quired, thereby building some flexibility into the fare inspection process.

Surcharge fares that are not paid at the time of inspection may be paid by mail or in person to Tri-Met within seven days. Persons who ignore a notice to pay a surcharge fare will incur a late charge after a certain time period. Persons who continue to ignore the surcharge fare will eventually have their account turned over to a collection agency. All record keeping, billing, and collection of surcharge fares will be handled by an outside contractor. Passengers who persistently travel without proof of payment will also be liable to increased civil penalties up to $500.

Tri-Met will institute an internal appeals procedure in order to provide recourse for persons who feel they have been charged a surcharge fare unfairly.

Public Information Program

An effective public information program is a vital component of the SSFC project. With approximately 140 000 trips on Tri-Met a day, a major communications effort is called for. Elements of the public information program include the preparation of decals and signage for use on Tri-Met vehicles and facilities, the preparation of exhibition buses to tour the region, and the development of brochures, advertising, and on-street customer assistance personnel. Closely related to the public information program is the training of all Tri-Met employees to have a basic understanding of the self-service system, as well as the detailed training of drivers, fare inspectors, and maintenance personnel. Perhaps the biggest challenge for the public information program is this: Although the full SSFC project consists of a complex of interrelated elements, the individual passenger is concerned only with an individual fare. Knowing and paying that fare must be made as simple as possible.

Schedule

Implementation of SSFC began in September 1980 on the award of project funding and will be complete at the start-up of self-service on September 5, 1982. The main task controlling the schedule has been the procurement time for the on-board equipment, which will have required 18 months from contract date to start-up.

Evaluation Program

A small but highly significant element of the SSFC program is an evaluation study sponsored by UMTA through the Transportation Systems Center to determine how well SSFC has worked and how other transit properties may benefit from Tri-Met's experience. This study will address seven areas of interest: fare compliance, operating impact, equipment performance, fare-payment characteristics, enforcement, and passenger attitudes and awareness. For each of these work elements comparisons will be made before and after start-up of SSFC and wherever possible numerical analysis will be performed.

The major aim of the evaluation study will be to help other transit properties decide whether it makes sense for them to follow a similar program and, for any who do make that decision, to provide data and perhaps recommendations on how to do so with the greatest benefit.

ACKNOWLEDGMENT

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REFERENCE

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Publication of this paper sponsored by Committee on Transit Service Characteristics.

Atlanta Transit Pricing Study: Moderating Impact of Fare Increases on Poor

MARY E. LOVELY AND DANIEL BRAND

Alternative methods for moderating the impact of fare increases on low-income groups in Atlanta are described and evaluated. The study, sponsored by the Transportation Systems Center under the Service and Methods Demonstration Program, considers five alternatives to a flat fare increase: direct user subsidies, quality-based fares, reduced fares on designated routes, peak/off-peak fare differentials, and distance-based fares. We evaluate these fare strategies according to a set of standardized criteria that considers the target efficiency, coverage of the target group, administrative cost, total cost, and degree of relief offered by each option. The study finds that a direct user subsidy provides the highest degree of relief to low-income patrons with the lowest revenue loss. This is because user subsidies are more efficient in reaching the target population and offer a higher level of coverage of the poor than do other alternatives. The results of the analysis also suggest that fare strategies that increase pricing efficiency by relating fares to cost, such as peak/off-peak fare differentials and distance-based fares, may not aid low-income riders. The analysis indicates that the equity implications of such pricing strategies must be assessed on a city-by-city basis. The desirability of direct user subsidies as a means of offering fare assistance appears to be more universal, however, primarily because it is distributed directly to the poor. With many transit properties facing court challenges to flat fare increases, these results may be of interest to operators throughout the United States.

This case study describes and evaluates alternative methods for moderating the impact of fare increases on low-income groups in Atlanta. Although the study primarily concerns the Metropolitan Atlanta Rapid Transit Authority (MARTA), which recently raised its fare from $0.25 to $0.50, the results of the study

may be of interest to transit agencies throughout the United States. Faced with financial pressures similar to those confronting MARTA, many authorities seek information on fare strategies that are capable of generating significant farebox revenue while maintaining low fares for those who can least afford fare increases.

The trend toward higher passenger fares in the public transit industry is well documented. Over the past few years, rapidly rising operating costs and slowly growing operating subsidies have forced transit operators in almost every major American city to increase farebox revenue. In January 1979, most major cities had base transit fares ranging from $0.25 to $0.50. Now most base fares are approximately $0.75, and some operators have planned for continuing fare increases to maintain farebox revenue cost-coverage targets. Cutbacks in Section 5 operating assistance from the Urban Mass Transportation Act of 1964 soon will make these financial pressures even more severe.

Several recent fare increases have provoked opposition. Both the Southeastern Pennsylvania Transportation Authority (SEPTA), which imposed a $0.15 increase in Philadelphia's base transit fare, and MARTA, which doubled its base fare to $0.50, faced court challenges when they announced fare changes in the summer of 1980. In both cities, coalitions of citizens' groups opposed the fare hikes because of the potential impact of higher fares on low-income transit patrons. Although initially raised on technical grounds concerning the transit boards' voting procedure or organization, these protests focused public attention on the necessity of higher passenger fares on the one hand and the needs of the poor on the other. Although court challenges have not yet been successful in preventing fare increases, they have forced transit authorities to consider the equity implications and political acceptability of fare changes.

One result of court hearings in Atlanta concerning MARTA's proposed fare change was the general realization that alternatives to the flat-fare increase should be found. The court recommended the formation of a committee of state and local officials and concerned citizens to study the problem.

The U.S. Department of Transportation aided the committee's quest for solutions by sponsoring a study of alternative pricing options through the Transportation Systems Center (1). Because the committee wanted to use the report in its planning efforts, the study had to be completed in a short period of time.

This paper presents the resulting analysis of alternatives to MARTA's flat-fare increase for moderating the impact of fare changes on low-income patrons. The pricing strategies that appeared to be the most promising, and which we discuss here, are direct user subsidies, quality-based fares, reduced fares on designated routes, peak/off-peak fare differentials, and distance-based fares.

First we present the five evaluation criteria that we used in assessing each pricing option. Next, we describe each pricing option and provide a quantitative analysis of each option with respect to the evaluation criteria. Finally, we summarize the results of the analysis and consider the implications of these findings for fare policy.

EVALUATION CRITERIA

To aid in the assessment of pricing strategies designed to aid the poor, we use five criteria that reflect concern about the efficiency and distribution of the subsidy. Using standardized criteria to evaluate each strategy facilitated comparison across alternatives and ensured that we explored each strategy fully. The five criteria are target efficiency, coverage, administrative cost and efficiency, total cost/financial responsibility, and degree of relief.

Target Efficiency

A major concern in the evaluation of transit pricing is the degree to which the fare adjustment reaches only the target population. Some pricing strategies can be directed to low-income riders. Other strategies may aid these groups but provide fare reductions for high-income riders as well. With limited resources, it is crucial that the price relief be targeted to those who need it most. In this study, we measured how efficiently the suggested pricing strategy performs this targeting function by estimating the percentage of the price relief that the intended target group would receive.

Coverage

Besides targeting aid to specific groups, it is desirable that the pricing strategy chosen for Atlanta maximize its coverage of the target group and provide the same degree of relief for all eligible riders. In this analysis, we measured this coverage as the percentage of all aid-eligible riders who would actually receive it.

Administrative Cost

Although it is desirable to choose a pricing strategy that targets aid efficiently, administrative costs should not outweigh the advantages of this efficiency. Moreover, the administrative cost of the program must not exceed the cost of passing the subsidy through to all riders (e.g., a user-side subsidy should cost less to provide than the cost of providing a general fare decrease to all MARTA riders). Therefore, we considered the relative difficulty of administering each pricing alternative.

Total Cost/Financial Responsibility

MARTA operates under legislative constraints that limit the range of adjustments the authority can make in its fare policy. MARTA operations are partly funded by a 1 percent local-option sales tax. Not more than 50 percent of the revenue from this earmarked sales tax can be used for operating assistance. Since MARTA is mandated to maintain a balanced budget, operating expenses not covered by sales-tax revenues must be obtained from passenger fares or other subsidy sources.

If MARTA institutes fare reductions for lowincome riders, it must obtain additional external funding or increase the amount of revenue it receives from other riders. The total cost of aiding low-income riders is therefore a very important evaluation criterion because it indicates the amount of funding that must be obtained through these sources. We estimated the total revenue loss from each option so that public officials could measure the adequacy of various sources of external funding. We also estimated the fare level necessary to sustain internal subsidization and compared these estimated figures across options.

Changes in patronage resulting from fare increases or decreases complicate the estimation of revenue loss from any given subsidy program. If fares for unsubsidized riders increase, some riders will restrict their patronage or switch to different time periods or different routes (depending on the type of fare increase implemented). In this study,

we did not estimate these secondary impacts of fare changes. However, we have noted where such secondary effects are likely to be significant.

Degree of Relief

Because this study's objective is to assess the capability of various pricing options to decrease transit fares paid by low-income riders, it is crucial that the degree of relief afforded by each option be carefully evaluated. To measure the degree of relief offered by each option, we estimated the average fare that would be paid by all eligible low-income riders and compared this with the current base fare of $0.50. We also compared the average fare paid by low-income patrons across options to determine which pricing strategy offers the largest reduction.

PRICING OPTIONS: OBJECTIVES, OPERATION, AND ASSESSMENT

In this study, we analyzed five pricing options that appear to hold promise for aiding low-income riders. They are direct user subsidy, quality-based fares, reduced fares on designated routes, peak/off-peak fare differentials, and distance-based fares. We present the objectives and an assessment of each pricing option below. In our analysis, we defined low-income persons as those having a total 1980 household income less than $5000 and those larger families with total income less than $10 000. We obtained data for this analysis from the May 1980 MARTA Transcard Integrated Fare Study (2). MARTA provided information on systemwide ridership in May 1980 and on the total number of individual patrons in each income group. For each alternative, we analyzed two subsidy levels: $0.10 and $0.20 reductions from the current $0.50 fare. Table 1 presents a summary of these analyses.

For the direct-user subsidy alternative, it was necessary to define the number of monthly trips that would be subsidized. To ensure that all high-value trips (e.g., work, educational, religious, and medical trips) are covered, the direct subsidy could apply to an unlimited number of trips each month. With no limit on the number of trips subsidized, however, the potential for resale of subsidized tokens or tickets is very great. A photographic identification mechanism for all those eligible can prevent some of this activity, but with MARTA's fully automated rail stations the potential for fraud under a program of unlimited subsidy would still exist.

Before one can arrive at a reasonable maximum number of subsidy-eligible trips, it is important to note that at the present time, through the purchase of a Transcard pass, frequent MARTA users can pay less than $0.50 per trip. On average, monthly Transcard patrons pay only $0.33 per trip (2). The average fare for an individual decreases as a pass patron's trip frequency increases. After a given trip frequency, a low-income patron would be better off purchasing a weekly or monthly Transcard rather than paying even a subsidized cash fare. The point at which a low-income patron would pay a lower average fare with a $4.00 weekly Transcard than with a subsidized fare depends on the level of the subsidy. With a $0.10 subsidy, one who makes more than 10 one-way trips per week would be better off by using a Transcard pass than by paying the subsidized fare. With a $0.20 subsidy, one would be better off with a Transcard if he or she makes more than 13 one-way trips. Note that a low-income rider faces this trade-off regardless of the fare alternative chosen to distribute the subsidy (e.g., user subsidies, peak/off-peak differentials). Thus, a limit of 10-13 trips per week can be set on the number of trips subsidized through a direct subsidy program, thereby significantly reducing the potential for fraud yet still ensuring that all trips by low-income patrons are covered by some type of subsidy mechanism.

Direct User Subsidy

Direct user subsidies give transit subsidies directly to low-income riders. Such subsidies avoid the problems of indirectly targeting subsidies to low-income riders through the services of the urban transit system. Many studies have shown that transit is a blunt instrument of social welfare in that subsidies to transit providers (as opposed to those offered directly to users) usually do not redistribute income to the poor. A direct user subsidy program could provide relief for low-income MARTA riders while alleviating pressure to keep transit fares low. Transportation subsidies for those with a low income are now offered by county welfare departments in Sacramento, California, and Arlington, Virginia.

The design of a direct user subsidy program should permit maximum use of existing institutions and programs. Because the administrative costs of screening and certifying individuals are quite high, user subsidies must be channeled through an existing administrative mechanism. In this study, we assumed that the Food Stamp certification procedure would be used to certify individuals for transit subsidy eligibility.

The target efficiency of user subsidies for MARTA riders would be very high (see Table 1). Only those properly certified would be permitted subsidized fares. Of course, fraud is possible but is likely to be limited, given the certification procedures already used in the Food Stamp Program. However, as mentioned, fraud can also be perpetrated by those eligible who resell subsidized tickets or tokens to those ineligible. Such behavior could be minimized by limiting the number of subsidized tokens given to those eligible each month and through the use of photographic identification.

A direct user subsidy program would provide excellent coverage for the poor. The State of Georgia Department of Family and Children Services estimates the participation rate of eligible households in the Food Stamp Program to be roughly 80 percent for Fulton County and 70 percent for De Kalb County. With an outreach advertising campaign on MARTA buses and trains, those eligible who wish to participate in the subsidy could take steps to enroll themselves at an agency providing certification for the program. Thus, coverage of the poor with direct user subsidies could be as high as 100 percent.

In estimating the revenue loss from a direct user subsidy, we considered the revenue effect of both existing and potential riders paying the discounted fare. As of September 1980, Fulton and DeKalb Counties had enrolled 139 991 individuals in their Food Stamp Programs. However, not all these are transit riders.

Therefore, we estimated the number of those who are subsidy-eligible and who are current riders. Household income eligibility limits for receiving food stamps indicate that most households with total earnings of less than $5000 are eligible for food stamps and would therefore be eligible for the transit subsidy. For those with household incomes between $5000 and $10 000, eligibility depends on the number in the household. In this analysis, we assumed that all MARTA riders with household incomes

Table 1. Comparisons of five alternatives designed to aid low-income riders.

Criterion	Fare Alternative					
	Direct User Subsidy	Quality-Based Fare	Reduced Fare on Designated Route		Peak/Off-Peak Fare Differential	Distance-Based Fare
			Plan 1	Plan 2		
Target efficiency	Close to 100 percent; identification program to minimize fraud	53 percent of subsidy goes to low-income riders	58 percent to low-income riders	77 percent to low-income riders	55 percent to low-income riders	Low, probably around 50 percent to low-income riders
Coverage	70-80 percent; all those who are eligible could receive aid	73 percent of low-income patrons subsidized	78 percent of low-income subsidized	29 percent of low-income subsidized	52 percent of low-income subsidized	Could be close to 40 percent subsidized
Administrative costs	High, reduced through extensive use of existing social service mechanisms	Low	Low	Low	Low	High implementation costs; costs to patrons in time lost due to fare procedures
Monthly revenue loss ($)						
$0.10 subsidy	151 788	728 964	495 696	160 372	560 992	N/A
$0.20 subsidy	394 649	1 147 928	991 392	320 744	1 121 984	N/A
Fare required to cover loss ($)						
$0.10 subsidy	0.55	1.08 (rail)	0.64	0.52	0.69	N/A
$0.20 subsidy	0.60	1.56 (rail)	0.78	0.55	0.88	N/A
Degree of relief[a] ($)						
$0.10 subsidy	0.40	0.46	0.48	0.51	0.54	N/A
$0.20 subsidy	0.30	0.41	0.45	0.48	0.59	N/A

Note: N/A = quantification not possible due to data limitations.

[a]Average fare for low-income riders, assuming subsidy funded by fare box.

below $5000 and half of all riders with household incomes between $5000 and $10 000 would be eligible for the transit subsidy. Under these assumptions, the number of current cash-paying riders that may be eligible for the transit subsidy is 67 462. (This figure does not include those currently purchasing Transcard passes since, as stated above, a monthly Transcard user pays an average fare of $0.33.)

Of course, not everyone who is eligible for food stamps registers for them nor will all those who register take advantage of the transit subsidy. Therefore, the maximum number of estimated subsidized trips must be scaled downward to reflect nonparticipation. At present, Food Stamp participation averages about 75 percent of the eligible population. If we also assume that 75 percent of those eligible for food stamps would engage in the "transaction costs" of participating in the transit subsidy, the number of current riders that would use the subsidy becomes 37 947.

Another factor to consider in estimating the number of trips subsidized is the number of tokens that would actually be purchased by those who are subsidy-eligible. Based on the May 1980 on-board survey, we estimated that 2 850 100 boardings were made by the subsidy-eligible. Dividing this number by the estimated number of the subsidy-eligible, we obtained an average weekly trip rate of 10 one-way trips per person. From this data, therefore, we assumed that all current MARTA riders who register for the transit subsidy would purchase their full allotment.

Under a $0.10 subsidy plan, we estimated that 1 517 880 boardings per month by current MARTA riders would be subsidized (37 947 persons making 40 subsidized trips per month). Monthly revenue forfeited by subsidizing this number of trips would be $151 788. Dividing the cost of subsidizing trips that would be made by current low-income cash fare patrons into the number of unsubsidized boardings indicates an increase in unsubsidized fares of $0.02.

We did not include the cost of subsidizing trips by new riders in these calculations. In fact, trips by new riders may actually serve as a source of net revenue if the marginal cost of serving these riders is less than the discounted fare. Unless additional capacity must be provided to meet demand from these new riders, furnishing discounted tickets or tokens for new trips by the subsidy-eligible is unlikely to have an adverse effect on transit deficits.

Under a subsidy plan of a $0.20 discount per trip, monthly revenue forfeited by this subsidy program would be $394 649. Apportioning the cost of the $0.20 subsidy among unsubsidized boardings indicates an increase in fares to unsubsidized riders of $0.06. Note that under the subsidy plans discussed here, moving from a $0.10 to a $0.20 subsidy more than doubles the subsidy cost. This is due to the larger number of trips per week that qualify for subsidization under the $0.20 subsidy plan.

The total cost of a direct subsidy plan would include costs other than the forfeited revenue. Even if certification is provided through the Food Stamp Program, some administrative costs would be incurred. Furthermore, if the marginal cost of serving new riders is higher than $0.30 or $0.40, the subsidy cost would be greater than that computed above.

With user subsidies, the average fare to low-income riders is set by the subsidy level. With a $0.10 subsidy, average fare for low-income riders would be $0.40; with a $0.20 subsidy, it would be $0.30. By taking frequent trips and using Transcard passes, low-income riders can reduce their average fare even further.

Quality-Based Fares

Quality-based fares are an attempt to relate fare to the quality of service provided. Authorities may

charge higher fares, for example, on rail transit service operated on its own right-of-way and on express bus service. Quality-based fares would aid low-income riders to the extent that high-income riders use high-quality services and to the extent that a transit authority uses the additional revenue collected to reduce or hold constant fares on routes serving primarily low-income riders. Whether or not this type of arrangement could be achieved in Atlanta depends on the trip patterns of all income groups and the types of services offered by MARTA.

MARTA could implement quality-based fares by raising fares on special or high-cost service. Existing examples of quality-based fares nationally include higher fares on rail service, express bus services, subscription bus services, airport services, special transit services for sports events, and vanpools. Resulting increased revenue could be used to aid low-income riders by reducing fares on regular surface bus services.

Because this fare strategy relates fare to service quality rather than directly to income, it is not surprising that quality-based fares would be inefficient in targeting aid to low-income riders. If bus fares are lowered, only 53 percent of those cash patrons aided and 50 percent of bus Transcard patrons aided would be riders with household incomes less than $10 000. Thus, under a quality-based fare scheme, 47 percent of total subsidy expenditures would be funneled to middle- and high-income riders.

Quality-based fares would perform slightly better against the criterion of coverage. Of all trips made by low-income patrons, 73 percent are cash-fare bus trips. Thus, reducing bus cash fares by $0.10 or $0.20 would aid 73 percent of all low-income riders.

Conversely, the impact of higher rail fares on low-income riders clearly indicates that quality-based fares are not a good method of aiding poor transit patrons. Raising rail fares would affect all riders, but it would particularly hurt low-income rail riders, who make up 30 percent of all cash rail patrons. Higher rail fares could also affect poor Transcard patrons, perhaps through a rail surcharge. Forty-four percent of all rail Transcard patrons are in the low-income category. The MARTA bus system carries many more people than its rail system and therefore it must be noted that only 12 percent of all low-income transit patrons use the rail system.

With a $0.10 reduction in bus fares, a quality-based subsidy would result in a revenue loss of $728 964 per month; a $0.20 reduction in bus fares would result in a loss of $1 457 928. At the higher level of subsidy, some Transcard users would be likely to switch to cash fares. For each user who does so, the average revenue loss would be $0.03 ($0.33 average Transcard fare minus $0.30 subsidized fare).

If rail patrons were to bear the subsidy cost to low-income bus riders, the impact on rail would be quite severe since bus riders outnumber rail riders by more than 5 to 1. The $0.10 reduction in bus fares, apportioned among all rail riders, would increase rail fares by $0.58 (to $1.08). A $0.20 reduction in bus fares would increase rail fares by $1.16 (to $1.56). Clearly, a large surcharge would also have to be added to Transcard passes when used on rail service lest everyone switch from cash fares to Transcard. This surcharge might decrease the amount by which rail fares would have to be raised. Substantial changes in rail ridership could also occur.

With a $0.10 subsidy, the average fare paid by low-income cash patrons would be $0.46. With a $0.20 subsidy, the average fare paid would be $0.41. These average fare calculations show that, due to its poor coverage of low-income patrons, reducing bus fares by $0.10 would drop the average fare for the poor by only $0.04. Reducing bus fares by a $0.20 discount would result in an average fare for those in the low-income category only $0.09 lower than the existing fare. With either subsidy level, 8-12 percent of the poor would pay very high rail fares. In addition, due to its poor target efficiency, many middle- and high-income bus patrons would be subsidized under this fare alternative.

REDUCED FARES ON DESIGNATED ROUTES

Reduced fares on designated routes might be an attractive alternative in that the transit authority could target lower fares to specific user groups. It could offer reduced fares on specific bus routes serving low-income residential areas or charge lower fares to patrons boarding at designated stops. This option would enable discounts to be distributed most selectively when income groups are concentrated in identifiable residential areas.

Data from the May 1980 on-board survey indicate that low-income patrons ride all segments of the MARTA system. Furthermore, low-income patrons made up no more than 80 percent of the riders on any route among this representative sample of bus routes. Therefore, to assess this fare option, it was necessary to assume some cutoff percentage of low-income riders in designating routes eligible for fare reductions. We analyze two cutoff plans here. These identify the set of routes where (a) 50 percent or more of the total cash fare route ridership are low-income patrons and (b) 70 percent or more of the total cash fare or Transcard riders are low-income patrons. Plan (a) defines the more inclusive set, accounting for 80 percent of all routes served. Plan (b) includes 26 percent of routes surveyed. These percentages reflect the wide dispersal of low-income patrons along the bus routes surveyed. We used these and other findings from the May 1980 on-board survey as the basis for generalizations about the distribution of low-income patrons throughout the MARTA bus system.

Looking at the target efficiency of both plans (a) and (b), it is clear that as the transit authority designated more routes for fare reductions, more of the subsidy would go to the middle- and high-income patrons. If buses with ridership composed of at least 50 percent low-income patrons charge reduced fares, 58 percent of all subsidized riders would be low-income. If buses with ridership composed of at least 70 percent low-income patrons charge reduced fares, 77 percent of all subsidized riders would be low-income. Thus, with this option, the transit authority would achieve higher target efficiency with fewer designated routes.

Not suprisingly, if the transit authority designated fewer routes for reduced fares, the subsidy program would cover a smaller percentage of all low-income patrons. With plan (a), which reduces fares on more buses, 78 percent of all low-income cash patrons would receive the subsidy. With plan (b), which reduces fares on fewer buses, only 29 percent of all low-income patrons would be covered by the subsidy. These figures dramatically illustrate the trade-off between target efficiency and coverage that would occur with this option.

The revenue that the authority would forfeit from each of these plans also reflects the trade-off between target efficiency and coverage. Under plan (a), granting fare reductions on buses with 50 percent low-income riders, an estimated 4 956 955 subsidized boardings would occur. With a $0.10 subsidy, forfeited passenger revenue will total

$495 696 and a cash-fare increase of $0.14 (to $0.64) would be necessary on other segments of the MARTA system. This increase would in turn lead to higher Transcard patronage or, perhaps, Transcard fare increases. With a $0.20 subsidy, revenue forfeited would be $991 392, and a $0.28 cash-fare increase (to $0.78) on bus and rail would be necessary.

Under plan (b), granting reductions on buses with 70 percent low-income riders, an estimated 1 603 720 subsidized boardings would occur, since 22 percent of all cash-fare bus boardings would be on designated routes. With a $0.10 subsidy, forfeited revenue would total $160 372 and a cash fare increase on bus and rail of $0.02 (to $0.52) would be necessary for internal subsidization. With a $0.20 subsidy, a $0.05 cash-fare increase (to $0.55) would be necessary. As with plan (a), this increase in the cash fare might induce some cash patrons to switch to Transcard or necessitate increased Transcard fares.

The estimated average fare for low-income cash-fare patrons under plan (a) with a $0.10 subsidy would be $0.48. With a $0.20 subsidy, the average fare for low-income patrons who pay cash would be $0.45. The average fare for low-income cash-fare patrons under plan (b) with a $0.10 subsidy would be $0.51. With a $0.20 subsidy, the average fare for low-income patrons who pay cash would be $0.48.

Peak/Off-Peak Fare Differentials

Peak/off-peak fare differentials are an option that may allow MARTA to bring its fare structure more in line with the cost of service as well as aid low-income riders. Metro, in Washington, D.C., for instance, charges higher fares for peak-period riders. It has long been believed that peak service costs more to provide than off-peak service. Thus, increasing peak fares could equalize existing variations in revenue collected as a percentage of cost at different times during the day. If, as has been suggested, a large number of off-peak riders are also from low-income groups, peak/off-peak pricing would help moderate the impact of fare increases on low-income riders.

The target efficiency of offering aid to low-income riders through peak/off-peak fare differentials on both bus and rail lines would be very poor. Only 55 percent of all off-peak riders are low-income individuals. Reducing off-peak fares, therefore, would aid both low-income and high-income individuals almost equally. Moreover, 45 percent of all individuals riding during peak hours are in the low-income category. Thus, almost half of those paying higher fares under this fare alternative would be low-income individuals.

Coverage of the poor with peak/off-peak fare differentials would also be inadequate. If lower off-peak fares were offered, only 52 percent of all low-income riders would be aided. Conversely, if higher peak fares were necessitated by off-peak hour decreases, 48 percent of all low-income riders would pay higher fares than they currently pay.

A $0.10 reduction in off-peak period fares would result in $560 992 in forfeited passenger revenue. If internal subsidization is required, a peak period fare increase of $0.19 to $0.69 would be necessary. A $0.20 reduction in off-peak period fares would result in forfeited revenue of $1 121 984. Absorbing this loss across peak period boardings would necessitate a $0.38 increase in peak fares to $0.88. The administrative costs of collecting different fares at various times of the day might further increase these fares.

With peak/off-peak differentials, the average fare paid by low-income patrons who pay cash fares depends on the number of boardings made by this group during the peak and off-peak periods and on the level of subsidy. With a $0.10 reduction in off-peak fares, the average fare for low-income patrons who pay cash would be $0.54, $0.04 higher than the current flat fare. With a $0.20 reduction in off-peak fares, the average fare for low-income patrons who pay cash would be $0.59.

Distance-Based Fares

Distance-based fares may offer MARTA the opportunity to capture a higher percentage of costs on long-distance trips as well as to reduce the impact of fare increases on low-income riders. The total cost of providing a longer-than-average trip is higher than the cost of providing shorter-than-average trips. Yet, with a flat fare, the poor, who typically (but not always) make shorter trips, may be paying a higher portion of the cost of their trips than more affluent riders who travel longer distances. Graduating fares by distance may also increase efficiency by matching fares more closely to the cost of providing service. Furthermore, depending on the response of riders to price changes, revenue intake may increase with a distance-based fare schedule.

Whether or not a distance-based fare schedule would aid low-income riders in Atlanta depends on their trip patterns. Many transportation researchers have observed that due to the distribution of various income groups within metropolitan areas, higher-income patrons typically ride longer distances than lower-income patrons. If Atlanta conforms to this pattern, moving from a flat fare to a distance-based fare collection method might aid low-income riders. A variation on this alternative is to charge distance-based fares only in the peak direction, assuming that low-income riders primarily travel long distances as reverse commuters.

Distance-based fares can be implemented in a variety of ways. While finely graduated fare structures may result in higher revenue intake, the costs to both the transit authority and passengers can be greater than the additional revenue collected. Distance-based fares are sometimes graduated by miles traveled, with a separate fare for each pair of stations. Fares may also be structured according to a network of zones, with a surcharge added to the base fare each time an additional zone is crossed. Zonal fares typically do not capture as much passenger revenue as either finely graduated or station-to-station pricing schemes. They may, however, be far easier to implement.

Detailed information on trip distance traveled by each income group was not available from the MARTA survey at the time of this study. As an alternative, we used information on journey-to-work patterns from the 1970 U.S. Census to provide a rough indication of distance traveled to work by each income group. The 1970 census data include place-of-residence and place-of-work statistics by income class but not by mode. Thus, the data indicate only work trip patterns in general, not trips on MARTA. We used these census data to assess distance-based fares by assuming that an individual who lives and works in the same geographic area makes short-distance work trips, whereas a person who lives in one county and works in another makes long-distance work trips.

Census data show that the income distribution of Atlanta city residents commuting to each of four destinations does not vary significantly between each origin-destination pair. Reducing short-distance fares, therefore, would be likely to aid

persons from all income groups. If combined with peak-directional pricing, the target efficiency of distance-based fares would be perhaps somewhat improved. From existing information, however, no firm conclusions can be drawn concerning target efficiency.

While distance-based fares would provide aid to persons from all income groups, the data suggest that they would assist a large percentage of low-income travelers. Low-income workers are more likely to work in their county of residence than outside it. Of employed low-income Atlanta residents, 84 percent work inside Atlanta. Of Fulton County's employed low-income residents, 44 percent work in Atlanta and another 51 percent work within the remainder of the county. Of low-income residents of DeKalb County, 60 percent work within the county, whereas 28 percent work in Atlanta. Although no data are available, trips made by the unemployed and nonwork trips made by low-income persons are likely to cover shorter distances than work trips.

The most serious problem with these data is that they indicate work locations for all persons, not just transit users. For example, transit, with its fixed routes generally radiating into and out from the central business district (CBD), does not serve short-distance neighborhood or crosstown trips well. In fact, transit is most competitive with automobile for trips to the CBD, which it serves directly. Therefore, the work locations and hence trip lengths of MARTA riders may be quite different from those suggested by aggregate census data. Furthermore, the data do not indicate whether intracounty trips are truly shorter than intercounty trips. Consequently, without additional information, little can be stated conclusively regarding distance-based fares.

CONCLUSION

Table 1 summarizes the quantitative analyses of the fare alternatives presented in this report. The table provides some important findings and a clear recommendation for direct user subsidies.

User subsidies have the highest target efficiency of any alternative analyzed. By limiting misuse through an identification program, close to 100 percent of subsidy aid would be funneled to low-income riders. Coverage of the poor would also be very high with user subsidies. With such a program, all low-income people eligible for transit aid could obtain it regardless of their travel patterns or residential location.

A disadvantage of user subsidies is that they can entail high administrative costs. Certifying and identifying the eligible and providing a subsidy mechanism (tickets or tokens) can be expensive. The subsidy program described here, however, would minimize these costs through extensive use of an existing social service, the Food Stamp Program. More importantly (as is shown in Table 1), due to their target efficiency and strong coverage potential, direct user subsidies would provide the highest degree of relief for the lowest revenue loss. Only one other fare alternative--reduced fares on routes serving at least 70 percent low-income riders--would have a similar or lower monthly subsidy cost. This option, however, would offer little relief for low-income riders.

Because of low target efficiency and/or inadequate coverage of the poor, the four other fare alternatives analyzed are inferior mechanisms for aiding low-income riders when compared with direct user subsidies. Quality-based fares would reduce the average fare paid by low-income riders but, because of poor target efficiency, would result in unacceptable fare increases on the rail system. Reduced fares on designated routes would either provide little relief or result in large fare increases for unsubsidized riders. Peak/off-peak fare differentials would offer both inadequate target efficiency and coverage and would actually result in higher average fares for the poor. Little information on distance-based fares is available, but their poor target efficiency and high administrative costs indicate that they would represent a very expensive mechanism for offering a minimum amount of aid to the poor.

These findings suggest that pricing options that may increase pricing efficiency by relating fares to cost, such as peak/off-peak fare differentials, quality-based fares, and distance-based fares, may not aid low-income riders. In fact, this analysis indicates that such pricing strategies may actually increase the average fare of poor transit patrons. Thus, we must assess the equity implications of pricing changes that offer greater efficiency by relating fares to cost on a city-by-city basis.

In conclusion, this analysis of five fare alternatives designed to reduce the impact of the MARTA fare increase on low-income riders clearly identifies direct user subsidies as the best method of offering relief. Direct user subsidies would be target efficient, provide good coverage of the poor, require only 10-20 percent fare increases for unsubsidized riders, and reduce the average fare for low-income riders. The high administrative costs of a direct subsidy program can be more than offset by these advantages.

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