

# Lessons from the Broome County Distance-Based Fare Demonstration: Effects of Zone Fares and Off-Peak Discounts on Ridership, Revenue, Pass Sales, and Public Opinion

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The Broome County, New York, Department of Public Transportation was the test site for an UMTA-sponsored demonstration of distance-based fares over the period 1986 through 1988. Binghamton is the major city in Broome County. The service area also includes the cities of Endicott and Johnson City and the Town of Vestal. Over the demonstration period, two fare changes were put in place. An interim fare structure was in effect in Calendar Year 1987 that featured half-fares for all riders in the off-peak period. A fare increase including the introduction of zone fares was implemented in January 1988. The full range of demonstration activity is discussed—off-peak fare reduction, introduction of zone changes, effect on pass sales, driver reaction, public reaction, and effect on university student ridership. The events of the demonstration are so intertwined that it is difficult to separate one topic from the other and still have a meaningful discussion. The impact of each element, therefore, is discussed as it relates to the whole. The demonstration showed that zone fares can be introduced effectively in a small transit system such as Broome County Transit. However, revenue effects are small. Whether or not to adopt zone fares should depend primarily on a system's policy regarding fare differentiation.

When transit systems were privately owned, distance-based or zone fare systems were common. Many large cities retained zone fares after public takeover because of the length of their routes. Small- and medium-sized systems generally opted for simple, flat fares, particularly when outside funding support became available. Broome County Transit, in New York, had a zone system in the past but had not used distance-based fares since becoming publicly owned.

Broome County Transit (BC Transit) is the fixed-route service component of the Broome County Department of Public Transportation. It provides service on 13 regular routes and 4 additional peak commuter routes with a fleet of 40 buses. Service is available throughout the tri-city area of Binghamton, Johnson City, and Endicott, plus the Town of Vestal. Its service area population is approximately 215,000.

As part of an UMTA-funded demonstration, BC Transit reintroduced zone fares in January 1988. A year's worth of data are now available to permit a full evaluation of the new

distance-based fare structure. Information on the implementation process also is available.

Although the demonstration began in 1986, implementation of the distance-based fares was delayed 18 months by the one-time availability of special funds from New York State. The funds had to be spent in 1987, so a fare restructuring and decrease were implemented in 1987. When the zone fares and a fare increase were implemented in January 1988, these changes followed a period of artificially low fares in 1987, rather than the 1986 base period. The chronology clearly complicates the interpretation of results and mixes the impact of zone fares with the impact of other fare restructuring changes.

## OVERVIEW OF THE FARE STRUCTURE

This demonstration has a complicated fare history. Table 1 presents the fares in effect at the beginning of the demonstration in 1986, the interim 1987 fare structure, and the 1988 zone-based fare structure that was the subject of the demonstration. In 1987, half-fares were introduced in the midday base period for all riders, rather than just senior citizens and handicapped individuals. This measure actually was a 5-cent fare increase for seniors in the midday. The other big change in 1987 was extending the half-fare senior citizen fare to the full day.

In 1988, fares were increased as presented in Table 1, but half-fare was retained for all midday riders. The principle features of the 1988 demonstration fare policy are as follows:

- Peak-period fares were increased by 20 percent from 50 to 60 cents;
- Zone fares were introduced at 10 cents per crossing in the peak period and 5 cents in the off-peak period;
- Half-fares of 30 cents (and zone fares of 5 cents) were available to all riders in the off-peak period, eliminating a special fare for senior citizens and disabled persons;
- Prepaid fares such as monthly passes and tokens exempted the rider from zone charges; and
- Transfers remained free.

This fare structure offset the 20 percent peak fare increase with the low off-peak fare. A large peak-base differential was

TABLE 1 BC TRANSIT FARE STRUCTURES

C A T E G O R Y	Y e a r i n E f f e c t		
	1986	1987	1988
ADULT CASH			
Regular Route			
Peak	\$ .50	\$ .50	\$ .60
Base	.40	.25	.30
Zone Crossing			
Peak	--	--	.10
Base	--	--	.05
Commuter Route	.75	.90	1.00
E & H CASH			
Peak	.50	.25	.60 (a)
Base	.20	.25	.30 (a)
STUDENT CASH	.35	--	--
TRANSFERS	Free	Free	Free
PREPAID MEDIA			
Tokens (20)	9.00	9.00	12.00
Tickets: Commuter Ten Ride	6.75	6.75	9.00
Monthly Passes			
Regular Route	18.00	18.00	24.00
Commuter Route	27.00	--	--
E & H	--	--	16.00
Student	--	--	16.00

(a) special identification no longer required

established. In 1986, the fare was 50 cents in the peak and 40 cents in the off-peak. In 1988, it was 60 cents peak and 30 cents base plus zone charges.

## EXPECTATIONS

What were the expectations for zone fares? The primary expectation was pricing flexibility. BC Transit management saw distance-pricing as a way to expand alternatives to periodic across-the-board fare increases. When this project began in 1986, BC Transit already had a time-of-day differential, a peak-base fare for all riders and a half-fare midday discount for senior citizens and disabled persons. It also had a discount student fare and free transfers. Zone fares added another pricing option to an already differentiated fare structure.

It also was hoped that pass and token sales would increase as a result of the policy to excuse zone charges for prepaid media users. There are many operational and financial advantages with the increased use of prepaid fares such as improved boarding times and better cash flow.

The traditional reason for introducing distance-based fares is to relate the cost of a ride to the resources consumed in providing it, resulting in improved fare equity. There had never been any public complaints about the inequity of the flat fare system in Broome County, however, so improving fare equity was not the primary motivating force. As originally conceived, the zone fare demonstration would have included a fare reduction for short trips as well as an increase for long trips. This element was dropped in favor of the reduced mid-

day fare. Because of the sharp increase in peak fares in 1988 and the deep midday discount introduced both in 1987 and 1988, it was not possible to isolate trip-length effects of zone fares.

## DATA LIMITATIONS

Student riders are an important element of total ridership. Students at the State University of New York (SUNY) at Binghamton comprised 34.7 percent of BC Transit's ridership in 1986. They paid their fare with a special token. If they did not have a token, they showed a student ID and paid a 35-cent cash fare. The 1987 fare structure eliminated this cash fare option because the base period fare was only a quarter. Further, the contract between SUNY and BC Transit was modified in 1987, eliminating student tokens and enabling any student to ride free by showing an ID. The result of all these changes is an apparent drop in the percentage of total ridership that students represented, primarily because those who used to pay the special 35-cent cash fare could no longer be identified separately in the drivers' counts. According to the dashboard counts, the proportion of student riders dropped sharply.

Year	Student Riders (%)
1986	34.7
1987	20.6
1988	22.4

There was no reason to expect such a drop. Rather, the effect was a result of changing the method of fare payment.

This is important because the zone fare impact analysis was conducted primarily on nonstudent ridership. Students riding free were not impacted by the 1988 fare structure change, and, therefore, their behavior should not have been included. Further, student revenue for the free riders was not reported with farebox revenue. It was reported as contract revenue and was a negotiated annual amount that does not reflect actual ridership. For these reasons, student riders were excluded from the analysis as much as possible. As the proportions indicated, however, the ability to accurately identify all student riders was lost in 1987. Some students appeared in the farebox ridership and revenue statistics for 1987 and 1988. For example, there was a 24 percent jump in nonstudent ridership in 1987. At first glance, this appeared to be caused by the lower off-peak fares. On closer examination, it was learned that total ridership increased only 2.1 percent, leading to the surmise that at least part of the increase in nonschool riders was caused by the classification problem.

**AGGREGATE RIDERSHIP AND REVENUE IMPACTS**

In the 3-year trend in total monthly ridership and net (non-school) ridership shown in Figure 1, net ridership increased

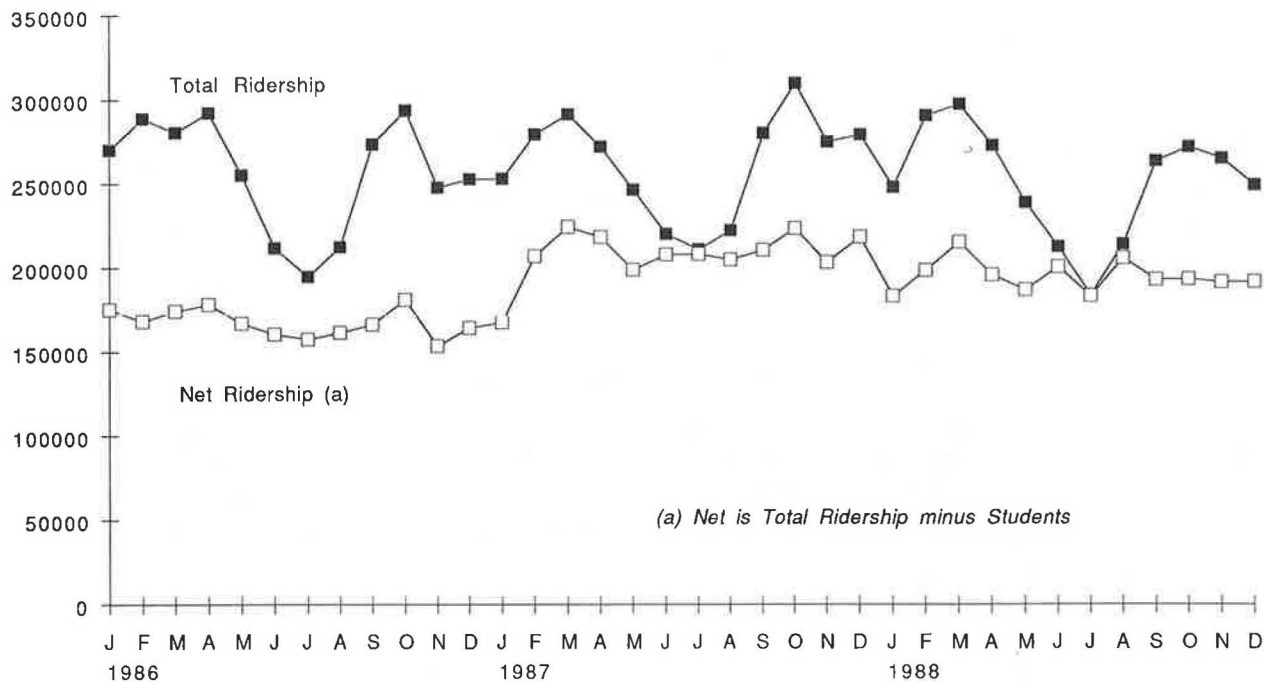
beginning in January 1987. No dramatic change occurred in total ridership. This is further proof of the measurement effect of dropping the student cash fare.

Table 2 presents system-wide ridership, nonschool ridership, and revenue for the 3 years of the demonstration. Calculating the straight line elasticities on these composite data yields  $-0.213$  for 1986-87 and  $-0.244$  for 1987-1988. The straight-line elasticity is defined as the percentage change in ridership divided by the percentage change in revenue.

Even though the 1986-1987 case involves a fare decrease and the 1987-1988 case involves a fare increase, the elasticities are very similar and fall into the expected range. In their extensive reference on elasticities, Mayworm and Lago (1) report the mean elasticity over a sample of 67 cases as  $-0.28 \pm 0.16$ . They also observe that "elasticities for fare increases do not differ from those for fare decreases." With results consistent with their findings, the Broome County demonstration adds another data point to their work.

For only nonstudent riders, the elasticity for 1987-1988, when the zone fares were introduced, was  $-0.359$ . This also is within the range reported by Mayworm and Lago (1). It also conforms to the industry-wide one-third rule of thumb known as the "Simpson & Curtin formula."

The elasticity for the 1986-1987 fare decrease cannot be calculated directly because of the problem with the classification of student fares discussed previously. Nonetheless, as



**FIGURE 1 Ridership trends.**

**TABLE 2 TOTAL AND NONSTUDENT RIDERSHIP AND REVENUE**

Year	Total Ridership		Nonschool Ridership		Farebox Revenue	
	Number	Change (%)	Number	Change (%)	Amount (\$)	Change (%)
1986	3,075,563	-	2,007,810	-	812,305	-
1987	3,139,753	2.09	2,492,743	24.15	732,583	(9.81)
1988	3,007,674	(4.21)	2,338,610	(6.18)	858,462	17.20

a test, the 1987 nonschool ridership was estimated by assuming that students remain the same proportion of total ridership and by applying the 1986 student percentage (34.7 percent) to the 1987 aggregate ridership (3,139,753). Calculating the elasticity for 1986–1987 using the resultant estimate of non-school riders (2,050,259) yields an elasticity of  $-0.232$ . This, too, is within the expected range.

Mayworm and Lago (1) also report that there is some evidence that fare elasticities are smaller for fare decreases than for fare increases, but their data would not conclusively support such a finding. The Binghamton data calculated on non-school riders also suggest a lower elasticity for a fare decrease, but the values lie within the confidence interval of the data assembled by Mayworm and Lago (1). No definitive statement can be made on the basis of the Binghamton results.

As expected, revenues were down during the 1987 interim fare changes and increased in January 1988 when fares were increased and zone fares implemented. The 3-year trend line is shown in Figure 2. Revenue from pass sales increased slightly as a proportion of total farebox revenues, mostly because of the introduction of new pass media. Pass sales will be discussed in more detail later.

**RIDERSHIP AND REVENUE BY TIME PERIOD**

Before the demonstration project, BC Transit had established a peak/off-peak fare differential. The fare changes that occurred during the demonstration further discounted the off-peak trip. Thus, some riders could be expected to shift discretionary trips from the weekday peak to the weekday off-peak and Saturday. (No service is operated on Sunday.) As the information in Table 3 indicates, during the baseline period of 1986, peak riders represented 49.9 percent of total riders and 50.0 percent of net riders (excluding students). A slight shift toward the off-peak did occur in two successive years. By 1988, peak passengers had declined to 45.7 percent of all riders and 46.3 percent of net (nonstudent) riders.

TABLE 3 RIDERSHIP BY TIME PERIOD

	Percent of Total Ridership		
	1986	1987	1988
Weekday			
Peak	50.2	47.3	45.8
Base	43.2	45.7	47.2
Subtotal	93.4	93.0	93.0
Saturday	6.6	7.0	7.0
TOTAL	100.0	100.0	100.0
Total Ridership	1,387,584	1,345,599	1,347,350
	Percent of Net Ridership (a)		
	1986	1987	1988
Weekday			
Peak	50.2	47.3	46.5
Base	42.4	45.0	45.6
Subtotal	93.0	92.3	92.1
Saturday	7.0	7.7	7.9
TOTAL	100.0	100.0	100.0
Total Ridership	826,951	1,015,838	979,255

(a) net ridership excludes students

The highest proportion of all riders (including students) in 1988 is the weekday base period. It has increased its share of all passengers from 43.5 percent in 1986 to 47.2 percent in 1988. As stated earlier, 45.0 percent of all riders in 1988 were carried in the weekday peak period. Saturday ridership rose from 6.6 percent in 1986 to 7.1 percent of all riders in 1988.

Similar proportions exist for the net (nonstudent) riders. When students are removed from the total, the peak period

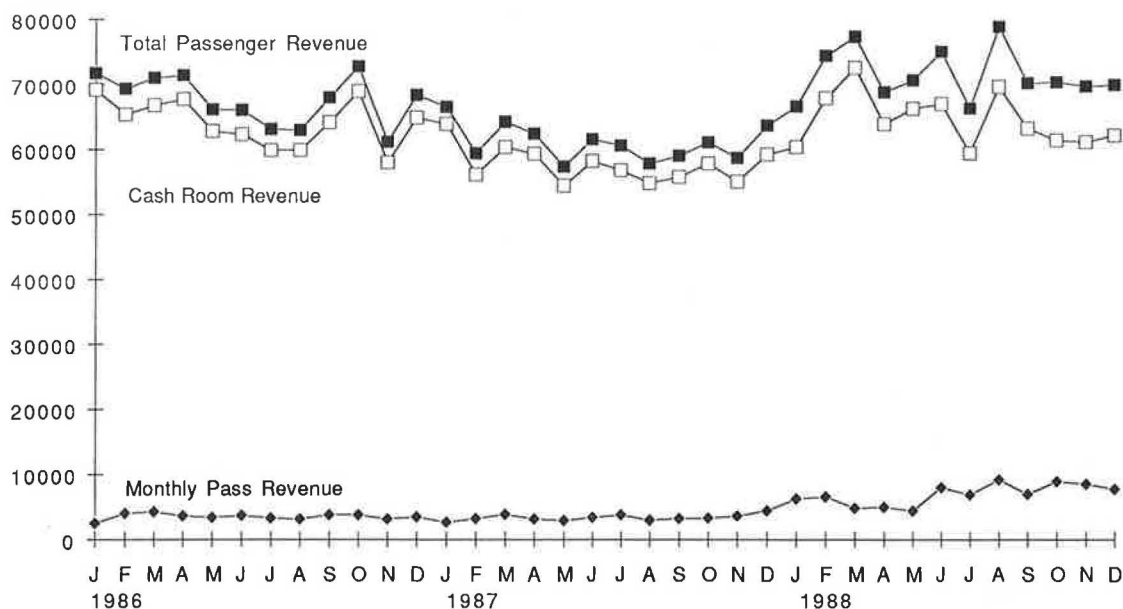


FIGURE 2 Revenue trends.

remains the highest proportion with 46.3 percent of net ridership. Weekday base-period riders are 46.0 percent of 1988 net passengers. The Saturday percentage increased from 7.0 percent in 1986 to 7.7 percent in 1988.

As Table 4 indicates, fare elasticities also can be calculated for the peak and base periods. The response to the 1987 midday fare change was in the range expected. There was no fare change in the peak period. Hence, no elasticity is reported. The 1988 elasticities are quite low, indicating that fewer people were lost to the fare increase than would be expected.

It is speculated that this apparent insensitivity to fare was in part caused by the turbulence in fares over the 3-year period. The elasticity calculated for the 1986-to-1988 fare change was in the normal range.

Period	1986-1988 Fare Elasticity	
	1986-1987	1987-1988
Peak	-0.388	
Base	-0.424	

Finally, the deeply discounted off-peak fares did succeed in shifting three to four percent of riders from the peak to the base period as well as in increasing total ridership for 1987 by about 2.1 percent (see Table 1). The impact of the off-peak fare reduction was an increase in ridership, all of it coming in the off-peak. As presented in Table 5, peak-period ridership declined in 1987, whereas total ridership increased.

#### PROPORTION OF RIDERS AFFECTED BY ZONE FARES

Fare zones were placed approximately 3 miles from the Binghamton central business district (CBD) at boundaries between Binghamton and the other municipalities in the service area. A pulse transfer system is used in downtown Binghamton, and most routes are through-routed. The CBD is not considered a zone boundary, so riders do not pay a zone charge until they cross a municipal boundary.

On average, about 35 percent of riders pay a zone charge. The distribution by time of day, determined by dashboard counts, is as follows:

Time of Day	Percent Paying Zone Charge (%)
a.m. peak	33
Midday	32
p.m. peak	35
Night	46
Saturday	39
System average	35

#### RIDERSHIP BY MONTHLY PASS USERS

It was speculated that monthly passes would become more attractive in the zone fare structure. BC Transit drivers count each time a passenger boards using a monthly pass. According to these driver counts, boardings by pass users have almost doubled since the baseline period, as follows:

Year	Boardings by Pass Users	
	1986-1987	Change (%)
1986	149,566	-
1987	175,158	17.1
1988	311,869	78.1

However, there is more than one type of pass being counted in this category. The fare changes included the introduction of a student pass and an elderly and handicapped pass, intended for those reduced fare riders who must ride frequently during the peak period. Their boardings are included in the total. By comparison, the 1986 boardings represent only adult pass users. Thus, some of the increase is attributable to the new passes.

A review of the actual number of passes sold can further distinguish these trends. The overall growth in the number of passes sold follows percentages similar to pass boardings.

Year	Total Passes Sold	
	1986-1987	Change (%)
1986	2,335	-
1987	2,991	28.1
1988	5,206	74.1

As stated, not all passes are sold to full fare riders. In 1988, adult full-fare passes were only 45.8 percent of the total of 5,206 passes sold; student passes accounted for 29.4 percent of the total; and the new elderly and handicapped pass accounted for 24.8 percent of the total.

Most relevant to the demonstration is the trend in sales of adult full-fare passes. The number of passes sold increased by 7.3 percent from 1987 to 1988. Recognizing the downturn in sales in 1987, the sales level in 1988 was 2.1 percent higher than the 1986 baseline period.

Year	Full-Fare Passes Sold	
	1986-1987	Change (%)
1986	2,335	-
1987	2,222	4.8
1988	2,384	7.3

With the expansion of the pass program has come a lower average usage rate for passes, in part a reflection of their greater use by reduced fare riders who may buy passes for convenience and not always exceed the breakeven point in the pass price. To illustrate, the 311,869 boardings by pass users in 1988 correspond to a total of 5,206 passes sold, for an average of 60 boardings per pass. This usage rate is similar to that of 1987, when a total of 2,991 passes were sold and

TABLE 4 PEAK- AND BASE-PERIOD ELASTICITIES

Traffic Period	Fare Change Elasticity	
	1986-1987	1987-1988
Peak	-	-0.183
Base	-0.264	-0.090

TABLE 5 TOTAL RIDERSHIP BY TIME PERIOD

Traffic Period	1986	1987	1988
Peak	1,534,706	1,463,125	1,374,507
Base	1,337,870	1,459,985	1,419,622
Saturday	202,987	216,643	213,545
Total	3,075,563	3,139,753	3,007,674



175,158 boardings were counted. However, in 1986, when only adult passes existed, 2,335 passes were sold and 149,566 boardings were recorded, for a rate of 64 boardings per pass.

Because a related objective is to move more passengers from cash to prepaid fares, BC Transit is succeeding. Pass user trips have increased from 5.6 percent of all revenue passengers in 1986 to 8.7 percent in 1988.

## INSTITUTIONAL IMPACTS

In addition to the quantitative impacts, Broome County's new distance-based fare structure can be assessed with respect to its impact on service users and providers. These impact areas include passenger satisfaction, fare payment abuse, driver acceptance, and internal record keeping.

### Passenger Satisfaction

The reaction of riders to the fare changes can be measured by two techniques—responses to the attitudinal questions on the on-board survey conducted annually during the demonstration and comments registered by individuals directly with BC Transit personnel.

#### On-Board Survey Results

The surveys conducted in 1987 and 1988 included questions to gauge the attitudes of passengers toward BC Transit. One of the most notable findings from the on-board survey was the change in attitudes about the fare structure. In 1987, when off-peak fares were reduced for all riders, almost 60 percent indicated they were very satisfied with the fares. Only about 5 percent were not satisfied. But in 1988, after the zone fare structure was implemented along with other fare increases, 38 percent said they were not satisfied. Only 21 percent said they were very satisfied. The balance of 41 percent said the fares were okay.

Attitude Toward Fare Structure	Percentage	
	1987	1988
Very satisfied	59	21
Service OK	33	41
Not satisfied	5	38
No response	3	—
Total	100	100

Thus, although the majority continued to give the fare structure a positive rating, the extent of the riders' satisfaction is much lower in the 1988 survey than in the 1987 survey. These results are not surprising, as the 1987 survey followed a fare decrease and the 1988 survey followed an increase.

#### Individual Comments

BC Transit reported that it received fewer negative comments than anticipated to the new zone fare structure. Most of the complaints were from elderly and handicapped (E & H) riders. The new fare structure eliminated a separate fare category

for these riders by establishing an off-peak fare for all riders equal to one-half of the full peak fare. However, in so doing, E & H riders traveling during the peak would now have to pay the full fare, reversing the policy change in 1987 to extend E & H fares to all hours.

In response to the concerns of E & H riders who had to travel in the peak period, BC Transit added a \$16 monthly E & H pass in March 1988, 2 months after the new fare structure was implemented. The pass price is high for those traveling only in the off-peak but attractive to those who make many peak trips.

In general, however, most riders understood and accepted the system's need to increase fares to generate additional revenue. The amount charged, even with zones, remains relatively low for the average rider. Further, regular riders can avoid zone charges by using passes and tokens.

### Fare Payment Abuse

BC Transit reported no significant problems with underpayment or other fare-beating techniques as a result of the zone fare structure even though enforcement was by the honor system. Any payment abuse that may have occurred, therefore, fell within generally acceptable levels.

### Driver Acceptance

Implementation of the zone fare structure was a smooth and orderly process. To a large extent, this is attributable to the advance planning and preparation undertaken by BC Transit. Some of the more significant activities include the following:

- Preparation of the *Driver's Manual for the Zone Fare System*. This booklet explains how and when to charge zone fares as well as how to fill out the new daily trip sheet. The manual also contains a map of each route showing where the zone lines are drawn. The manual was designed to be carried on board by the driver. In addition to receiving the manual, each driver participated in a training session on zone fares.

- Preparation of the *Passenger Guide to the New Zone Fare System*. This pamphlet presents the new fare structure, explains how the zone charges work, and shows all zone lines on individual route schematic maps. This guide was available on board buses, at BC Junction, and through BC Transit's other passenger information outlets.

- Posting of Zone Decals on All Bus Stop Signs. As part of the zone fare structure implementation, BC Transit posted a color-coded triangle on bus stop signs showing in which particular zone the stop was located. The symbols were highly visible and helped to orient riders and drivers to the zone lines. This action helped reduce potential payment disputes resulting from a lack of information.

The driver is the primary person with whom the rider interacts. In the case of a fare change, they can receive the brunt of the passengers' negative reactions. However, in this case, riders were well informed of the change and drivers had little difficulty. As a result of their training, they also were prepared to inform riders and enforce the new fares.

### Recording Keeping

BC Transit's established procedures include a driver count of all passenger boardings by major fare categories. Drivers used a key pad installed on the farebox for these counts. At the end of each trip, they transfer the totals to their daily trip sheet and reset the counter.

Because these thorough procedures were already in place, only minor modifications were needed to accommodate the zone fare structure. Essentially, the counting buttons and the trip sheet columns were redefined to incorporate zone crossings. These adaptations occurred throughout all record-keeping activities for ridership and revenue reconciliation. As information is provided for each trip, staff can aggregate the results into peak and off-peak periods as well as the major fare categories. A monthly summary is prepared as part of BC Transit's routine management information reports.

### CONCLUSIONS

The Broome County demonstration has shown a number of things about distance-based fares:

- It is possible to implement a zone fare system without seriously disrupting riders, drivers, or system revenue. Though there may be phase-in problems, these are overcome readily.
- The increase in total ridership resulting from an off-peak discount calculated on aggregate statistics can be expected to conform to fare change elasticities at the low end of the normally expected range:  $-0.20$  to  $-0.25$ .
- Elasticities to fare changes implemented through zone

charges are in the range expected for any fare change when calculated on the resultant average fare.

- Zone fares do not have the potential to dramatically increase revenue in a small- to medium-sized system, because only about 30 percent of the riders will pay zone fares.
- A sharp off-peak discount on the order of half-fare will shift about 3 to 4 percent of riders to the off-peak and increase total ridership slightly. Revenues will fall about 10 percent while ridership increases about 2 percent.
- Adult full-fare passengers do not increase their purchase of transit passes significantly when zone fares are introduced, even if zone fares are forgiven for pass users. An increase in pass sales did result from the introduction of new passes for students and senior citizens, which also exempted the user from zone charges.

The findings from the Binghamton demonstration indicate that transit systems of this size that adopt a policy of fare differentiation can introduce zone fares at no detriment. Modest revenue gains and ridership losses can be expected as with any price increase. However, if the system has adopted a philosophy of fare simplicity, there is no compelling reason to abandon that philosophy on the basis of these results, as the revenue impacts of zone fares were not large.

### REFERENCE

1. P. Mayworm and A. Lago. *Patronage Impacts of Changes in Transit Fares and Services*. U.S. Department of Transportation, Sept. 1980.

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