares were not increased.

REFERENCES

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