# Analyzing the Equity Impacts of Transit Fare Changes: A Case Study of AC Transit

Cornelius Nuworsoo
University of California Transportation Center
2614 Dwight Way
Berkeley, California 94720-1782
Tel: (510) 642-5728
Fax: (510) 643-5456
Email: nuworsoo@berkeley.edu

Elizabeth Deakin
University of California Transportation Center
2614 Dwight Way
Berkeley, California 94720-1782
Tel: (510) 642-4749
Fax: (510) 643-5456
Email: edeakin@berkeley.edu

Aaron Golub
University of California Transportation Center
2614 Dwight Way
Berkeley, California 94720-1782
Tel: (510) 643-4149
Fax: (510) 643-5456
Email: goluba2@yahoo.com.

**Word Count**
Abstract (236) + Main body + References = 5805
6 tables * 250 = 1500
**Total = 7305**

Cornelius Nuworsoo, Elizabeth Deakin, and Aaron Golub

**Analyzing the Equity Impacts of Transit Fare Changes: A Case Study of AC Transit**


## ABSTRACT

Many transit agencies, faced with budget shortfalls, must consider increasing fares. In this paper we analyze the case of the Alameda-Contra Costa Transit District (AC Transit). In March 2005, AC Transit put forth five alternative fare proposals for public discussion. The proposed fare structures included combinations of fare hikes, base fare reductions, eliminations of free transfers, and discontinuation of periodic passes. Using data from the agency's 2002 on-board survey, we assessed the impacts of the various fare proposals on different subsets of riders and evaluated the equity of each proposal. We also estimated the fare revenues resulting from each proposal, using alternative estimations of price elasticity to estimate changes in ridership due to changes in price. The analysis reveals that fare policies that increase the cost of transfers or eliminate unlimited-use passes produce dramatically unequal impacts on various groups of patrons. Proposals for flat fares per ride were found to be the least equitable of the fare policies, even when the base fare was lowered, because lower income riders, youth, and minorities make more trips and transfer more frequently than their more affluent counterparts. Proposals that maintained existing pass instruments and allowed transfers for small fees were the most favorable. The case study demonstrates the utility of on-board transit survey data in analyzing the effects of proposed fare changes and illustrates an approach that could be used by other transit agencies to evaluate fare options.

# 1 BACKGROUND

## 1.1 Introduction

Transit agencies from time to time must evaluate changes in fares and fare structures. In this paper we present an analysis of one such case. In March 2005, faced with budget shortfalls, the Alameda-Contra Costa Transit District (AC Transit) put forth five alternative fare policy proposals for public discussion. The goal of the proposals was to raise fare revenues. The proposed structures included combinations of fare hikes, base fare reductions, eliminations of free transfers, and discontinuation of periodic passes. In this paper, we assess the impacts of the various fare proposals on different subsets of riders. This breakdown of impacts is used to assess how each proposal will affect different user groups as well as to evaluate how equitable each proposal is. We also estimate the fare revenues resulting from each proposal, using alternative estimations of price elasticity, i.e., accounting for likely shifts in ridership due to changes in price.

## 1.2 Pricing and Equity

While increases in revenues are often the major justification for transit fare changes, public transit agencies are also concerned about the equity of the changes. Here we define equity as "fairness in the distribution of goods and services (among the people in an economy)" (Friedman, 2002). In the context of transit fares, equity may be defined as how just pricing is among various constituents of riders. Three possible criteria for setting fares equitably would be as follows.

1. *The benefit criterion* asserts that people should pay for services in proportion to the benefits they receive from them. For example, transit passengers might pay more for express services than for slower, multi-stop local services or pay more for direct services than for services requiring a transfer, etc.
2. *The cost criterion* asserts that people should be charged for the use of the transit services in proportion to the cost of providing service to them. This is complex to determine for individual riders, but could be partially captured through time-of-day and location-based pricing.
3. *The ability to pay criterion* asserts that people should be charged for the use of transit in proportion to their wealth. While this may be partially achieved by charging lower fares to such groups as the youth, the elderly and the handicapped, there is no guarantee that the actual rider in the group is economically disadvantaged.

Transit fares often stray considerably from all of these criteria. One reason is that equity is not the only criterion for pricing structures. For example, for ease of fare collection, many bus services replaced distance and zone based fares with flat fares in the 1970s, a change that made long trips (often made by more affluent travelers) a better deal than shorter trips. Nevertheless equity remains an important consideration for most operators, particularly as measured by ability to pay.

Judging by the third criterion therefore, whenever new pricing policies are introduced, it is prudent to ensure that the incidence of fare increases is not any more onerous on members of disadvantaged groups than others. The objective of this paper is to analyze pricing policy options in terms of this principle.

A large and growing literature addresses the subject of equity (Miller et al, 1970; Rawls, 1971; Altshuler, 1979; Friedman, 2002). Studies have applied the concept of equity to such diverse issues as pricing road congestion (Deakin and Harvey, 1996, Litman, 1996; Richardson, 1998), irrigation and residential water supply (Tsur, 1995; Howe, 1996; Fauconnier, 2004), and public transit. Studies that dealt specifically with equity issues in transit covered investments (Garcia, 1998; Garrett et al, 1999; and Deakin et al, 2002), finance (Taylor, 1991; and Wachs, 2003), time-of-day pricing (Watkins, 1984), and distance-based fares (Ballou et al, 1979).

Community groups also have been known to organize to fight for equity. In Los Angeles, for instance, advocates for bus riders, which comprised mainly minority groups, successfully challenged the transit authority's plans to spend massive sums on a suburban-oriented light rail system while at the same time cutting bus services in the central city (Garcia, 1998).

A few studies have looked at the equity of transit fare policies per se. A 1980 paper by Cervero, Wachs, Berlin and Gephart investigated new pricing policies proposed by three transit agencies for spring 1980. They found that the proposed fare increases across-the-board appeared promising in terms of revenue yield, but were more regressive than existing structures, redistributing disproportionately more income away from low-income, transit-dependent users. The analytical method of the study by Cervero et al. bears the closest resemblance to the method employed in this paper.

Deakin and Harvey (1996) articulated the need to be cognizant of the equity implications of fare change policies. They noted:

> Transportation price increases are especially a concern for low income people who have a limited ability to "choose" to pay the higher costs and hence would be priced out of routine use of certain high-cost travel options. Higher transportation prices also are a worry for moderate income people, especially those who have little flexibility about when or where they travel and hence might have to devote a larger share of their income to transportation. Equity can also be examined by looking at the distribution of impacts by location in the region (e.g. central city vs. suburbs), by gender of the traveler, by race and ethnicity, and so on.

The Transit Cooperative Highway Research Project Report 94 (TCRP-94, 2003) stated the following observations about equity and environmental justice issues in public transit:

- Environmental justice initiatives to insure that all population segments receive fair treatment are increasingly affecting transit agencies' consideration of potential fare changes. Such initiatives have resulted in legal challenges to proposed fare increases in several cities; moreover, even where such challenges have not proven successful—or have not actually entered the courts—they have influenced the fare policy decision-making process.
- In some cases, equity-based challenges have resulted in modifications to fare proposals or legal restrictions on future changes. In others, they have merely required the agencies to go to

great lengths to explain and defend their rationale for raising fares. Moreover, because of such challenges, many transit agencies, especially those in other large cities, feel that they must now pay greater attention to equity concerns in considering possible fare changes.

In line with these observations, this paper assesses the impacts of proposed fare change policies on various constituents of riders to determine if proposed fare change proposals were equitable.

## 1.3 Elasticity and User Responses to Fare Changes

The changes proposed by AC Transit may significantly impact the way riders will use the system. Bus riders' responses to changes in fares and fare structures have been studied extensively (see Pratt, et al., 2000 for a summary) and are expressed in terms of elasticity. Elasticity is defined as "the percentage change in the use of a particular transportation service resulting from a 1 percent change in an attribute such as price, trip time, or frequency of service" (Small and Winston, 1999). General conclusions from the extensive body of work indicate that overall ridership elasticity with respect to fare changes for bus systems is about -0.40 (Linsalata, et al., 1991; Pratt et al., 2000). That sensitivity diminishes with increasing city size, during peak hours, for work related trips, and for seniors and riders who are transit dependent (De Leuw, et al., 1979; Pratt et al., 2000).

Approximately 1.5 million people live in AC Transit's 364 square mile service area. Two studies have looked specifically at city size and found fare elasticities of -0.24 and –0.36 for the largest urban areas (Mayworm, et al., 1980; Linsalata, et al., 1991). Fare elasticities for poorer riders are not well understood because of the confounding issues of transit dependency (Pratt et al. 2000). Studies of fare elasticity based on automobile ownership show that auto-less riders have markedly lower fare elasticities (De Leuw, et al. 1979a and 1979b). Youth were found to have higher sensitivity to fares, presumably because of lower incomes (Mayworm, et al., 1980).

The proposed elimination of unlimited use monthly passes would also have significant impacts on ridership. Besides the cost savings for riders making more trips than the number needed to "breakeven", passes afford other conveniences riders find valuable. A survey of riders in Atlanta found that "Convenience/ No need for cash" and "Easier to transfer" were common reasons given, besides cost savings, for purchasing monthly passes (Parody, 1982).

# 2 THE FARE POLICY PROPOSALS

The proposed alternatives for fare structures are compared with the existing fare structure in Table 1 and are outlined as follows:

[Table 1]

**Proposal 1: "Pay per ride"**

- Lower base, single-ride fares
- Eliminate pre-paid tickets and passes except monthly passes for seniors and the disabled
- Eliminate transfers; passengers would pay full fare on each boarding

**Proposal 2**: **"Raise fares and transfer fees"**

- Raise fares in all categories except for senior, disabled and youth monthly passes
- Raise the fee for transfers from $0.25 to $0.50

**Proposal 3: "Raise fares with two free transfers"**

- Raise fares in all categories except for senior, disabled and youth monthly passes
- Free, two-ride transfers (with payment of fare) that would be valid for 1.5 hours

**Proposal 4: "Retain existing structure and add weekly pass"**

- Retain all current fares and transfers fees
- Introduce a weekly, unlimited-ride pass

**Proposal 5: "Proposal #1 but retain youth pass"**

- Lower cash fares
- Eliminate pre-paid tickets and adult monthly passes, but retain monthly passes for seniors, the disabled and the youth
- Eliminate transfers; passengers would pay full fare on each boarding.

The fare proposals were not intended to affect such group pass programs as the City of Berkeley ECO Pass and the University of California Student Class Pass. These programs are therefore excluded from the analysis.

# 3 PROFILE OF RIDERS

To determine whether various fare proposals could differentially affect subsets of riders, we first prepared profiles of AC Transit riders using AC's 2002 on-board surveys. The rider characteristics summarized here were selected to conform with items most relevant to the analysis. Rider profiles are therefore outlined in terms of (a) local versus transbay travel, (b) number of rides taken on one-way trips, (c) payment type and (d) fare groups. These characteristics are compared by gender, income group and race.

## 3.1 Local vs. Transbay Trips

93% of AC Transit bus trips are local and the remaining 7% are transbay. Transbay trips are significantly different from local:

*By Gender*

The distribution of trips between local and transbay travel is the same by gender. However, there are approximately 10% more female riders than male riders on AC Transit.

*By Income Group*

At 17% to 40%, riders in upper income groups make significantly more transbay trips than the overall average of 7%. Low-income riders make only 2% of the transbay trips.

*By Race*

At 15% and 9% respectively, whites and Asians make significantly more transbay trips than other racial groups.

## 3.2 Number of Rides on One-Way Local Trips

*By Gender*

At about 44% each, the distribution of trips among single-ride and two-ride trips is the same by gender. The remaining 13% of trips on AC transit involve three or more legs.

*By Income Group*

60% to 65% of low income bus users' one way trips require two or more bus rides. For middle to higher income groups, more than half (53%) of trips require a single bus.

*By Race*

Among Whites and Asians, more than half or approximately 55% of trips involve single rides. Members of other racial groups take two or more rides to complete 55% to 60% of their trips.

## 3.3 Payment Type (Local Trips)

*By Gender*

At 46% each, the distribution of payment type is the same between those who use cash and those who use passes. The shares are quite similar by gender. The remaining 8% of trips on AC transit are paid for with the 10-pack ticket.

*By Income Group*
Payment by both cash and its variant, the 10-pack ticket, increases slightly with increase in income.

*By Race*
Slightly more than half of rides by the minority groups of Asian, African and Native American descent entail use of the pass. 64% of rides by Latinos involve cash payments.

## 3.4 Fare Group (Local Trips)

*By Gender*
The distribution of trips between the fare groups is the same by gender. Adults make up two-thirds of the ridership followed by the youth at 23%. Seniors and disabled constitute small, but significant proportions at 6% each.

*By Income Group*
Seniors and disabled riders are more likely to fall into the low income brackets than adults. While the majority of the youth were not able to identify their household incomes, those who responded indicated a significant proportion in low income groups. Adult riders dominate in all the income groups.

*By Race*
The distribution of fare groups is quite similar among various racial groups.

# 4 FARE POLICY OPTIONS: EVALUATION METHODOLOGY

## 4.1 Ridership data and Sample Sizes

The analysis of fare policy options is based on AC Transit's most recent on-board rider survey, which was conducted in 2002. The database has 15,370 records of linked, one-way trip information and socio-economic characteristics of riders. More than ninety percent of the trip data constitutes local travel while the remainder covers transbay trips. "The estimated sampling error for the survey is ± 1% at the 95% confidence level. This means that we are 95% confident that all AC Transit riders would produce responses to each survey question within approximately one percentage point of the results obtained from this sample" (Blash et al, 2003). The effects of fare proposals depend upon initial fares and transfer policies, so the analysis was structured as follows:

(a) We separated local travel from transbay travel since different initial fares apply.
(b) Since currently, only the first transfer is at a discount, we sorted the trips in the database by the number of rides taken to complete a linked, one-way trip. For example, a trip which involves three rides is one where the rider has made two transfers – an initial boarding at a base fare, a transfer onto the second ride at the applicable transfer fee, and a second transfer onto the third ride that could involve another fare payment if cash or the ten-pack ticket were used.

Table 2 describes the sample for the analysis. Part a of the table shows the sample sizes of valid cases and reveals that sample sizes are large enough to support an analysis by number of rides for local trips, but for transbay trips the sample is too small to separately analyze the categories with 3 and 4+ rides. Therefore in this paper, our analyses of transbay trips do not consider the number of rides that constitute linked trips.

To identify the effects of individual features of the five fare proposals, the data were further cross classified by the four fare categories: youth, senior, disabled and adult; and by the three primary fare media: cash, 10-ride ticket and monthly pass. As noted earlier, the fare proposals do not affect group pass programs and trips made using these passes were excluded from the analysis. Table 2 parts b and c compare the distributions of sample sizes by these classifications. Sample sizes for transbay trips by some fare categories are too small to be statistically reliable and therefore analysis of transbay trips was restricted to the classification by fare media.

[Table 2]

By using the 2002 Rider Survey to represent the AC Transit market and sub-markets, we essentially assumed that market shares and traveler characteristics in each submarket remained the same since the survey was conducted. Some changes in overall ridership have certainly occurred. Nevertheless, in our view, the 2002 Rider Survey is the best, most recent and most complete dataset describing user trips by all of the different fare media and categories. While the demographics of users in particular fare and payment categories might have changed in the last three years, it is doubtful that they have changed enough with respect to each other to make the inter-category comparisons made here invalid. Finally, the methodology used here should be robust; if additional, more recent data become available, they could easily be used to update the data used here and thus to update the findings.

## 4.2 Assessing Impact on Rider Expenditure

The crux of the analysis involved the calculation of average costs of linked one-way trips for subsets of patrons depending on the fare category and type of payment used. The assumptions and procedure are outlined as follows:

(a) All data in the database were weighted to reflect system-wide usage at the time of the survey.
(b) Each trip in the database was assigned a base fare, which depended on the following:
    1. Whether the trip was local or transbay
    2. What type of fare category the respondent belonged to
    3. What type of fare media the respondent used.
(c) The odd-numbered legs of one-way trips (i.e. first and third legs) were assigned base fares while even-numbered legs (i.e. second and fourth legs) were treated as transfers. For Proposal #3, the second and third legs were considered transfers, where applicable. See Table 1 for fare structures.
(d) The base fares and transfer fees were summed to arrive at the cost of each linked, one-way trip.
(e) The mean costs of one-way trips were calculated for the user groups of interest (youth, seniors, disabled, adult, by income, etc)

(f) The procedure was repeated for the existing fare structure and the five proposed fare structures.
(g) The differences in costs of one-way trips between existing and proposed fare structures were compared to determine the impacts on riders.

## 4.3 Assessing Impact on Agency Revenues

Since the proposals were put forward primarily to generate increased revenues, we continued with a comparative study of the effects of the fare changes on agency revenues. The revenues were calculated by multiplying expected (average) fares and the ridership for each individual group. The most current ridership numbers for each category were the 2003 boardings reported to the National Transit Database (NTD).

Initially, revenues were calculated with ridership at the existing (2002) level. This is essentially an assumption that there would be the same distribution of users with the same distribution of payment types under the new proposals as in the existing case.

More realistically, both ridership and its distribution among users and fare types are likely to change as price structures are altered. Some users will decide not to travel at all, or will change the way they travel. Riders who currently make many transfers might decide to take alternatives like rail (BART) or drive or walk for part of their trip if they must pay for each leg of their trip on the bus. Others who use a pass to make many trips might make fewer trips if passes are discontinued. Riders who now pay cash might decide to ride more if cash fares go down under new proposals. Some riders will be more sensitive to price changes than others, depending on demographics such as income or age; rider sensitivity to price also depends on trip purpose; e.g., riders going to work will be less sensitive to price than riders making discretionary trips. To reflect these likely changes in ridership after the fare changes, the revenue estimates were refined to consider the effects of price elasticities on ridership. The elasticity values we used in this analysis were based on a comprehensive national study (TCRP-B-12, 2000) and are discussed in more detail in the results section which follows.

# 5 RESULTS

## 5.1 Ridership patterns

The effects of fare proposals depend on the initial fare and the charge for transfers. Table 3 shows the splits between single-ride and multiple-ride trips among the four key types of payment for combined local and transbay travel. System-wide, slightly more than half of AC Transit patrons take two or more bus rides to complete each one-way trip. These riders are somewhat lower income than the average patron and are more likely to be members of ethnic or racial minority groups.

[Table 3]

## 5.2 Impacts of Fare Changes on Riders

With a preponderance of multiple-ride trips, fare policies that either increase the cost of transfers or reduce the availability of unlimited-use passes create dramatically unequal levels of impacts on different groups of patrons, who use AC Transit differently. The unequal rate of transfers exhibited by different groups means the elimination of discounted transfers will have an unequal fare increase on these different groups. Youth and Senior users transfer more often than Adult users, and therefore are impacted more. The analysis is structured to produce results by the various categories of fare and payment types, income levels, ethnic and racial categories, and other demographics.

Parts a and b of Table 4 compare levels of impacts of the fare proposals on several constituents of AC Transit riders under two assumptions for the level of pass use. The following discussion refers to the higher level of pass use (Table 4a), considered close to typical.

## 5.3 Impacts of Proposal 1: "Pay per ride" and Proposal 5: "Proposal #1 but retain youth pass"

Proposals #1 and #5, which eliminate passes and transfers, have the least favorable impacts for patrons who transfer often. Fares rise 20% overall, and the impacts are highly regressive, with poorer patrons facing up to a 34% fare hike while those earning more than $100,000 experience only a 9% increase. Former pass holders would experience the largest overall fare increases, with a 128% increase; youth would be close behind with an 82% increase in fares. Native and African American riders would see a 31% average fare increase, versus a 9% increase for Caucasian riders. The impacts therefore will be disproportionately higher on youth, low-income earners and minority groups in comparison with the general impact on all patrons.

## 5.4 Impacts of Proposal 3: "Raise fares with free transfers"

The two-free-transfer feature of Proposal #3 renders it the most favorable alternative proposal from an equity perspective, in spite of the fact that it also features the highest base fare hike. It is neutral or slightly progressive in its impacts across income groups, with the poorest riders seeing a 6% increase in average fares while fares for the wealthiest riders go up 17% on average. The overall increase for all riders is 11%. Riders who make multiple transfers, many of whom are also low income and minority, fare better under these fares than with other proposals. The segments of riders most severely impacted are single-ride local trip makers and transbay travelers. However the impact would affect fare categories relatively uniformly.

## 5.5 Impacts of Proposal 2: "Raise fares and transfer fees"

Proposal #2 is similar to Proposal #3, but involves a lower fare hike and includes a transfer fee hike. Across most subgroups, the distribution of impacts is fairly flat. Differential impacts occur for riders who make multiple-ride trips. The overall fare increase is roughly 13%. The poorest riders see an increase of 12% while the wealthiest groups experience a 15% average increase.

## 5.6 Impacts of Proposal 4 "Retain existing structure and add weekly pass"

Proposal #4 is nearly the same as the existing fare structure and a straightforward analysis does not indicate any real differences. Because the weekly pass is a new option, we analyzed this

proposal to see what the effects would be if weekly passes were to replace the 10-ride ticket. Results show favorable impacts on the group of riders who currently use the 10-ride ticket, since they would spend similar amounts as under existing fares, but enjoy free transfers because of the pass. Fares for almost all rider groups would thus go down under this proposal if 10-ride ticket holders convert to weekly passes. The introduction of unlimited-ride weekly passes would thus constitute another source of convenience to the riding public, but at the cost of revenue loss for AC Transit.

[Table 4]

## 5.7 Sensitivity Analysis of Impacts

Without available data on typical numbers of trips made by various pass users, we performed sensitivity analyses to assess possible impacts. At the low end we assumed the typical monthly pass user made 40 trips a month for the adult, breakeven price of $1.50 per trip. At the high end, we assumed a pass user made twice as many (80) trips a month for an adult fare of $0.75 per trip.

Table 5 compares the estimated average costs of one-way local trips considering the various differential fares and transfer fees under existing and proposed fare policies. The following impacts are noteworthy:

- The fewer the number of trips made by monthly pass users, the lower will be the impact on riders of the pay-per-ride proposals #1 and # 5.
- For proposal #2, which maintains the existing structure but hikes fares and transfer fees, the fewer the number of trips made by pass users, the higher are its impacts on subsets of riders.
- Since proposal #3 combines the existing structure with fare hikes and two free transfers, the fewer the number of trips made by monthly pass users, the lower will be its impacts on riders. However, the range of impacts is narrower than for proposals #1, #2 and #5.

[Table 5]

## 5.8 Price Elasticities and Net Impacts on Fare Revenues

This responsiveness of AC Transit patrons to changes in the price of service is the elasticity of ridership with respect to price. If ridership is elastic, a rise in fares should be followed by decline in the number of users, and a larger fare increase would cause a larger decline in the number of users. Here, as a rough estimation, two elasticity values are applied across the board to rider groups defined by fare-type and payment-method. A typical estimate assumes an elasticity of transit ridership with respect to fares of –0.33 (Curtin, 1968); a more conservative estimate uses the value of –0.1. With a 10% fare increase, if the price elasticity is –0.33, the ridership decline would be 3.3%. If the elasticity is only –0.1, a 1% ridership decline would be likely.

Table 6 presents the estimated changes to fare revenues by the proposed fare policies under two assumptions for the level of pass use. Since we did not have access to the full accounting data on

AC Transit receipts, the estimates are for "changes in fare revenues" only. Administrative cost savings or increases are not included in the analysis.

The top row of revenues reflects the estimates with no changes in ridership due to fare changes. The next set of rows shows results using a –0.1 price elasticity. Revenue projections are weaker for all of the proposals, as riders are lost from the rise in fares. Using a more typical ridership response to price, the third set of rows shows that many of the revenue increases could turn out to be fairly small.

The revenue impacts of proposals #1 and #5 shrink substantially when price elasticity is considered. This follows from the changes in ridership occurring because of drastic rises in fares for many users which offset the benefits of cuts in fares for others. The estimate reflects the loss of patrons who previously used passes or made many transfers to complete their trips, and the increase in ridership at the single fare rate.

Proposal #3, with the most neutral impacts across users, is seen to be less affected by losses in ridership than proposals #1 and #5. Under the case of high pass use, it shows the potential of increasing revenues substantially and on par with proposal #2, but with fewer equity implications. The sensitivity analysis reveals that proposal #3 will also produce the most stable levels of revenue irrespective of the level of pass use.

[Table 6]

# 6 CONCLUSIONS

This case study of possible fare policy changes shows the usefulness of on-board survey data in equity and revenue analyses. The study also shows the importance of considering network topography and transfer policies and their interaction with social and economic groups. For the AC Transit case, the survey data revealed that transfers were far more predominant among low income groups than among the more affluent. Therefore policies that increased the cost of multi-ride trips disproportionately affect the low income. In addition, the data revealed that low income travelers, youth, and the disabled were more likely to use unlimited ride passes than the affluent bus users of the district. Hence policies that reduced pass availability were again more likely to fall heavily on the low income.

While the specific findings would vary by transit district, the methodology shown here should be broadly applicable.

# 7 REFERENCES

1. Altshuler, Alan, **The Urban Transportation System: Politics and Policy Innovation**, The MIT Press, Cambridge, Massachusetts, 1979
2. Ballou, Donald P. and Lakshmi Mohan, **Evaluation of ridership, revenue and equity implications of distance-based fares for transit systems**, School of Business, State University of New York, Albany. 1979
3. Blash, Lisel Monique Nakagawa and John Rogers, 2**002 On-Board Passenger Survey: System-wide Results**, Prepared for Alameda-Contra Costa Transit District by the Public Policy Research Institute, San Francisco, September 2003
4. Cervero, Robert B., Martin Wachs, Renee Berlin and Rex J. Gephart, **Efficiency and equity implications of alternative transit fare policies,** School of Architecture and Urban Planning, University of California, Los Angeles. 1980
5. Curtin, J., "**Effects of Fares on Transit Riding**", *Highway Research Record 213*, pp. 8-18, 1968
6. De Leuw, Cather and Company (1979b). **Evaluation of the Denver RTD Off-Peak Fare-Free Transit Demonstration**. San Francisco, CA.
7. De Leuw, Cather and Company (1979a). **Evaluation of the Trenton Off-Peak Fare-Free Transit Demonstration**." New York, NY.
8. Deakin, Elizabeth, Christopher Ferrell, Jonathan Mason, and John Thomas, **Policies and Practices for Cost effective Transit Investments**, *Transportation Research Record*, 2002

9. Deakin, Elizabeth, **Social Equity and Planning** *Berkeley Planning Journal*, Department of City and Regional Planning, University of California, Berkeley, Volume 13, 1998-1999
10. Deakin, Elizabeth and Greig Harvey, **Transportation pricing strategies for California: an assessment of congestion, emissions, energy and equity impacts,** final report; California Air Resources Board, Sacramento, CA 1996
11. Fauconnier, Isabelle, **The Privatization of Residential Water Supply and Sanitation Services: Social Equity Issues in the California and International Contexts**, *Berkeley Planning Journal*, Department of City and Regional Planning, University of California, Berkeley, Volume 13, 1998-1999
12. Federal Transit Administration. **FTA transit program changes and final funding levels for fiscal year 1998 under the Transportation Equity Act for the 21st century**; Government Printing Office, Washington, D.C., 1998
13. Friedman, Lee S., *The Microeconomics of Public Policy Analysis*, Princeton University Press, Princeton, N.J., 2002
14. Garcia, Robert, **Transportation Equity in Los Angeles**, **The MTA and Beyond**, Environmental Defense Fund, 1998.
15. Garrett, M and Brian Taylor, **Reconsidering Social Equity in Public Transit**, *Berkeley Planning Journal*, Department of City and Regional Planning, University of California, Berkeley, Volume 13, 1998-1999
16. Hodge, David C., **My Fair Share: Equity Issues in Urban Transportation,** *The Geography of Urban Transportation*, Guilford Press 1995
17. Howe, Charles W. "**Water Resources Planning in a Federation of States: Equity versus Efficiency**", *Natural Resource Journal*. Vol. 36, Winter 29-36. 1996.
18. Linsalata, J. and Pham, L. H. (1991), **Fare Elasticity and Its Application to Forecasting Transit Demand**. American Public Transit Association, Washington, DC (1991).
19. Litman, Todd, **Using road pricing revenue: economic efficiency and equity considerations**, *Transportation research record*. No. 1558 Nov. 1996
20. Mayworm, P. D., Lago, A. M., and McEnroe, J. M. (1980), **Patronage Impacts of Changes in Transit Fares and Services**. Urban Mass Transportation Administration, Ecosometrics, Incorporated, Bethesda, MD (1980).
21. Miller, S.M. and Pamela Roby, **The Future of Inequality**, Basic Books, New York, 1970
22. Multisystems, Inc., Mundle & Associates, Inc., and Simon & Simon Research and Associates, Inc, **TCRP REPORT 94: Fare Policies, Structures and Technologies: Update**, Sponsored by Federal Transit Administration and Transit Development Corporation, TRANSPORTATION RESEARCH BOARD, WASHINGTON, D.C., 2003 -- http://trb.org/publications/tcrp/tcrp_rpt_94.pdf
23. Parody, T. A., **Atlanta Integrated Fare Collection: Demonstration Report**. For Urban Mass Transportation Administration, By Charles River Associates, Boston, MA 1982
24. Pratt, R. et al. **Traveler Response to Transportation System Changes,** Transit Cooperative Research Program, Transportation Research Board. Washington, D.C. March 2000

25. Rawls, John. **A Theory of Justice**, Cambridge, MA, Belknap Press of Harvard University Press, 1971.

26. Richardson, Harry W. and Chang-Hee Christine Bae, **The equity impacts of road congestion pricing,** *Road pricing, traffic congestion and the environment: issues of efficiency and social feasibility,* Cheltenham, U.K.; Northampton, MA, Edward Elgar, c1998.

27. Small, Kenneth A. and Clifford Winston, 1999. "**The Demand for Transportation: Models and Applications**." *Essays in Transportation Economics and Policy: A Handbook in Honor of John R. Meyer*, J. Gómez-Ibáñez, W. Tye, and C. Winston, eds. Washington, D.C.: Brookings Institution Press, Chapter 2, pp. 11-55.

28. Taylor, Brian D., **Unjust equity: an examination of California's Transportation Development Act**, *Transportation research record*. No. 1297, 1991

29. Taylor, Brian D., **Program Performance vs. Transit Performance: Explanation for Ineffectiveness of Performance-Based Transit Subsidy Programs**, *Transportation Research Record*, 1995

30. Transit Cooperative Research Program, "**Traveler Response to Transportation System Changes: Interim Handbook**", Transportation Research Board National Research Council, TCRP Project B-12, Washington, D.C. March, 2000

31. Tsur, Yacov and Ariel Dinar, **Efficiency and equity considerations in pricing and allocating irrigation water,** World Bank, Agriculture and Natural Resources Dept., Agricultural Policies Division, 1995

32. Wachs, Martin, **Improving Efficiency in Transit Finance**, *The Brookings Institution Series on Transportation Reform*, Brookings Institution Press, 2003

33. Watkins, Therese Marie, **The equity impacts of time-of-day transit pricing**, University of California, Berkeley. Dept. of City and Regional Planning – Dissertations, 1984.

## Table 1: Existing Fare Structure and Five Fare Change Proposals

| | Existing | Proposal 1 | Proposal 2 | Proposal 3 | Proposal 4 | Proposal 5 |
|---|---|---|---|---|---|---|
| **Cash** | | | | | | |
| Local Adult | $1.50 | $1.00 | $1.75 | $2.00 | $1.50 | $1.00 |
| Local Youth | $0.75 | $0.50 | $0.85 | $1.00 | $0.75 | $0.50 |
| Local Senior/Disabled | $0.75 | $0.50 | $0.85 | $1.00 | $0.75 | $0.50 |
| | | | | | | |
| Transbay Adult | $3.00 | $2.00 | $3.50 | $4.00 | $3.00 | $2.00 |
| Transbay Youth | $1.50 | $1.00 | $1.70 | $2.00 | $1.50 | $1.00 |
| Transbay Senior/Disabled | $1.50 | $1.00 | $1.70 | $2.00 | $1.50 | $1.00 |
| | | | | | | |
| **31-Day Ticket/ Monthly Pass** | | | | | | |
| Local Adult | $60.00 | --- | $70.00 | $70.00 | $60.00 | --- |
| Local Youth | $15.00 | --- | $15.00 | $15.00 | $15.00 | $15.00 |
| Local Senior/Disabled | $20.00 | $20.00 | $20.00 | $20.00 | $20.00 | $20.00 |
| Transbay Adult | $100.00 | --- | $116.00 | $116.00 | $100.00 | --- |
| | | | | | | |
| **10-Ride Ticket** | | | | | | |
| Local Adult | $15.00 | --- | $17.50 | $20.00 | $15.00 | --- |
| Local Youth/ Senior/Disabled | $7.50 | --- | $8.50 | $10.00 | $7.50 | --- |
| Transbay Adult | $30.00 | --- | $35.00 | $40.00 | $30.00 | --- |
| | | | | | | |
| **Weekly Pass** | | | | | | |
| Local Adult | --- | --- | --- | --- | $20.00 | --- |
| Local Youth/ Senior/Disabled | --- | --- | --- | --- | $10.00 | --- |
| Transbay Adult | --- | --- | --- | --- | $35.00 | --- |
| | | | | | | |
| **Local Transfer** | | | | | | |
| 1.5 hrs/1 use | $0.25 | --- | $0.50 | --- | $0.25 | --- |
| 1.5 hrs/2 uses | --- | --- | --- | Free w/local fare | --- | --- |
| | | | | | | |
| **Transbay Transfer** | | | | | | |
| 1.5 hrs/1 use | Free w/transbay fare | --- | Free w/transbay fare | --- | Free w/Transbay fare | --- |
| 1.5 hrs/2 uses | --- | --- | --- | Free w/transbay fare | --- | --- |

**Source:** [www.ACTransit.org](http://www.ACTransit.org)

## Table 2: Sample Characteristics

**a. Sample Sizes by Number of Rides per Trip**

| Classification | Number of Rides on Linked, One-Way Trip | | | | Total | % of Valid Responses | Average Number of Rides |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4+ | | | |
| Local Trips | 4,117 | 4,213 | 780 | 464 | 9,574 | 92% | 1.75 |
| Transbay Trips | 711 | 127 | 13* | 5* | 856 | 8% | 1.2 |
| All Trips | 4,828 | 4,340 | 793 | 469 | 10,430 | 100% | 1.71 |
| Percent of Sample | 46% | 42% | 8% | 4% | 100% | | |

*sample size too small to support detailed analysis

**b. Sample Sizes by Type of Fare**

| | Youth | Senior | Disabled | Adult | Total | % of Valid Responses |
|---|---|---|---|---|---|---|
| Local Trips | 2,476 | 570 | 642 | 5,887 | 9,574 | 92% |
| Transbay Trips | *10 | *18 | *15 | 812 | 855 | 8% |
| All Trips | 2,486 | 588 | 657 | 6,699 | 10,429 | 100% |
| Percent of Sample | 24% | 6% | 6% | 64% | 100% | |

*sample size too small to support detailed analysis.

**c. Sample Sizes by Type of Payment**

| | Cash | 10-Ride Ticket | Monthly Pass | Total | % of Valid Responses |
|---|---|---|---|---|---|
| Local Trips | 4,427 | 777 | 4,370 | 9,574 | 92% |
| Transbay Trips | 121 | 280 | 454 | 855 | 8% |
| All Trips | 4,548 | 1,057 | 4,824 | 10,429 | 100% |
| Percent of Sample | 44% | 10% | 46% | 100% | |

**Table 3: Distribution of Single and Multiple Ride Trips by Fare Category**

| | Youth | Senior | Disabled | Adult | All |
|---|---|---|---|---|---|
| Single-Ride Trips | 44% | 39% | 32% | 50% | 47% |
| Multiple-Ride Trips | 56% | 61% | 68% | 50% | 53% |

## Table 4: Changes in Response to Fare Policy Options

### a) Percent Changes in One-Way Fares for Selected Constituents (Local Trips) ~ for Pass Use at 80 Bus Rides per Month

| Constituents | Fare Change (Percent) | | | | |
|---|---|---|---|---|---|
| | **Proposal 1: "Pay per ride"** | **Proposal 2: "Raise fares and transfer fees"** | **Proposal 3: "Raise fares with two free transfers"** | **Proposal 4: "Retain existing structure and add weekly pass"** | **Proposal 5: "Proposal #1 but retain youth pass"** |
| **System-wide Average:** | | | | | |
| All patrons | +20 | +13 | +11 | -3 | +10 |
| **Fare Class:** | | | | | |
| Youth | **+82** | +12 | +3 | -4 | -10 |
| Senior | -9 | 10 | 3 | -6 | -9 |
| Disabled | -5 | 1 | -6 | -3 | -5 |
| Adult | 14 | 13 | **13** | -3 | **14** |
| **Payment Type:** | | | | | |
| Cash | -7 | **16** | **13** | 0 | -7 |
| Prepaid Ticket | -11 | **17** | **13** | -30 | -11 |
| Monthly pass users | **+128** | -1 | +4 | 0 | **+78** |
| **Income:** | | | | | |
| CalWORKS participants | **+34** | +9 | +6 | -3 | **+25** |
| Income under $10,000 | **+22** | +10 | +6 | -3 | **+17** |
| Income $10,000 to $29,999 | +20 | +13 | +9 | -3 | **+17** |
| Income $30,000 to $49,999 | 12 | **15** | **16** | -3 | 9 |
| Income $50,000 to $74,999 | 10 | **16** | **18** | -4 | 7 |
| Income $75,000 to $99,999 | 7 | **15** | **17** | -5 | 0 |
| Income $100,000 plus | 9 | 12 | **16** | -6 | -3 |
| **Race:** | | | | | |
| Asian/Pacific Islander | **+21** | +13 | **+15** | -7 | **+13** |
| Black / African American | **+30** | +12 | +8 | -3 | **+15** |
| Native American Indian | **+31** | +9 | +8 | -2 | **+15** |
| White | +9 | **+15** | **+17** | -4 | +3 |
| Hispanic/Latino | +14 | +13 | +10 | -2 | +7 |
| Other | +16 | +10 | +10 | -5 | +5 |

**00** – impact higher than system-wide average

## b) Percent Changes in One-Way Fares for Selected Constituents (Local Trips) ~ for Pass Use at 40 Bus Rides per Month

| | Fare Change (Percent) | | | | |
|---|---|---|---|---|---|
| **Constituents** | **Proposal 1: "Pay per ride"** | **Proposal 2: "Raise fares and transfer fees"** | **Proposal 3: "Raise fares with two free transfers"** | **Proposal 4: "Retain existing structure and add weekly pass"** | **Proposal 5: "Proposal #1 but retain youth pass"** |
| **System-wide Average:** | | | | | |
| All patrons | +4 | +21 | +9 | -3 | -1 |
| **Fare Class:** | | | | | |
| Youth | **+41** | +15 | -1 | -3 | -6 |
| Senior | -5 | +15 | -2 | -4 | -5 |
| Disabled | -2 | +9 | -8 | -2 | -2 |
| Adult | 0 | **+22** | **+11** | -3 | 0 |
| **Payment Type:** | | | | | |
| Cash | -7 | **+24** | **+13** | 0 | -7 |
| Prepaid Ticket | -11 | **+23** | **+13** | -30 | -11 |
| Monthly pass users | **+20** | +12 | +4 | 0 | **+3** |
| **Income:** | | | | | |
| CalWORKS participants | **+10** | +21 | +4 | -3 | **+5** |
| Income under $10,000 | **+7** | +21 | +4 | -3 | **+4** |
| Income $10,000 to $29,999 | +4 | +21 | +7 | -2 | **+2** |
| Income $30,000 to $49,999 | -3 | +21 | **+13** | -3 | -5 |
| Income $50,000 to $74,999 | -5 | +20 | **+15** | -3 | -7 |
| Income $75,000 to $99,999 | -5 | +20 | **+15** | -4 | -9 |
| Income $100,000 plus | -3 | +19 | **+14** | -5 | -10 |
| **Race:** | | | | | |
| Asian/Pacific Islander | +1 | +19 | **+12** | -5 | -3 |
| Black / African American | **+9** | +20 | +6 | -2 | 0 |
| Native American Indian | **+9** | +20 | +6 | -2 | 0 |
| White | -4 | +19 | **+15** | -4 | -8 |
| Hispanic/Latino | **+7** | **+23** | +7 | -1 | **+2** |
| Other | +3 | +20 | +7 | -4 | -3 |

**00** – impact higher than system-wide average

**Table 5: Mean Cost of One-Way Local Trips by Fare Change Policy (All Groups of Riders)**

| | Existing | Proposal 1: "Pay per ride" | Proposal 2: "Raise fares and transfer fees" | Proposal 3: "Raise fares with two free transfers" | Proposal 4: "Retain existing structure and add weekly pass" | Proposal 5: "Proposal #1 but retain youth pass" |
|---|---|---|---|---|---|---|
| **Mean Cost of Trip** | | | | | | |
| 80 Trips | $1.12 | $1.34 | $1.26 | $1.24 | $1.08 | $1.23 |
| 40 Trips | $1.27 | $1.32 | $1.53 | $1.37 | $1.23 | $1.25 |
| Difference | +$0.15 | -$0.02 | +$0.27 | +$0.13 | +$0.15 | +$0.02 |
| **Percent Change from Existing** | | | | | | |
| 80 Trips | | 20% | 13% | 11% | -3% | 10% |
| 40 Trips | | 4% | 21% | 9% | -3% | -1% |

**Table 6: Estimated Changes to Fare Revenues per Year**

| Condition | Changes in Fare Revenues | | | | |
|---|---|---|---|---|---|
| | **Proposal 1: "Pay per ride"** | **Proposal 2: "Raise fares and transfer fees"** | **Proposal 3: "Raise fares with two free transfers"** | **Proposal 4: "Retain existing structure and add weekly pass"** | **Proposal 5: "Proposal #1 but retain youth pass"** |
| 80 Bus Trips per Month | | | | | |
| **Initial Estimate – No change in ridership (Price Elasticity = 0.0)** | | | | | |
| Change (Millions of Dollars) | 7.4 | 5.4 | 5.3 | -2.0 | 3.7 |
| Change (%) | 18% | 13% | 13% | -5% | 9% |
| **Conservative Estimate – Price Elasticity = -0.1** | | | | | |
| Change (Millions of Dollars) | 5.4 | 4.8 | 4.7 | -1.9 | 2.8 |
| Change (%) | 13% | 11% | 11% | -4% | 7% |
| **Typical Estimate – Price Elasticity = -0.33** | | | | | |
| Change (Millions of Dollars) | 0.6 | 3.4 | 3.3 | -1.6 | 0.7 |
| Change (%) | 1% | 8% | 8% | -4% | 2% |
| 40 Bus Trips per Month | | | | | |
| **Initial Estimate – No change in ridership (Price Elasticity = 0.0)** | | | | | |
| Change (Millions of Dollars) | -0.4 | 8.3 | 4.8 | -1.7 | -2.5 |
| Change (%) | -1% | 19% | 11% | -4% | -6% |
| **Conservative Estimate – Price Elasticity = -0.1** | | | | | |
| Change (Millions of Dollars) | -0.4 | 7.3 | 4.2 | -1.6 | -2.3 |
| Change (%) | -1% | 17% | 10% | -4% | -5% |
| **Typical Estimate – Price Elasticity = -0.33** | | | | | |
| Change (Millions of Dollars) | -0.5 | 5.0 | 3.0 | -1.3 | -1.8 |
| Change (%) | -1% | 12% | 7% | -3% | -4% |