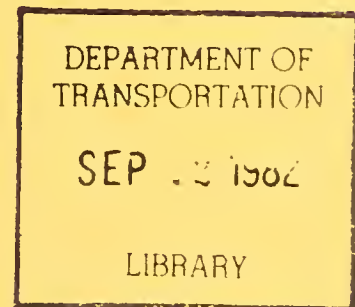


HE
18.5
.A37
no.
DOT-
TSC-
UMTA-
82-1

ment
rtation
iss
ation
ation

Off-Peak Fare-Free Transit: Mercer County, New Jersey

Final Report
March 1982



NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

NOTICE

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

17C
18,5
.43
no. DOT-TSC-UMTA-82-1

1. Report No. UMTA-MA-06-0049-80-3		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle OFF-PEAK FARE-FREE TRANSIT: MERCER COUNTY, NEW JERSEY				5. Report Date March 1982	
				6. Performing Organization Code DTS-243	
7. Author(s) David L. Connor				8. Performing Organization Report No. DOT-TSC-UMTA-82-1	
9. Performing Organization Name and Address DeLeuw, Cather & Company* 165 West Wacker Drive Chicago IL 60601				10. Work Unit No. (TRAIS) UM227/R2676	
				11. Contract or Grant No. DOT-TSC-1409	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Urban Mass Transportation Administration Office of Planning, Management and Demonstrations Office of Service and Methods Demonstrations Washington DC 20590				13. Type of Report and Period Covered Final Report October 1977-March 1980	
				14. Sponsoring Agency Code UPM-30	
15. Supplementary Notes *Under contract to: U.S. Department of Transportation Research and Special Programs Administration Transportation Systems Center Cambridge MA 02142					
16. Abstract The Mercer County Fare-Free Demonstration was a test of the effects of eliminating transit fares system-wide on the Mercer Metro bus system during off-peak hours. This report summarizes the analyses and presents the findings of the evaluation of the demonstration's impacts. Mercer County, New Jersey, includes Trenton, the state capital, as its major urbanized area and numerous suburban residential concentrations. Local public transportation in the country was almost solely provided by Mercer Metro. The demonstration encompassed a 12-month period during which fares were eliminated during off-peak hours on the bus system's local routes. The evaluation data principally consisted of passenger surveys, general population surveys, special group surveys, and ridership counts conducted before, during and after the fare elimination. The evaluation was designed and conducted to explore the effects of the fare elimination on the transit operator, the riding public, the general populace, and the local business community. Evaluation issues were concerned with ridership volumes , passenger characteristics, transit operations, public response, and attitudes, effects on commercial activities, and public response to the fare elimination.					
17. Key Words Fare-Free Transit Demonstration Projects Pricing Incentives Mercer County Off-Peak Transit Promotion			18. Distribution Statement DOCUMENT IS AVAILABLE THROUGH SUPERINTENDENT OF DOCUMENTS U.S. GOVERNMENT PRINTING OFFICE WASHINGTON DC 20402		
19. Security Classif. (of this report) UNCLASSIFIED		20. Security Classif. (of this page) UNCLASSIFIED		21. No. of Pages 184	22. Price

DEPARTMENT OF
TRANSPORTATION
SEP 22 1982
LIBRARY



1. Report No. UMTA-MA-06-0049-80-3		2. Government Accession No. PB 82-207119		3. Recipient's Catalog No.	
4. Title and Subtitle Off-Peak Fare-Free Transit: Mercer County, New Jersey.				5. Report Date March 1982	
				6. Performing Organization Code DTS-243	
7. Author(s) D.L. Connor				8. Performing Organization Report No. DOT-TSC-UMTA-82-1	
9. Performing Organization Name and Address DeLew, Cather & Company* 165 West Wacker Drive Chicago, Illinois 60601				10. Work Unit No. (TRAIS) MA-06-0049	
				11. Contract or Grant No. DOT-TSC-1409	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Urban Mass Transportation Administration 400 Seventh Street, S.W. Washington, D. C. 20590				13. Type of Report and Period Covered Final Report Oct. 1977 - Mar. 1980	
				14. Sponsoring Agency Code URT-30	
15. Supplementary Notes *Under contract to:		U.S. Department of Transportation Transportation Systems Center Cambridge, Massachusetts 02142			
16. Abstract The Mercer County Fare-Free Demonstration was a 12-month test program of the effects of eliminating transit fares system-wide on the Mercer Metro bus system during off-peak hours. (Mercer County, New Jersey, includes Trenton and numerous suburban residential areas.) This report summarizes the analyses and presents the findings of the demonstration's impacts. This evaluation was designed and conducted to explore the effects of the fare elimination on the transit operator, the riding public, the general populace, and the local business community. Evaluation issues were concerned with impacts on ridership volumes, passenger characteristics, transit operations, public awareness and attitudes, effects on commercial activities, and public response to the fare elimination. The evaluation data mainly consisted of passenger surveys, general population surveys, special group surveys, and ridership counts conducted before, during, and after the fare elimination. The major conclusion reached by the evaluators of the demonstration was that free-fare is probably more valuable as a tool for transit promotion than as a full-time transit pricing strategy. This report contains a bibliography and charts related to data collection, ridership, trip-making, etc. A related report is titled Findings of Preliminary Analyses of the Trenton Off-Peak Fare-Free Transit Demonstration, January 1979 (PB 298893, A04).					
17. Key Words Mercer Metro Bus System Fare-Free Evaluation Demonstration Ridership Bus System Public Attitudes Trenton Demonstration Passenger Off-Peak Fare-Free Pricing Incentives			18. Distribution Statement Available to the Public through the National Technical Information Service, Springfield, Virginia 22161.		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 182	22. Price A09



PREFACE

This report presents findings of the evaluation of the Mercer County (New Jersey) systemwide off-peak fare-free transit demonstration. The demonstration began on March 1, 1978 and continued for 12 months, ending on February 28, 1979. The project included investigation of the effects of eliminating off-peak fares on ridership, transit operations and costs, user characteristics, public attitudes, and regional travel.

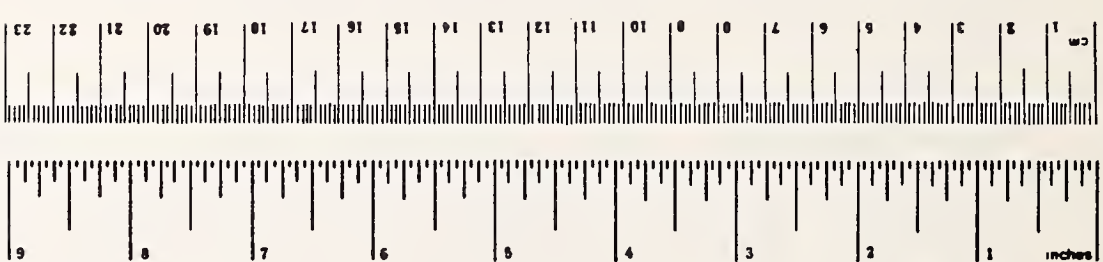
The project was sponsored under the Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstration (SMD) program, under authorization from Title II of the National Mass Transportation Assistance Act of 1974. The evaluation was conducted by DeLeuw, Cather & Company for the Transportation Systems Center (TSC) of the U.S. Department of Transportation under Technical Task Directive DOT-TSC-1409-03. The principal author of this report was David Connor, with technical assistance provided by Robert Knight.

Acknowledgement is due to several people for their assistance and cooperation during the demonstration project and the evaluation period: Messrs. Lawrence Doxsey and A. H. Studenmund, Technical Monitors - Transportation Systems Center; Mr. Roland Quigley (and staff), Director of Operations - Mercer Metro; Mr. Richard Hollinger (and staff), Bureau of Operations Research - New Jersey Department of Transportation; Dr. Vincenzo Milione, SMD project manager - UMTA. Acknowledgement is also due to several DeLeuw, Cather & Company staff members for their assistance in the evaluation: Ms. Sherrill Swan; Mr. Gordon Shunk; Mr. Paul Ong; and Mr. Robert Donnelly.



METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures			
Symbol	When You Know	Multiply by	To Find
LENGTH			
in	inches	2.5	centimeters
ft	feet	30	centimeters
yd	yards	0.9	meters
mi	miles	1.6	kilometers
AREA			
in ²	square inches	6.5	square centimeters
ft ²	square feet	0.09	square meters
yd ²	square yards	0.8	square meters
mi ²	square miles	2.6	square kilometers
	acres	0.4	hectares
MASS (weight)			
oz	ounces	28	grams
lb	pounds	0.45	kilograms
	short tons (2000 lb)	0.9	tonnes
VOLUME			
tsp	teaspoons	5	milliliters
Tbsp	tablespoons	15	milliliters
fl oz	fluid ounces	30	milliliters
c	cups	0.24	liters
pt	pints	0.47	liters
qt	quarts	0.95	liters
gal	gallons	3.8	liters
ft ³	cubic feet	0.03	cubic meters
yd ³	cubic yards	0.76	cubic meters
TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature



Approximate Conversions from Metric Measures			
Symbol	When You Know	Multiply by	To Find
LENGTH			
mm	millimeters	0.04	inches
cm	centimeters	0.4	inches
m	meters	3.3	feet
m	meters	1.1	yards
km	kilometers	0.6	miles
AREA			
cm ²	square centimeters	0.16	square inches
m ²	square meters	1.2	square yards
km ²	square kilometers	0.4	square miles
ha	hectares (10,000 m ²)	2.5	acres
MASS (weight)			
g	grams	0.035	ounces
kg	kilograms	2.2	pounds
t	tonnes (1000 kg)	1.1	short tons
VOLUME			
ml	milliliters	0.03	fluid ounces
l	liters	2.1	pints
l	liters	1.06	quarts
l	liters	0.26	gallons
m ³	cubic meters	35	cubic feet
m ³	cubic meters	1.3	cubic yards
TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature

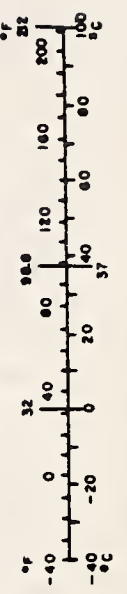


TABLE OF CONTENTS

	<u>PAGE</u>
1.0 INTRODUCTION.....	1
1.1 The Fare-Free Transit Concept.....	1
1.2 Objectives of the Demonstration.....	2
1.3 Issues for Evaluation.....	4
1.3.1 Travel Behavior.....	4
1.3.2 Transportation Supply and Costs.....	4
1.3.3 Secondary Effects.....	4
1.3.4 Implementation Process.....	5
1.4 Report Overview.....	5
2.0 EXECUTIVE SUMMARY.....	6
2.1 Free-Fare as a Transit Pricing Strategy.....	6
2.1.1 Effectiveness.....	6
2.1.2 Efficiency.....	7
2.1.3 Equity.....	8
2.2 Attitudes Toward Fare-Free Transit.....	8
2.3 Free-Fare as a Promotion Tool.....	9
2.4 Impacts of the Program by Population Segment.....	10
2.4.1 Effects on Transit Users.....	10
2.4.2 Effects on the Transit Operator.....	13
2.4.3 Effects on the General Population.....	15
2.4.4 Effects on the Business Community.....	17
3.0 BACKGROUND.....	18
3.1 The Setting.....	18
3.1.1 Geography.....	18
3.1.2 Demographics.....	18
3.1.3 Transportation.....	20
3.2 The Demonstration Project.....	23
3.2.1 Timing and Organization.....	23
3.2.2 Implementation and Operation.....	23
3.2.3 The Evaluation Process.....	24

	<u>PAGE</u>
4.0 TRAVEL BEHAVIOR ISSUES.....	26
4.1 Overall Ridership Impacts.....	26
4.1.1 Pre-Demonstration Ridership.....	26
4.1.2 Ridership During the Demonstration.....	26
4.1.3 Ridership Since Fare Reinstatement.....	28
4.1.4 Temporal Ridership Changes.....	29
4.1.5 Ridership Distribution by Route.....	29
4.2 Travel Choice Impacts.....	31
4.2.1 Additional Trips by Prior Users.....	33
4.2.2 Trips by New Off-Peak Users.....	34
4.2.3 Shifts From Peak to Off-Peak Bus Service.....	34
4.3 Trip Characteristics.....	35
4.3.1 Effects of Fare Elimination on Trip Purposes.....	35
4.3.2 Effects on Trip Lengths and Patterns.....	37
4.3.3 Effects on Trip Destinations.....	38
4.4 Effects on User Characteristics.....	39
4.4.1 Personal Characteristics of Off-Peak Riders.....	39
4.4.2 Household Characteristics of Off-Peak Riders.....	41
4.4.3 Travel Characteristics of Off-Peak Riders.....	43
4.4.4 Effects on the Transportation Disadvantaged.....	49
4.5 Ridership Impact Prediction.....	51
4.5.1 Elasticities of Demand with Price.....	52
4.5.2 Regression Analyses.....	55
4.5.3 Predicted Versus Revealed Behavior.....	56
5.0 TRANSPORTATION SUPPLY AND COST ISSUES.....	58
5.1 Effects on Quality of Service.....	58
5.1.1 On-Time Performance.....	58
5.1.2 Delay.....	59
5.1.3 Passenger Loads and Crowding.....	60
5.1.4 On-Board Security.....	62
5.2 Effects on Service Utilization.....	63
5.2.1 Fleet Utilization.....	64
5.2.2 Effects on Labor.....	66
5.2.3 Effects on Vehicle Maintenance.....	67
5.3 Financial Impacts.....	67
5.3.1 Revenue Loss.....	67
5.3.2 Operating Costs.....	68
5.3.3 Effects on Transit Subsidization.....	69
5.3.4 Fare Savings Benefits.....	71

	<u>PAGE</u>
6.0 SECONDARY EFFECTS.....	72
6.1 Effects on Bus Drivers.....	72
6.2 Effects on Public Attitudes Toward Transit.....	73
6.3 Environmental Impacts.....	76
6.4 Revitalization of the Inner City.....	77
7.0 IMPLEMENTATION ISSUES.....	79
7.1 Financing.....	79
7.2 Initial Coordination.....	79
7.3 Administration.....	79
7.4 Operating Changes and Training.....	80
7.5 Marketing.....	80
7.6 Program Monitoring.....	81
7.7 Reaction to Changes.....	81
8.0 FINDINGS AND CONCLUSIONS.....	83
8.1 Overview.....	83
8.2 Travel Behavior Issues.....	84
8.2.1 Effects on Ridership.....	84
8.2.2 Effects on Trip Characteristics.....	84
8.2.3 Effects on User Characteristics.....	85
8.3 Transportation Supply and Cost Issues.....	85
8.3.1 Effects on Service Quality.....	85
8.3.2 Effects on Transportation Supply.....	86
8.3.3 Financial Effects.....	86
8.4 Secondary Effects.....	86
8.4.1 Effects on Bus Drivers.....	86
8.4.2 Effects on Public Attitudes.....	86
8.4.3 Effects on the Environment.....	87
8.4.4 Effects on the Inner City.....	87
8.5 Implementation Issues.....	88
8.6 Transferability of Results.....	88

APPENDICES

A	Data Collection.....	A.1
B	Analysis of Confidence.....	B.1
C	Mercer Metro Ridership Estimates.....	C.1
D	Supporting Data.....	D.1
E	Bibliography.....	E.1
F	Report of Inventions.....	F.1

TABLES

	<u>PAGE</u>
4.1	Estimated Mercer Metro Ridership..... 30
4.2	Estimated Sources of New Off-Peak Bus Trips..... 33
4.3	Changes in Off-Peak Trip Purposes..... 35
4.4	Trip Purposes by Substitute Mode..... 37
4.5	Age Distribution of Riders Before Fare Elimination..... 40
4.6	Off-Peak Bus Trips by Age Group..... 40
4.7	Off-Peak Bus Trips by Size of Household..... 41
4.8	Off-Peak Bus Trips by Income Level..... 42
4.9	Off-Peak Bus Trips by Auto Ownership Levels..... 43
4.10	Off-Peak Trip Rates by Age..... 44
4.11	Off-Peak Trip Rates by Sex..... 45
4.12	Off-Peak Trip Rates by Income..... 46
4.13	Off-Peak Trip Rates by Size of Household..... 47
4.14	Off-Peak Trip Rate by Auto Accessibility..... 48
4.15	Incidence of New Low Mobility Users..... 50
4.16	Trip Rate Impacts Among Low Mobility Groups..... 51
4.17	Demand/Price Elasticities..... 54
4.18	Predicted Versus Revealed Behavior..... 56
5.1	Extra Service Requirements..... 64
5.2	Effects on Productivity and Efficiency..... 65
5.3	Summary of Ridership/Revenue Impacts..... 68
5.4	Summary of Effects of Transit Subsidization..... 70
5.5	Estimated Fare Savings Benefits..... 71
6.1	Bus Drivers' Perceptions of Changes in Incident Occurrence..... 73
6.2	Perceived Attitudes Toward Mercer Metro Service..... 74
6.3	Tax Support for Fare-Free Service..... 75
6.4	Merchants' Survey Responses (July 1979)..... 78

FIGURES

	<u>PAGE</u>
3.1 Location of Mercer County.....	19
3.2 Mercer County.....	19
4.1 Mercer Metro Monthly Ridership.....	27
4.2 Change in Hourly Ridership Distribution (Weekday).....	31
4.3 Sources of Fare-Free Ridership.....	32
4.4 Bus Trip Length Distributions.....	38
5.1 Effects on On-Time Performance.....	59
5.2 Effects on Bus Occupancy.....	61
5.3 Effects on Bus Crowding.....	61
7.1 Sources of First Learning About Free-Fare.....	81

1.0 INTRODUCTION

1.1 The Fare-Free Transit Concept

Over the last several decades, American transit fare policy changed from its original approach where the transit supplier (typically a private entrepreneur) priced the service to cover costs plus profit. As cost pressures increased, the private operators gave way to public transit agencies which operated without the expectation of profit, but with hopes of at least recovering operating costs through farebox revenues. This goal proved unattainable as costs continued to rise and ridership declined. With each fare increase, patronage and revenue fell further.

Despite a growing inability to recover costs from its patrons, the nation's urban centers continue to depend on transit. For many of the poor, elderly, handicapped, and young, transit is essential for even minimal access to needed services and opportunities. The very structure of the typical city, with its dense employment core, requires public transit to prevent intolerable radial roadway and downtown street traffic congestion during commute hours.

Because of these continuing needs for transit service, public subsidies have appeared -- first, for capital investments, then for operating costs. In the past decade, the subsidies have assumed the role of transit's primary source of funds; farebox revenue now typically covers as little as one-third or less of the costs. Even at the present high level of subsidy, however, transit authorities face mounting deficits. Large increases in Federal subsidies since the mid-1960's have helped to hold the line against further fare increases in many cities, and transit ridership has halted its long decline and begun to inch upwards.

Against this historical backdrop, the concept of free transit -- that is, transit supported entirely by means other than fares -- can be seen as an extension of a pattern of increasing subsidy which began long ago. To cover the remaining one-third of costs by subsidy is not so much a radical departure as it is the final step along a familiar path. However, there is still a major difference between the fare-free concept and the fare subsidy programs: to date, subsidies have been used to prevent fare increases, not to reduce or eliminate fares.

The concept that transit service should be a free or public good has been suggested as a means of simultaneously solving a number of transportation problems. The argument has been that as the cost of making a transit trip decreases to zero, the mobility of those dependent on transit for transportation will increase; the elderly, those with low incomes, and young people will experience an increase in educational, employment, and shopping opportunities. Decreasing transit fares to zero would also offset what some have felt to be an unfair cost comparison between transit and the automobile, given the low perceived cost of driving an automobile on a trip and the level of spending on roads and similar automobile-oriented facilities. The decreased relative cost of transit would attract present automobile

users and, by decreasing vehicle miles traveled (VMT), help to ameliorate congestion, energy shortages, and air pollution problems.

The prevailing conventional wisdom with respect to fare-free transit has been that fare reductions are inferior to service improvements as a method of increasing the mobility of the transportation disadvantaged and attracting people out of their automobiles. Domencich and Kraft⁽¹⁾ argued, on the basis of economic theory and existing observed elasticities, that few if any of the perceived goals of the proponents of free transit would in fact be best achieved by that policy. This conclusion rested on the assumption that consumer behavior with respect to price changes of a particular amount are roughly comparable, even if the new price is zero. However, such a position was justified by intuition rather than by postulated theoretical models or observed elasticities. The objective, then, was to improve understanding of the characteristics of demand for a bus ride as the price of that ride approached zero.

1.2 Objectives of the Demonstration

If the primary question to be answered by fare-free experiments is the nature of bus demand at zero price, many other questions also needed to be addressed. Some of the other issues are:

- o What are the effects of fare-free transit on the population in general and representative governmental bodies? -- In particular, does free transit have significant environmental/energy-related benefits; what are the direct economic effects of financing free transit; what, if any, are the indirect economic effects of increased bus use and mobility?
- o How does fare-free transit affect transit users? -- What is the magnitude of fare savings and who realizes them; what are the mobility impacts of the program; how does free transit affect service quality, comfort, and security?
- o Does free transit have significant impacts on the local business community? -- Are retail sales affected; are security measures affected?
- o What are the effects of fare-free transit on the provider(s) of public transportation? -- What are the magnitudes or revenue loss, operating cost changes, administrative costs; what are the effects on operational efficiency; how does free transit affect the local transit image; what are the effects on drivers?

(1) Free Transit, Lexington, Massachusetts: D. C. Heath and Company, 1970.

By passage of the National Mass Transportation Assistance Act of 1974, Congress authorized under Title II a total of \$40 million to fund "research and development, establishment, and operation of demonstration projects to determine the feasibility of fare-free urban mass transportation systems". In its first report to Congress regarding fare-free demonstrations, UMTA argued:

". . . the overriding objective of publicly-funded demonstrations should be to learn; that is, to provide definitive answers about the costs and the efficacy of fare cuts in achieving their objectives . . . This can only be achieved if a strong emphasis is placed on matters of experimental design."⁽²⁾

Section 203 of Title II details certain guidelines for selecting from candidate demonstration sites including: 1) decaying central cities with immobile resident populations; 2) cities of various size; 3) high level of transit service connecting center city residents with employment, shopping, and recreation opportunities; and 4) having, to the extent feasible, different public transportation modes. Section 204 cites five objectives for studies of fare-free transit, including identification of:

- o The effects of fare-free transit on vehicular traffic and attendant congestion, air pollution, and noise.
- o The most suitable mode for fare-free transit.
- o The extent to which fare-free transit increases "frivolous" ridership.
- o The extent to which fare-free transit might reduce the need for urban highways.
- o The best means of continued financing of free- or reduced-fare transit on a continuing basis.

The Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstrations (SMD) Program has primary responsibility for the selection, funding and study of these demonstration programs. In particular, UMTA is concerned with the transferability of the knowledge acquired through the demonstrations to other areas. Local area sponsors also had questions to be answered by the demonstration; these too were addressed in the experimental design.

The legislative intent and the explicit objectives of Congress joined with the interests and hypotheses of the various transportation professionals involved to formulate specific related issues to be studied by evaluation of the effects of the demonstration programs. These issues are identified and discussed in more detail later. Following is a summary description of the Mercer County demonstration.

(2) Report to Congress Concerning the Demonstration of Fare-Free Mass Transportation, Washington, D.C.; U.S. Department of Transportation, 1975.

1.3 Issues for Evaluation

In preparing the plan for evaluation of the Mercer County Fare-Free Demonstration, a number of issues, with varying importance, were identified. These specific issues were grouped into functional categories for purposes of discussion:

- o Travel Behavior
- o Transportation Supply and Costs
- o Secondary Effects
- o Implementation Process

1.3.1 Travel Behavior

The travel behavior issues included ridership impacts; effects on travel choices (trip generation and frequency, mode and temporal shifts); effects on trip characteristics (trip purposes, trip lengths); and user impacts, including analysis of the differences/similarities of "new" versus "prior" users (socio-economic characteristics, effects on low mobility/disadvantaged groups, group ridership). These issues were the focus of most interest in the demonstration, because they were perceived to be most indicative of the utility of fare-free transit in achieving stated transportation goals.

1.3.2. Transportation Supply and Costs

Effects of the fare-free program on the supply and cost of transportation services were dependent on the experiment's effects on travel behavior; if transit ridership increased substantially, numerous supply-side effects would be expected, including a need for added service. The issues of particular concern included effects on service quality (schedule adherence, delay, crowding, security); effects on service utilization (fleet and labor productivity, maintenance); and financial impacts (revenue loss, operating costs effects, transit subsidy). All of these effects were essentially concerned with the extent to which ridership changes required service or operating modifications.

1.3.3. Secondary Effects

If off-peak transit ridership increased significantly in response to fare elimination, a variety of related, but indirect effects might be expected. Of particular concern were: effects, if any, on commercial centers served by bus; public attitudes toward transit; and environmental impacts (reduced traffic, air pollution, noise). Each of these had been previously suggested as areas which might potentially benefit from fare-free transit.

1.3.4 Implementation Process

There are a variety of actions which would be required if fare-free transit were to be implemented elsewhere. It is useful to document, to the extent feasible, what types of tasks and coordination would be required. In general, implementation issues include: project development (initial coordination and financing); project initiation (marketing, administration, and operating changes); and project maintenance tasks (monitoring and marketing).

1.4 Report Overview

The remainder of this report is organized into seven sections plus appendices, as follows:

- o Section 2: a narrative executive summary of the evaluation, emphasizing the observed findings with only highlights of the statistical details.
- o Section 3: a background description of the demonstration site and the project as well as the evaluation process.
- o Sections 4-7: detailed descriptions of the observations and findings, organized with respect to the major evaluation issues -- travel behavior, transportation supply and cost, secondary effects, and implementation.
- o Section 8: a summary of the conclusions of the evaluation, emphasizing the likely transferability of the results to other locales.
- o Appendices: detailed descriptions of data collection, statistical confidence considerations, ridership data, and other supporting detailed data.

2.0 EXECUTIVE SUMMARY

The Mercer Metro Fare-Free Transit Demonstration was a test of the effects of eliminating system-wide fares during the non-peak hours of service. It was run for twelve months on the Mercer Metro bus system in Mercer County (Trenton) New Jersey. The major conclusion reached by the evaluators of the demonstration was that free-fare is probably more valuable as a tool for transit promotion than as a full-time transit pricing strategy.

The concept of fare-free transit, as envisioned under Title II of the National Mass Transportation Assistance Act (1974), was intended to be tested from the viewpoint of a transit pricing strategy -- a potentially permanent approach to transit pricing. It is from that viewpoint that the Trenton demonstration was designed (within the constraints of the off-peak period limitation) and from which it must be ultimately evaluated.

The evaluation itself was essentially descriptive; that is, it was conducted by measuring changes in various characteristics which occurred before and after the fare elimination and analyzing those changes in the light of pre-conceived hypotheses and expectations. There were no pre-determined measures or standards of "success" or "failure".

2.1 Free-Fare as a Transit Pricing Strategy

The assessment of the fare-free program, as a transit pricing strategy, can be generally described in three terms: effectiveness (the extent to which the program achieved its goals); efficiency (the relationship between the program benefits and costs); and the equity (how the benefits and costs were distributed amongst various population segments). The evaluators' interpretations and impressions of these three factors are presented below.

2.1.1 Effectiveness

The effectiveness of the program cannot be measured solely by gains in ridership. Some judgment must be made regarding the true value (or range of values) of the new off-peak bus trips. Regardless, during the demonstration Mercer Metro experienced relatively large sustained increases -- roughly 40 to 50 percent -- in its off-peak ridership levels that at times taxed the capacity of certain segments of the system.

On average, rates of travel increased during the demonstration for prior off-peak bus users. Also, new riders were attracted to the off-peak service. Although the relative increases varied, most prior riders reported an increase in trips in response to free-fare. Most of the typically classified "low mobility"

or "transportation disadvantaged" groups were not disproportionately represented in the increased ridership. Some may have been already meeting their travel needs; for others mobility limitations may be imposed at the level of total travel rather than specific trips and their sensitivity to a 15 cent fare saving may be low.

One indication that the program did improve mobility for some, however, was an apparent increase in the extent of group travel (i.e., travel together by two or more people where at least one is dependent on another for mobility -- for example, a mother with small children). Both the occurrence of group travel and the size of the groups were observed to increase during the free-fare demonstration, indicating more mobility for people who must travel together at relatively higher total costs per trip.

Overall, new trip generation was not a large component of the ridership increase. Reportedly, most of the new bus trips would have been made anyway but by an alternate mode. Among them, about an equal portion would have been made either by automobile or by walking. From the standpoint of improved environmental conditions diverted automobile trips can be construed as having value. However, the magnitude of the impact on regional automobile travel was negligible. Diverted walking trips, in the absence of other known merits, may be construed as having no value (since the free bus captured what might have otherwise been healthful exercise); however, since those riders opted not to walk they must have construed the free ride as having value.

Overall, the fare-free program seemed to be quite effective from the standpoint of increasing off-peak bus use. It clearly improved the mobility of some people and probably increased their options and opportunities. From the larger viewpoint, however, fare-free (off-peak) transit did not appear to significantly divert automobile trips, nor disproportionately increase the mobility of the transportation disadvantaged.

2.1.2 Efficiency

Given that during the demonstration a large number of additional riders used the off-peak bus service, a sizable benefit was realized by those people in the form of the fares saved. It can also be argued that the program had other benefits including additional sales volumes, increased employment opportunities, decreased public assistance needs, etc. However, during the demonstration period there were no indications that those effects, if any, were at all large enough to quantify; they can be considered negligible. The only other potentially significant benefit was an avoided cost associated with a small labor-saving change at Mercer Metro; reduced revenues slightly decreased the amount of staff time required to empty fare-boxes and count money.

The principal "cost" element of the project was the revenue lost because fares were not paid by off-peak passengers. Indirect costs associated with extra service requirements to meet heavy passenger demands were marginal and were offset by the potential labor saving benefit cited above. Other costs such as increased maintenance costs and increased administrative expenses were negligible.

In essence then, the benefits of the program tested in Trenton were limited to the fare savings of the passengers carried and a somewhat unquantifiable benefit which is associated with the value of the promotional potential of free-fare transit.

The costs were essentially limited to the fares not collected from the number of passengers who would have normally been carried. Based on the estimated ridership during the demonstration the estimated total fare savings were about \$403,000. Based on the projected ridership had there been no fare-free demonstration the estimated total revenue loss was about \$339,000. Accordingly, the ratio of the fare-saving benefits to the costs was estimated to be about 1.2. That leads to the question of how the benefits and costs were distributed.

2.1.3 Equity

The benefits of the demonstration almost entirely accrued to the bus riders (except for the promotion value); whereas, the costs would have accrued to the local population, through the operator, had this not been a demonstration project funded mostly by the Federal government.

Insofar as the bus users are representative of the general population, the funding would be equitable. However, in general the Mercer Metro bus user has lower income than the overall Mercer County resident and therefore probably pays fewer taxes. (Interestingly though, those who made greatest use of the service during the demonstration seemed to come from the more affluent user households.)

The average additional cost per off-peak bus rider amounted to about \$24 for the one year demonstration. The average value to each off-peak rider, assuming a linear demand curve, was about \$29. The average cost of the demonstration per Mercer County household was about \$3.50.

2.2 Attitudes Toward Fare-Free Transit

One aspect of the evaluation of fare-free transit was to examine the support base for the program and also the groups who did not favor or even opposed free bus service. Because most of the impacts were minimal on an area-wide scale, the proportion of the local population directly affected, and thereby most likely to be for or against the concept, was small. However, some measures of support are available.

Transit users were probably the most obvious and ardent supporters of the fare-free transit concept, as evidenced by their increased use of the free service. That is not to say that all users favored the free service, but a large majority did. It is likely that support for the concept among users was related to the extent of use. Most favored continuation of the free service, with about one-third favoring expansion of the free hours; only a small proportion favored ending the service, as one would expect.

The general public seemed to be more generally supportive of fare-free transit during the demonstration than before, and had a more favorable view of using tax funds to pay for the free bus service than for the Mercer Metro system in general. More

than half of the people surveyed supported continuation of the free service, while a sizable proportion favored expansion of the free hours of service; about one-fifth favored discontinuance of the free buses. Despite the increased favorable response during the demonstration compared with before, it should be noted that the overall position of the public regarding additional taxes remained slightly negative.

The bus users and the general public reported markedly similar levels of support for free transit service for selected groups. Free bus service for senior citizens was overwhelmingly popular (90-95 percent support); free service for the poor was also favored (65-70 percent support). Free bus service for young people on the other hand was opposed, with only about 30 percent support.

Among close observers of the demonstration (including transit management and demonstration monitors) feelings were mixed. Personal opinions ranged from limited support, with particular concerns about the youth rowdyism issue, to active support for continuation of the program. Near the end of the demonstration there was no apparent willingness on the part of county officials to continue the program with local funds. When the demonstration ended and fares were reinstated there was virtually no reaction from either bus users or the public, nor from the media, despite a rather large fare increase (from zero to 40 cents).

Opposition to the program was centered among bus drivers, with some disfavor reported among affected merchants and some passengers. Mercer Metro drivers were nearly unanimous in their opposition to the fare-free bus service, despite pre-demonstration support. Early in the project drivers reported an increase in the number of incidents on the buses which ranged from undesirable behavior by some passengers (particularly youths) to abusive, threatening behavior, with a couple of assaults noted. These conditions were attributed to the free bus service by the drivers, leading them to request early termination of the program. After the first few months of the demonstration, the drivers complaints apparently dissipated, however, their opposition to free-fare apparently continued.

Asked about their perceptions of the program, merchants in downtown Trenton and at suburban shopping malls were generally negative. Unfavorable observations by merchants outpaced favorable comments by about two to one. About 60 percent of the merchants responding to a survey said they did not support system-wide fare-free bus service. Common complaints centered around a lack of buying power among fare-free users and perceived increases in loitering, shoplifting, and vandalism during fare-free hours.

A small proportion of the passengers (about 10%-15%) reported that they favored discontinuance of fare-free service, mostly because of crowding, some because of on-board rowdyism. About ten percent reported that they liked nothing about the fare-free service.

2.3 Free-Fare as a Promotion Tool

Early in the demonstration, there were indications that the fare-free concept may have value as a short-term tool for promoting transit use. Ridership response to the fare elimination was immediate; the largest monthly ridership during the

demonstration was estimated to have occurred in the first month of the program. Indicating that the response time to a free service promotion might also be very short.

Periodic promotional free service may be a way to build a "transit habit" in the local populace. At the least, free service could be used as a periodic reminder of the availability of bus service; as a focus for an advertising campaign; and as a way to reach new residents to an area. The lower cost of short-term free service also would allow opportunities for applications to peak service, perhaps on a route-specific or corridor basis.

After fare reinstatement, off-peak ridership returned to about the pre-demonstration level while one would have expected a sizable ridership drop in response to the off-peak fare increase. This is evidence that there was significant retention of the higher off-peak ridership after fares were reinstated. It is not presently known what, if any, are the relationships between the length of fare-free service and retention of attracted ridership. However, if it can be shown that there is a point of diminishing returns on pricing promotions, then short-term fare eliminations could be evaluated on the basis of length of time to recover lost revenue through retained ridership.

As an exercise in comparing the long-term versus short-term value of free-fare, it is useful to estimate the time required to recoup lost revenue. It was estimated that retained ridership was on the order of 10,000 trips per week. Based on assumed average fares with the post-demonstration off-peak fare of 40 cents these retained trips would contribute over \$3,000 revenue per week. Presuming constant retention of those riders, the total cost of the 12-month demonstration would be recouped in slightly over two years.

2.4 Impacts of the Program By Population Segment

As would be expected, the fare-free transit demonstration had its most significant and direct impacts on transit users, followed to a lesser degree by the impacts on the transit operator. There were some immediate effects on the general population and on the business community and some indications of possible long-term effects if fare-free transit were adopted as a long-term technique. The following discusses interpretations of the observed impacts on these four groups.

2.4.1 Effects on Transit Users

The effects of the program on Mercer Metro passengers included direct economic benefits in the form of fare savings; effects on mobility stemming from increased travel flexibility and convenience; and effects on the quality of transit service from the consumer's viewpoint.

The clearest and most immediate impact of the demonstration on transit users was the fare savings. Based on estimates of normally expected off-peak ridership (had there not been a fare-free demonstration), the fare savings were estimated to be about \$280,000; to this must be added the value of the fare savings associated with trips generated by the free service. Assuming a linear demand curve, the net value of the new off-peak bus trips was estimated to be about \$123,000 during the demonstration. The total value of the fare savings, therefore, was about \$403,000, equivalent to about \$0.50 per week for each off-peak bus user.

Use of the off-peak bus service increased by about 25-30 percent (person trips) after fares were eliminated. Most of the new off-peak bus trips (69%) were trips which would have been made by another mode of travel if fares were charged; only about 17 percent of the new bus trips were newly generated travel. The remainder (14%) would have been made by bus during peak periods and as such do not represent added bus trips.

Prior riders mostly increased their off-peak bus travel by diverting trips from other modes to the fare-free service -- over half (52%) were reported to be diverted trips. Among these trips, prior walk trips were the largest group. One-quarter (25%) of their new off-peak travel was trips which would have been made by bus during the peak periods.

People who reported being attracted to the off-peak bus service because fares were eliminated (new users) made 43 percent of the new trips. It was estimated that there were about 2,000 of these new users, compared with about 12,000 prior off-peak users; a 15 to 20 percent gain in the number of people served. Off-peak bus trips by new users were nearly all diverted from other modes. Trips which reportedly would have been made by auto accounted for nearly half of the new user's trips, prior walking trips for over one-third.

People in all age groups increased their use of the off-peak bus service after fares were eliminated. Young people and middle-aged people seemed to ride the off-peak buses more frequently during the demonstration than they had before and seemed to be most responsive to the free service. Senior citizens' off-peak bus travel increased by about 20 percent during the demonstration, somewhat below the average reported increase of 25-30 percent.

Increased use of the fare-free service was reportedly greater by people in the middle and upper income groups than by people in poorer households. People in households earning \$10,000 or less annually reported an increase in trips of only about 20 percent, while people in the \$10-15 thousand range reported an increase of more than seven times that rate. People in households with annual incomes of \$15,000 or more reported travel increases of nearly 60 percent, people in the highest income group (over \$25,000) reported an increase over 150 percent. This may be attributable to greater travel flexibility due to a complimentary mix of the opportunities for travel and transit dependence among middle income people, whereas those characteristics may be opposing and constraints among low and high income people.

As with income-related response to the free service, the largest relative increases in trip volumes were reported by people in households with multiple automobiles. People in zero-car households reported about a 20 percent increase in trips, while people in households with one or two autos reported about 60 percent increases and people in households with three or more autos reported nearly 90 percent increased off-peak bus travel. It is likely that among people with no automobile, other constraints, such as advanced age or severe poverty, may impose restrictions on their total opportunity for travel which are unrelated to mode/price conditions.

The fare-free program seemed to increase access to new opportunities for a number of bus riders. About half of the people sampled (52%) reported that they used the free service to make trips for new purposes which they would not have if fares had been charged. Most of those new trips were for shopping (45%), while a sizable number (about 25%) were for social or recreational purposes. About 30 percent of the people said they took the free bus to new places which they would not have if the regular fare had been charged; these were mostly new shopping trips (50%). While the new trips do represent some potential for indirect economic effects -- for example, increased income resulting from new employment opportunities -- these were very small, and inestimable with available data.

Perceived Effects on Service Quality:

From the viewpoint of the majority of a sample of transit users, there was no significant degradation of service quality during the demonstration despite some apparent bus crowding, some travel delays, and some increase in on-board rowdiness. Bus users were generally more positive about Mercer Metro service during the demonstration than before. Responses to general questions regarding Mercer Metro's performance and subsidization, as well as specific characteristics including the cost of service, bus travel time and comfort, convenience of the service, and safety from crime and accident, were all more favorable while the demonstration was in progress than before.

Summary of Effects on Transit Users:

Transit users increased their rate of off-peak bus travel significantly and some new people were attracted to the system by the fare elimination. About half of the people surveyed said they generally tried to arrange their travel to take advantage of the free service. About 40 percent of the prior users reported that they made more trips during free-fare than before; about seven percent said they made fewer. Most of the new bus trips were diverted from other modes; many were former walk trips. There was no apparent correlation between the number of new bus trips and any common socio-economic status. However, in general young people seemed to have the largest attraction to the free bus service.

In general, bus users seemed to be very supportive of the free service, but it was interesting that there was virtually no adverse reaction or comment of any sort by the transit riding public when the program ended. (This may be because the fare-free demonstration was clearly represented to the public as a short-term experiment rather than a permanent program.) Asked if they generally liked or disliked the free service, 91 percent of the respondents said they liked it. Not surprisingly, most

(71%) of these responded that they liked the fact that it was free, but a large portion (23%) also said they liked the "convenience" of not paying. Nine percent said they did not like it at all.

Crowded buses was the most commonly cited (28%) dislike about the program; on-board rowdyism was a close second (23%). These dislikes, together with a stated general aversion to riding with strangers (12%) are indicative of some sensitivity to the decrease in privacy on the buses when passenger loads increase. However, many of the bus riders (44%) surveyed said they had no dislikes at all. About 15 percent of the people surveyed said that they had avoided the service at some time, mostly because of crowding and to some extent rowdyism. A very small proportion (1% to 2%) said that they had made fewer trips because of on-board rowdyism.

Bus users strongly favored free bus service for the elderly (95%) and not so strongly for the poor (71%); there was very little support for free service for young people (31%). They mostly favored continuation of the free service during off-peak hours (74%), while only a small portion favored expansion of hours (34%); only 14 percent favored discontinuance. However, only about half were willing to support such a program through local taxes.

2.4.2 Effects on the Transit Operator

Like transit users, Mercer Metro experienced some direct economic effects (although they were for the most part reimbursed because of the demonstration aspect of this project); they also experienced more definitive indirect economic effects. In addition, the operator had other effects from operational impacts and increased transit awareness.

The other side of the "benefit" of fare savings realized by free bus riders was the "cost" of the associated revenue loss to the operator; the respective values are not equal. The operator can consider as loss only the revenue which would have been expected with normal ridership. This revenue loss had two components: the normally expected off-peak passenger revenue, estimated to be \$280,000; and the revenue which was lost because some peak-period passengers diverted to the off-peaks, which was estimated to be about \$59,000. The total revenue loss was therefore estimated to be about \$339,000.

Other direct economic effects included costs to start-up, administer, and market the program. In the Mercer Metro case, start-up and administrative costs were negligible. The demonstration project budget included \$45,000 for marketing, but that is somewhat misleading because of Mercer Metro's low profile before the demonstration. A system with a more typical standard marketing budget would not incur such a high rate of special costs for free-fare promotion.

Indirect Economic Effects:

Areas of indirect economic effect include costs associated with providing extra service to meet fare-free-related passenger demand; possible increased vehicle maintenance costs; and cost savings which may be realized by reduced money handling. The low level of extra service required by the fare-free demonstration was met using standard "extra" drivers and buses which Mercer Metro normally has in reserve. The costs associated with this service were thereby limited to the on-road costs (gas., oil, tires, etc.) which were liberally estimated to be something under \$10,000. No extra vehicle maintenance costs were discerned. There was a potential to save something under 1,000 staff hours per year by reduced fare-box emptying needs; the cost savings associated with this were almost exactly the same as the on-road costs of the extra service. Indirect economic effects were therefore apparently very small and counterbalanced each other.

Effects on Transit Operations:

Because of existing excess off-peak capacity before the demonstration, increased passenger demands generated by fare elimination required less than a one percent increase in service, which as discussed above was met from available extra resources. However, the effects on existing capacity were quite noticeable. It was estimated that the occurrence of crowded buses (i.e., buses with loads at or above seated capacity) increased during the off-peaks from less than five percent of the bus trips to over 15 percent after fares were eliminated. Average bus loading increased an average of about 60 percent. Increased passenger loading was also manifested by increased proportions of late buses in the off-peaks (from about 25 percent before to about 45 percent during).

Apart from the impacts on crowding and delay, no other significant effects were noted on operation, maintenance, or administration of the bus system. However, there were significant adverse impacts on bus driver morale and cooperation.

About three months after the demonstration began bus drivers became highly critical of the program because of an apparent increase in the occurrence and severity of on-board harassment and rowdyism, particularly by young people. The drivers, unified and persistent in their complaints, together with the local press, were the catalyst leading to a county-sponsored public hearing in June 1978, called to examine the rowdyism issue. Following the meeting, press coverage and driver's complaints about on-board incidents subsided.

One effect of the demonstration on the operator was a perceived marketing advantage which was manifested by a smaller than expected impact on ridership when a major fare increase was implemented. During the demonstration (December 1978) a fare change was implemented which raised peak fares immediately and raised off-peak fares, including elimination of the general half-fare program, effective at the end of the demonstration. When fares were reinstated the off-peak fare went from zero to \$0.40; post-demonstration off-peak ridership seemed to be higher than might have been expected without the ridership growth experienced during the fare-free demonstration. Had there not been a fare increase, it is probable that this effect would have been manifested as retained new ridership.

Before the demonstration Mercer Metro had no advertising or marketing program and maintained a low profile in much of the county. Publicity and a marketing program associated with the demonstration increased the visibility of the bus service. Despite negative publicity associated with the on-board rowdyism issue, general perceptions of Mercer Metro service seemed to improve during the demonstration.

General awareness of Mercer Metro seemed to increase among the residents of the county; perceptions of the operator's satisfactory provision of transit service also improved. The opinions of both the population in general and bus users were more positive regarding the adequacy of service during the demonstration than before.

During the fare-free demonstration about 2,000 new people were enticed to use the off-peak service because fares were eliminated. Of those, 60-70 percent were estimated to still be using the off-peak service after fares were reinstated.

Mercer Metro did not experience any major or unanticipated impacts on its operation because of the off-peak fare elimination. Fare losses were approximately as projected before the demonstration; the need for extra service to meet the increased passenger loads were minimal and were met at very low marginal costs; and administrative, maintenance, and operations impacts were negligible.

The only significant impact other than revenue loss was the degradation of driver morale resulting from increased on-board incidents. Overall, Mercer Metro public image and the local awareness of transit seemed to improve during the demonstration.

2.4.3 Effects on the General Population

The effects of the fare-free transit demonstration on the general population of Mercer County were minimal. The potential effects, if free off-peak service became a permanent policy are somewhat greater, but still small. They include economic effects (directly resulting from cost burdens and indirect effects) and environmental impacts.

Because of the demonstration nature of this project, most of the costs were borne by the Federal government rather than local bodies. If fare-free off-peak transit were to become policy in Mercer County, however, it is likely that 100 percent of the costs would be required from local sources because of the state provisions for transit subsidization. At the time of the demonstration, that would have amounted to about \$340,000 for lost revenue (all other costs being either negligible or offset by small cost savings). However, it is more appropriate to consider the probable costs under present fare policies which are considerably different.

Based on available data and the newly increased fares the probable current annual revenue loss to Mercer Metro for an off-peak fare-free program would be about \$760,000. This is nearly double the cost of the demonstration and is roughly equivalent to an average cost of seven dollars (\$7.00) per household for the current year. This projected cost equals about one percent of the total 1979 county budget and to finance the year's free service from general purpose property tax would require an increase in the tax rate from about \$0.937 per \$100 of assessed value to \$0.949 per \$100.

Indirect economic effects might be realized by increased taxes from higher sales volume; public savings from reduced public assistance costs if job opportunities were improved for the inner city poor; other reduced social welfare costs; and reduced demand for land for streets and parking. All of these potentials are probably small. Not surprisingly, they were not observed during the 12-month demonstration. It is possible that a permanent zero-fare pricing strategy could generate such effects.

Environmental Impacts:

The effects of the fare-free program on local traffic volumes and associated air quality and energy conditions were estimated to be extremely small. The total maximum reduction in the extent of vehicle use, based on the very best of conditions, was estimated to be less than one percent. It should be noted, that in order to significantly affect traffic volumes, increased transit ridership would have to far exceed available transit capacity.

The public's awareness of Mercer Metro service seemed to increase during the demonstration, as did the extent of favorable perception of the system. General satisfaction with Mercer Metro service increased, as did public support of additional tax support for free fare (although it remained negative overall). Perceptions regarding specific characteristics of the service (cost, travel time, comfort, convenience, and safety), were also more favorable during the demonstration than before. The public seemed to favor selected aspects of fare-free transit and oppose others.

Summary of Effects on the General Public:

The effects of the fare-free program on the general public were so small that they were barely noticeable. By the same token, the costs of providing the service (even at current rates) would also be small relative to current tax burdens. The question, therefore, from the public view would seem to be whether or not fare-free transit is a sufficiently desirable program from a social standpoint. The indications are that the public seemed to think it was desirable for selected groups -- senior citizens and to a lesser degree, the poor.

2.4.4 Effects on the Business Community

Impacts of the program on merchants and other business people within the Mercer Metro service area are essentially limited to economic effects (personal responses must be measured as part of the general public). Indirect economic effects include potentials for increased or decreased sales volume, and increased security and vandalism costs; these effects can be somewhat measured qualitatively.

An overall increase in the number and proportion of shopping trips was reported for the entire Mercer Metro service area. Although no sales data were available, there was some indication that there was a relative increase in the proportion of shopping trips destined for the downtown Trenton business district after fares were eliminated.

In general, merchant's perceptions of the program were more negative than positive. Despite some support for fare-free service among the merchants surveyed (about 40 percent), less than five percent reported a willingness to pay for such a program; a somewhat higher proportion did support a general tax subsidy. Many merchants complained of increased loitering and shoplifting, particularly by youths, during free service hours; some supported free service only for senior citizens.

Summary of Effects on the Business Community:

Despite a lack of detailed data, it is likely that the fare-free program had no positive impact on retail sales volume, and may have only marginally, if at all, attracted new shoppers to downtown Trenton. Merchant's perceptions of the program were essentially negative, with common complaints of increased loitering, shoplifting, and vandalism. There was essentially no support for merchant-based funding of fare-free transit.

3.0 BACKGROUND

3.1 The Setting: Mercer County, New Jersey

3.1.1 Geography

Mercer County, New Jersey, as shown in Figure 3.1, is located between Philadelphia and New York City and is approximately 226 square miles in area. Its major city, Trenton, is the state capital and is located next to the Delaware River which bounds Mercer County and Pennsylvania on the west. The countryside is generally flat with some rolling hills; there are no major mountains or other natural obstacles. The County experiences typical northeastern U.S. weather, including four distinct seasons.

3.1.2 Demographics

The county (shown in Figure 3.2) is composed of the city of Trenton, four boroughs, and eight townships. Mercer County population in 1977 was estimated to be 317,000, an increase of about 10 percent since 1970. The city of Trenton had an estimated 98,000 residents in 1977, a drop of about six percent since 1970. Other urbanized centers include the municipalities of Hamilton Township (83,000), Ewing Township (34,000), Princeton (13,000), and several smaller towns. In 1970, population density in Trenton was about 14,000 persons per square mile; in the rest of Mercer County the density was about 1,000 persons per square mile.

The county has varied manufacturing employers, concentrations of research/ education facilities, large rural/agricultural areas, and growing suburban residential areas. Trenton was a site of early industrialization; recently, development pressures in the surrounding suburbs have resulted in the growth of major office complexes in the outlying areas. Between 1960 and 1970 the county experienced an increase in the number of available jobs, while the city of Trenton experienced a decline. Moreover, Trenton's employment composition changed from predominantly manufacturing to a government and service orientation. The shift from manufacturing (which was largely supported by city resident employees) to office/service (which is largely supported by commuters) directly contributed to the deterioration of Trenton's business district and urban residential areas. A growing suburban population created a market for major suburban shopping centers, further contributing to the decline of the mercantile attraction of the Trenton central business district. These trends have led to abandoned industrial, commercial, and residential areas, classic examples of "urban blight".

The city's general economic status is significantly lower than the rest of the county. In 1970 the median household income in Trenton was about \$9,000, while it was about \$12,000 for the remainder of the county. Nearly 13 percent of the city's families had combined annual incomes below the poverty level; only slightly more than three percent were below the poverty level in the rest of the county.

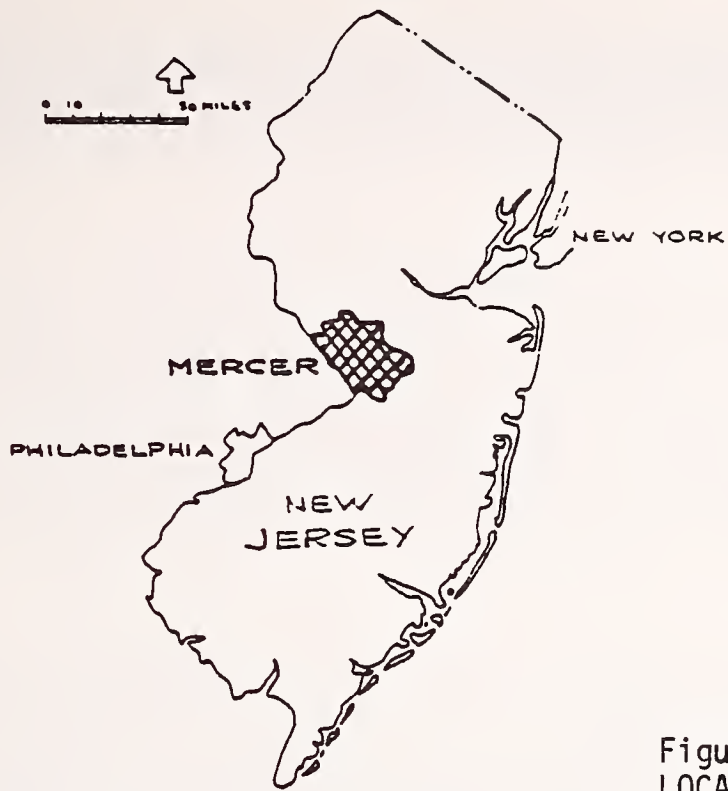


Figure 3.1
LOCATION OF MERCER COUNTY

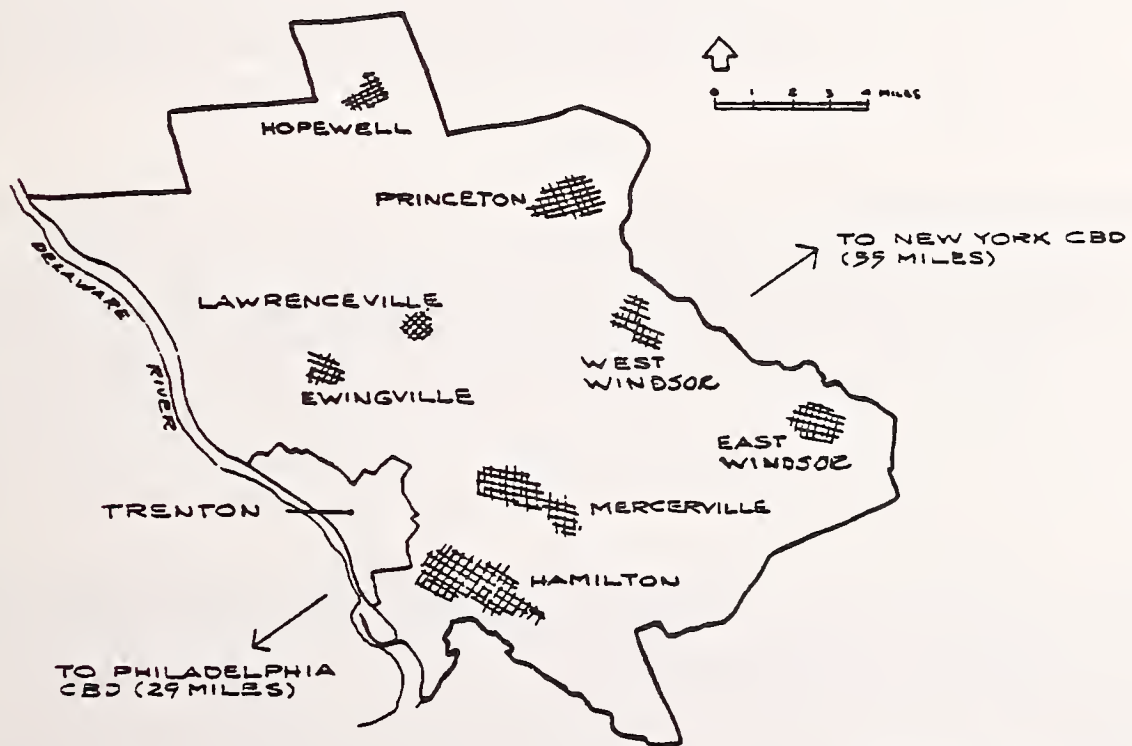


Figure 3.2
MERCER COUNTY

Trenton also had a high proportion of one-person households (24 percent) relative to the balance of the county (13 percent). Similarly, the city had a relatively high proportion of families with female heads (23 percent compared with eight percent in the rest of the county).

3.1.3 Transportation

A significant portion of the county's residents are transit-dependent, typically identified as young people, the elderly, and persons who do not have access to a car. In 1970, about 10 percent of Mercer County's population was over sixty-five years old and 30 percent were under seventeen. Over 17 percent of the households did not have an auto available; 45 percent of the households had only one auto, meaning other members of the family would often be transit-dependent when that car was in use.

Most of Mercer County is well served by high-speed highways and ring arterials. Roadway access to Trenton is good, but there are some traffic circulation and parking problems in the downtown area. The principal passenger rail service in the county is provided on the Amtrak main line, with trains operated both by Amtrak and Conrail (under contract to the New Jersey Department of Transportation). The Conrail Reading division also provides service through West Trenton.

Mercer Metro, a division of the Mercer County Improvement Authority, is the principal supplier of conventional, fixed-route, public transit service within the county. Since assuming the operations of the privately-owned Capital Transit Company in 1969, Mercer Metro has been the only publicly-owned and operated transit property in the state. In addition to farebox revenue, Mercer Metro's main sources of funds are the State of New Jersey, through the Commuter Operating Agency; the Federal government; and the county.

3.1.3.1 Mercer Metro Operations

The following summarizes characteristics of the Mercer Metro operation at the time the fare-free demonstration was initiated. Service changes were not made during the demonstration, with the exception of a peak-period fare increase which is discussed in detail later. Changes in the six months following fare reinstatement were minimal.

Equipment:

Mercer Metro operated a fleet of 96 buses: 70 were regularly used in peak-period service and 45 in off-peak service. Twenty-one of these buses were added to the fleet in the year preceding the demonstration.

Route Structure:

Mercer Metro operated sixteen regular routes; twelve providing general service within the city and county, one a shuttle service in the Trenton CBD - State Capital area. The remaining three served destinations outside the county: one to Fort Dix and

McGuire Air Force Base, plus some intracounty service; another to Asbury Park, New Jersey; and a third to New Jersey shore resorts during the summer. These out-of-county destinations were not included in the free-fare experiment.

Geographical Coverage:

Excluding the three routes extending outside the county, the system was some 280 route-miles in length. In 1977, more than 3.2 million vehicle-miles of service were provided, most of it over these intracounty routes.

Approximately 65 percent of the county's population lived within one-quarter mile of a bus route. Within the city of Trenton, almost all points fall within the quarter-mile transit coverage zone. The system also provided service to all senior citizen housing concentrations, most hospitals, some nursing homes, most regional shopping centers, most of the county's major employment sites, and intercity bus/rail terminals.

Hours of Service and Headways:

Maximum operating hours extended from 5:05 AM to 12:55 AM Mondays through Fridays and 6:30 AM through 11:45 PM on Sundays and holidays. Most routes operated somewhat fewer hours. Fourteen of the sixteen routes operated on Saturdays; nine routes operated on Sundays and holidays. Weekday peak-period headways averaged 30 minutes, while in daytime off-peak periods buses operated on 30- and 60-minute headways. Evening service was further reduced to one- and two-hour headways. Saturday service was about the same on most lines as on weekdays. All Sunday/holiday services had headways of one hour or more all day.

Fares:

Transit base fares were 30 cents with additional zone charges on a few long trips. However, two special half-fare programs limited the 30 cent fare to peak-periods. One of these programs is a statewide program for senior citizens (65 and older) who pay half fare between 9:30 AM and 4:00 PM and after 7:00 PM Monday through Friday, as well as all day Saturday, Sunday and holidays. The second program was a system-wide half-fare program for all riders between 10:00 AM and 2:00 PM and after 6:00 PM Monday through Saturday, plus all day Sunday and holidays. Transfers cost 5 cents for all riders at all times. The fare on the State Complex Shuttle route was 10 cents for all except senior citizens, who paid 5 cents.

3.1.3.2 Patronage and Trip Characteristics

Historically, Mercer Metro has had very stable ridership volumes and travel patterns. This is largely attributable to a minimum of service changes in recent years and limited Trenton-area development. Since the gasoline shortage of 1973-74 Mercer Metro ridership growth has been estimated to be in the two to three percent range annually.

Ridership:

In 1977, the year immediately preceding the demonstration, Mercer Metro carried about 6,530,000 passengers. Weekday ridership averaged about 23,000 person-trips, exhibiting a fairly stable growth pattern. The use of transfers was just under one million per year, about one for each six to seven riders.

Data from a 1975 Mercer Metro survey, indicate that midday (10 AM - 2 PM) ridership was about 26 percent of the daily total, slightly higher than the industry average. Ridership after 6 PM was about six percent. Taken together, the off-peak periods contributed a total of about one-third of the typical weekday ridership and about 40 percent of the annual total.

Trip Purposes:

Data from the Trenton/Mercer Transit Development Study indicate that in 1975 about forty-nine percent of all Mercer Metro person-trips (non-home-bound) were work-oriented. Seventeen percent were for shopping, 14 percent for school, and the remaining 20 percent for other purposes. The pre-demonstration on-board survey in the fall of 1977 indicated that among off-peak (non-home-bound) trips 19 percent were for work, 33 percent for shopping, 11 percent for school, 19 percent were social, and 18 percent were for other purposes.

Trip Lengths:

According to 1975 Mercer Metro data, average passenger trip length ranged (by route) from 1.4 miles to 4.8 miles, averaging about 2.5 miles. Data from the 1977 on-board survey indicate that the average off-peak trip length was about 3.2 miles. This could reflect a wide disparity in trip length data.

3.1.3.3 Cost of Service

Total 1977 operating expenses for the Mercer Metro system were \$4.67 million; about 40 percent of the expenses were offset by farebox revenues (1.87 million). Based on the reported 1977 passenger volume, the average system-wide operating cost per passenger was about \$0.72. The average cash fare was about \$0.29 per passenger including transfers, leaving a unit subsidy cost of about \$0.43 per passenger, system-wide.

Reported average trip lengths, when combined with patronage and operating cost figures, yield a unit cost-effectiveness ratio of about \$0.25 (operating costs per passenger-mile). The reported 1977 vehicle mileage of 3.2 million leads to a unit operating cost of about \$1.46 per vehicle-mile.

3.2 The Demonstration Project

3.2.1 Timing and Organization

The Mercer County Fare-Free Transit Demonstration was a test of the effects of eliminating off-peak fares throughout the Mercer Metro bus system. Fares were abolished on ten intra-county routes and three shuttle routes (three inter-county routes were excluded from the demonstration) during the hours of 10 AM - 2 PM and after 6 PM, Monday through Saturdays, and all day on Sunday and major holidays. The demonstration began on March 1, 1978, and continued for 12 months, ending on February 28, 1979.

The project was jointly sponsored by the Urban Mass Transportation Administration (UMTA), Service and Methods Demonstration (SMD) Program; the New Jersey Department of Transportation (NJDOT); and Mercer County through the Mercer County Improvement Authority (MCIA). Major funding for the project was provided by UMTA through a demonstration grant of \$500,000; total project cost was \$625,000, with the difference provided by the county. Approximately 53 percent of the project budget was to reimburse Mercer Metro for anticipated revenue loss (\$332,000), while the remainder was for administration (\$80,000), data collection (\$122,000), marketing (\$45,000), and contingencies (\$46,000).

Evaluation of the effects of the demonstration project was the responsibility of the USDOT Transportation Systems Center (TSC). De Leuw, Cather functioned as Evaluation Contractor, under the direction of TSC, for performance of the evaluation.

3.2.2 Implementation and Operation

About one month prior to the elimination of off-peak fares on the Mercer Metro System a marketing program was implemented to inform area residents of the upcoming demonstration. The multi-media program was designed to present the facts of the demonstration, rather than actively promote transit in general or the fare-free program in particular. Prior to this effort, Mercer Metro had maintained a very low profile in advertising and media exposure.

Off-peak fare elimination was initiated at a public ceremony on March 1, 1978, at the Trenton Commons which was attended by elected officials, project sponsors, and local citizens. This ceremony received widespread media coverage. Initial response to the fare elimination generated significant passenger volume increases with substantial off-peak bus crowding. The initial response tapered off slightly in the first month of the demonstration.

In June 1978 concern over a purported increase in on-board rowdyism during off-peak hours culminated in a public hearing conducted by Mercer County. Bus drivers were the most vocal participants, strongly arguing for discontinuance of the demonstration. Increases in youth rowdyism expected to occur after school ended did not materialize; complaints and press coverage of the issue soon diminished and were not raised again.

In September 1978 the New Jersey Commuter Operating Agency (COA) acted to raise all intrastate bus and rail fares ten percent, effective October 1, 1978. After hearing arguments regarding the effects of such an increase on the evaluation of the Mercer County demonstration, the COA agreed to delay implementation of the peak period fare increase for Mercer Metro until December 3, 1978. Although peak fares changed during the demonstration, post-implementation data collection was completed before the increase took place, and off-peak fares continued to be eliminated.

During December 1978 Mercer County and NJDOT considered the feasibility of continuing the fare-free operation beyond the scheduled end of the demonstration. It was concluded that regardless of any desire to continue the program, there were no local funds to support the revenue loss. Accordingly, the demonstration ended on February 28, 1979, following a media campaign to inform the local citizenry and to advise the elderly and handicapped about continuation of the on-going state-wide, off-peak, half-fare program.

3.2.3 The Evaluation Process

The ultimate basis for evaluation of this demonstration was comparison of a pair of comprehensive data sets; one assembled in October-November 1977 (before off-peak fares were eliminated) and the other in October-November 1978 (after off-peak fares were eliminated). In this way, the effects of seasonal variations on the data and subsequent conclusions were minimized. The two data sets each consist of the results of a comprehensive on-board survey, a telephone survey, and personal interviews at a suburban shopping center and a downtown Trenton shopping area. In addition, the survey data sets were supplemented by eight passenger volume observations conducted periodically throughout the demonstration; two before and five following the elimination of fares, and an additional count after fares were reinstated.

Supplementing these primary data sets were a few specialized data. In May 1978 a small scale on-board survey was conducted to obtain some interim information on the effects of the program; an interview of bus drivers was conducted in September 1978 to gather information about their experiences and attitudes regarding zero fares. After the demonstration ended a survey of retail merchants was conducted to obtain data on their perceptions of the program; and a follow-up telephone survey of bus riders was conducted to get similar observations from transit users. Appendix A presents details of the data collection for this evaluation. Appendix B discusses statistical significance and testing considerations.

Ridership response to the free transit service was monitored by means of the periodic passenger counts. Each of the sample counts was expanded to estimate system-wide ridership on weekdays, Saturdays, and Sundays. These estimates were then used to evaluate ridership trends throughout the demonstration and were adjusted for seasonal and secular growth effects to develop two estimates of "typical" ridership, one with off-peak fares, and one without. Comparison of these estimates indicates the average net ridership effect of the demonstration. A post-demonstration passenger estimate (also "typical") indicates the residual ridership effect of the program -- that is, the extent of retention of new trips after fares were reinstated. Appendix C presents details on the ridership estimation technique.

Changes in travel behavior were measured by the two on-board surveys and the two telephone surveys; residual effects following fare reinstatement were measured by the follow-up telephone survey of bus-users. Changes monitored in these ways included general user characteristics and effects on low mobility groups; trip frequency and purpose characteristics; mode and temporal shifts; and group ridership impacts. For the most part, the evaluations were made on the basis of measuring changes in proportions of total off-peak ridership, or in absolute values or means.

Determination of the effects on transportation supply and costs were based on both quantitative and qualitative measures. Many of these analyses were based on data from regular Mercer Metro records including cost and revenue data, on-board incident reports, bus mileage and service records, etc. Some analyses regarding loading and schedule adherence were performed using passenger count and bus observation data. A drivers interview and a dispatcher's log provided qualitative measures of some supply-side effects.

Secondary effects of the demonstration were measured or estimated in a variety of ways. Commercial center effects were evaluated using retail sales data and responses to a retail merchants attitudinal survey. Environmental impacts were estimated based on ridership and mode choice data from on-board surveys. Effects on public and bus user attitudes were measured by responses to the telephone surveys.

Evaluation and documentation of the implementation process was accomplished by subjective appraisal of interviews with participants in the planning and implementation stages of the demonstration. These included people at UMTA, NJDOT, and Mercer Metro.

4.0 TRAVEL BEHAVIOR ISSUES

4.1 Overall Ridership Impacts

Pre-demonstration ridership data were taken from revenue-based estimates prepared by Mercer Metro and matched with data from sample head counts conducted by Mercer Metro and the data collection contractor. Ridership estimates during the demonstration were developed based on periodic sample counts, as were post-demonstration estimates. All estimates were reconciled with actual revenue received to correct for sampling or estimating errors. A detailed description of the estimation procedure, together with route- and time-specific ridership estimates are presented in Appendix C. The following is a summary of significant ridership impacts of the demonstration.

4.1.1 Pre-Demonstration Ridership

In the years preceding the fare-free transit demonstration, Mercer Metro passenger volume was quite stable, with modest annual growth. (During that time only minor service changes were made.) Using system revenue as an indicator of passenger volume changes, the average annual ridership growth factor for the years 1974 through 1977 was estimated to be about 2.3 percent per year. Passenger volume in 1977 was estimated to be about 6,530,000 riders.

Typical weekly ridership on the Mercer Metro system during 1977 was estimated to be about 130,000; about 23,000 passengers per day on weekdays, 11,000 on Saturdays, and about 4,000 on Sundays. Off-peak ridership (i.e., during the half-fare hours) accounted for about 35 percent of the weekly total; 31 percent on weekdays and 45 percent on Saturdays. (All Sunday ridership was at half fare.) For weekdays, the midday half-fare period (10 AM - 2 PM) accounted for about 26 percent of the daily totals, while the evening half-fare period (after 6 PM) accounted for about five percent.

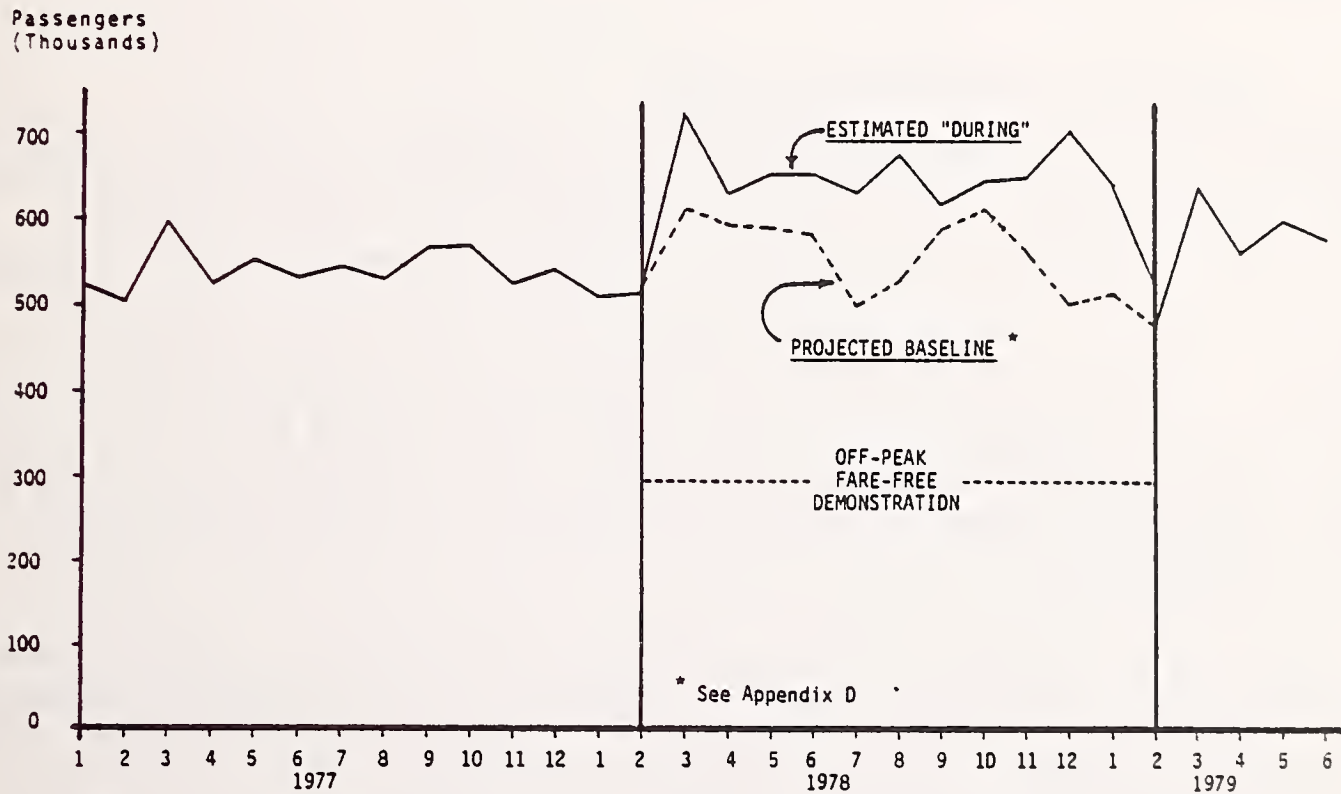
4.1.2 Ridership During the Demonstration

Total ridership during the one-year demonstration period was estimated to be 7,780,000 passengers, about 16 percent more than would have been expected with no fare-free program. This represents the combined effects of 46 percent higher total off-peak ridership and about five percent less peak period ridership. The net off-peak gain (excluding the trips shifted from the peaks) was estimated to be about 40 percent. Much of the five percent drop in peak ridership was believed to be a result of riders changing their time of travel in order to ride free. (This "temporal shift" and other sources of the additional bus trips during the free periods are discussed in more detail later.)

Figure 4.1 illustrates the estimated trend of ridership on Mercer Metro in recent months. The total ridership gain during the twelve-month demonstration is evident in the figure; other notable points include:

- o The level of immediate short-term response in the first month of the demonstration. (Coincidentally, however, March does appear to typically be a high volume month.)
- o The lack of a ridership depression during summer months.
- o The Thanksgiving/Christmas holiday period ridership peak.

Figure 4.1
MERCER METRO MONTHLY RIDERSHIP



Typical weekday ridership increased about nine percent overall, from 23,400 person-trips to 25,400 per day. The net gain resulted from off-peak ridership increases of about 3,300 person-trips, coupled with peak-period ridership drops of about 1,300 person-trips. Compared with the expected ridership had there not been a fare-free demonstration, the net gain represented about 2,000 additional trips per weekday.

Saturday ridership increased about 30 percent overall, with additional riders in all time periods. The off-peak periods gained about 1,600 passengers (31 percent), mostly in the evening fare-free period. The fare-paying periods also gained ridership, a total of about 1,800 riders (29 percent), mostly in the afternoon peak. For many people, time-of-travel decisions are probably more flexible on Saturdays than on weekdays. The overall growth in Saturday ridership, coupled with comments from Mercer Metro dispatchers and management, seems to indicate that while the free service attracted new trips, the riders did not necessarily restrict themselves to the free time periods for both legs of a round trip, overlapping into peak period service.

Free service was provided all day on Sundays, allowing maximum flexibility in the use of free Mercer Metro service. In response, Sunday ridership increased nearly 70 percent, a gain of about 2,700 trips.

4.1.3 Ridership Since Fare Reinstatement

In December 1978, while the demonstration was in progress, the State of New Jersey Commuter Operating Agency (COA) which was responsible for establishing fare policy in New Jersey, imposed a state-wide fare increase on all transit operators in their jurisdiction. The Mercer Metro increase included a 10 cent basic fare increase from 30 cents to 40 cents, and elimination of the former system-wide off-peak, half-fare program. (The senior citizen and handicapped half-fare program remained in force.) Because of the ongoing demonstration and potential impacts on data collection and evaluation, the COA agreed to postpone implementation of the off-peak fare changes until the end of the demonstration; peak fares, however, were raised in December 1978. At the end of the demonstration (February 28, 1979) off-peak fares on the Mercer Metro system jumped from zero to 40 cents. This change in fare policy clearly has some effects on the retention of the ridership which was gained during the demonstration.

Had there been no fare-free demonstration and no fare increase, weekly ridership in the Spring 1979 on Mercer Metro would be expected to be an estimated 135,000 person-trips. Based on two estimates of peak period ridership change after the ten cent December fare increase, the peak shrinkage ratio for such a fare increase on Mercer Metro was estimated to be between -0.30 and -0.35. This is probably somewhat high for the Mercer Metro off-peak case, however, because the 15 cent fare was exceptionally low compared with the peak fare and with other transit fares in the area and elimination of the half-fare program would probably not show as large a flexibility as a general price increase. (The estimated arc elasticity of demand with the fare elimination was estimated to be about -0.19; see Section 3.5.) Assuming a shrinkage ratio of -0.30 for peak periods and -0.20 for the off-peak yields an estimate of about 111,000 total person-trips per week without free fares but with the fare increase in effect. This seems to be a reasonable expectation.

Based on post-demonstration passenger count data and revenue records, the actual weekly ridership in Spring 1979 was estimated to be about 121,000 passengers. This is about 28,000 fewer passengers than were carried during the demonstration, but it is about 10,000 more passengers per week than might have been expected if the system-wide fare increase had been implemented without having had the fare-free demonstration (after seasonal adjustments). Thus, while the fare increase confounds the question of post-demonstration ridership retention, it seems safe to say that the demonstration substantially lessened the subsequent impact of the off-peak fare increase. Among other things, this translates into a sizable farebox revenue increase as discussed later.

Table 4.1 summarizes various ridership estimates throughout the demonstration, and provides estimates of fare increase impacts. Two post-demonstration retention effects are pointed out in the table: Saturday and Sunday seem to have had better retention than weekdays, and the off-peaks seem to have had good retention of ridership, despite the absence of any pricing incentives after fare reinstatement.

4.1.4 Temporal Ridership Changes

Figure 4.2 illustrates the estimated relative changes in weekday bus ridership during the fare-free demonstration based on corner count observations. There is clear evidence that peak period ridership declined somewhat in response to the off-peak fare elimination, while the off-peak ridership clearly increased substantially. (It should be stressed that the changes shown in Figure 4.2 are relative not absolute.) Aggregate morning peak-period loss was about 10 percent while in the evening peak the loss was about seven percent, overall the morning fare-free period gained 43 percent while the night free service gained an estimated 58 percent. Supporting numerical data are presented in Appendix D.

4.1.5 Ridership Distribution by Route

Of the ten principal routes which offered free off-peak service, five (G, P, R, S, X) were estimated to have experienced ridership gains during the demonstration that were disproportionately larger than their pre-demonstration share of ridership. The most significant relative gains were reported on Routes R and S. Of the five routes which were estimated to have had disproportionately low ridership gains, two (K and T) were nearly proportional to their pre-demonstration share of ridership, two others (H and Q) were considerably lower. Supporting data are presented in Appendix D.

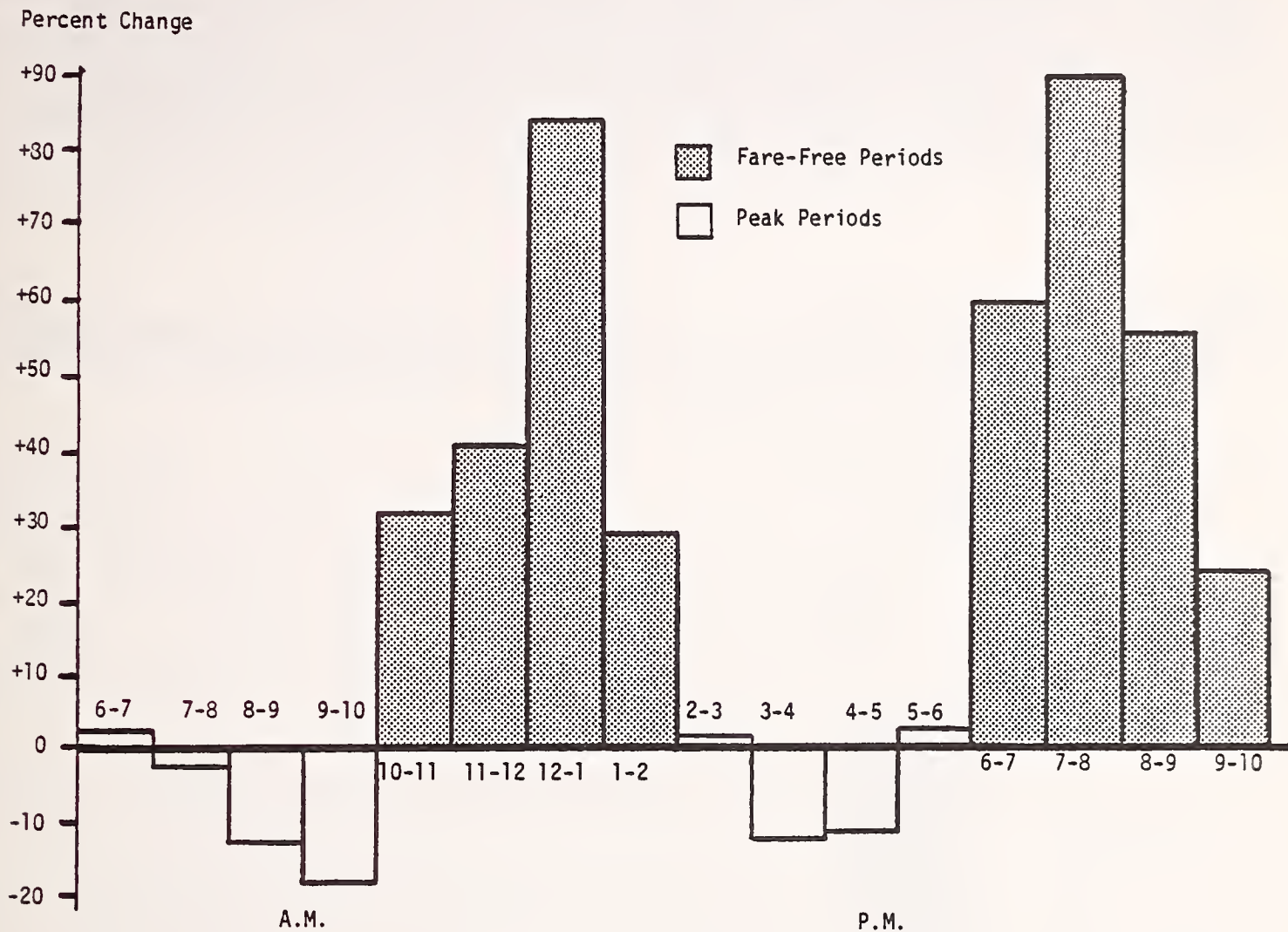
Table 4.1
ESTIMATED MERCER METRO RIDERSHIP

	(1) Trends Extended To 1978	(2) Estimated During The Demonstration	(3) Trends Extended To 1979	(4) Trends With Fare Increase	(5) Estimated Actual 1979 (Post-Demo)
Weekday:					
Before 10AM	7,300	6,600	7,500	6,800	7,000
10AM-2PM	6,000	8,600*	6,100	4,100	6,300
2PM-6PM	8,900	8,300	9,100	8,200	6,600
After 6PM	1,200	1,900*	1,200	800	800
<u>TOTAL</u>	<u>23,400</u>	<u>25,400</u>	<u>23,900</u>	<u>19,900</u>	<u>20,700</u>
Saturday:					
Before 10AM	1,700	2,200	1,700	1,500	2,200
10AM-2PM	4,000	4,500*	4,100	2,700	3,500
2PM-6PM	4,600	5,900	4,700	4,200	5,800
After 6PM	1,200	2,300*	1,200	800	1,400
<u>TOTAL</u>	<u>11,500</u>	<u>14,900</u>	<u>11,700</u>	<u>9,200</u>	<u>12,900</u>
Sunday:	3,900	6,600*	4,000	2,700	4,300
Weekly:					
Peak Periods	87,300	82,600	89,400	80,700	76,000
Off-Peaks	45,100	65,900*	45,800	30,700	44,700
<u>TOTAL</u>	<u>132,400</u>	<u>148,500</u>	<u>135,200</u>	<u>111,400</u>	<u>120,700</u>

Source: Based on averages of "before", "during", and "after" ridership estimates, seasonally adjusted and reconciled with revenue experience.

- (1) Projected "typical" ridership if there had been no fare-free program.
 - (2) Estimated "typical" ridership during the fare-free demonstration.
 - (3) Projected post-demonstration ridership without the effects of the demonstration or the fare increase.
 - (4) Projected post-demonstration ridership considering only the effects of the fare increase.
 - (5) Estimated actual post-demonstration ridership.
- * Fare-Free time periods.

Figure 4.2
CHANGE IN HOURLY RIDERSHIP DISTRIBUTION (WEEKDAY)



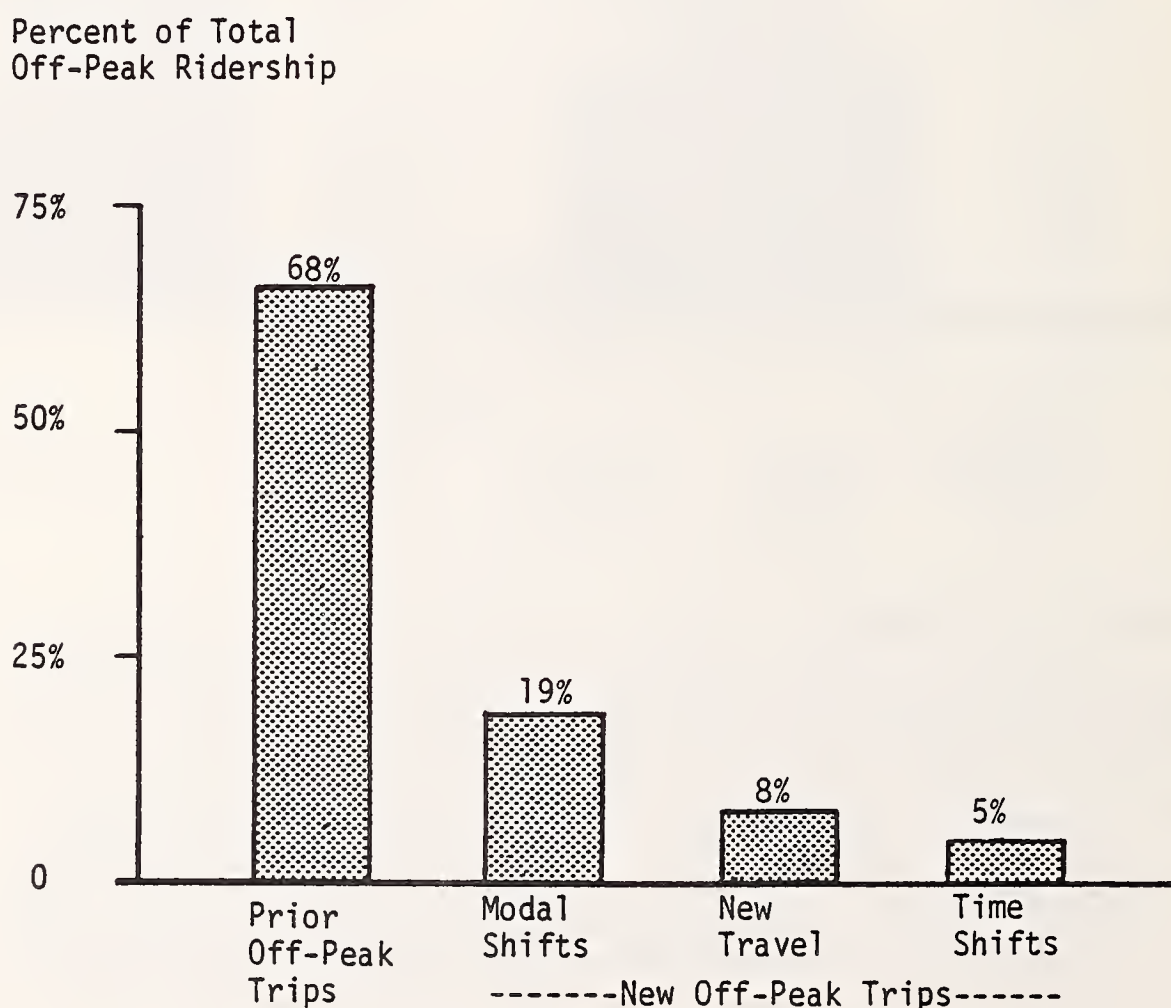
4.2 Travel Choice Impacts

As discussed earlier, it has been suggested for some time that elimination of off-peak transit fares would modify the way people choose to travel. Included among these often hypothesized changes have been:

- o Increased off-peak bus trip frequency by people who already use the off-peak bus service (prior riders), including: newly generated trips; existing trips presently made by another mode, (auto, walk, taxi, etc.) which would be shifted to the free bus; and trips which are presently made by bus during peak periods which would be shifted to the free, off-peak service.
- o Generation of new off-peak bus trips by people who did not formerly use the off-peak bus service (new riders) as a direct response to the elimination of fares. These trips might also be existing trips diverted from other modes and from peak-period buses.

Figure 4.3 illustrates the relationship between new ridership and total passenger volume during this demonstration. Base ridership (i.e., estimated off-peak ridership if there had been no demonstration) accounted for about two-thirds of the total; new ridership, derived from a variety of sources, accounted for the remainder. Modal shifts accounted for about 19 percent; temporarily shifted trips represented about eight percent; and newly generated trips were about five percent of the total.

Figure 4.3
 SOURCES OF FARE-FREE RIDERSHIP



It was estimated that typical off-peak ridership on Mercer Metro increased by nearly 21,000 person-trips per week in response to the fare-free demonstration. Table 4.2 summarizes the estimate of how those trips were distributed among passengers by user status (prior riders vs. new riders) and source (new trips vs. shifted trips). Prior riders (persons who had used the off-peak bus service before fares were eliminated) accounted for about 57 percent of the new person-trips; the remainder of the new trips were made by new off-peak riders. The largest increase was from trips which were newly generated (26%) and those previously made by walking (26%); shifts from auto (driver and passenger) accounted for about 24 percent of the total. "Other" mode shifts include trips which would have been made by taxi, bicycle, hitchhiking, etc.

Table 4.2
ESTIMATED SOURCES OF NEW OFF-PEAK BUS TRIPS

New Bus Trips	New Off-Peak Bus Trips Per Week		
	Prior Riders	New Riders	Total (%)
Generated Trip	2,800	2,700	5,500 (26)
Modal Shifts:			
o Auto Driver	800	1,100	1,900 (9)
o Auto Passenger	1,400	1,700	3,100 (15)
o Walk	2,900	2,500	5,400 (26)
o Other	1,100	1,000	2,100 (10)
Temporal Shifts	3,000	--	3,000 (14)
TOTAL	12,000	9,000	21,000(100)

Sources: On-board surveys (10/77 and 10/78); ridership estimates.

4.2.1 Additional Trips by Prior Users

About eighty percent of a sample of fare-free bus users (telephone survey 5/79) reported that they had used the Mercer Metro system during off-peak (half fare) hours before the fare-free demonstration began. They reported making an average of 3.7 one-way, off-peak bus trips per week before fares were eliminated. Based on estimated pre-demonstration off-peak ridership, and the reported average trip rate, it is estimated that there were slightly more than 12,000 regular users of Mercer Metro's off-peak service before the fare-free demonstration. This represented slightly over four percent of the county population.

Forty-seven percent of the prior users reported that during the demonstration they made more bus trips than they had before fares were eliminated; an equal amount reported that their travel had remained the same; six percent reported making fewer trips. Overall, the prior riders reported an average weekly trip rate of 4.7 one-way, off-peak trips during the demonstration, 1.0 trips per week (27 percent) higher than before fares were eliminated. Based on the estimated number of pre-demonstration users, the number of new bus trips attributable to increased trip frequency by prior riders is 12,000 off-peak trips per week, about 57 percent of the total new travel. Based on on-board survey data (10/78), the primary sources of increased bus trip frequency among these prior users were shifts from peak-period buses, shifts from the walk mode; and newly generated trips.

4.2.2 Trips by New Off-Peak Users

Of the total increased off-peak ridership on the system, approximately 9,000 weekly person-trips were made by individual riders who were new to Mercer Metro's off-peak service. New riders reported making an average of about 4.3 bus trips per week, somewhat lower than the rate reported by prior users during the demonstration. Based on the trip rate and the total ridership by new users, it is estimated that about 2,000 new individuals were attracted to the off-peak service by the fare elimination. The addition of these 2,000 users represents about a 17 percent increase in the number of system users because of the fare elimination.

The extent of new travel (i.e., trips generated by the free service) by new (off-peak) Mercer Metro users was not a large portion of the total increase in passenger volume, but was nearly one-third of the total trips by new users. About 30 percent of the trips by new off-peak users were reportedly entirely new off-peak trips. This accounts for about 2,700 one-way trips per week, or about 13 percent of the total ridership increase.

The largest portion of the new ridership by new users was trips which were previously made by other means and were shifted to the off-peak bus service in response to the fare elimination. This accounts for about 70 percent of the trips by the new passengers, and represents a total of over 6,000 trips per week (30 percent of the total increase). Prior auto trips were also a large source (nearly one-third) of the new bus trips by new riders, as were prior walk trips (28%).

4.2.3 Shifts From Peak to Off-Peak Bus Service

Mercer Metro's off-peak hours were defined as 10 AM - 2 PM and after 6 PM, Mondays through Saturdays and all day on Sundays and major holidays. It has been suggested that these short hours limited the length of the off-peaks when discretionary trips are more likely to be made, and that many trips might shift from the fringes of the relatively long peak periods to the off-peaks. (It should be noted again that before the demonstration there already was a 15 cent price differential between the peaks and off-peaks.) About 40 percent of the off-peak bus users surveyed by telephone (post-demonstration follow-up survey - 5/79) indicated that they had changed their time of travel in order to take advantage of the free service; 21 percent said they did so "frequently".

There was some question regarding the number of trips which were shifted from peak to off-peak service. Based on ridership estimates it appears that the peak periods carried about 4,400 (5%) fewer passengers per week during the demonstration than before. (Weekday peaks showed about 8% fewer, while Saturday peak ridership was estimated to be higher during the demonstration.) In the absence of other explanations for a peak-period ridership decline, it would appear that shifts from peak to off-peak accounted for about 4,400 new off-peak trips per week. However, survey responses indicate that the typical number of trips which were shifted from peak to off-peak was more on the order of 3,000 trips per week. Because of possible unknown confounding factors which may have affected peak ridership, it was concluded that the survey-based estimates were probably more reliable than the hourly ridership estimates.

4.3 Trip Characteristics

It was hypothesized that some of the new bus trips generated by off-peak fare elimination might have significantly different characteristics than trips made before fares were eliminated. Zero-fare trips might be made for different purposes; it was suggested that trip lengths might be different; and that there might be different destinations for free trips. The following summarizes investigation of those effects.

4.3.1 Effects of Fare Elimination on Trip Purposes

Based on passenger surveys conducted before the fare-free demonstration began, the most common purposes for off-peak bus trips on Mercer Metro (excluding home-bound trips) were work (20 percent) and shopping (14 percent); miscellaneous trip purposes (e.g. personal business, church, lunch, etc.), accounted for about eleven percent. During the demonstration, work and shopping trips continued to be prevalent, but shopping trips gained in share of the total trips (16 percent) while work trips were a smaller percentage than before (17 percent). This trend was led by the introduction of the new bus trips among which shopping was the prevalent purpose (19 percent) and work trips ranked only second (13 percent). The only significant difference in trip purposes by prior versus new off-peak riders were in work trips which were reportedly a smaller relative share of prior users' trips when fares were eliminated. Table 4.3 illustrates reported changes in the trip purpose distributions.

Table 4.3
CHANGES IN OFF-PEAK TRIP PURPOSES

Destination Purpose	Percent of Trips Reported				Net Change	
	<u>W/Fares</u> Total	<u>Total</u>	<u>W/out Fares</u> Prior Users	<u>New Users</u>	<u>Trips/Week</u>	<u>Percent</u>
Home	36	34	37	33	+ 6200	+ 38
Work	20	17	15	20	+ 2200	+ 24
School	7	7	7	6	+ 1500	+ 46
Shop	14	16	16	15	+ 4300	+ 68
Medical	3	4	3	3	+ 1300	+ 95
Recreation	2	3	3	3	+ 1100	+ 119
Social	7	8	9	7	+ 2100	+ 67
Other	11	11	10	13	+ 2300	+ 46
<u>TOTAL</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>+21,000</u>	<u>+ 46</u>

Source: On-board survey (10/78).

Presuming that for the most part work and school trips are non-discretionary trips, in the sense that they are made on a schedule not set by the tripmaker, they would be expected to have less relative attraction to fare-free service than would trips with more scheduling flexibility. To the extent that they are represented in the new trips they must mostly come from mode shifts and/or newly generated trips, since they would be less likely to be generated by temporal shifts. Other trip purposes, however, including shopping, social, recreational, medical, and trips for various miscellaneous purposes are probably more discretionary relative to new generation and temporal shift. These trips then would probably be more likely to be part of the group of new off-peak trips.

Table 4.4 presents distributions of trip purposes by self-reported substitute modes had the regular fare been charged for the trip. The most significant differences between trip purposes before fare elimination and after are apparent in this table. Most notable are the trip purposes among the "no trip" (if fares were charged) responses. These are newly generated trips and are disproportionately represented in the shopping and social purpose categories, while being largely under-represented in the work and school categories. That the demonstration did not generate many new work trips in relation to shopping and social trips is not surprising given the hours when free service was provided. The only modes which contributed proportionately to work trips were the auto modes (driver and passenger), with auto drivers also over-represented in the shopping category. Peak period bus diversions also contributed to the shopping trip prominence. Also notable is the over-representation of school trips among diverted walk mode responses, supporting early indications that youths were diverting parallel walk trips to the free bus service.

In general, the demonstration seems to have promoted use of the free bus service for discretionary (whether in terms of need or time-of-travel) trips. Shopping trips were clearly the largest attraction (excluding home-bound trips). All trip purposes experienced substantial relative gains, with off-peak work trips being least affected.

Table 4.4
TRIP PURPOSES BY SUBSTITUTE MODE⁽¹⁾

PURPOSE	SUBSTITUTE MODE (PERCENT OF RESPONSES)						
	NO TRIP	BUS SAME TIME	PEAK BUS	WALK	AUTO DRIVER	AUTO PASSENGER	OTHER
Home	27	36	36	36	19	39	29
Work	9	20	11	12	24	20	13
School	3	7	7	13	7	7	6
Shopping	28	14	24	11	28	11	8
Medical	2	3	5	4	2	4	12
Recreational	7	2	2	6	4	3	2
Social	13	7	8	5	7	7	15
Other	11	11	9	13	9	9	15
Percent of Total Trips	8	68	5	8	3	5	3

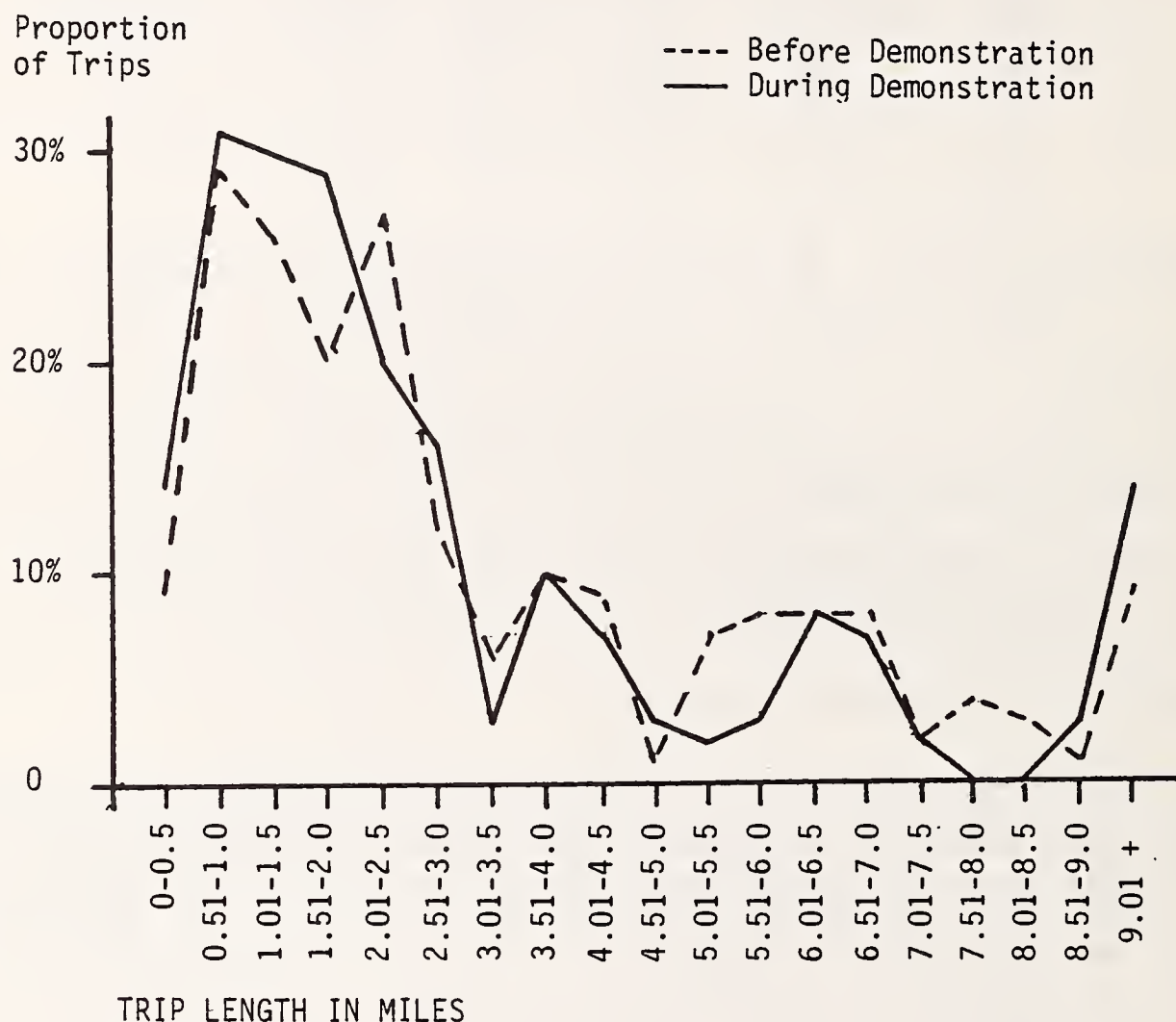
Source: On-board survey; 10/78.

(1) Mode which would have been used if regular fare had been charged for the trip.

4.3.2 Effects on Trip Lengths and Patterns

On-board survey respondents (10/77 and 10/78) were asked to indicate the origins and the destinations (O-D) of their trips, in order to examine changes in trip patterns and trip lengths. Analysis of a systematic sub-sample of on-board survey O-D responses (200 each before and during) indicates that there was a small difference in bus trip lengths before and during the demonstration. The mean trip length for the sample taken before fares were eliminated was about 3.3 miles; among the sample taken during the demonstration, the mean was 3.1 miles. The small decrease may be a result of the attraction of short distance prior walk trips. If so, the possible under-representation of short-trips in the sample, because of insufficient time for the respondent to complete the questionnaire, may be masking a larger decrease in the average trip length. Figure 4.4 illustrates the distributions of trip lengths from the two samples; despite some small variations, the two distributions are markedly similar.⁽¹⁾ We conclude that the observed change in average trip length is not significant, though the sampling biases may have hidden an actual reduction in trip length due to the addition of many new short trips.

Figure 4.4
 BUS TRIP LENGTH DISTRIBUTIONS



(1) Standard tests of statistical significance cannot be used to evaluate the average trip-length change because of these highly non-normal distributions.

4.3.3 Effects on Trip Destinations

Respondents to the post-demonstration bus user survey (5/79) were asked whether they had used the free bus service to go to new places to which they would not have gone if regular fares had been charged for the trip. Thirty percent of the respondents indicated that they had travelled to new places. Half of the 30 percent said that they had continued to use the bus to go to those places after fares were reinstated.

The only new destination reported with significant frequency was a major regional shopping mall in suburban Mercer County (Lawrence Township). Two of Mercer Metro's most heavily travelled routes (K and T) served the mall via downtown Trenton. About 11 percent of the respondents reported going to the mall by bus during the demonstration for shopping, whereas they said they would not have done so before the fares were eliminated. There were no other often reported new destinations, for any purpose. Particularly downtown Trenton, which is the focus of Mercer Metro's radial route network, was not reported as a new bus trip destination with any frequency, despite the concentration of service in that area. It did, however, have a small (but significant) reported gain in shopping trip destinations.

4.4 Effects on User Characteristics

Fare-free transit service has been suggested as a method of improving the mobility of transportation disadvantaged people and thereby increasing their opportunities for employment, shopping, recreation and education. New trips by both old and new riders do represent additional travel and increased mobility; trips diverted from other modes may also indicate improved mobility, to the extent that the free service increased the riders' freedom to choose when, where, or how far to travel. Following are descriptions of the characteristics of Mercer Metro passengers before off-peak fares were eliminated and those of new riders attracted to the system by the free service. (It should be noted that some of these data rely on respondent recall over a one-year or more period.)

4.4.1 Personal Characteristics of Off-Peak Riders

4.4.1.1 Distribution of Ages

Respondents to the post-demonstration telephone survey (5/79) who reported that they were prior Mercer Metro riders reported their ages as shown in Table 4.5 (Percent of Off-Peak Users); these are compared in the table with the distribution of ages for the county population. Also shown are the equivalent number of users in each age group and the respective portions of the total county population who used the off-peak bus service by age group. On the average, Mercer Metro carried about five percent of the persons in the county aged nine or above. However, the share of the age group 17-to-24 which used the system was about double the average.

Table 4.6 summarizes the relationship between off-peak bus trips and the ages of the trip makers (respondents) before, during, and after the demonstration. There was a difference reported in the distribution of trips made by people in the various age groups between the pre-demonstration and the fare-free times, but age distribution among the retained ridership (post-demonstration) showed no significant difference (in either distribution by group or mean) from the pre-demonstration period. The age distribution of trips reported by new users was different than that reported by prior riders during the demonstration which accounts for some of the change. However, the age distribution of trips among prior riders also reportedly changed in the same direction as the new riders. The apparent tendency among trips by both prior and new users was a skew toward

the younger age groups (24 years and younger), at the expense of the middle and upper age groups. Among new users, there were significantly fewer trips reported by the upper age groups.

Table 4.5
AGE DISTRIBUTION OF RIDERS BEFORE FARE ELIMINATION

Age Group	Percent of County Population	Percent of Off-Peak Users ⁽²⁾	Number of Off-Peak Users ⁽²⁾	Users as a Percent of Population
9-16 ⁽¹⁾	17%	16%	1900	4%
17-24	16%	36%	4300	10%
25-44	29%	23%	2800	4%
45-64	27%	18%	2200	3%
65 and Over	11%	7%	800	3%

Source: U.S. Census (1970); post-demonstration bus-user telephone survey (5/79).

- (1) Nine years is the presumed lower practical limit on bus user age (unaccompanied), based on ungrouped age distribution from on-board survey (10/78).
 (2) Adjusted for trip frequency; represents number of people who used the off-peak service, based on total weekly ridership.

It should be noted that there are multiple data sets from which different age distributions can be derived, which would lead to conflicting inferences regarding the relative response to free-fare among age groups (see Appendix D). Subjective conclusions by demonstration observers support the use of the data reported above; however, there is some question because of the conflicting statistics. Regardless of the relative response to fare-elimination, it is evident that all age groups did increase their ridership.

Table 4.6
OFF-PEAK BUS TRIPS BY AGE GROUP⁽¹⁾

Age Group	Before	Weekly Off-Peak Bus Trips During Demonstration		After
		Prior Users	New Users	
16 or less	6,300(14%)	10,300(18%)	2,000(22%)	6,800(15%)
17-24	16,600(37%)	23,300(41%)	3,600(40%)	15,700(35%)
25-44	11,700(26%)	12,000(21%)	2,200(25%)	11,700(26%)
45-64	6,800(15%)	7,400(13%)	800(9%)	7,200(16%)
65 or Over	3,600(8%)	4,000(7%)	400(4%)	3,600(8%)
TOTAL	45,000(100)	57,000(100)	9,000(100)	45,000(100)

Source: Post-demonstration bus-user survey (5/79) and on-board survey (10/78).

- (1) The use of two different data sets may affect the comparability of these data.

4.4.1.2 Sex of Off-Peak Passengers

Before the demonstration began, Mercer Metro's off-peak users were predominantly female. A number of data sources confirm that the portion of female users was about 56 percent, while about 57 percent of the trips were made by females, indicating insignificant differences in trip frequency between males and females. County-wide, the proportion of females in the population (nine years or older) was about 52 percent (Source: 1970 U.S. Census). The fare-free demonstration apparently had only slight effect on the proportion of female ridership. Fifty-seven percent of the person-trips reported by prior off-peak passengers were made by females; among new off-peak passengers, 52 percent of the trips were made by females. This reduction is mostly attributable to a relatively larger increase in the average trip rate of males (from 3.7 before to 5.0 during) than in the average female trip rate (from 3.6 to 4.6) during the demonstration.

4.4.2 Household Characteristics of Off-Peak Riders

4.4.2.1 Size of Households

The distribution of household sizes of off-peak users and trips were nearly identical, although somewhat skewed toward larger households relative to the county as a whole, supporting the common belief that larger households, perhaps with greater potential for mobility limitations, are over-represented among bus users compared with the local population in general. Table 4.7 summarizes the distribution of trips by household size. The small changes in distribution among the groups before, during and after the demonstration are not significant, nor are the differences between prior users and new users, indicating that the size of the trip-maker's household was not a significant parameter relative to the free off-peak bus demonstration.

Table 4.7
OFF-PEAK BUS TRIPS BY SIZE OF HOUSEHOLD (1)

Household Size	Weekly Off-Peak Bus Trips			
	Before	During Demonstration		After
		Prior Users	New Users	
One Person	4,900(11%)	6,800(12%)	1,100(12%)	4,900(11%)
Two People	8,100(18%)	8,500(15%)	1,500(17%)	7,700(17%)
Three People	6,300(14%)	8,500(15%)	1,200(14%)	5,800(13%)
Four People	8,600(19%)	10,300(18%)	2,100(23%)	8,600(19%)
Five People	6,300(14%)	8,000(14%)	1,100(12%)	6,700(15%)
Six or More	10,800(24%)	14,900(26%)	2,000(22%)	11,300(25%)
Total	45,000(100)	57,000(100)	9,000(100)	45,000(100)

Source: On board survey (10/78); post-demonstration follow-up survey (5/79). The use of two data sets may affect comparability.

(1) Observed changes were found to be essentially insignificant.

4.4.2.2 Income Levels

The mean passenger income, based on the data in Table 4.8 before the fare-free demonstration began, was estimated to be \$11,000 (computed based on class marks; upper mean presumed to be \$30,000). This is compared with a similarly calculated mean of about \$15,000 for the Mercer County population at large.⁽²⁾ The comparable figure during the demonstration for prior riders was slightly over \$12,000, possibly indicating an increase in ridership among prior passengers in the above average income levels. New riders reported an average income of over \$14,000, indicating an even higher proportion of above average income passengers. These changes are evidenced by the distribution changes shown in the table. Post demonstration passenger income levels apparently returned to approximately the same as before fares were eliminated.

Table 4.8
OFF-PEAK BUS TRIPS BY INCOME LEVEL ⁽¹⁾

Household Income Level	Weekly Off-Peak Bus Trips			
	Before	During Demonstration		After
		Prior Users	New Users	
\$5,000 or Less	12,600(28%)	13,100(23%)	1,400(16%)	13,000(29%)
\$5,001-10,000	13,500(30%)	14,300(25%)	1,900(21%)	14,000(31%)
\$10,001-15,000	6,300(14%)	13,100(23%)	2,500(27%)	6,300(14%)
\$15,001-25,000	9,500(21%)	9,700(17%)	1,800(20%)	9,000(20%)
Over \$25,000	3,100(7%)	6,800(12%)	1,400(16%)	2,700(6%)
TOTAL	45,000(100)	57,000(100)	9,000(100)	45,000(100)

Source: On-board surveys (10/77 & 10/78); post-demonstration follow-up survey, (5/79). The use of two data sets may affect comparability.

(1) Does not include any adjustments to normalize for inflationary increases.

4.4.2.3 Automobile Ownership and Availability

The average number of automobiles owned per household among prior off-peak passengers was estimated to be 1.0, with a relatively high 39 percent of the passengers reporting no cars owned by members of their households. About 40 percent of the prior riders reported that they generally had an auto available for their use. Table 4.9 summarizes auto availability for off-peak bus riders.

There was a significant difference in the average auto availability reported by prior users during the demonstration (about 1.2) compared with before fares were eliminated about (1.0). The largest difference, however, was reported by new

(2) Source: Random household telephone survey (11/78) results.

passengers; this group had an average household auto ownership of nearly 1.5 cars. There was no significant difference in the reported levels of auto availability before and after the demonstration.

Table 4.9
OFF-PEAK BUS TRIPS BY AUTO OWNERSHIP LEVELS

Autos in Household	Weekly Off-Peak Bus Trips			
	Before	During Demonstration		After
		Prior Users	New Users	
Zero	17,600(39%)	18,800(33%)	1,900(21%)	14,900(33%)
One	13,500(30%)	18,200(32%)	2,800(31%)	15,300(34%)
Two	9,000(20%)	12,000(21%)	2,700(30%)	9,900(22%)
Three or More	4,900(11%)	8,000(14%)	1,600(18%)	4,900(11%)
<u>TOTAL</u>	<u>45,000(100)</u>	<u>51,000(100)</u>	<u>9,000(100)</u>	<u>45,000(100)</u>

Source: On-board surveys (10/77 and 10/78); post-demonstration bus user follow-up survey. The use of two data sets may affect comparability.

4.4.3 Travel Characteristics of Off-Peak Riders

4.4.3.1 Overall Bus Trip Frequency

Based on data from the post-demonstration follow-up survey, overall the average frequency of bus trips during the off-peak periods increased as a result of the demonstration from about 3.7 one-way trips per week to 4.7 trips per week, a 27 percent increase. Prior users of the off-peak bus service reported an average trip rate of 4.7 per week during the demonstration, while new users (those attracted by the free service) reported an average rate of about 4.3 trips per week. (It should be noted that the "before" data for the trip rate analyses rely on respondent recollection over a one-and-one-half year period.)

The average post-demonstration trip rate was 2.8 trips per week, about a 76 percent retention of the pre-demonstration rate. The large decrease must be considered in light of the post-demonstration off-peak fare increase. Using the previously assumed off-peak demand/price elasticity as an indicator of expected trip rate changes with the 40 cent post-demonstration off-peak fare, there would have been expected retention of about 66 percent, a weekly trip rate of about 2.4, had there been no fare-free program. Among new users who continued to use the off-peak service after fares were reinstated, the average reported trip rate was 1.6 one-way trips per week, considerably lower than the rate of 2.9 trips per week reported by prior users.

4.4.3.2 Trip Frequency by Age

Estimated off-peak bus trip rates (average number of one-way trips per week) for conditions before, during, and after the demonstration are presented by age group in Table 4.10. The rates indicate that young people aged 16 years or less reported the greatest response to the off-peak fare elimination, but persons in the middle age groups reported the largest residual effects.

Table 4.10
OFF-PEAK TRIP RATES⁽¹⁾ BY AGE

Age Group	Rate Before	During Demonstration		After	
		Rate	Change	Rate	Retention ⁽²⁾
9-16	3.5	5.8	+66%	2.3	66%
17-24	3.8	4.9	+29%	2.9	76%
25-44	3.9	4.9 ⁽³⁾	+26%	3.0	77%
45-64	3.3	3.7	+12%	2.5	76%
65 or Over	4.4	4.4	--	3.0	68%

Source: Post-demonstration follow-up survey (5/79).

- (1) Average one-way bus trips per week.
 (2) After rate as a percent of the before trip rate.
 (3) Significant with only 95% confidence.

Before fares were eliminated, senior citizens (65 years or over) reported being relatively the most active users of the off-peak bus service. People 17 to 44 years old had slightly above average trip frequency, and people under 17 years and 45 to 64 years had below average off-peak bus trip rates.

During the demonstration people under 17 years reported increasing their trip rate by an average of 2.3 trips per week, by far the largest increase (66%) reported by any age group. (The rate of 5.8 trips per week was also the largest absolute trip rate reported by any group of riders in any socio-economic group.)

Senior citizens, however, reported no increase in their rate of travel. People 17-to-44 reported near average trip rate increases. People in the 45-to-64 age group seemed to be the least active users of the off-peak bus service before the demonstration and also reported a below average increase in rate of travel after fare elimination.

When the demonstration ended, people in the youngest age group again responded most significantly, reporting trip rates well below their pre-demonstration level; senior citizens also reacted markedly to fare reinstatement. Other age groups (17-to-64) had average reaction to the reimposition of off-peak fares. All age groups reported lower trip rates after the demonstration than they had before; the decrease is at least partially attributable to the large increase in off-peak fares.

It was estimated that fare elasticity might account for a reduction in off-peak bus use to about 66 percent of the pre-demonstration rates. Given that estimate, the response by people 16 or less and 65 or over could be explained fully by the fare elasticity, indicating no residual trip frequency effect on the demonstration for those age groups. This seems intuitively feasible considering the purposes and times of the youth travel, and indications that seniors did not increase their rate of travel in response to the demonstration. This also indicates that despite a less dramatic response by people in the middle age groups, the residual trip frequency effects of the demonstration were greater for them than for the younger people.

4.4.3.3 Trip Frequency by Sex

Table 4.11 illustrates the bus trip frequency response of female versus male riders during off-peak periods. The largest response to fare elimination was reported by males. While both sexes had comparable pre-demonstration trip rates, males reported an increase of 35 percent compared with 28 percent for females. Retention after fare reinstatement was somewhat higher for females. Thus, males as a class were apparently more sensitive to the fare changes, both increases and decreases.

Table 4.11
OFF-PEAK TRIP RATES^(*) BY SEX

<u>Sex</u>	<u>Rate Before</u>	<u>During Demonstration</u>		<u>After</u>	
		<u>Rate</u>	<u>Change</u>	<u>Rate</u>	<u>Retention^(*)</u>
Male	3.7	5.0	+35%	2.7	73%
Female	3.6	4.6	+28%	2.8	78%

Source: Post-demonstration follow-up survey (5/79).

(*) See definitions on Table 4.10.

4.4.3.4 Trip Frequency by Household Income

Reported off-peak trip rates for before, during, and after the fare-free demonstrations are shown in Table 4.12 by income group (annual household income). The figures indicate that people in the middle-income categories were most responsive to fare elimination, but those at the lower and upper income levels had the largest residual effects.

Table 4.12
OFF-PEAK TRIP RATES (*) BY INCOME

Income Group	Rate Before	During Demonstration		After	
		Rate	Change	Rate	Retention (*)
\$5,000 or Less	3.5	4.6 (1)	+31%	3.0	86%
\$5,001-\$10,000	4.3	4.7 (1)	+ 9%	3.1	72%
\$10,001-\$15,000	3.7	5.3	+43%	2.4	65%
\$15,001-\$25,000	3.2	4.3 (1)	+34%	2.6	81%
Over \$25,000	2.8	3.2 (1)	+14%	2.5	89%

Source: Post-demonstration follow-up survey (5/79).

(*) See Definitions on Table 4.10.

(1) Significant with only 95% confidence.

Before the demonstration, people in the \$5-10 thousand income range reported the most active use of the off-peak service, while people in the lowest category, five thousand dollars or less, reported a below average trip rate. While it might be expected that people in the lowest income group would report at or near the highest trip rates, it is likely that there is a point of low income below which total travel is depressed, resulting in lower overall bus trip rates. The lowest pre-demonstration trip rates were reported by the upper income groups, particularly the people with household incomes in excess of \$25,000. This is consistent with what might be expected based on probable travel options and price sensitivity. (The rate of 2.8 one-way trips per week for people in the over \$25,000 group was the lowest reported pre-demonstration trip rate of any socio-economic group.)

During the demonstration, people in the lowest income category (as well as in the \$15-25 thousand group) reported trip frequency responses above the average, but not as high as other groups. The largest relative increase in trip frequency was reported by people in households with incomes in the \$10-15 thousand range, making those people the most active users of the free bus service among all income groups. The most active pre-demonstration income group, \$5-10 thousand, had the smallest relative increase; this may be an indication that their pre-demonstration trip frequency was near the maximum for that group, leaving little flexibility for increase. Increased trip frequency among people in the highest income group was relatively low, a further indication of reduced price sensitivity.

Post-demonstration trip rates reflected convergence of the frequency of use among income groups. This may very well be a reflection of transit captivity resulting from the combined effects of travel options and/or price sensitivity. People in the lowest and highest income groups reported the highest residual effects, with percent retention well above the average. It is possible that these are highly captive riders with corresponding limited modal options -- and for the lower income group, high sensitivity to fare levels. To a lesser extent the same may be true of the abutting income groups, but it is likely that their travel options are greater. People in the \$10-15 thousand group who use the system (and the boundary people in

the abutting groups) may include many of the choice riders, having a more flexible mix of travel options and travel funds. This group would then have greater freedom to respond to price changes.

4.4.3.5 Trip Frequency By Size of Household

Table 4.13 summarizes the reported trip rate impacts of the demonstration classified by the size of the bus users household. Households with two people reported the highest relative increase in trip frequency; the largest households (those with six or more people) also reported a higher than average increase; but one-person households reported an increase lower than the average. In general the residual effects decreased as household size increased.

Table 4.13
OFF-PEAK TRIP RATES^(*) BY SIZE OF HOUSEHOLD

<u>Size of Household</u>	<u>Rate Before</u>	<u>During Demonstration</u>		<u>After</u>	
		<u>Rate</u>	<u>Change</u>	<u>Rate</u>	<u>Retention</u> ^(*)
One Person	3.2	3.6 ⁽¹⁾	+13%	2.8	88%
Two People	3.6	5.5 ⁽²⁾	+53%	2.9	81%
Three People	4.0	4.5 ⁽²⁾	+13%	3.0	75%
Four People	3.3	4.2 ⁽¹⁾	+27%	2.6	79%
Five People	3.8	4.7 ⁽¹⁾	+24%	3.0	79%
Six or More	3.8	5.2	+37%	2.6	68%

Source: Post-demonstration follow-up survey (5/79).

(*) See definitions on Table 4.10

(1) Significant with only 95% confidence.

(2) Significant with only 85% confidence.

Before the demonstration began, riders from households with three people reported the highest average trip rate, followed by people from the two largest household size groups. People who lived alone reported the lowest rates. These figures seem to indicate that there may not be a direct correlation between the size of a household and the off-peak bus trip frequency of any member of the household. Attempts at bivariate linear regression analysis supported that indication.

During the demonstration, two-person households reported the largest increase in average trip rate. The group with the highest reported pre-demonstration rate (three-person households) reported the lowest percent increase, as did people who lived alone. Those people living in households with six or more persons reported a trip rate increase slightly above average.

Post-demonstration retention appeared to be roughly proportional to the inverse of the size of the household, but it is not clear that there is any cause/effect relationship. In general, it appears that household size may not be a relevant characteristic for evaluation of trip frequency effects of transit price changes.

4.4.3.6 Trip Frequency by Auto Accessibility

Table 4.14 illustrates the reported effects of the demonstration on trip rates based on automobile accessibility. In general, response to fare elimination was reportedly greater among households with autos than those without, but the subsequent residual effects seemed to be larger in an inverse relation.

Table 4.14
OFF-PEAK TRIP RATE (*) BY AUTO ACCESSIBILITY

<u>Autos in Households</u>	<u>Rate Before</u>	<u>During Demonstration</u>		<u>After</u>	
		<u>Rate</u>	<u>Change</u>	<u>Rate</u>	<u>Retention (*)</u>
Zero	3.8	4.4	+16%	3.0	79%
One	3.4	4.6	+35%	2.6	76%
Two	3.7	4.7	+27%	2.6	70%
Three or More	4.0	5.4	+35%	2.4	60%
<u>Auto Availability</u>					
Usually available	3.4	4.4	+29%	2.4	71%
Not available	3.9	5.0	+28%	3.0	77%
<u>Driver Status</u>					
Licensed Driver	3.5	4.8	+37%	2.1	60%
Not Licensed	3.9	4.7	+21%	3.0	77%

Source: Post-demonstration follow-up survey (5/79).

(*) See definitions on Table 4.10.

Before off-peak fares were eliminated, the highest reported trip rates were among people in households with three or more autos, while zero-car households reported the second highest, followed closely by the rate for people in two-car households. A reason for the relatively high bus trip rates among people from households with two or more autos may be that a disproportionately large share of young people (16 and under), who were also the most active off-peak trip makers, reported living in those households. While users in that age group represented about 14 percent of the total responses, they were nearly 24 percent of the people in multiple-car households while only ten percent of the zero- and one-car household respondents. A similar effect was also noted among the two-car household respondents.

During the demonstration, the largest trip rate increases were reported by people in one-car households and households with three-or-more autos. The latter is explained by the age distribution effect reported above. The increased ridership among the one-car household respondents, however, is not affected by a large share of young people, and appears to be an auto-related increase. Respondents from zero-car households reported only slight increase in trip frequency, perhaps because of being near a relative maximum rate before fare elimination.

Residual effects were clearly related to auto ownership, which somewhat supports the contention that the large response in the multiple-car households was likely a result of discretionary trips by a high proportion of young people. The highest retained trip rate was reported by people in zero-car households (79%) decreasing (at an increasing rate) as auto accessibility increased.

4.4.4 Effects on the Transportation Disadvantaged

Trenton has a large proportion of people who have potential transportation disadvantages. Typical indicators of limited mobility include age (either those too young to have automobile access or senior citizens who often do not maintain an auto or drive), low income, or lack of an automobile. Data reported in the 1970 Census indicate that about 12 percent of Trenton's residents were 65 or older while 16 percent were between 9 and 16 years (corresponding data for the rest of Mercer County were eight percent and 15 percent, respectively); about 13 percent of the city's families reported incomes below the contemporary poverty level (three percent in the rest of the county); and most notably, 35 percent of Trenton's households reported that they had no auto (11 percent in the rest of the county).

Table 4.15 illustrates the response to the free service by people reporting they had at least one indication of potential mobility limitation -- and were new users of the system. These are compared with the overall proportion of people with those indicators. It is evident that young people were the only "low mobility" group which proportionately responded more among new users than among the prior ridership. In all other categories, the low-mobility groups were under-represented among new users.

The response to off-peak fare elimination by persons with potential mobility limitations was no more significant when examined on the basis of changes in trip frequency. Table 4.16 summarizes the reported trip rate impacts of the demonstration on selected groups. The average change in reported trip rate from before to during the demonstration was about 27 percent (one trip per person per week). The most markedly higher-than-average rate change was reported by young people. People with no drivers license also reported an above average increase in trip rate, which is partially attributable to a high percentage of young people in that group. Other transportation disadvantaged groups did not report significantly higher-than-average trip rate increases after fares were

eliminated. This could indicate that those groups did not have any markedly different mobility characteristics than others in the Trenton area. It is more likely, however, that the proportionate (or below) response to off-peak fare elimination by those groups, indicates that mobility limitations may be a relative function of lifestyle, affecting total travel, and not particularly sensitive to isolated improvements such as off-peak transit fare elimination. It is interesting that the post-demonstration trip rates of the low mobility groups are generally higher than average, except for the young people and non-drivers, a further indication that much of the ridership increase by the young was discretionary travel.

Table 4.15
INCIDENCE OF NEW LOW MOBILITY USERS

<u>Low Mobility Group</u>	Proportion ⁽¹⁾ of Trips Reported During the Demonstration	
	<u>New Users</u>	<u>Prior Users</u>
Zero-Car Households	23%	33%
Income below \$5,000	12%	18%
Age: 16 or below	23%	18%
Age: 65 or above	4%	7%

Source: On-board survey (10/78).

(1) The numbers represent the share of trips reported among the entire group; i.e., among trips made by new users 23% were reported by people in zero-car households, 77% were reported by people in households with cars; among trips made by prior users 33% were reported by people in zero-car households, 67% were reported by people in households with cars.

Another indirect indication of response to the fare elimination by the transportation disadvantaged is the extent of travel by dependent groups (i.e., persons riding together because one or more of the group cannot ride alone, such as a mother and young children). The pre-demonstration hypothesis was that people with low or fixed travel budgets would make more use of the off-peak service after fare elimination. The thinking was that while a 30-45 cent round-trip fare was not exceptionally high, for people with limited means and children, or other dependents, who would have to travel together, the fare can be multiplied, by two, three, or more, thereby increasing the total cost of the trip and by extension, the relative value of fare elimination.

Table 4.16
 TRIP RATE IMPACTS AMONG LOW MOBILITY GROUPS⁽¹⁾

	<u>Rate Before</u>	<u>During Demonstration Rate</u>	<u>Change</u>	<u>Rate After</u>
Average of All Users	3.7	4.7	+27%	2.8
<u>Low Mobility Groups</u>				
Age: 16 or Below	3.5	5.8	+66%	2.3
Non-Drivers	3.5	4.8	+37%	2.1
Income Below \$5,000	3.5	4.6	+31%	3.0
Auto Not Available	3.9	5.0	+28%	3.0
Zero-Car Households	3.8	4.4	+16%	3.0
Age: 65 or Above	4.4	4.4	--	3.0

Source: Post-demonstration follow-up telephone survey (5/79).

(1) Average off-peak one-way bus trips per week.

Based on observations during on-board surveys, both the rate of occurrence and the average size of groups travelling during the off-peaks increased significantly after fares were eliminated. Before the demonstration, about three percent of the observed boardings were recorded as dependent groups, after fare elimination the proportion increased to over six percent, with roughly the same distribution by type of group dependency (i.e., children, elderly, handicapped). The average group size increased from about 2.6 persons per group to about 2.9 after fares were eliminated.

4.5 Ridership Impact Prediction

Despite large volumes of data on the response of transit demand associated with price increases, there has been essentially no corresponding information for large-scale price reductions until the fare-free demonstrations. It is, therefore, useful to quantify the changes observed in Mercer County in a normalized fashion. Perhaps the simplest way to normalize the data is by computing demand/price elasticities; they are discussed below. Other approaches include regression analyses and examination of predicted behavior versus revealed behavior; these are discussed in following subsections.

4.5.1 Elasticities of Demand with Price

R. H. Pratt Associates⁽³⁾ analyzed common uses and computations of transportation price elasticities. That work, together with fare policy analyses by Peat, Marwick, Mitchell & Co.⁽⁴⁾ are excellent sources of detailed elasticity discussions. Pratt Associates outlined three common methods for computing transportation elasticities: point elasticity; shrinkage ratios; and arc elasticity. Of these, the last appears to be most appropriate for applications to the Mercer County results. Point elasticity cannot be applied because of a lack of information regarding the demand/price functional relationship. Arc elasticity is generally applied assuming a linear demand curve. Shrinkage ratio is too narrowly defined for use in analyzing fare reduction; it is conceptually only useful for price increases. Arc elasticity(n) is essentially a ratio of the proportional changes in demand(Q) and price(P), evaluated at a midpoint and is defined as:

$$n = \frac{\Delta Q}{(Q_1 + Q_2)/2} \div \frac{\Delta P}{(P_1 + P_2)/2}$$

$$n = \frac{\Delta Q(P_1 + P_2)}{\Delta P(Q_1 + Q_2)}$$

The sign of the elasticity is negative indicating an inverse relationship between ridership and price. The condition of a 100 percent fare change, as in the Mercer County case, causes the quantity $(P_1 + P_2)$ to be equal to ΔP , reducing the formula to:

$$n = \Delta Q / (Q_1 + Q_2)$$

The estimated annual off-peak ridership on Mercer Metro had there been no free-fare demonstration would have been about 2,280,000 passengers; peak ridership was estimated to have been about 4,450,000 passengers. The estimated annual off-peak ridership with fares eliminated was about 3,570,000 passengers; peak ridership was estimated as 4,210,000 passengers. Peak-period diversions were estimated to total about 240,000 passengers. Computing the arc elasticity on the basis of total ridership gain, the gross elasticity of demand with the fare elimination was about -0.22, as shown below:

(3) Traveler Response to Transportation System Changes, Federal Highway Administration, Washington, D.C.; February, 1977.

(4) Public Transportation Fare Policy, U.S. Department of Transportation, Washington, D.C.; May, 1977.

Gross Elasticity:

$$\frac{(2,280,000 - 3,570,000)}{(2,280,000 + 3,570,000)} = -0.22$$

Inclusion of the temporal-shift trips in the computation of "n" is useful from the standpoint of describing total off-peak ridership change, but somewhat overstates the elasticity, because it treats those trips as new bus trips which they are not, in fact. From a strict elasticity viewpoint, the shifted bus trips should be excluded and the ridership response should be examined on the basis of net increase. Again using the arc formula, the net demand/price elasticity would be about -0.19, as shown below:

Net Elasticity:

$$\frac{(2,280,000 - 3,333,000)}{(2,280,000 + 3,333,000)} = -0.19$$

The more appropriate measure of sensitivity for the temporally shifted trips is to calculate the cross elasticity, which measures the change in demand for one good (a peak-period bus trip) when the price changes for a substitute good (an off-peak bus trip). This is computed to be about +0.03 using the arc elasticity formula as shown below:

Cross Elasticity (peak shifts):

$$\frac{(4,450,000 - 4,210,000)}{(4,450,000 + 4,210,000)} = +0.03$$

(Note that the sign of the cross elasticity is positive indicating a direct relationship between peak ridership change and off-peak fare change.)

Examination of the disaggregate elasticities by the various socio-economic groups can help to identify how the response to the program was distributed. In particular, the variation of the disaggregate elasticities from the net elasticity in terms of magnitude and direction is indicative of the extent of each subgroup's sensitivity to the price change. Table 4.17 summarizes relevant disaggregate arc elasticities and their respective relationships with the net elasticity.

Table 4.17
DEMAND/PRICE ELASTICITIES

<u>Disaggregation Group</u>	<u>Arc Elasticity</u>	<u>Percent Variation From Net Elasticity</u> (1)
Trip Purposes:		
o Work	-0.11	- 42%
o School	-0.19	--
o Shop	-0.25	+ 32%
o Medical	-0.32	+ 68%
o Recreation	-0.37	+ 95%
o Social	-0.25	+ 32%
o Other	-0.19	--
Age of Rider:		
o 16 or less	-0.31	+ 63%
o 17-24	-0.24	+ 26%
o 25-44	-0.08	- 58%
o 45-64	-0.12	- 37%
o 65 or over	-0.12	- 37%
Household Income:		
o 5K or less	-0.09	- 53%
o 5K - 10K	-0.10	- 47%
o 10K- 15K	-0.41	+116%
o 15K- 25K	-0.08	- 58%
o Over 25K	-0.43	+126%
Auto Ownership:		
o Zero	-0.11	- 42%
o One	-0.22	+ 16%
o Two	-0.21	+ 11%
o Three(+)	-0.30	+ 58%
Household Size:		
o One Person	-0.23	+ 21%
o Two People	-0.10	- 47%
o Three People	-0.22	- 16%
o Four People	-0.16	+ 16%
o Five People	-0.19	--
o Six or more	-0.23	+ 21%

Source: On-board surveys (10/77 & 10/78); post-demonstration bus user follow-up survey (5/79).

(1) Positive (sign) variation indicates a higher than average (net) elasticity, while negative variation indicates lower than average.

The disaggregate elasticities tend to clarify and substantiate some indications of relative response:

- o The largest relative response seemed to come from middle and upper income riders.
- o There was some indication of an inverse relation between age and ridership response.
- o Among the large volume trip purposes, shopping trips appeared most elastic (higher elasticities were computed for other low volume purposes).
- o There seemed to be no discernible trend between household size and fare-free response.
- o There was an apparent direct relation between auto ownership and demand elasticity.

4.5.2 Regression Analyses

Analysis by regression techniques can be helpful in identifying and measuring the strength of relationships between various socio-economic variables and the response to the fare-free program. Very few potential relationships were identified during the analysis, however, there were two, as pointed out in the previous section. Disaggregate elasticity analysis indicated possible relationships between:

- o Age and ridership response as measured by, 1) changes in trip rates; and 2) by elasticity.
- o Auto ownership and ridership response as measured by elasticity.

Simple bivariate regressions of the grouped data indicated that there were strong correlations between each of these socio-economic indicators and the respective measures of ridership response. The intent of this analysis was to find if there was a direct, systematic relationship among the statistics of the grouped data. The elasticity of demand apparently varied directly (and systematically) with the number of autos in the trip-maker's household; with correlation coefficient of about 0.86. The percent change in trip rate appeared to vary inversely with age group, with a correlation of about 0.78. The correlation of elasticity with age group was somewhat lower at about 0.53. Other socio-economic variables including household size and income were similarly tested, with changes in rate and elasticity, but no correlations were found (R^2 of as low as 0.04). Relevant data are summarized in Appendix D. Apart from those three relationships, no other systematic correlations appear to be present in the data. This could indicate, that apart from random behavior, together with other influences, the response to Mercer Metro fare-free service was related only to age group and auto ownership.

4.5.3 Predicted Versus Revealed Behavior

A common technique for forecasting the impacts of changes to transit systems has long been to survey passengers and/or service area residents, asking them to predict their response to the subject change. This was done in the pre-demonstration surveys to enable a comparison of "predicted" versus "revealed" behavior as reported in later surveys. (Note: these were not taken from panel data.) Transportation analysts have known that predicted response is usually overestimated; comparison with revealed behavior provides a measure of the extent of overestimate in the Mercer County fare-free case.

As expected, survey respondents generally overestimated their use of the free-fare bus service based on comparison of predicted versus reported use. Prior bus users, being closer to the behavior in question, were far more accurate in their predictions than was the general populace. When asked to predict the number of trips they would make, rather than just a general "would" or "would not" use question, respondents were considerably more accurate. Table 4.18 summarizes responses to a general question and a frequency specific question and compares the pre-demonstration predictions with reported or observed behavior. (Additional data are presented in Appendix D.)

Table 4.18
PREDICTED VERSUS REVEALED BEHAVIOR

<u>General Use Question</u>	<u>Self-Reported Responses</u>		<u>Ratio of "Predicted" to "Revealed"</u>
	<u>Predicted</u>	<u>Revealed</u>	
Percent of people saying they would use the fare-free bus service:			
o Bus Users	80%	95%	0.8
o General Population	60%	5%	12.0
<u>Frequency-Specific Question</u>			
Average number of one-way, off-peak bus trips per week:			
o Bus Users	8.7	4.7	1.9
o General Population	2.1	0.2	10.5

Source: Telephone surveys (11/77 and 11/78); post demonstration bus user follow-up survey (5/79).

When asked simply to predict if they would or would not use the fare-free bus service, bus users seemed to underestimate their response slightly; the population as a whole, however, significantly overestimated its response. Asked to estimate the frequency of use of the free service, both groups predicted more use than they actually had. Bus users overestimated their response by a factor of about two, while the general population was overestimated by a factor of about ten.

The factors of overestimate are indications of the reliability which might be placed on survey-predicted response to such a change in fare policy. Clearly little credence can be placed on predicted use by the service area population which is mostly non-users of the bus service. Bus riders, who are typically more cognizant of the way the service is used, were more accurate in their predictions but also overestimated their response. Thus any such self-predicted survey results should be adjusted downward by those approximate factors to estimate fare-free ridership response.

5.0 TRANSPORTATION SUPPLY AND COST ISSUES

5.1 Effects on Quality of Service

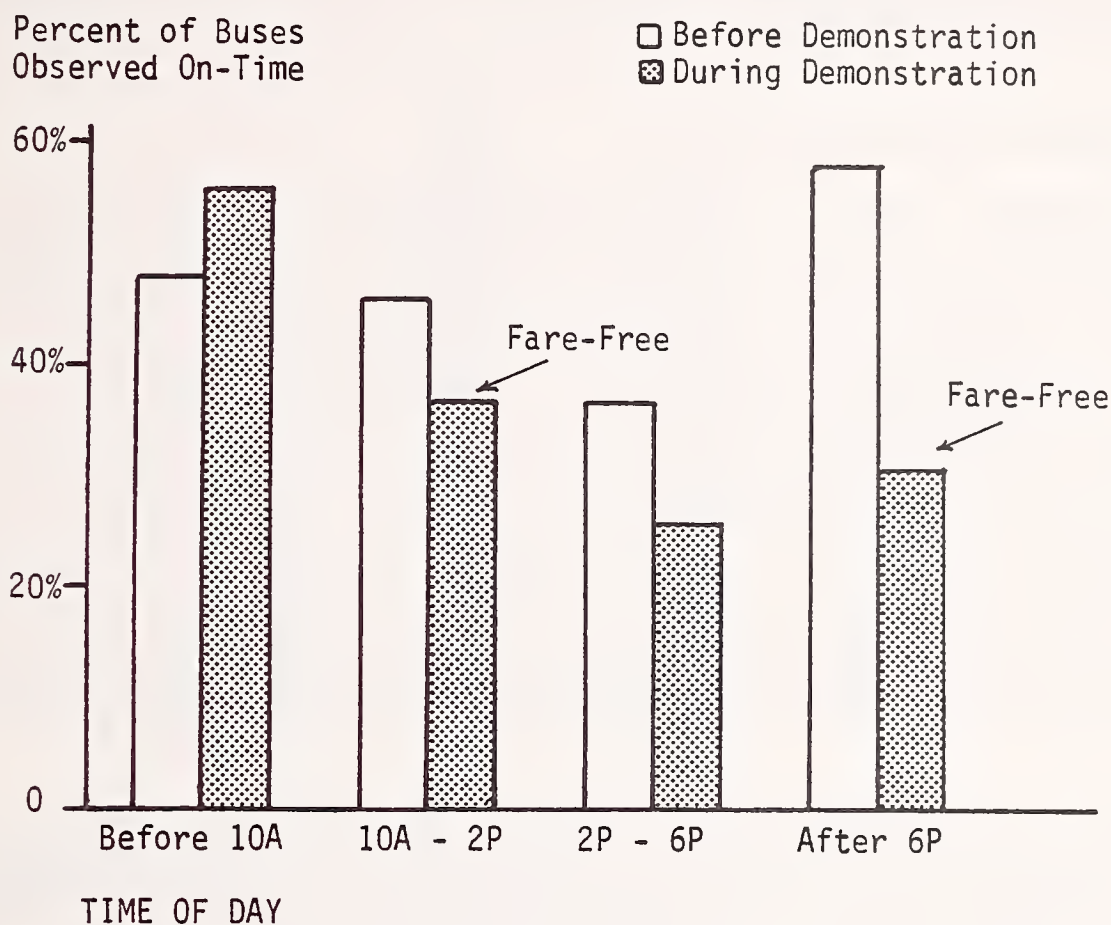
The increased passenger loads on Mercer Metro off-peak buses resulted in degradation of the quality of the service; mainly by increasing the occurrence and the length of bus delays. Passenger comfort deteriorated somewhat as well, manifested by increased crowding on the buses (larger average loads as well as increased occurrence of capacity-loaded buses) and an apparent increase in the level of on-board harassment, particularly by youths on some routes. Despite the indications that service quality was negatively affected, bus user attitudes did not seem to reflect general dissatisfaction with the service.

5.1.1 On-Time Performance

Some of the most clearly definable results of the fare-free demonstration were effects on the transportation operations of Mercer Metro. A major operational impact of the demonstration was, as might be expected given the increased passenger loads, an apparent increase in the run times of the buses. In the bus driver's interview, 64 percent indicated that they were experiencing longer trip times as a result of the free-fare program; 61 percent said they had shorter, or missed, layovers; and 53 percent said they had problems staying on schedule. The reportedly increased run times had noticeable effects on schedule adherence.

Analysis of data on the on-time performance of Mercer Metro buses indicated an overall increase in the occurrence of late bus arrivals during the demonstration. There was a comparable decrease in the percent of buses arriving early and a slight decrease in the overall percent of buses on-time (0 to 5 minutes late). (Other definitions of on-time were also examined with no disproportionate differences found.) Before the demonstration, about 50 percent of the off-peak buses observed were found to be on-time. At the same time, slightly over 40 percent of the peak period buses were on time. After fares were eliminated, off-peak on-time performance dropped to about 35 percent, while peak period performance decreased marginally. Figure 5.1 illustrates the observed on-time performance for the respective time periods. Appendix D presents related tabular data.

Figure 5.1
EFFECTS ON ON-TIME PERFORMANCE



5.1.2 Delay

It was estimated that before the demonstration approximately 20-25 percent of Mercer Metro off-peak buses were five or more minutes late; however, the increase in the off-peaks (fare-free periods) was relatively much larger. The portion of late peak period buses increased by about 15 percentage points (about a 40 percent net increase), while the off-peak portion increased by about 20 percentage points (a net increase of about 90 percent). Similarly, there was a slight decrease in the proportion of off-peak bus trips which were observed to be running ahead of schedule.

To investigate changes in the extent of delay, average delay (minutes/bus) was estimated for the buses which arrived after the scheduled time. Before off-peak fares were eliminated the estimated average off-peak period delay was about 4.4 minutes per bus; during the demonstration this increased to about 5.6 minutes per bus (a 27 percent increase). By comparison pre-demonstration peak-period delay was about 5.1 minutes per bus, which increased to about 5.3 during the months of the demonstration (about a four percent increase).

The nature of bus operations makes it difficult to isolate effects of delay into distinct time periods; delay impacts overlap time until the cause(s) are removed and the system has an opportunity to recover. Nonetheless, it seems that one effect of the passenger load changes resulting from free fare was to increase the occurrence of late buses and the extent of delay in the off-peak periods. Appendix D presents related data.

5.1.3 Passenger Loads and Crowding

Increased passenger volumes, with only minimal added off-peak bus service, would necessarily result in increases in the vehicle productivity of Mercer Metro. To measure the extent of increased loading, average bus loads were estimated for the times before, during, and after the fare-free demonstration, for the peak and off-peak periods. Figure 5.2 illustrates the apparent changes which occurred in bus occupancy; related tabular data are given in Appendix D. The data indicate that during the off-peaks the average load on Mercer Metro buses increased by about 60 percent, while during the peaks it only increased an average of about five percent. (Actually all of the peak increase appeared as a ten percent increase in the period from 2 PM - 6 PM, which is considered to be an indication of spillover from the abutting off-peaks.) Post-demonstration loads seemed to be slightly higher than before fares were eliminated, while during the peaks they were about the same as the pre-demonstration average. Weekend load effects were comparable to the weekday, but the largest relative increase in average load (a gain of about 125 percent) was estimated for the Saturday evening fare-free period.

The increase in bus occupancy was an indication that passenger comfort may have been degraded by the fare-free program. The extent of passenger discomfort (decreased seat availability and selection) was measured by examining changes in the rate at which buses loaded to or above seated capacity were observed. The extent of increased off-peak crowding is evident in Figure 5.3. (Tabular data are in Appendix D.) Before the demonstration, off-peak buses were observed loaded to capacity only about one to two percent of the time. Once fares were eliminated, however, the occurrence increased to about 15-20 percent of the buses. Peak period crowding remained about the same during the demonstration as it had been before. After the demonstration, crowding occurrence returned to levels at or below those observed before fares were eliminated.

Figure 5.2
EFFECTS ON BUS OCCUPANCY

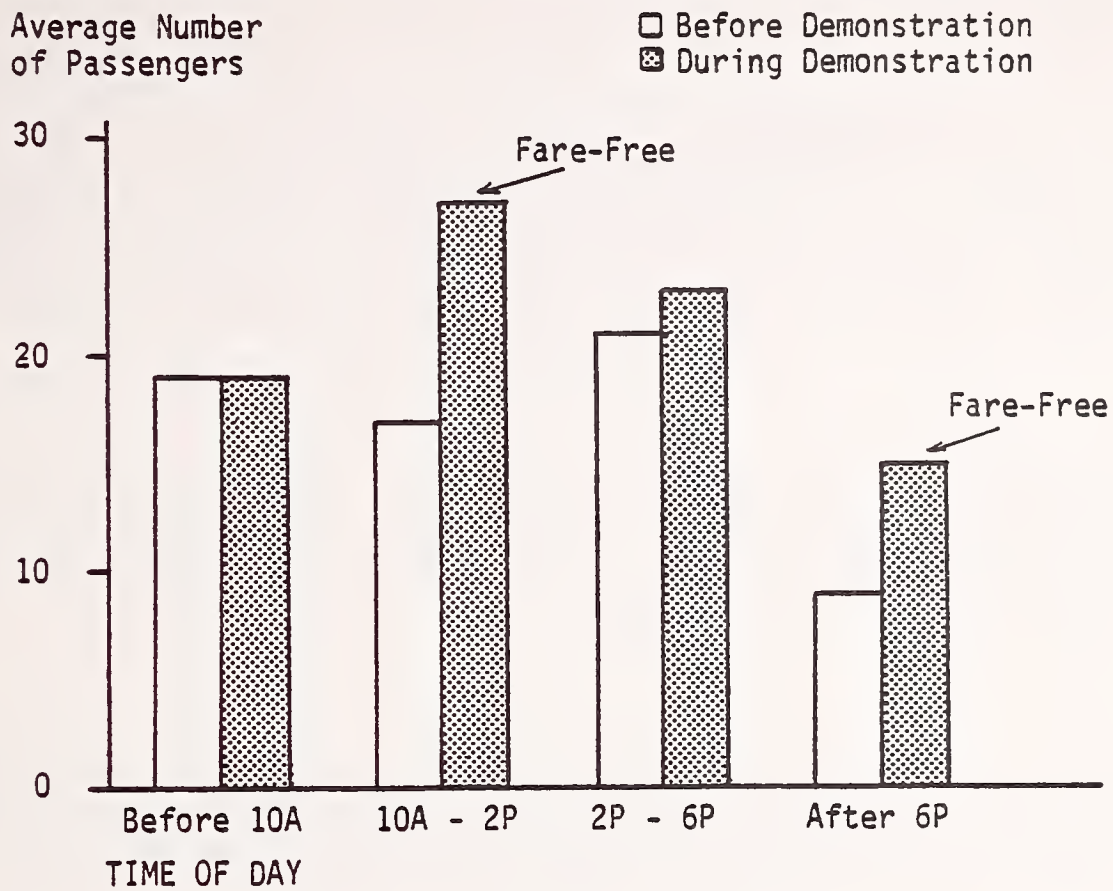
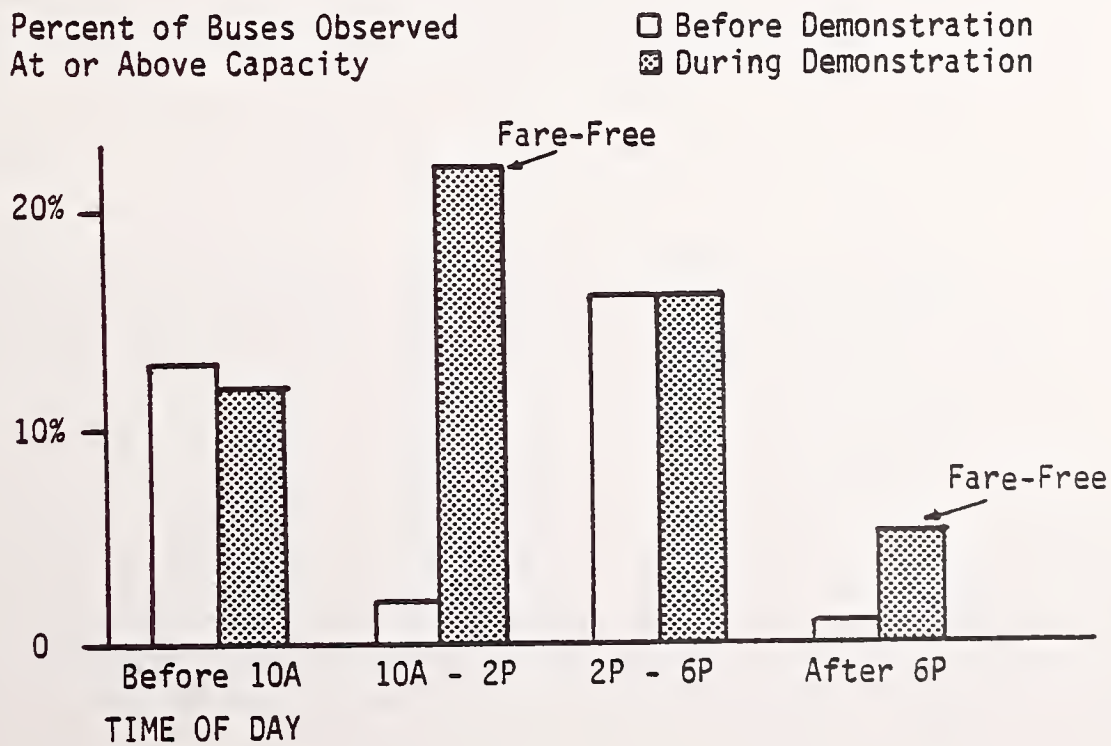


Figure 5.3
EFFECTS ON BUS CROWDING



5.1.4 On-Board Security

The most locally publicized issue related to the fare-free program was a perceived increase in the occurrence of on-board incidents of harassment, violence, or vandalism. To a large degree this perception was the reaction of bus drivers, a few passengers, and the management of a regional suburban shopping mall regarding a purported increase in rowdiness on the buses by young riders. Bus drivers complained that evening runs, and those serving the mall (especially on Saturdays) were particularly troubled by disorderly young people. As a result of a specific on-board incident, the local press joined the drivers in a protest against the rowdiness which was perceived to be a by-product of the fare-free program.

Data were assembled from a variety of sources to investigate the occurrence of on-board incidents and the juvenile rowdiness issue in particular. Mercer Metro driver report records were reviewed and incidents were tabulated; data from suburban shopping centers were reviewed to identify the rate of occurrence of incidents by juveniles; and special on-board observations of selected routes were performed by the Office of Investigative Services of the New Jersey Department of Transportation. The following summarizes these investigations.

On-Board Incidents:

Based on tabulations of Mercer Metro driver reports for 1977, 1978, and the first six months of 1979, there was an overall increase in on-board incidents during the demonstration; however, the increase was shown to begin around November 1977 - four months before the free-fare program began (March 1, 1978).

Until early summer, there was no additional significant increase in the absolute numbers or rate of occurrence of vandalism, passenger abuse, operator abuse, or personal property damage incidents. During the summer months the occurrence rate dropped to early 1977 levels, adding credence that the incident problem (whether fare-free related or not) was linked with school age youths. In fall 1978 the rate of incidence again rose, but not as high as previous months. February 1979, the last month of the demonstration, posted a large increase in the number and rate of incidents, though no public reaction was noted. Post-demonstration data show incidence levels typical of the months before October 1977.

Before fares were eliminated, there was an average of 2.1 incidents of the abusive or harassment type reported per month by Mercer Metro drivers. (Incidents included are occurrences such as assaults, thefts, vandalism, drunk or disorderly persons, etc.; they do not include accidents, off-bus vandalism, etc.) The rate of occurrence before the demonstration was about one incident for every 260,000 person-trips. During the demonstration there was an average of 4.5 incidents reported per month, one for every 140,000 passengers, representing double the pre-demonstration rate of occurrence. While this was a relatively large increase, the numbers do not reflect the fact that the beginning of the higher incidence rate pre-dated fare elimination by about four months. This pre-demonstration increase confounds the extent to which higher rates of incidence can be attributed to fare elimination. However, it is fairly certain, based on driver and passenger complaints, that there was a change in on-board atmosphere caused by boisterous, inconsiderate, unruly

youths, if not a real increase in serious on-board incidents. It also appeared that these conditions, which may have been perceived by some passengers as offensive or threatening, were most prevalent on particular routes (those serving the shopping mall) at particular times (evenings and Saturdays), rather than a service-wide occurrence.

During the fare-free demonstration, the temporal distribution of on-board incidents seemed to change. Before the demonstration, 54 percent of the total incidents occurred during the off-peak hours; seven percent were during the midday, 31 percent during the evening, and 16 percent on Sunday. During the demonstration, 74 percent of the total occurred during the off-peak; with 19 percent during the midday, 46 percent at night, and nine percent on Sundays. Based on a small (three month) sample, since the end of the fare-free demonstration, 60 percent of the total incidents have occurred during off-peak hours.

In addition to the review of drivers' reports special on-board observations were made of passenger behavior. Investigators from the New Jersey Department of Transportation's Bureau of Investigative Services made unannounced checks of conditions on-board Route K and at the bus stop serving the regional shopping mall. Two incident types were commonly observed during the fare-free periods: 1) smoking/eating on the bus, and 2) use of profane/loud language. These incidents occurred on the average of three times per trip; no before data are available to indicate if this represented an increase since the free-fare program began. Mercer Metro management indicated that such incidents have always occurred to some degree on the buses as might be expected in any public place. The observed rate of occurrence of these incidents does not appear to be extraordinary. No incidents were noted in the more serious categories involving property damage and personal harassment.

The impact of on-board rowdyism on ridership was probably small. About 15 percent of the respondents to the post-demonstration bus-user follow-up survey reported that they had avoided using the free bus for some reason. Of those respondents, about 36 percent (or about five percent of the total) reported that the reason they avoided using the free bus was some type of on-board rowdyism.

5.2 Effects on Service Utilization

Early interest in the effects of fare-free service on supply-side issues decreased as the demonstration progressed. Despite the increased occurrence and extent of bus crowding, the demonstration did not seem to have major effects on the Mercer Metro operations in terms of fleet and driver requirements or vehicle maintenance on a system-wide basis. One corridor, however, did experience marked supply-side effects.

5.2.1 Fleet Utilization

5.2.1.1 Fleet Requirements and Service Mileage

Service changes during the demonstration were limited to the addition of "trailer" buses ("double-headers"); buses which operate on the same schedule as another, trailing the scheduled bus solely to provide additional capacity. Mercer Metro dispatchers retained a log of the fare-free trailers for the period March 1978 through December 1978. (Extrapolations were made to estimate the twelve-month demonstration totals where appropriate.)

During the demonstration period, about 230 extra buses were dispatched to meet heavy passenger demands during the fare-free service hours. Virtually all of this extra service was required by one route (Route K) which connects downtown Trenton with most of the suburban shopping malls. Table 5.1 summarizes extra service requirement data.

Table 5.1
EXTRA SERVICE REQUIREMENTS

<u>Month</u>	<u>Number of Extra Bus Runs</u>	<u>Number of Extra Hours</u>	<u>Percent of Extra Hours</u>	
			<u>Saturday</u>	<u>Sunday</u>
March 1978	56	273	33%	16%
April	20	118	43%	57%
May	29	87	13%	48%
June	14	45	20%	58%
July	11	63	5%	76%
August	6	41	-	100%
September	8	52	-	75%
October	12	74	-	88%
November	21	114	23%	46%
December	29	165	42%	32%
January 1979 ⁽¹⁾	10	55	-	80%
February ⁽¹⁾	10	55	-	80%
TOTAL	226	1142 ⁽²⁾	23%	50%

Source: Mercer Metro dispatcher's log.

(1) Extrapolated.

(2) 99% on Route K.

The extra buses operated an estimated 1150 platform hours (99% on Route K), of which about 70 percent were in the free periods. (Schedule overlaps generated about 350 hours of extra service in the abutting peak periods.) Nearly 75 percent of the

extra service was required on weekends; 23 percent on Saturdays, and 50 percent on Sundays.

Extra service requirements were greatest in the initial months of the demonstration when interest and ridership were highest, gradually dropping off through the summer months and peaking again in November and December during the holiday shopping peaks. Weekday extra service demands, after March, were concentrated in May and June, and around the July 4th, Thanksgiving and Christmas-New Years holidays.

The dispatchers' diary does not indicate the mileage logged by the extra buses, but a reasonable estimate can be made based on average speed. Presuming an average operating speed of 15 miles per hour (equivalent to the scheduled speed of Route K), the trailer buses travelled an estimated total of nearly 17,300 miles (4100 miles in March 1978 alone). This represents an increase of less than one percent (0.7%) over the annual system mileage for the fare-free routes (2,592,000).

5.2.1.2 Effects on System Productivity

The estimated total ridership for the twelve-month demonstration period was 7,780,000 passengers; 3,570,000 (46%) during off-peak periods. Had there not been fare-free bus service the projected ridership during the same twelve months would have been 6,700,000 passengers; 2,280,000 (34%) during the off-peaks. Based on estimates of the proportion of hours of service in the off-peak periods, the total number of miles of bus service in the off-peaks was estimated to be 925,000 per year (39 percent of the total). Using these figures, the values of common system productivity indicators, with and without free-fares, are as shown in Table 5.2.

Table 5.2
EFFECTS ON PRODUCTIVITY AND EFFICIENCY

Indicator	Off-Peak Fare Basis		Marginal ⁽¹⁾ Effect
	With Fares	Without Fares	
<u>Passengers Per Bus Mile</u>			
o Total	2.6	3.0	-
o Off-Peak	2.3	3.4	-
o Peak Periods	2.8	2.7	-
<u>Passengers Per Bus Hour</u>			
o Total	34.0	39.4	-
o Off-Peak	29.6	44.4	-
o Peak Periods	36.8	36.1	-
<u>Passengers Per Dollar</u>			
o Total	2.5	2.6	3.0
o Off-Peak	1.8	2.2	3.3
o Peak Periods	3.2	3.1	-

(1) Change in passenger volume relative to incremental change in mileage, service hours, and cost.

Examination of the productivity indicators in the table clearly illustrates the effectiveness of the fare-free demonstration in increasing ridership relative to the supply-side resource investment. The fare-free program increased overall system productivity by raising off-peak vehicle productivity to levels higher than in pre-demonstration peak periods with only minor losses in peak productivity.

Supply-based productivity analysis illustrates the relationship between fare-free generated ridership and added supply, but is incomplete because it does not consider the total cost of generating the new ridership. It neglects the effects of the loss of off-peak revenue and the cost of the added service, however small that may be. The indicator of passengers per dollar spent to provide the service does consider those factors. As shown in the table, the fare-free service registered an improvement in this category as well. The marginal effect shows that the gain in passengers relative to the resource investment was larger than prior off-peak performance on the system, even with consideration of all costs. These indicators imply that, if consideration of the absolute monetary cost is excluded, fare-free service can yield high ridership return. (It must of course be kept in mind that these comparisons are based on a system with a very low prior off-peak fare of 15 cents.)

A further indication of the extent of productivity increase on the system was the experience with boardings on a per-trip basis. Based on projected ridership without free-fare, average loading during the off-peak hours would have been about 60 boardings per round trip (2,280,000 passengers on 38,000 trips). The estimated actual loading was over 90 boardings per round trip (3,570,000 passengers on 38,500 trips), a 50 percent increase.

5.2.2 Effects on Labor

The most significant and direct effect of the program on the Mercer Metro workforce was the increase in driver hours necessitated by added off-peak service. About 1,150 additional driver hours were logged, commonly ranging from short assignments of 45 minutes to full shifts of about eight hours. (The increased passenger loads on the Route K bus were not restricted solely to off-peak hours; though generated by and during fare-free times, the effect on demand was often distributed throughout the day to accommodate return trips.) The drivers for the extra service were, for the most part, extra-board drivers who would have been paid whether or not they had been assigned to the free-fare trailers.

The only other staff position noticeably affected by the fare-free demonstration was that of fare-box emptier. Mercer Metro has usually found it necessary to empty its fareboxes five nights a week. During the demonstration, because of the reduced revenue, there was apparently only need to empty the boxes three nights a week. Since the demonstration was only scheduled to last one year, Mercer Metro decided not to change the collector's duties and then have to return to five-night emptying. If, however, free-fare was a permanent policy, it is likely the operator would assign that person additional duties, resulting in some minor improvement to staff utilization.

There were no changes required in administrative and operational staff assignments. The only noticeable impact on these areas was during the first weeks of the demonstration when there was an increase in requests for route and schedule information.

5.2.3 Effects on Vehicle Maintenance

Mercer Metro management has indicated that there was no noticeable effect on vehicle maintenance, either mechanical or cosmetic. No extraordinary increases were noted in maintenance costs during the demonstration period. The lack of impact on maintenance is not surprising considering the low level of increased service mileage.

5.3 Financial Impacts

5.3.1 Revenue Loss

The major cost element of the fare-free program (exclusive of demonstration related costs) was the loss of revenue resulting from off-peak fare elimination. This loss had two components: the loss of regular off-peak revenue and a loss from regular peak-period riders who shifted trips to the off-peaks.

Farebox receipts for regular route service during the twelve month period from March 1977 through February 1978 (the twelve months immediately preceding the demonstration) totaled approximately \$1,340,000. Based on an annual growth factor of 1.023 (as determined by average compound factor for observed annual revenue growth), the expected revenue for the 12-month demonstration period would have been about \$1,370,000. Projected revenue through the demonstration period had there not been a peak period fare increase, was estimated to be approximately \$1,031,000.

The difference of \$339,000 represents the estimated net revenue loss to Mercer Metro. (A pre-demonstration estimate prepared by the New Jersey Department of Transportation projected off-peak revenue loss as \$332,000.) Approximately \$280,000 of the loss was attributable to loss of revenue from regular off-peak passengers (including estimated normal growth), while \$59,000 was attributable to a net loss in revenue from peak-period ridership decreases. Table 5.3 summarizes the annual ridership and revenue projections.

Table 5.3
 SUMMARY OF RIDERSHIP/REVENUE IMPACTS

Projected Without Free-Fare (Trends Extended):

	<u>Annual Passengers</u>	<u>Annual Revenue</u>
Off-Peak	2,280,000	\$ 280,000
Peak	<u>4,450,000</u>	<u>\$1,090,000</u>
TOTAL	6,730,000	\$1,370,000

Estimated With Free-Fare:

	<u>Annual Passengers</u>	<u>Annual Revenue</u>
Off-Peak	3,570,000	\$ -
Peak	<u>4,210,000</u>	<u>\$1,031,000</u>
TOTAL	7,780,000	\$1,031,000

Net Effects:

	<u>Annual Passengers</u>	<u>Annual Revenue</u>
Off-Peak	+1,290,000	-\$ 280,000
Peak	<u>- 240,000</u>	<u>-\$ 59,000</u>
TOTAL	+1,050,000	-\$ 339,000

5.3.2 Operating Costs

The only potentially significant effects on Mercer Metro operating costs were in the areas of extra service requirements and changed staff functions; these effects were very small. Although there may be additional maintenance costs associated with increased passenger volumes (i.e., increased wear-and-tear resulting from more stops and larger loads) these were so small, if they existed at all, that they were unnoticeable.

It was estimated that Mercer Metro provided an additional 17,300 miles of service during about 1,150 platform hours. The costs of this extra service can be divided into: labor costs, fixed or station costs, and variable or mileage costs. Based on the Mercer Metro cost allocation formula, the maximum cost of the extra service would be as follows:

<u>Item</u>	<u>Unit Cost(1)</u>	<u>Units</u>	<u>Cost</u>
Labor	\$12/hour	1150 hours	\$13,800
Mileage	\$0.56/mile	17,300 miles	8,700
Fixed	\$11,500/peak vehicle	N/A	--
TOTAL			\$22,500

The cost allocation formula, however, does not consider the marginal cost of providing the extra service. Essentially all of the drivers used for this service were extra-board drivers who are paid their full rate regardless of whether or not they drive. Therefore, assigning them to this service added no marginal labor cost. The only costs which were actually incurred were the mileage related expenses of putting the vehicles on the road, somewhat under \$10,000.

There were some indications that a small cost saving could be realized by a reduced need for farebox emptying from five to three times per week. Presuming that this were in fact possible, and the saved time could be productively reassigned, the value to the operator could be on the order of \$8,500. The cost saved by reduced money-handling would almost evenly offset the marginal cost of providing the extra service, thereby reducing the operating cost considerations considerably. The extent of operating cost impacts is so small as to be meaningless relative to revenue loss.

5.3.3 Effects on Transit Subsidization (2)

Total 1978 costs for Mercer Metro (excluding charter operations) were about \$4,595,000 (3), of which an estimated \$4,054,000 was attributable to the operation of the routes which were included in the fare-free program. Similarly, the 1978 estimated revenue attributed to those routes, if there had been no fare-free program, was about \$1,370,000.

Based on an annual cost of about \$4,054,000; estimated revenue of about \$1,031,000; and total passenger volume of about 7,780,000 for the demonstration, the net cost per passenger was estimated to be about \$0.39. If there had been no fare-free program the total costs would have been about the same (\$4,054,000), with revenue of about \$1,370,000 and ridership of about 6,730,000, the net cost per passenger would have been about \$0.40.

Unitized loss per passenger with fare-free service was slightly lower (about one cent per passenger) than it would have been expected to be with fares, because of high

(1) 1978 unit rates inflated at 10% per year; source: Trenton/Mercer Transit Development Study, March 1978.

(2) Revenue figures used in the financial impact analyses have been adjusted to reflect the estimated values had there not been a peak-period fare increase.

(3) Report to the New Jersey Public Utilities Commission, Mercer Metro Division, 1978.

productivity during the demonstration for little extra cost and a particularly low pre-demonstration off-peak fare (15 cents). However, despite the small improvement in unit loss, there were no substantial cost savings to offset the absolute loss of revenue, thereby requiring added subsidization. Table 5.4 summarizes the estimated subsidization data.

Table 5.4
SUMMARY OF EFFECTS ON TRANSIT SUBSIDIZATION

<u>Indicator</u>	<u>Off-Peak Fare Basis</u>		<u>Difference</u>
	<u>With Fares</u>	<u>Without Fares</u>	
Passengers:			
o Peak	4,450,000	4,210,000	- 240,000
o Off-Peak	<u>2,280,000</u>	<u>3,570,000</u>	<u>+1,290,000</u>
o Total	6,730,000	7,780,000	+1,050,000
Operating Cost:			
o Total Cost	\$4,054,000	\$4,054,000	-
o Unit Cost	\$0.60	\$0.52	-\$0.08
Estimated Revenue:			
o Total Revenue	\$1,370,000	\$1,031,000	-\$ 339,000
o Unit Revenue	\$0.20	\$0.13	- \$0.07
Transit Subsidy:			
o Total Deficit	\$2,684,000	\$3,023,000	+\$ 339,000
o Unit Deficit	\$0.40	\$0.39	- \$0.01

An alternative to additional subsidization might be found in differential pricing of the peaks and off-peaks. To recoup the off-peak revenue loss, peak-period revenue would have to increase by \$339,000; considering additional expected losses in peak ridership the average peak revenue might have to increase from about 24 cents per passenger to 36 cents per passenger, approximately a 50 percent increase, requiring a peak period fare of about 45 cents (compared with 30 cents). This peak fare increase would have to be considerably larger to recoup the losses with Mercer Metro's present fare structure (40 cent base fare, no system-wide off-peak half-fare). (The above is based on crude approximations; it is presented only as an order-of-magnitude indication of the required pricing differential.)

5.3.4 Fare Savings Benefits

The elimination of off-peak fares constituted a benefit to the users which was derived from their fare savings. For those trips which would have been taken even if fares were charged, the benefit can be valued at the average off-peak fare which was about 12 cents per passenger. For trips diverted from the peak period service, the benefit can be valued at the average peak fare which was about 24 cents per trip. (Clearly fare is not the sole determinant of "price".) For newly generated trips, both by prior off-peak riders and by new off-peak riders the value of the trip must be discounted from the 12 cent level. Assuming a linear demand curve, the discounted value of new trips would be placed at an average of about 6 cents (midday between zero and the 12-cent pre-demonstration average). Given those assumptions and the estimated free-fare ridership composition, the total benefit of the fare savings would be about \$403,000 as indicated in Table 5.5.

Table 5.5
ESTIMATED FARE SAVINGS BENEFITS

<u>Type of Trip</u>	<u>Estimated Number of Passengers</u>	<u>Average Value of Each Trip</u>	<u>Estimated Benefit</u>
Prior Off-Peak Bus Trip	2,280,000	\$0.123	\$280,000
Diverted from Peak Bus	240,000	\$0.245	\$ 59,000
New Trip By Prior Rider	525,000	\$0.060	\$ 32,000
New Trip by New Rider	<u>525,000</u>	<u>\$0.060</u>	<u>\$ 32,000</u>
TOTAL	3,570,000	\$0.113	\$403,000

6.0 SECONDARY EFFECTS

6.1 Effects on Bus Drivers

The headquarters of one of the largest bus drivers' unions, the Amalgamated Transit Union (ATU), was an early and ardent supporter of fare-free transit. With this influence, Mercer Metro drivers were initially enthusiastic about the Mercer County Demonstration. Not long after off-peak fares were eliminated Mercer Metro drivers became opposed to the demonstration, however, asking that it be prematurely ended. Complaints by bus drivers were the principal catalyst for a county-sponsored public hearing in June 1978 to air grievances about on-board crime and harassment.

A sample of Mercer Metro drivers, who had collectively driven all fare-free times and routes, were interviewed in September 1978 regarding their experiences with the program. Their responses are summarized below:

- o Nearly all of the drivers interviewed (95 percent) reported having received bad comments from passengers regarding the fare-free program; 89 percent said they frequently received bad comments.
- o Good comments about the program were reported by 31 percent of the drivers; only six percent said good comments were received frequently.
- o Ninety-two percent of the drivers said the program made their job less enjoyable, while the remainder (8%) said it was made more enjoyable or not affected by the demonstration.

Common complaints about the program centered on the effects on running time and delay and consequential loss or reduction of layover breaks. Other areas of objection concerned an increase in on-board incidents of rowdyism and harassment which the drivers attributed to the fare-free demonstration. The drivers contended that previous users, especially senior citizens, had stopped using the off-peak bus service to avoid the on-board incidents. Table 6.1 summarizes drivers' responses to questions about the nature of on-board behavior and discipline problems. The responses clearly indicate the extent of the drivers' negative perceptions and attitudes toward the program. By contrast the public's attitudes toward free-fare, and Mercer Metro in general, were more positive. With regard to "on-board safety", however, bus riders did not report increased positive perception, during the demonstration, whereas for other characteristics they did.

Table 6.1
 BUS DRIVERS' PERCEPTIONS OF CHANGES IN INCIDENT OCCURRENCE

Type of Incident	Frequency of Occurrence Without Fares				
	Much More	More	Same	Less	Much Less
Passenger Argument					
o With a Driver	97%	3%			
o With Others	79%	18%	3%		
Smoking/Eating/Drinking	97%				3%
Offensive Language/Behavior	97%				3%
Vandalism	85%	6%	9%		
Attempted Theft	57%	14%	25%	4%	
Joyriding	100%				

Source: Mercer Metro Drivers' Interview (9/78).

6.2 Effects on Public Attitudes Toward Transit

Respondents to the telephone surveys were asked about their general perception of whether Mercer Metro service was meeting the county's public transportation needs. Before the demonstration began 80 percent of the bus users said they were satisfied, 51 percent were "very" satisfied (nine percent had no opinion); after fare elimination this was only slightly higher at 85 percent, with 55 percent "very" satisfied (two percent had no opinion). (Among the randomly selected population sample, 45 percent had no opinion before the demonstration dropping to 35 percent during.) Among responses from the general population, 76 percent said they were satisfied, 29 percent "very", before fares were eliminated; 79 were satisfied after fare elimination, with 51 percent "very" satisfied. These indicate a slightly more favorable perception of Mercer Metro adequacy, but this may be largely a response to greater awareness of the service.

Table 6.2 summarizes analysis of the reported attitudes of bus users and the population at large with respect to five characteristics of the Mercer Metro system before and during the fare-free demonstration. (See footnotes to the Table for an explanation of the quantification system.)

The scores indicate that the general population was considerably less satisfied with Mercer Metro service before fares were eliminated and continued to be so during the demonstration, despite an apparent overall increase in satisfaction. Before the demonstration began, a sample of the population-at-large had an average indeterminant response ("don't know") for all five characteristics of nearly 45 percent (i.e., only about 55 percent of the people surveyed had an opinion). During the demonstration the percent not responding was about 50 percent (not a significant change). Thus, the level of transit awareness of the general public, as measured by the willingness to express an opinion, does not seem to have been enhanced by the fare-free program. Among those willing to express an opinion the responses of the general population were markedly similar to those of bus users in most instances.

Table 6.2
PERCEIVED ATTITUDES TOWARD MERCER METRO SERVICE

	Score ⁽¹⁾ for System Attributes				
	<u>Cost Of Bus</u>	<u>Travel Time</u>	<u>Comfort of Bus</u>	<u>Convenience</u>	<u>On-Board Safety</u>
<u>Users</u> ("Don't Knows" 1-2%)					
Before	1.0	0.8	0.9	1.0	1.0
During	1.4	1.2	1.1	1.5	1.0
<u>General Population</u> ("Don't Knows" 45-50%)					
Before	0.5	0.5	0.5	0.5	0.5
During	0.7	0.6	0.6	0.6	0.6
<u>General Population</u> (Excluding "Don't Knows")					
Before	1.0	0.8	0.9	0.8	0.9
During	1.5	1.2	1.2	1.0	1.2

Source: Bus user and random telephone surveys, before and during demonstration.

(1) Scoring basis: Product of arbitrarily assigned response point values (very unsatisfied = -2; unsatisfied = -1; satisfied = +1; very satisfied = +2) and percent (decimal equivalent) responding. See Appendix D for percent responses.

Bus users reported increases in favorable attitudes toward all five of the system characteristics. This is somewhat surprising since there are strong indications that travel time was lengthened by the increased passenger loading resulting from free off-peak service. Similarly, attitudes toward passenger comfort might have been expected to become more negative because of decreased seat availability with more bus crowding. Also, a reported increase in on-board rowdiness and harassment might have been expected to result in a more negative perception of on-board safety. The overall positive trend of perceptions of the system attributes may be indicative of a strong "good news" response to fare elimination which could have subliminally affected perceptions of all characteristics.

Survey respondents were asked two questions related to financing local public transportation. The first generally asked if the tax support for Mercer Metro should be increased, held the same, or decreased. The second specifically asked about paying more taxes to support fare-free service. Table 6.3 summarizes the response to these two questions before and following fare elimination. As might be expected, bus users tended to be more supportive of general tax support for bus service than the population in general was. Also, during the demonstration, bus users reported an increase in their support for tax assistance to Mercer Metro. The population at large reported less support for Mercer Metro tax assistance during

the demonstration than before, in spite of a general increase in positive attitudes toward the bus services by the same group. (It should be noted, however, that neither group moved toward the lower tax support position.)

While support for general tax assistance stayed about the same or increased slightly during the fare-free demonstration, support for added taxation to maintain fare-free service generally declined. Using a scoring system as described earlier (-2 to +2) to aggregate and measure the responses to the fare-free tax support question indicates that although bus users were not particularly supportive of the concept of taxation for fare-free service before the demonstration, the general attitude was a drop in support, with increased polarization, after fares were eliminated. A similar polarization of opinion was reported by the general population sample, with the overall trend slightly favorable although remaining negative. (Although individual changes in proportions were statistically significant, changes in the calculated mean "scores" were not.) Interestingly, this was the only attitudinal question which had a small portion of non-responses among the general population.

Table 6.3
TAX SUPPORT FOR FARE-FREE SERVICE

	Percent of Responses			
	By Users		General Population	
	Before	During	Before	During
<u>General Tax Support:</u>				
o More tax	41	51	30	23
o Same tax	21	27	20	29
o Less tax	13	7	8	6
o No opinion	25	15	42	42
<u>Added Tax for Free-Fare:</u>				
o Strongly favor	24	31	9	22
o Favor	21	16	22	16
o Oppose	12	18	20	15
o Strongly oppose	21	29	34	40
o No opinion	22	6	15	7

Source: Bus user and random household telephone surveys before and during demonstration.

Throughout the demonstration there were indications that there was more support for limited fare-free transit than for system-wide fare elimination. In particular, there were commonly references to support for free transit for senior citizens. Despite the system-wide intent of this experiment, a question was included in the telephone surveys conducted during the demonstration to somewhat measure this stratified support. Following is a breakdown of support for free transit service among major subgroups of the target public. The elderly received the most support among both users and the general public, followed by low income people. Free transit for young people was supported by less than one-third of each group.

<u>Support Free Transit For:</u>	<u>Bus Users</u>	<u>General Population</u>
Elderly	95%	90%
Poor	71%	66%
Young (16 or Under)	31%	31%

Telephone survey respondents were asked to indicate if they supported changes to the hours of free service. While the majority favored continuation of the off-peak free service, only about one-third favored expansion of the free service hours. A small portion favored total discontinuance of the free service.

<u>Support Free Transit During:</u>	<u>Bus Users</u>	<u>General Population</u>
Same Hours	74%	61%
Expanded Hours	34%	40%
No Hours	14%	19%

People who reported using the off-peak bus service more frequently during the demonstration than before (including new users) indicated most often (68 percent) that the cost saving was the reason for their increased travel; some (12 percent) indicated that the convenience of not having to pay the fare was the reason. Among those reporting fewer trips during the demonstration (six percent) most (80 percent) attributed it to a non-free-fare related reduction in the number of trips, while the remainder blamed on-board conditions (rowdiness, etc.).

When asked what they liked about the fare-free program, 64 percent of the sample bus riders said the cost savings to themselves; 23 percent cited the convenience of no-fare boarding; seven percent said they liked that the bus was free for other people (typically for senior citizens); and six percent liked other things. Nine percent said they did not like anything about the program. When asked if they generally liked or disliked the fare-free program, 91 percent indicated that they had liked it. Twenty-eight percent of the sampled riders said they did not like the crowded buses, during the demonstration; twenty-three percent specifically cited on-board rowdiness or harassment as a problem; while 12 percent indicated that they, in some way, disliked the increased exposure to other passengers (strangers). Together these represent a sizable number of negative comments all of which are to a large degree representative of the lack of privacy on transit systems and the aggravation thereof which occurs with increased ridership. Other types of negative comments, including references to increased bus delay, were made by about eight percent of the respondents. Forty-four percent of the respondents indicated that they did not dislike anything about the program.

6.3 Environmental Impacts

Based on reported modal shifts, the fare-free program diverted about 4,000 auto-driver trips and 3,000 auto-passenger trips per week. Presuming that each diverted trip represents an avoided auto trip, there would be an estimated 350,000 to 400,000 avoided auto trips per year. Using an average trip length of 4.0 miles (longer than the estimated length of 3.0 miles) would yield an estimate of avoided automobile travel of about 1.6 million vehicle-miles (VMT) per year.

Estimates of the total 1977 VMT in Mercer ranged from 3.5 million per day⁽¹⁾ to 6.0 million per day⁽²⁾. Using a conservative estimate for 1978 of 3.5 million VMT per day yields an annual total of about 1.3 billion VMT per year.

Using a liberal estimate of VMT saved by the fare-free demonstration and a conservative estimate of total VMT in the county results in an estimated VMT reduction due to free off-peak bus service of about 0.1 percent. It is evident that this could hardly have a noticeable effect on local traffic congestion, air quality, or energy consumption. In fact, if all of the VMT savings were concentrated within the city of Trenton (220 million annual VMT) the reduction would still be less than one percent (0.7%). It should be pointed out, however, that if the Mercer Metro system were to divert auto passengers far in excess of its total capacity the effect on regional VMT would still be small. For example if Mercer Metro ridership were to double and all new passengers were diverted auto drivers, the effect on regional VMT would be only about 2%.

6.4 Revitalization of the Inner City

One of the major objectives of fare-free transit is to serve as a catalyst in the improvement of the vitality of urban cores. Trenton, as discussed earlier, has been a city with common characteristics of urban decay. Mercer Metro extensively serves Trenton's downtown, however, with the hub of the city serving as the focus of the system's radial route network. (Only one route, a crosstown shuttle with low service levels, does not pass through the core.) The system operates on a timed-transfer basis, with the transfer point at downtown Trenton.

There is an existing commercial center (downtown mall) in Trenton called The Commons. It is two blocks of auto-free plaza in the heart of Trenton's mercantile area. It is reasonable to expect that the first indication of revitalization of the core would be an increase in the number of shopping trips destined to the downtown because the attraction was already in place. Before the demonstration began, about nine percent (9%) of the total trips were shopping trips destined toward Trenton (20 percent of all in-bound trips); after fares were eliminated this increased to nearly 19 percent (33 percent of all in-bound trips). By comparison, out-bound off-peak shopping trips represented 11 percent of all off-peak trips before the demonstration (20 percent of the out-bound trips), and 16 percent after fare elimination (39 percent of out-bound trips). It appears that the downtown mercantile area experienced both an overall increase in shopping destinations which was relatively larger than the increase among trips destined away from Trenton. At the same time, the percent of in-bound trips increased from 45 percent of the total before the demonstration to 58 percent of the total during. Appendix D presents detailed data on trip purposes by direction.

In the absence of usable data on retail sales volume for merchants served by the free buses throughout the service area, a survey was conducted to measure the merchants' perceptions of the program. Over 100 responses were received from merchants in the

(1) Source: Delaware Valley Regional Planning Commission.

(2) Source: New Jersey Department of Transportation.

Trenton core, a regional shopping mall, and two smaller suburban shopping centers. Merchants were asked about their perceptions of the free off-peak program relative to its effects on their businesses. About 27 percent of the comments received were positive (i.e., increased shoppers, increased sales, etc.), while 57% were negative (i.e., decreased shoppers, increased loitering, etc.); 16 percent commented that there had been no effect noticed. Forty-one percent of the respondents said that they support fare-free transit as a means of bringing people to their stores; 37 percent support a tax-based payment for free-fare. When asked if they would be willing to participate in a merchant-funded free transit program, only about five percent said they would. Table 6.4 presents details on the merchants' responses.

Table 6.4
MERCHANTS' SURVEY RESPONSES (July 1979)

	Number of Responses	Positive Comments	Negative Comments	No Effect	Support Free-Fare	Support Tax For Free-Fare	Support Merchant Funding
<u>All Stores:</u>							
CBD (1)	25	10	23	7	9	9	2
RSM (2)	57	27	64	12	21	18	2
SSC (3)	29	13	17	10	16	14	2
Total	111	50	104	29	46	41	6
<u>Retail Stores:</u>							
CBD	22	7	23	6	7	7	2
RSM	46	24	54	8	17	14	1
SSC	21	9	15	7	12	10	1
Total	89	40	92	21	36	31	4
<u>Services:</u>							
CBD	3	3	0	1	2	2	0
RSM	11	3	10	4	4	4	1
SSC	8	4	2	3	4	4	1
Total	22	10	12	8	10	10	2

- (1) CBD = Trenton Commons.
(2) RSM = Regional Shopping Mall.
(3) SSC = Suburban Shopping Centers.

7.0 IMPLEMENTATION ISSUES

7.1 Financing

Pre-demonstration financing arrangements were arranged without major problems. Eightypercent of the cost of the program was funded by the federal government through the UMTA demonstration project grant program; the remaining twenty percent by Mercer County. Authorization for federal funding of fare-free transit demonstrations derived from Title II of the 1974 UMTA Act. The federal portion of this project was provided through Title II funds. NJDOT, the designated recipient of federal transportation funds for New Jersey, distributed funds to Mercer Metro for loss of revenue, and to the data collection contractor and the advertising agency for their services.

7.2 Initial Coordination

Initial coordination of the many participants in the fare-free demonstration was possibly the most difficult aspect of the program, particularly because of a very short lead time. Participants included the Urban Mass Transportation Administration (UMTA), the Transportation Systems Center (TSC), the New Jersey Department of Transportation (NJDOT), Mercer County, the Mercer County Improvement Authority (MCIA), Mercer Metro (MM), the Evaluation Contractor (DeLeuw, Cather), the Data Collection Contractor (Garmen Associates), and a Marketing Contractor (Bozell & Jacobs).

Prior to submission of the NJDOT grant application to UMTA, methods of financing the local share of the program had been developed. Data collection design and methodology were not developed until UMTA approved the project proposal; this left only about two months for preparation before the initial stage of data collection was implemented.

The national office of the bus driver's union (ATU) had taken a position supporting fare-free transit. Nonetheless, it was concluded that the understanding and cooperation of Mercer Metro bus drivers would be essential to the success of the program. Attempts to meet with drivers, however, were thwarted by outside events. Two attempts to meet were made: the first meeting had to be cancelled because of inclement weather; the second was inadvertently scheduled during union elections and also had to be cancelled. By that time other activities received priority attention, and no further attempts were made to meet with the bus drivers. In the light of subsequent developments regarding on-board incidents, and the drivers' reaction to them, the failure to have a pre-demonstration meeting may have been an important factor.

7.3 Administration

The fare-free demonstration did not require any major changes in Mercer Metro's administrative functions. An observed effect of the program on administrative staff was an increase in schedule and route information requests during the first weeks of

the demonstration. Other minor effects included changes in ridership estimation procedures because Mercer Metro uses a revenue/average-fare method, and some problems in bookkeeping and reporting functions because of revenue loss and reimbursement.

It was concluded that the revenue loss reduced the frequency of farebox emptying from five times per week to three which would have allowed reassignment of some office staff hours. However, because the program would terminate Mercer Metro did not attempt to change the money handling procedure.

7.4 Operating Changes and Training

Before the fare-free demonstration, Mercer Metro had a half-fare program during the same off-peak hours. This enabled them to implement the price change from the schedule viewpoint quite easily. The scheduled bus stops where the fare change began and ended had been pre-determined for the half-fare program. (As a policy, the fare changed at a particular bus stop -- the scheduled location of the fare change time -- rather than at the clock time in order to avoid controversy if a bus was not on schedule.) The same locations were applicable for the fare-free service.

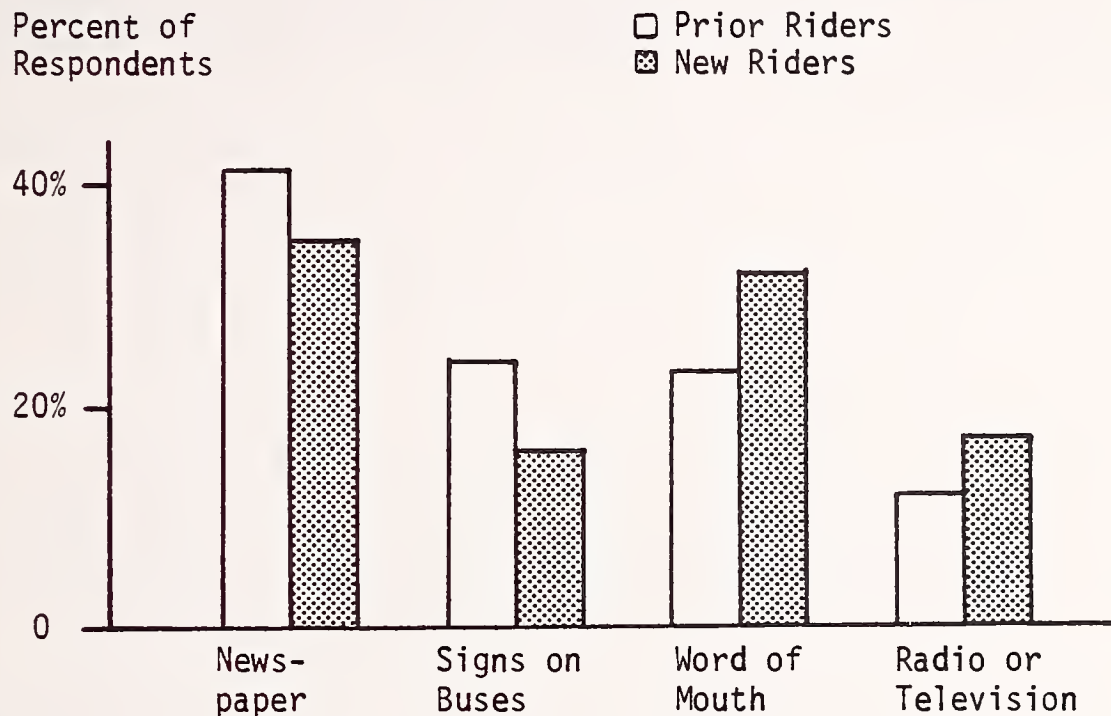
The only operating change was the dispatch of trailer buses (a second bus operating on the same schedule solely for the purpose of increasing capacity) to meet heavy demands. This was accomplished by using extra drivers who would normally be available for assignment and did not, therefore, involve extra labor cost.

7.5 Marketing

Mercer Metro had essentially no advertising or marketing effort before the fare-free program; hence, there was no existing mechanism to disseminate information about the free service. In order to ensure that the public was made aware of the program, a marketing consultant was engaged to prepare and administer a publicity and advertising campaign to advise the public of the free bus service. The marketing program was structured as an information dissemination effort rather than a general transit or free-fare promotion in order to minimize the potential effect of new marketing efforts on ridership. The program included the use of press releases, radio announcements, newspaper advertisements, large signs on the sides of the buses, and route/service information posters at major generators. After the pre-implementation marketing campaign, local newspaper advertisements were periodically run. In addition, the newspapers spontaneously ran articles and editorials, both supporting and criticizing the program.

Based on responses to a question on the May 1978 on-board survey, newspaper advertising was the most effective media. Among new off-peak passengers word-of-mouth was reported to be a large source of information about the free bus service program. Figure 7.1 summarizes the reported sources of information about the program.

Figure 7.1
SOURCES OF FIRST LEARNING ABOUT FREE-FARE



7.6 Program Monitoring

The most extensive and comprehensive monitoring of the program took place during the data collection efforts described in Appendix A. Mercer Metro dispatchers maintained a log of all operational changes necessitated by the fare-free program until January 1979. Essentially this included noting when buses were sent out to relieve overcrowding. The New Jersey Department of Transportation also collected and maintained copies of relevant articles and editorials which appeared in local newspapers. No other special attempts were made to monitor the program in any way different from normal operating monitoring, including driver's reports of on-board incidents, monthly financial reports, and quarterly corner counts.

7.7 Reaction to Changes

Each of the groups affected by the fare-free program reacted differently to it. Riders, for the most part, felt positively about it, although there was some concern about increases in crime. Some displeasure was also expressed because of overcrowding and the difficulty in keeping the buses on schedule. There was essentially no public or media reaction when the demonstration ended. Most Mercer Metro bus drivers opposed free-fare, after initially supporting it. Being frequent targets of crime on buses, they were probably more sensitive to on-board security problems

than even the riding public. Being the first point of access for riders, they also receive most passenger complaints. They also complained about missed layovers when the buses were late because of increased passenger loads. Local administrators of the program were enthusiastic, however, their enthusiasm apparently was not strong enough to shift priorities to be able to commit local financial support for a continuation of the program, nor was there apparent community support for the funds to be offered. The general attitude seemed to be that free-fare was a good concept, but not attractive enough to divert resources in order to make it a continuing policy.

8.0 FINDINGS AND CONCLUSIONS

8.1 Overview

The major effect noted was a sizable, sustained gain in ridership during the off-peak service hours, with significant retention of the newly gained ridership after the fares were reinstated. Most of the new ridership came from trips which would have been made anyway, but many by a different mode of travel if fares had been charged. Many of the diverted trips reportedly would have been otherwise made by walking. Newly generated trips accounted for only a small portion of the additional off-peak bus trips during the demonstration period.

The free service reportedly attracted on the order of 2,000 (about one percent of the population) new people to use the off-peak buses who had not apparently done so before the demonstration. There did not seem to be any major differences in the socio-economic characteristics of the new bus riders when compared with the prior off-peak riders. Although some differences were measured in the relative response to fare elimination among some socio-economic groups, those differences were also concluded to be insignificant from a practical standpoint.

With the exception of the lost revenue, the program did not have major effects on the operations of Mercer Metro. There were some indications of increased bus delay and crowding because of the larger passenger volumes. Operating costs were not significantly affected. The most notable impact on operations was a decrease in driver morale attributed to perceived increases in the occurrence of on-board rowdyism and harassment by young passengers.

In general the results of the program seemed to indicate that there is limited utility for free off-peak bus service as a pricing strategy to achieve long-term transportation goals. It did not significantly reduce the level of automobile travel in the service area and cannot reasonably be expected to. It did not particularly improve the mobility of the transportation disadvantaged in the area. It did not apparently generate any significant derived benefits to area commercial activities, particularly the Trenton CBD. It did not apparently increase the opportunities for work, school, etc. for area residents.

On the other hand, the results of the demonstration did indicate that fare elimination may be a good technique for transit promotion. The program produced an immediate, sustained gain in off-peak ridership on Mercer Metro buses which was probably largely retained when fares were reinstated despite a large jump in the off-peak fare. This indicates that fare eliminations can probably be used to increase transit ridership and that there may be an optimal duration for free service which will pay for itself in a reasonable time by way of increased revenue when fares are replaced. Also, fare elimination may be useful in introducing new or improved service, much in the way product give-aways are used, or as a buffer to be used in advance of a fare increase to offset anticipated losses in ridership.

8.2 Travel Behavior Issues

8.2.1 Effects on Ridership

The fare-free program causes an immediate, relatively large increase in off-peak ridership on the Mercer Metro system, contributing to an overall net gain in system ridership. When fares were reinstated after the demonstration, there was an apparent residual effect in retained ridership, despite a rather large post-demonstration fare increase. The immediate, sustained ridership response led to the conclusion that off-peak passenger demand is sensitive to price.

About three-quarters of the new off-peak ridership were trips which would have been made by another mode if fares had been charged; that includes trips which would have been made by peak period bus. The remainder represented newly generated travel both by prior off-peak bus riders and by new off-peak riders. The proportion of trips which were newly generated indicated that the fare elimination did increase personal mobility to some extent.

Among the trips which were diverted from other modes, about one-third were from the auto mode, another one-third were from the walk mode, and the remainder were directly from peak-period bus and other modes. The auto diversions were concluded to have had no significant impact on regional auto travel, as would be expected.

8.2.2 Effects on Trip Characteristics

It was hypothesized that eliminating fares might affect the distribution of purposes found among off-peak bus trips. All trip purposes reportedly increased, and there were no major observed differences in proportions either between total trips or between prior riders relative to new riders. There was a slight overall decrease in the proportion of non-discretionary trips (work and school) and a slight increase in the proportion of discretionary trips (shopping, recreation, etc.).

Newly generated trips were a small portion of the total; however, among them there was a substantially higher proportion of discretionary trips compared with either the pre-demonstration trips or the new trips from modal diversions. This leads to the conclusion that newly generated travel resulting from the fare elimination was for more discretionary purposes than was off-peak bus travel in general.

There were essentially no observed changes in trip lengths or in trip patterns as a result of the fare elimination. A large proportion of new trips were reportedly destined to a suburban, regional shopping mall which could be construed to be detrimental to downtown business. On the other hand there was a reported gain in the number of shopping trips destined for the downtown area. It was concluded that the effects of off-peak fare elimination on business volume were negligible.

8.2.3 Effects on User Characteristics

There was no conclusive evidence that any particular socio-economic group was disproportionately responsive to the off-peak fare elimination, despite some indication that responsiveness was inversely related to age. Other personal characteristics (sex, income, household size, etc.) did not appear to be very different for new users nor on a person-trip basis. There may have been a slight inverse relationship with auto ownership. It was concluded that the absence of socio-economic variability indicated that a broad pricing strategy is not well suited to specifically improving the mobility of the transportation disadvantaged.

8.3 Transportation Supply and Cost Issues

8.3.1 Effects on Service Quality

There generally seemed to be some degradation of the quality of the off-peak bus service during the demonstration, but the passengers did not apparently notice or mind. The added passengers caused increased bus delay and a higher proportion of late buses as well as an increase in the average length of the delay. These were not concluded to be major problems since there were few related passenger complaints. Bus drivers complained that the delays negatively affected their layover breaks.

The increased passenger volume also caused higher average bus occupancy in the off-peaks during the fare-free demonstration. A significant increase was observed in the proportion of off-peak buses which had standees during the periods that fares were eliminated, particularly during the 10AM-2PM period on weekdays. The bus crowding problem was sometimes discussed by passengers, but infrequently; bus drivers, however, complained frequently about bus crowding. Except for the minor dissatisfaction of passengers and drivers, bus crowding was not a major issue of the demonstration.

On-board security, on the other hand, was a major issue. Bus drivers and some passengers complained that after fares were eliminated there was a large increase in on-board rowdyism and harassment, particularly by youths. Analyses of available data indicated that the increase in on-board incidents was roughly proportionate to the ridership growth. Nonetheless, the drivers' attitudes and the media coverage did contribute to making on-board security an issue throughout the demonstration. It was concluded that this was a major impact because it generated negative publicity which may have in turn affected the off-peak passenger volume and ridership composition. Also, it is probable that continuation of the fare-free program beyond the demonstration period would have been strongly resisted by the Mercer Metro drivers.

8.3.2 Effects on Transportation Supply

It was concluded that the effects of the off-peak fare elimination on transportation supply factors were minimal. There was some need for added service in the form of "trailer" buses to meet exceptionally heavy passenger demands on particular routes, however, the added service mileage was estimated to be less than one per cent of the total off-peak mileage. The excess capacity on the bus system during off-peak hours was sufficient to handle most of the increased passenger load.

The effects on off-peak system productivity were substantial, largely because most of the additional ridership was carried without much added service. The overall gain in productivity was about 50 percent, equivalent to the ridership gain. The gain in efficiency (passengers carried per unit cost), which considers the cost of the revenue loss, was about 20 percent.

Other supply side effects, including labor, maintenance, administration, etc. were negligible. Those types of effects, even if measurable, probably would require longer to materialize than the twelve-month demonstration period allowed.

8.3.3 Financial Effects

The net transportation-related cost of the program (i.e., those costs which would have been borne by the operator if it had not been a demonstration) were found to be limited to the "cost" of the uncollected revenue, an estimated \$339,000. This was equivalent to a unit cost of about \$0.30 for each added passenger. Based on the estimated "value" of the free bus trips, the approximate ratio of the benefits to costs was slightly more than one (1.2) for the project.

8.4 Secondary Effects

8.4.1 Effects on Bus Drivers

One of the most noticeable effects of the fare-free program was a negative reaction by the bus drivers because of the purported increase in on-board incidents by youngsters. The level of discontent at one point was very high, even threatening to prematurely end the demonstration. The drivers also complained about increased delays and reduced layover time. It was apparent that the bus drivers perceived a degradation of their working conditions, leading them to oppose free-fare despite a policy of free-fare support by the headquarters of their labor union.

8.4.2 Effects on Public Attitudes

A large proportion of the general public reported that were not familiar enough with Mercer Metro to comment on its service quality. Of those who had opinions, the overall reaction to the service was positive before the demonstration and slightly higher after the fares were eliminated. The public attitude toward tax support for free-fare was generally negative before the demonstration and even more so during the program.

Among Mercer Metro users the proportion of people with no opinion was small. The response to questions about the service quality were positive and only slightly higher than for the general public. After fares were eliminated, the users' attitudes were about the same as those of the general public. The level of support among bus users for tax-based funding of free-fare decreased during the demonstration, relative to before; they did, however, remain slightly in favor of added tax support for Mercer Metro in general.

It is likely that a psychological effect related to the free bus service contributed to the generally positive attitudinal response. This was compounded by the higher visibility of Mercer Metro because of increased media exposure. It is not known whether negative publicity related to the on-board rowdyism issue affected the extent of positive response; the only characteristic to not show at least some attitudinal improvement, however, was regarding on-board safety as perceived by bus users. Responses to the tax support issues generally seemed to be along the user/non-user lines.

Substantial proportions of the Mercer Metro users and the general public supported continuation of the fare-free program, while about a third supported expanded free service hours. A small proportion favored ending the fare-free service.

There was strong support reported by both the bus riders and the general public for free bus service, for elderly people, and substantial support among both groups for free bus service for low income people. Less than a third of the people surveyed, however, supported free bus service for the young. This may partially reflect a response to the on-board rowdyism publicity.

8.4.3 Effects on the Environment

The impacts of fare elimination on traffic volumes, air quality, noise and congestion were negligible. It should be noted that the maximum potential for such impacts, given current transit capacity, is also very small. Accordingly, it was concluded that transit pricing techniques, particularly in the off-peaks, cannot effectively reduce automobile use and traffic levels.

8.4.4 Effects on the Inner City

It was concluded that despite some apparent increase in shopping trips to downtown areas, there was little evidence that fare-free transit would significantly enhance the commercial competitiveness of the inner city. The higher level of transit trip making (especially off-peak) would probably be hardly noticeable across the commercial areas and, as noted by some merchants, the buying power of most people attracted by a 15-cent fare saving was probably low.

8.5 Implementation Issues

Many of the issues associated with the implementation of the fare-free program at Mercer Metro were either related to or affected by the fact that it was a demonstration project. Local financing was limited to 20 per cent of the cost; the number of participating agencies and the related coordination effort were magnified; the demonstration was designed to minimize the need for operating changes; and the free-fare marketing effort was developed independent of other Mercer Metro service characteristics. It is unlikely that a fare elimination project in another locale would have comparable conditions for implementation.

8.6 Transferability of Results

As might be expected, one demonstration in fare-free transit does not provide much basis for generalizing the transferability of the effects to other areas. There were, however, some conclusions regarding what types of expectations might be generally reasonable for fare elimination programs.

There were no grounds which would indicate that one could generally assume that the effects of the Mercer County fare-free demonstration would be directly transferable to other locales, particularly ones with different geographic, socio-economic, and transportation characteristics. Cross-study of the Mercer County results with those of a similar project in a much different area (Denver, Colorado), however, could help to identify any common findings which can be isolated from local particulars and related to the fare-free technique.

Regression analyses of the fare-free response by socio-economic group did not yield predictive relationships with high correlation. Elasticities were calculated for the various socio-economic groups, but they are limited for prediction purposes, because of the inability to show correlation.

At best, the data presented in the report regarding relative ridership effects may be applicable for estimating fare elimination impacts (off-peak) elsewhere. The transferability of those data, however, is limited by unknown factors associated with local characteristic differences and with the passage of time.

The effects of the demonstration on schedule adherence were dependent on the characteristics of the on-street operation and the ridership gain. It is likely that most properties would have some measurable degradation of on-time performance, given a 50 percent increase in passengers. Crowding effects are largely dependent on the amount of excess capacity which is available and/or policy divisions regarding extra service. On-board security problems are likely to increase with the number of passengers, but local characteristics will probably be a determinant factor as well.

The transferability of the observed transportation supply effects to other areas is mostly a question of local policy decisions regarding the provision of additional service. By implication, the extent of available excess capacity and the relative ridership gain are determinants of the need for additional service. Other supply

side effects can also be expected to be dependent on local characteristics; for example, driver labor impacts may be different at a property with different extra-board operations.

Financial effects are dependent on the ridership gain, the local fare policy, and the local costs; findings from the Mercer County demonstration, therefore, are not directly transferable. The general finding that revenue loss was the major fiscal impact could very well be transferable, particularly if there is pre-existing excess capacity. Within the variation of other particular sites, it is likely as well that secondary costs and savings would be somewhat offsetting.

Although the particular proportions may be different, it is likely that the attitudinal and secondary responses to fare elimination would be similar in other areas. For example, the concept of higher subsidization for the elderly and the poor is fairly common and could be expected to receive support. Also, most transit properties do not have sufficient excess capacity to significantly affect the level of regional automobile use. The issue of inner city revitalization is far too complex to be significantly affected by the travel impacts of off-peak fare elimination at any site.

APPENDICES

Appendix A DATA COLLECTION

The general approach to data collection for evaluation of the impacts of the Mercer County Fare-Free Demonstration was to conduct two sets of matched surveys; one before the demonstration program and one during it. These data sets were collected one year apart to minimize any effects of seasonality. The matched data sets included: passenger counts, on-board surveys, activity center surveys, follow-up bus rider telephone surveys, and random household telephone surveys. These were supplemented by periodic monitoring of ridership levels, an interim passenger survey, a post-demonstration bus user follow-up survey, and interviews with bus drivers and retail merchants. The data were collected to gather information about particular issues, including: travel behavior; transportation supply and costs; and secondary effects, such as regional economics. The chronology of the data collection efforts is shown in Figure A.1, along with sample sizes.

On-Board Surveys:

The principal on-board surveys were conducted once during October-November, 1977, before the fare-free program began, and again one year later, during the demonstration. Surveys were distributed on about fifty percent of the bus blocks which had at least one-third of their runs during the fare-free period. In the first survey, two interviewers were assigned to each bus with instructions to give forms to everyone, to record the number of boarding passengers, to give assistance as time permitted, and to ask for names and telephone numbers (recording them on the survey sheet) so passengers could be contacted during the follow-up phone survey. During the second survey only one interviewer was used, with a written request for names and telephone numbers at the bottom of the form; boarding counts were conducted by using sequentially numbered survey instruments and periodically recording numbers distributed.

Generally, the information obtained through the survey included trip characteristics and socio-economic data. The two surveys had many primary uses including estimating the impact of the fare-free program on various socio-economic groups including low-mobility persons; other uses included analyses of new trip generation and changes in mode choice, impacts on group ridership, time-of-day shifts in travel, fare savings, and changes in trip lengths, purposes, and patterns.

Figure A.1
DATA COLLECTION CHRONOLOGY

<u>DATE</u>	<u>DATA SET</u>	<u>SAMPLE SIZE</u>
<u>Before Fare Elimination:</u>		
10-11/77	On-Board Survey	4651
10-11/77	Activity Center Interviews	640
10-11/77	Follow-Up Telephone Surveys	
	• Bus Users	152
10-11/77	Random Telephone Surveys	367
11/77	Corner Counts	N/A
2/78	Corner Counts	N/A
<u>During Free-Fare Demonstration:</u>		
3/78	Corner Counts (twice)	N/A
5/78	Mini-On-Board Survey	2100
5/78	Corner Counts	N/A
7/78	Corner Counts	N/A
8/78	Bus Driver Interviews	36
10/78	On-Board Survey	4912
11/78	Activity Center Interviews	767
11/78	Follow-Up Telephone Survey	
	• Bus Users Only	143
	• Random Household (1977) Panel	50
11/78	Random Telephone Surveys	303
<u>After Fare Reinstatement:</u>		
3/79	Corner Counts	N/A
5/79	Follow-Up Telephone Survey	541
	Retail Merchants Survey	111

N/A: Not Applicable

These surveys were also used to investigate the effects of the program on CBD commercial activity, suburban shopping center use, traffic congestion, and the concomitant effects on energy and air pollution. Samples of the instruments used in these two surveys are shown in Figures A.2 and A.3.

In addition to the major on-board surveys, a mini-survey was conducted in May, 1978, during the demonstration. The sample was roughly one-half the size of the two major surveys. Questions dealt mostly with trip characteristics and socio-economic data. No information was obtained about specific origins and destinations. The survey instrument is shown in Figure A.4.

The greatest potential for bias in the data is introduced by the survey procedure; it is caused by the self-selection of respondents, i.e., the people who responded to the survey were only those who were willing. No information was gathered as to how, or if, the characteristics of the participants differed from those who did not participate. It is possible that this might have introduced some type of age or socio-economic biasing. It is also probable that persons who were approached more than once (people who rode at different times or on different buses during the survey periods) were more likely to refuse to respond repeatedly. Since data were processed on a route-block basis rather than by individual passengers, this could also have introduced some biasing relative to trip rate calculations. This is adjusted for by factoring on the basis of reported trip frequency. Some people perceived the survey instrument as too long to complete it in a short trip. This could have caused some loss of information regarding the extent of, and changes in the characteristics of short trips. On-site observations did not qualitatively identify other biasing problems.

Telephone Surveys:

Surveys of awareness of and attitudes toward transit, together with the collection of detailed trip data for the respondent's entire household, were conducted through telephone interviews. These surveys were divided into two types: a survey of a sample of the general population; and follow-up surveys of bus users (from the on-board surveys) and persons interviewed at the activity centers. The general population survey was conducted once before fare elimination and once again, a year later, during the demonstration; a 50-household panel was selected from the first survey to be re-interviewed during the second for tracking purposes. Follow-up surveys were conducted on the

Figure A.2

On-Board Survey (10/77)

MERCER METRO BUS SURVEY

sponsored by
 New Jersey Department of Transportation
 in cooperation with
 Urban Mass Transportation Administration
 Mercer County Improvement Authority

OFFICE USE ONLY

GRP
 C E O
 AGE

Dear Rider:

Your answers to these few questions will help us plan for a future bus service in Mercer County. Please return this form with your answers before you get off.

1. I AM COMING FROM (CHECK ONE):
 None..... Work..... School..... Shopping.....
 Medical.. Recraational.. Social/Visiting.. Other(what?)..

2. THAT PLACE WAS AT _____ IN _____
 (address or nearest corner) (city)

3. I GOT TO THIS BUS BY (CHECK ONE):
 Walking..... Driving a car.. Riding in a car.. Taxi..
 Another Bus.. (What Route? _____) Other (What?) _____

4. I GOT ON THIS BUS AT _____ IN _____
 (address or nearest corner) (city)

5. I WILL GET OFF THIS BUS AT _____ IN _____
 (address or nearest corner) (city)

6. I AM NOW GOING TO (CHECK ONE):
 None..... Work..... School..... Shopping.....
 Medical.. Recraational.. Social/Visiting.. Other(what?)..

7. THIS WILL BE AT _____ IN _____
 (address or nearest corner) (city)

8. I WILL GET THERE FROM THIS BUS BY (CHECK ONE):
 Walking..... Driving a car.. Riding in a car.. Taxi..
 Another Bus.. (What Route? _____) Other (What?) _____

9. I WOULD HAVE MADE THIS TRIP EVEN IF THE BUS HAD NOT BEEN RUNNING: True..
 False..

10. THE NUMBER OF CARS OWNED OR OPERATED BY MEMBERS OF MY HOUSEHOLD IS:
 None.. 1.. 2.. 3 Or More..

11. THE NUMBER OF PEOPLE IN MY HOUSEHOLD IS:
 1.. 2.. 3.. 4.. 5.. 6 Or More..

12. I AM (CHECK ONE): Male.. Female..

13. MY AGE IS (CHECK ONE):
 16 Or Under.. 17-24.. 25-44.. 45-64.. 65 & Over..

14. THE NUMBER OF BUS TRIPS (ONE-WAY) I MAKE WHICH START BETWEEN 10:00 AM AND 2:00 PM OR AFTER 6:00 PM IS (CHECK ONE):
 Less Than 2 Per Week.. 2-5 Per Week.....
 6-9 Per Week..... 10 Or More Per Week..

15. THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF MY HOUSEHOLD IS (CHECK ONE):
 \$ 0-\$5,000..... \$5,001-\$10,000.. \$10,001-\$15,000..
 \$15,001-\$25,000.. Over \$25,001....

THANK YOU FOR YOUR COOPERATION:

T
 O/E
 N

MERCER METRO BUS SURVEY

sponsored by
 New Jersey Department of Transportation
 in cooperation with
 Urban Mass Transportation Administration
 Mercer County Improvement Authority

OFFICE USE ONLY

GRP
 C E O
 NO.
 1 0
 DIR

Dear Rider:

Your answers to these few questions will help us to plan for improved bus service in Mercer County. Please return this form with your answers before you get off.

1. I AM COMING FROM (CHECK ONE):
 Home Work School Shopping
 Medical Recreational Social/Visiting Other

2. I AM NOW GOING TO (CHECK ONE):
 Home Work School Shopping
 Medical Recreational Social/Visiting Other

3. I CHANGED THE TIME THAT I STARTED MY TRIP IN ORDER TO TAKE ADVANTAGE OF THE FREE BUS SERVICE?
 Yes No

4. IF THE BUS SERVICE WERE NOT FREE FOR THIS TRIP, I WOULD HAVE
 Not Made The Trip Taken The Bus Anyway
 Driven Or Ridden In An Auto Walked
 Taken A Taxi Other (Explain _____)

5. THE NUMBERS OF TRIPS I TYPICALLY MAKE USING THE FREE BUS SERVICE FOR:
 Number of One-Way Trips Per Week

Trips To Work Or School is	_____
Shopping Trips is	_____
Other Trips is	_____

6. I FIRST LEARNED ABOUT THE FREE BUS SERVICE FROM:
 Radio Television Friend Or Relative
 Bus Signs Newspapers Other (Explain _____)

7. THE NUMBER OF CARS OWNED OR OPERATED BY MEMBERS OF MY HOUSEHOLD IS:
 None 1 2 3 Or More

8. THE NUMBER OF PEOPLE IN MY HOUSEHOLD IS:
 1 2 3 4 5 6 Or More

9. I AM (CHECK ONE): Male Female

10. MY AGE IS (CHECK ONE):
 16 Or Under 17-24 25-44 45-64 65 And Over

11. THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF MY HOUSEHOLD IS (CHECK ONE):
 \$-0-\$5,000 \$5,001-\$10,000 \$10,001-\$15,000
 \$15,001-\$25,000 Over \$25,001

T									
O/E									
N									

WE MAY NEED ADDITIONAL INFORMATION ABOUT YOUR BUS TRAVEL, IF SO CAN WE CONTACT YOU BY PHONE?
 Telephone Number _____ Day Evening
 Whom Should We Ask For (First Name) _____

THANK YOU FOR YOUR COOPERATION!

MERCER METRO BUS SURVEY

sponsored by
New Jersey Department of Transportation

OFFICE USE ONLY

GRP

TYPE C E O

DIR I O

DEAR RIDER:

YOUR ANSWERS TO THESE FEW QUESTIONS WILL HELP US TO PLAN FOR IMPROVED BUS SERVICE IN MERCER COUNTY. PLEASE RETURN THIS FORM WITH YOUR ANSWERS BEFORE YOU GET OFF.

1. I AM COMING FROM (CHECK ONLY ONE):
 Home Work School Shopping
 Medical Recreation Social/Visiting Other

2. THAT PLACE IS AT (NEAREST STREET CORNER):
 _____ AND _____ IN _____
(Street Name) (Street Name) (City)

3. I AM NOW GOING TO (CHECK ONLY ONE):
 Home Work School Shopping
 Medical Recreation Social/Visiting Other

4. THAT PLACE IS AT (NEAREST STREET CORNER):
 _____ AND _____ IN _____
(Street Name) (Street Name) (City)

5. BEFORE THE FREE BUS SERVICE BEGAN....
 I did not travel to that place
 I did travel to that place (if so, how?):
 By walking By bus, but at a different time By bus, at the same time
 By car, as a driver By car, as a passenger By taxi Other

6. IF THE BUS SERVICE HAD NOT BEEN FREE FOR THIS TRIP TODAY, I WOULD HAVE....
 Not made the trip Walked Taken the bus, but at a different time Taken the bus, at the same time
 Ridden in an auto Driven an auto Taken a taxi Other

7. IN THE FUTURE IF THE FREE BUS SERVICE IS STOPPED....
 I would not make this trip
 I would continue to make this trip (if so, how?):
 By walking By bus, but at a different time By bus, at the same time
 By car, as a driver By car, as a passenger By taxi Other

8. THE PURPOSE AND NUMBER OF ONE-WAY TRIPS PER WEEK THAT I USUALLY USE THE FREE BUS SERVICE FOR ARE:

	<u>Number of One-Way</u>
	<u>Trips per Week</u>
Work or School.....	_____
Shopping.....	_____
Other.....	_____

9. BEFORE THE FREE BUS SERVICE BEGAN, I USUALLY USED THE BUS DURING MIDDAY (10 AM-2 PM) AND EVENING (AFTER 6 PM) HOURS FOR....
 No trips per week 1-2 trips per week 3-4 trips per week
 5-6 trips per week 7-9 trips per week 10 or more trips per week

10. THE NUMBER OF CARS OWNED OR OPERATED BY MEMBERS OF MY HOUSEHOLD IS:
 None 1 2 3 or more

11. THE NUMBER OF PEOPLE IN MY HOUSEHOLD IS:
 1 2 3 4 5 6 or more

12. I AM Female Male

13. MY AGE IS: _____ years

14. THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF MY HOUSEHOLD IS:
 0-\$5,000 \$5,001-\$10,000 \$10,001-\$15,000 \$15,001-\$25,000 Over \$25,000

WE MAY NEED ADDITIONAL INFORMATION ABOUT YOUR BUS TRAVEL;
 IF SO, MAY WE CONTACT YOU BY PHONE? Telephone Number _____ Day Evening
 Whom Should We Ask For? (First Name) _____

THANK YOU FOR YOUR COOPERATION.

same schedule, with one exception: the activity center follow-up sample was considered to be too small (50 respondents chosen from three sites) to be reliable and was deleted from the second survey. In addition, a post-demonstration bus-user follow-up survey was conducted. Sources for this sample included the three prior on-board surveys. Following is a description of the telephone surveys:

Random Telephone Surveys

Two telephone surveys of persons chosen at random from the general Mercer County population, were conducted: one in November of 1977 and the other in November 1978. Nine hundred names were chosen from the telephone book covering Trenton and the suburban areas of Mercer County, of which one-third were to be interviewed. Respondents were asked about all trips made by members of their household during the fare-free time periods on the preceding day. One trip was randomly chosen for more detailed investigation. Attitudes towards transit and free service were also examined.

The primary purpose of these data was to evaluate the awareness and support of the general public toward transit and free bus service. A secondary purpose was to investigate the mode choices made and travel volumes produced by the residents of the project area during the fare-free time periods. The instruments used in the two surveys are shown in Figures A.5 and A.6.

In analyzing the data, responses were weighted according to geographic distribution. Comparison with 1970 census data showed that the sample was fairly representative of the general population of Mercer County. The procedure biases the data towards households with telephones, since households without (or with unlisted numbers) were not contacted. New Jersey Bell had no data on the number of households without telephones, but indicated that it is probably a very small share of the population, perhaps on the order of 5-10 percent. The names selected from the telephone book were not chosen at random, but rather in a systematic manner (every "nth" non-business number). This is not considered to be a significant deviation from random selection.

Figure A.5 (Side 1)

MERCER METRO FREE FARE DEMONSTRATION
TELEPHONE SURVEY

November 1977

ADDRESS _____ Street _____ City _____

IS THIS _____ ?
(telephone no.)

MELLO MR/MRS _____, MY NAME IS _____
(use full name)

	INT.	DATE	TIME	RESULTS
1				
2				
3				
4				

I AM DOING A SURVEY FOR THE DEPARTMENT OF TRANSPORTATION. WE WOULD APPRECIATE YOUR HELP IN ANSWERING A FEW QUESTIONS ABOUT YOUR FAMILY'S TRAVEL.

FIRST, DO YOU LIVE IN MERCER COUNTY? YES NO

→ (If the answer is no, thank the person and end the interview)

1) WE ARE INTERESTED IN ONE-WAY TRIPS MADE YESTERDAY BETWEEN THE HOURS OF 10 AM AND 2 PM AND AFTER 6 PM. WE WOULD LIKE TO GET A LIST OF ALL TRIPS MADE BY ALL MEMBERS OF YOUR HOUSEHOLD DURING THOSE TIMES.

FIRST, YOURSELF. PLEASE TELL ME THE PURPOSE OF EACH TRIP AND HOW IT WAS MADE. (OTHER MEMBERS OF YOUR HOUSEHOLD?)

→ (If no trips were made by any members of the household, check the box and go to question #9) None

PERSON	PLACE	PURPOSE AT DESTINATION								MEANS OF TRAVEL						
		HOME	WORK	SCHOOL	SHOPPING	MEDICAL	RECREATION	SOCIAL/VISIT	CHAUFFEURING	OTHER	WALK	AUTO-RIDE	AUTO-DRIVE	TAXI	BUS	OTHER
1																
2																
3																
4																
5																
6																
7																
8																
9																

→ (If more than nine trips are reported use a supplemental sheet and check this box)

→ (select the proper trip and record the number.)

NOW I NEED SOME DETAILED INFORMATION ABOUT ONE OF THE TRIPS YOU HAVE DESCRIBED. PLEASE ANSWER THE FOLLOWING QUESTIONS ABOUT THE TRIP WHICH WAS MADE:

BY _____ TO _____ BY _____
(person) (purpose) (means of travel)

2) ABOUT WHAT TIME DID THE TRIP BEGIN? _____ AM PM

3) WHERE DID THE TRIP BEGIN?

_____ IN _____
(address or street corner) (city)

4) WHAT PLACE WAS THAT? WAS IT:

HOME WORK SCHOOL SHOPPING MEDICAL
 RECREATION SOCIAL CHAUFFEURING OTHER _____
(explain)

5) WHERE DID THE TRIP END?

_____ IN _____
(address or street corner) (city)

6) HOW MUCH DID YOU PAY FOR PARKING? NOTHING CENTS
OTHER _____ (explain)

AUTO

→ (skip to question #9)

BUS

7) WOULD YOU HAVE MADE THIS TRIP IF THE BUS HAD NOT BEEN RUNNING? YES NO

8) WAS AN AUTO AVAILABLE TO YOU FOR THIS TRIP? YES NO

9) HOW FAR FROM YOUR HOME IS THE NEAREST MERCER METRO BUS STOP?

BLOCKS or MILES (or fraction) DON'T KNOW

10) HOW MUCH IS THE BASIC BUS FARE:

FOR COMMUTER HOURS DON'T KNOW

FOR MIDDAY AND NIGHTTIME DON'T KNOW

11) HOW MANY ONE-WAY BUS TRIPS ARE MADE BY MEMBERS OF YOUR HOUSEHOLD IN A TYPICAL WEEK?

NONE PER WEEK PER DAY

→ (if "none", skip to question #14)

<input type="checkbox"/>	1
<input type="checkbox"/>	2-5
<input type="checkbox"/>	6-35
<input type="checkbox"/>	36-40
<input type="checkbox"/>	41-47
<input type="checkbox"/>	48-79
<input type="checkbox"/>	80
<input type="checkbox"/>	1
<input type="checkbox"/>	8-9
<input type="checkbox"/>	10-11
<input type="checkbox"/>	12-13
<input type="checkbox"/>	14-15
<input type="checkbox"/>	16-17
<input type="checkbox"/>	18-19
<input type="checkbox"/>	20-21
<input type="checkbox"/>	22-23
<input type="checkbox"/>	24-25
<input type="checkbox"/>	26-27
<input type="checkbox"/>	28
<input type="checkbox"/>	29
<input type="checkbox"/>	31-34
<input type="checkbox"/>	36-39
<input type="checkbox"/>	41
<input type="checkbox"/>	43-46
<input type="checkbox"/>	48-50
<input type="checkbox"/>	52
<input type="checkbox"/>	53
<input type="checkbox"/>	55-58
<input type="checkbox"/>	60-61
<input type="checkbox"/>	62-63
<input type="checkbox"/>	65-67

MERCER METRO FREE FARE DEMONSTRATION
TELEPHONE SURVEY (PAGE 2)

3	1
	2-5
	6-8
	10-12
	13-15
	16-18
	20
	21
	22
	23
	24
	25
	26
	27
	29-31
	32-34
	35-37
	39
	40
	42
	43
	44
	45
	48-77
	79
	80

12) HOW MANY OF THESE ONE-WAY TRIPS DO YOU MAKE?
 NONE PER WEEK PER DAY

13) HOW MANY OF THE ONE-WAY BUS TRIPS THAT YOU MAKE BEGIN:
 BETWEEN 10 AM AND 2 PM ON WEEKDAYS & SATURDAYS?
 AFTER 6 PM ON WEEKDAYS & SATURDAYS?
 ANYTIME ON SUNDAYS?

	# OF ONE-WAY BUS TRIPS		
	NONE	PER WEEK	PER DAY

14) EVEN IF YOU DON'T USE THE BUS SYSTEM, WE WOULD LIKE TO KNOW HOW YOU FEEL ABOUT VARIOUS QUALITIES OF THE MERCER METRO BUS SERVICE.
 ARE YOU SATISFIED OR DISSATISFIED WITH: (VERY OR SOMEWHAT??)

QUALITIES	VERY SATISFACTORY	SOMEWHAT SATISFACTORY	HALF AND HALF	SOMEWHAT UNSATISFACTORY	VERY UNSATISFACTORY	DON'T KNOW
COST OF BUS SERVICE						
BUS TRAVEL TIME						
COMFORT						
CONVENIENCE						
SAFETY FROM CRIME & ACCIDENT						

15) HOW SATISFIED ARE YOU THAT THE BUS SYSTEM IS MEETING THE PUBLIC TRANSPORTATION NEEDS OF MERCER COUNTY?
 VERY SATISFIED SOMEWHAT DISSATISFIED DON'T KNOW
 SOMEWHAT SATISFIED VERY DISSATISFIED

16) SHOULD MORE, LESS OR THE SAME AMOUNT OF TAX MONEY BE USED TO SUPPORT THE MERCER METRO BUS SYSTEM?
 MORE LESS THE SAME DON'T KNOW

17) IF MERCER METRO BUS SERVICE WERE FREE BETWEEN 10 AM AND 2 PM AND AFTER 6 PM ON WEEKDAYS AND SATURDAYS, AND ALL DAY ON SUNDAY, DO YOU THINK YOU WOULD USE IT?
 YES NO NOT SURE
 → (if no, skip to question #19)

18) WOULD YOU USE IT FOR:

	NO	NOT SURE	YES	# OF ONE-WAY TRIPS PER WEEK
TRIPS TO WORK OR SCHOOL				
SHOPPING TRIPS				
OTHER TRIPS				

19) MIDDAY AND EVENING FREE BUS SERVICE WOULD HAVE TO BE PAID FOR SOMEHOW. SUPPOSE THE ADDITIONAL TAX COST PER HOUSEHOLD WERE BETWEEN \$10 AND \$20 PER YEAR. DO YOU FAVOR OR OPPOSE PAYING THIS AMOUNT? (STRONGLY OR SOMEWHAT??)

STRONGLY FAVOR SOMEWHAT OPPOSE NEITHER
 SOMEWHAT FAVOR STRONGLY OPPOSE DON'T KNOW

20) APART FROM THE QUESTION OF HOW TO FINANCE IT, HOW DO YOU FEEL ABOUT FREE BUS SERVICE DURING MIDDAY AND NIGHTTIME HOURS AND ALL DAY ON SUNDAY? DO YOU FAVOR OR OPPOSE IT? (STRONGLY OR SOMEWHAT??)

STRONGLY FAVOR SOMEWHAT OPPOSE NEITHER
 SOMEWHAT FAVOR STRONGLY OPPOSE DON'T KNOW

21) FINALLY, IN ORDER TO COMPARE YOUR ANSWERS WITH THOSE OF OTHER PEOPLE BEING SURVEYED, WE NEED TO KNOW A FEW THINGS ABOUT YOUR HOUSEHOLD.

21) HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS OF YOUR HOUSEHOLD?

22) WHAT IS THE TOTAL NUMBER OF PEOPLE INCLUDING YOURSELF IN YOUR HOUSEHOLD?

23) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES YOUR AGE:
 16 OR UNDER 17-24 25-44 45-64 65 OR OLDER

24) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD.
 UNDER \$5,000 \$10,001 - \$15,000 OVER \$25,001
 \$5,001 - \$10,000 \$15,001 - \$25,000

AFTER WE LOOK AT THE SURVEY RESULTS, WE MAY NEED TO ASK SOME PEOPLE A FEW MORE QUESTIONS. SO THAT WE CAN TALK TO THE SAME PERSON AGAIN, WOULD YOU GIVE ME YOUR FIRST NAME PLEASE?

THANK YOU.

25) (do not ask, record by observation) Male Female

26) (do not ask, record by observation) Recontact Possible No Recontact

Figure A.6 (Side 1)

(Nov/77)

MERCER METRO FREE FARE DEMONSTRATION
TELEPHONE SURVEY

ADDRESS _____
 _____ Street _____ City

IS THIS _____ ?
 (telephone No.)

HELLO MR/MRS _____, MY NAME IS _____
 (use full name)

I AM DOING A SURVEY FOR THE DEPARTMENT OF TRANSPORTATION. WE WOULD APPRECIATE YOUR HELP IN ANSWERING A FEW QUESTIONS ABOUT YOUR FAMILY'S TRAVEL.

FIRST, DO YOU LIVE IN MERCER COUNTY? YES NO

→ (if the answer is no, thank the person and end the interview)

1) WE ARE INTERESTED IN ONE-WAY TRIPS MADE YESTERDAY BETWEEN THE HOURS OF 10 AM AND 2 PM AND AFTER 6 PM. WE WOULD LIKE TO GET A LIST OF ALL TRIPS MADE BY ALL MEMBERS OF YOUR HOUSEHOLD DURING THOSE TIMES.

FIRST, YOURSELF. PLEASE TELL ME THE PURPOSE OF EACH TRIP AND HOW IT WAS MADE. (OTHER MEMBERS OF YOUR HOUSEHOLD?)

→ (if no trips were made by any members of the household, check the box and go to question #2) None

PERSON	PLACE	PURPOSE AT DESTINATION								MEANS OF TRAVEL						
		HOME	WORK	SCHOOL	SHOPPING	MEDICAL	RECREATION	SOCIAL/VISIT	CHAUFFERING	OTHER	WALK	AUTO-RIDE	AUTO-DRIVE	TAXI	BUS	OTHER
1																
2																
3																
4																
5																
6																
7																
8																
9																

→ (if more than nine trips are reported use a supplemental sheet and check this box . . .

2) HOW FAR FROM YOUR HOME IS THE NEAREST MERCER METRO BUS STOP?

BLOCKS or MILES (or fraction) DON'T KNOW

3) HOW MUCH IS THE BASIC BUS FARE:

FOR COMMUTER HOURS DON'T KNOW

FOR MIDDAY AND NIGHTTIME DON'T KNOW

4) HOW MANY ONE-WAY BUS TRIPS ARE MADE BY MEMBERS OF YOUR HOUSEHOLD IN A TYPICAL WEEK?

NONE PER WEEK

→ (If "none", skip to question #8)

5) HOW MANY OF THESE ONE-WAY TRIPS DO YOU MAKE?

NONE PER WEEK

→ (if "none", skip to question #8)

6) HOW MANY ONE-WAY TRIPS DO YOU MAKE IN A TYPICAL WEEK USING THE FREE BUS SERVICE FOR:

	BETWEEN 10 AM-2 PM	AFTER 6 PM
WORK OR SCHOOL	_____	_____
SHOPPING	_____	_____
OTHER PURPOSES	_____	_____

7) BEFORE THE FREE SERVICE BEGAN, HOW MANY ONE-WAY BUS TRIPS DID YOU MAKE IN A TYPICAL WEEK FOR:

	BETWEEN 10 AM-2 PM	AFTER 6 PM
WORK OR SCHOOL	_____	_____
SHOPPING	_____	_____
OTHER PURPOSES	_____	_____

MERCER METRO FREE FARE DEMONSTRATION

--	--

2									
---	--	--	--	--	--	--	--	--	--

TELEPHONE SURVEY (PAGE 2)

8) EVEN IF YOU DON'T USE THE BUS SYSTEM, WE WOULD LIKE TO KNOW HOW YOU FEEL ABOUT VARIOUS QUALITIES OF THE MERCER METRO BUS SERVICE.

ARE YOU SATISFIED OR DISSATISFIED WITH: (VERY OR SOMEWHAT?)

QUALITIES	VERY SATISFACTORY	SOMEWHAT SATISFACTORY	HALF AND HALF	SOMEWHAT UNSATISFACTORY	VERY UNSATISFACTORY	DON'T KNOW
COST OF BUS SERVICE	_____	_____	_____	_____	_____	_____
BUS TRAVEL TIME	_____	_____	_____	_____	_____	_____
COMFORT	_____	_____	_____	_____	_____	_____
CONVENIENCE	_____	_____	_____	_____	_____	_____
SAFETY FROM CRIME & ACCIDENT	_____	_____	_____	_____	_____	_____

9) ARE YOU SATISFIED OR DISSATISFIED THAT THE BUS SYSTEM IS MEETING THE PUBLIC TRANSPORTATION NEEDS OF MERCER COUNTY? (VERY OR SOMEWHAT?)

- VERY SATISFIED SOMEWHAT DISSATISFIED DON'T KNOW
 SOMEWHAT SATISFIED VERY DISSATISFIED

10) SHOULD MORE, LESS OR THE SAME AMOUNT OF TAX MONEY BE USED TO SUPPORT THE MERCER METRO BUS SYSTEM?

- MORE LESS THE SAME DON'T KNOW

- 11) (A) IF THE FREE-FARE PROGRAM ENDS, DO YOU THINK THAT ELDERLY PEOPLE SHOULD CONTINUE TO RIDE FREE?.....
- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| | YES | NO | |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- (B) WHAT ABOUT YOUNG PEOPLE, UP TO 16? SHOULD THEY CONTINUE TO RIDE FREE?...
- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|
- (C) HOW ABOUT PEOPLE WITH LOW INCOMES, REGARDLESS OF AGE?.....
- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|
- (D) DO YOU THINK THAT THE FREE-FARE PROGRAM SHOULD BE CONTINUED AS IT IS, FOR EVERYBODY?.....
- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|
- (E) SHOULD IT BE EXPANDED TO INCLUDE ALL HOURS OF THE DAY?.....
- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|
- (F) SHOULD IT BE COMPLETELY DISCONTINUED?.....
- | | | | |
|--|--------------------------|--------------------------|--------------------------|
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|

12) CONTINUATION OF THE FREE BUS SERVICE WOULD HAVE TO BE PAID FOR SOMEHOW. SUPPOSE THE ADDITIONAL TAX COST PER HOUSEHOLD WERE BETWEEN \$10 AND \$20 PER YEAR. DO YOU FAVOR OR OPPOSE PAYING THIS AMOUNT? (STRONGLY OR SOMEWHAT?)

- STRONGLY FAVOR SOMEWHAT OPPOSE NEITHER
 SOMEWHAT FAVOR STRONGLY OPPOSE DON'T KNOW

FINALLY, IN ORDER TO COMPARE YOUR ANSWERS WITH THOSE OF OTHER PEOPLE BEING SURVEYED, WE NEED TO KNOW A FEW THINGS ABOUT YOUR HOUSEHOLD.

13) HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS OF YOUR HOUSEHOLD?

14) WHAT IS THE TOTAL NUMBER OF PEOPLE INCLUDING YOURSELF IN YOUR HOUSEHOLD? .

15) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES YOUR AGE:

- 16 OR UNDER 17-24 25-44 45-64 65 OR OLDER

16) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD.

- UNDER \$5,000 \$5,001-\$10,000 \$10,001-\$15,000
 \$15,001-\$25,000 OVER \$25,001

THANK YOU.

17) (do not ask, record by observation) Male Female

Follow-Up Telephone Surveys

A sample of the on-board surveys, and activity centers for the first phase, on which names and telephone numbers had been included, were selected to be called in a follow-up telephone interview. Essentially identical to the random telephone interviews, these were conducted to obtain data on household travel characteristics and attitudes towards transit in general, as well as the fare-free program, especially among users of the system. The survey was conducted on three different occasions; November 1977, December 1978, and May 1979. The survey instruments used in the first and third phases are shown in Figures A.7 and A.8. The instrument used in the second phase is identical to the one used in the second phase of the random telephone survey (Figure A.6).

The data obtained in this manner have the same biases as the on-board surveys and activity center interviews. In addition, there is a further self-selection bias of only surveying those persons who were willing to supply their name and phone number.

Activity Center Interviews:

Two activity center surveys were conducted before and during the fare-free demonstration at the Trenton Commons (the central shopping district) and at Quaker Bridge Mall (a regional, suburban shopping mall). Interviews also were conducted once at the Mercer Medical Center but were not repeated. Persons at Trenton Commons were surveyed on two weekdays and a Saturday while people at Quaker Bridge Mall were surveyed on one weekday and a Saturday.

These surveys were conducted to investigate attitudinal and behavioral patterns as well as to investigate the fare-free program's impact on CBD commercial activity and on shopping center use. Figures A.9 and A.10 are samples of the instruments used during the two surveys.

The major potential bias in these data is caused by self-selection of respondents. There may be a greater likelihood in an activity center than on a bus that a person approached by an interviewer will refuse to complete the survey. Thus, only the "willing" are interviewed.

MERCER METRO FREE FARE DEMONSTRATION
ACTIVITY CENTER/BUS FOLLOW-UP TELEPHONE SURVEY

IS THIS _____?
(telephone no.)

MAY I SPEAK WITH _____?
(contact name) CB / day time

MY NAME IS _____ . WHEN WE RECENTLY INTERVIEWED YOU
(use full name)

AT QBM/TC/MMC, ON THE BUS, YOU WERE KIND ENOUGH TO GIVE US YOUR NAME AND PHONE NUMBER. TO HELP COMPLETE OUR SURVEY FOR THE DEPARTMENT OF TRANSPORTATION, WE WOULD APPRECIATE YOUR HELP IN ANSWERING A FEW QUESTIONS ABOUT YOUR FAMILY'S TRAVEL.

FIRST, DO YOU LIVE IN MERCER COUNTY? YES NO

→ (if the answer is no, thank the person and end the interview)

1) WE ARE INTERESTED IN ONE-WAY TRIPS MADE YESTERDAY BETWEEN THE HOURS OF 10 AM AND 2 PM AND AFTER 6 PM. WE WOULD LIKE TO GET A LIST OF ALL TRIPS MADE BY ALL MEMBERS OF YOUR HOUSEHOLD DURING THOSE TIMES.

FIRST, YOURSELF. PLEASE TELL ME THE PURPOSE OF EACH TRIP AND HOW IT WAS MADE. (OTHER MEMBERS OF YOUR HOUSEHOLD?)

→ (if no trips were made by any members of the household, check the box and go to question #2) None

PERSON	PLACE	PURPOSE AT DESTINATION								MEANS OF TRAVEL						
		NONE	WORK	SCHOOL	SHOPPING	MEDICAL	RECREATION	SOCIAL/VISIT	CHAUFFERING	OTHER	WALK	AUTO-RIDE	AUTO-DRIVE	TAXI	BUS	OTHER
1																
2																
3																
4																
5																
6																
7																
8																
9																

→ (if more than nine trips are reported use a supplemental sheet and check this box . . .)

2) HOW FAR FROM YOUR HOME IS THE NEAREST MERCER METRO BUS STOP?

BLOCKS or MILES (or fraction) DON'T KNOW

3) HOW MUCH IS THE BASIC BUS FARE:

FOR COMMUTER HOURS DON'T KNOW

FOR MIDDAY AND NIGHTTIME DON'T KNOW

4) HOW MANY ONE-WAY BUS TRIPS ARE MADE BY MEMBERS OF YOUR HOUSEHOLD IN A TYPICAL WEEK?

NONE PER WEEK PER DAY

→ (if "none", skip to question #7)

5) HOW MANY OF THESE ONE-WAY TRIPS DO YOU MAKE?

NONE PER WEEK PER DAY

6) HOW MANY OF THE ONE-WAY BUS TRIPS THAT YOU MAKE BEGIN:

BETWEEN 10 AM AND 2 PM ON WEEKDAYS & SATURDAYS?
AFTER 6 PM ON WEEKDAYS & SATURDAYS?
ANYTIME ON SUNDAYS?

	# OF ONE-WAY BUS TRIPS	
	NONE	PER WEEK PER DAY

1

2-9

10-13

14-18

19-25

26-37

38

39

40-41

42-43

44-45

46-47

48-49

50-51

52-53

54-55

56-57

58

59-61

62-63

64-65

66-68

69-71

72-74

75-77

78-80

**MERCER-METRO FARE FREE TRANSIT DEMONSTRATION
POST-DEMONSTRATION BUS USER TELEPHONE SURVEY**

Hello. May I speak with _____ Call Back: _____

My name is _____. I am calling as part of the Mercer Metro free bus demonstration project. As you may recall, we interviewed you last year about the free bus service and you gave us your name and telephone number so that we could ask you some additional questions. Now, we'd like to get your opinions about the free bus program. First.....

<p>① Before the free off-peak bus service began, did you ride Mercer Metro buses during the half-fare hours?</p> <p><input type="checkbox"/> Yes..... How many One-Way(Off-peak) trips per week?.. _____</p> <p><input type="checkbox"/> No..... Did you start using Mercer Metro because of the free off-peak bus service?</p> <p style="margin-left: 40px;"><input type="checkbox"/> No.... Then why did you start?</p> <p style="margin-left: 80px;"><input type="checkbox"/> Just started making the trip</p> <p style="margin-left: 80px;"><input type="checkbox"/> Just moved into the area</p> <p style="margin-left: 80px;"><input type="checkbox"/> Prior mode of trip ended</p> <p style="margin-left: 80px;"><input type="checkbox"/> Other _____</p> <p style="margin-left: 40px;"><input type="checkbox"/> Yes.... How did you make those trips before?</p> <p style="margin-left: 80px;"><input type="checkbox"/> Did not make them</p> <p style="margin-left: 80px;"><input type="checkbox"/> Drove an auto</p> <p style="margin-left: 80px;"><input type="checkbox"/> Rode in an auto</p> <p style="margin-left: 80px;"><input type="checkbox"/> Walked</p> <p style="margin-left: 80px;"><input type="checkbox"/> Other _____</p>	<p>1 <input type="checkbox"/></p> <p>2 - 3 <input type="checkbox"/></p> <p>4 <input type="checkbox"/></p> <p>5 <input type="checkbox"/></p> <p>6 - 7 <input type="checkbox"/></p>
<p>② During the months that the off-peak buses were free, did you make the same number, fewer, or more bus trips than before fares were eliminated?</p> <p><input type="checkbox"/> The same</p> <p><input type="checkbox"/> Fewer....How many <u>fewer</u> one-way trips per week?..... _____</p> <p><input type="checkbox"/> More.....How many <u>more</u> one-way trips per week?..... _____</p> <p style="margin-left: 40px;">Why? _____</p>	<p>8 <input type="checkbox"/></p> <p>9-10 <input type="checkbox"/></p> <p>11-12 <input type="checkbox"/></p>
<p>③ Since the free bus service ended, how many one-way, off-peak bus trips do you make in a typical week?..... _____</p> <p>How many of those are for...</p> <p style="margin-left: 40px;">Work or School..... _____</p> <p style="margin-left: 40px;">Shopping..... _____</p> <p style="margin-left: 40px;">Other Purposes..... _____</p>	<p>13-14 <input type="checkbox"/></p> <p>15-16 <input type="checkbox"/></p> <p>17-18 <input type="checkbox"/></p> <p>19-20 <input type="checkbox"/></p>
<p>④ On which bus route did you <u>most frequently</u> ride free?</p> <p>G H K L P Q R S T X POL PIL Z</p>	<p>21-22 <input type="checkbox"/></p>
<p>⑤ At what times did you <u>most frequently</u> use the free bus service?</p> <p><input type="checkbox"/> Weekday middays (10am-2pm)</p> <p><input type="checkbox"/> Weekday evenings (After 6pm)</p> <p><input type="checkbox"/> Saturday middays (10am-2pm)</p> <p><input type="checkbox"/> Saturday evenings (After 6 pm)</p> <p><input type="checkbox"/> Sundays</p>	<p>23 <input type="checkbox"/></p> <p>24 <input type="checkbox"/></p> <p>25 <input type="checkbox"/></p> <p>26 <input type="checkbox"/></p> <p>27 <input type="checkbox"/></p>
<p>⑥ Did you frequently avoid using the free bus service during any fare-free time, for any reason?</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Yes.... What time, or times, did you avoid using it and why?</p> <p style="margin-left: 40px;"><input type="checkbox"/> Weekday middays _____</p> <p style="margin-left: 40px;"><input type="checkbox"/> Weekday evenings _____</p> <p style="margin-left: 40px;"><input type="checkbox"/> Saturday middays _____</p> <p style="margin-left: 40px;"><input type="checkbox"/> Saturday evenings _____</p> <p style="margin-left: 40px;"><input type="checkbox"/> Sundays _____</p>	<p>28 <input type="checkbox"/></p> <p>29 <input type="checkbox"/></p> <p>30 <input type="checkbox"/></p> <p>31 <input type="checkbox"/></p> <p>32 <input type="checkbox"/></p> <p>33 <input type="checkbox"/></p>
<p>⑦ Did you ever change the time of a bus trip from a fare-paying period to the off-peak in order to ride free?</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Yes.....Frequently? <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	<p>34 <input type="checkbox"/></p> <p>35 <input type="checkbox"/></p>

<p>⑧ Did you generally try to arrange your bus travel so that most of your bus trips could be made during the fare-free hours? <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	36	<input type="checkbox"/>
<p>⑨ Did you use the free bus service to make more trips than you made before it was free? <input type="checkbox"/> No <input type="checkbox"/> Yes..... What were the purposes of the <u>new</u> trips? <input type="checkbox"/> Work <input type="checkbox"/> School <input type="checkbox"/> Shopping <input type="checkbox"/> Recreation <input type="checkbox"/> Social <input type="checkbox"/> Medical <input type="checkbox"/> Other _____ Do you still use the bus for those purposes?: <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	37	<input type="checkbox"/>
	38	<input type="checkbox"/>
	39	<input type="checkbox"/>
	40	<input type="checkbox"/>
	41	<input type="checkbox"/>
	42	<input type="checkbox"/>
	43	<input type="checkbox"/>
	44	<input type="checkbox"/>
	45	<input type="checkbox"/>
<p>⑩ Did you use the free bus to go to places that you wouldn't have gone to if the regular fare had been charged for the trip? <input type="checkbox"/> No <input type="checkbox"/> Yes..... Where and for what purpose? <input type="checkbox"/> Work _____ <input type="checkbox"/> Shopping _____ <input type="checkbox"/> Personal business _____ <input type="checkbox"/> School _____ <input type="checkbox"/> Recreation _____ <input type="checkbox"/> Other _____ Do you still use the bus to go to those places? <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	46	<input type="checkbox"/>
	47-48	<input type="checkbox"/>
	49-50	<input type="checkbox"/>
	51-52	<input type="checkbox"/>
	53-54	<input type="checkbox"/>
	55-56	<input type="checkbox"/>
	57-58	<input type="checkbox"/>
	59	<input type="checkbox"/>
<p>⑪ What did you like about the free bus program? <input type="checkbox"/> No cost to me <input type="checkbox"/> No cost to others <input type="checkbox"/> Convenient not to pay fare <input type="checkbox"/> Nothing <input type="checkbox"/> Other _____</p>	60	<input type="checkbox"/>
	61	<input type="checkbox"/>
	62	<input type="checkbox"/>
	63	<input type="checkbox"/>
	64	<input type="checkbox"/>
<p>⑫ What did you dislike about the free bus program? <input type="checkbox"/> Crowded buses / No seats <input type="checkbox"/> Rowdyism / Harrassment <input type="checkbox"/> Don't like other kinds of passengers <input type="checkbox"/> Buses not on schedule <input type="checkbox"/> Nothing <input type="checkbox"/> Other _____</p>	65	<input type="checkbox"/>
	66	<input type="checkbox"/>
	67	<input type="checkbox"/>
	68	<input type="checkbox"/>
	69	<input type="checkbox"/>
	70	<input type="checkbox"/>
<p>⑬ All things considered, did you mostly like or dislike the free bus program? <input type="checkbox"/> Like <input type="checkbox"/> Dislike</p>	71	<input type="checkbox"/>
<p>⑭ How much money do you think you saved in a week by using the free bus?</p>	72	<input type="checkbox"/>
	73-74	<input type="checkbox"/>
<p>⑮ Do you have a drivers license? <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	75	<input type="checkbox"/>
<p>⑯ Do you generally have a car or other motor vehicle available for your personal use? <input type="checkbox"/> No <input type="checkbox"/> Yes</p>	76	<input type="checkbox"/>
	77	<input type="checkbox"/>
	78	<input type="checkbox"/>
	79	<input type="checkbox"/>
	80	<input type="checkbox"/>
	81	<input type="checkbox"/>
	S	<input type="checkbox"/>
	A	<input type="checkbox"/>
	C	<input type="checkbox"/>
	H	<input type="checkbox"/>
	I	<input type="checkbox"/>
TEL	2 - 6	<input type="checkbox"/>
NAM	9 - 15	<input type="checkbox"/>
SER	16 - 20	<input type="checkbox"/>
FAX	21 - 25	<input type="checkbox"/>

October 1977

ACTIVITY CENTER INTERVIEW

OFFICE USE ONLY

Date _____
Time of Interview _____

(Introduction: To be read by the interviewer)

WE ARE DOING A TRAVEL SURVEY FOR THE NEW JERSEY DEPARTMENT OF TRANSPORTATION.
I WOULD LIKE TO TAKE A COUPLE OF MINUTES TO ASK YOU A FEW QUESTIONS ABOUT THE TRIP YOU JUST MADE.

1. HOW OFTEN DO YOU COME TO QBH / COM / HOSP (CHECK ONE):
(circle one)

NONE THAN ONCE A WEEK.
ONCE EVERY 1-2 WEEKS...

ONCE EVERY 3-4 WEEKS..
LESS THAN ONCE A MONTH..

2. HOW DID YOU GET HERE? (CHECK ONE):

WALKED..
DROVE A CAR..
PASSENGER IN A CAR..

BUS...
TAXI.....
OTHER(WHAT?)..... _____

(If the answer is "BUS", Thank the respondent and end the interview.)

3. WHERE DID YOU COME FROM? (CHECK ONE):

NONE.....
WORK.....
SCHOOL.....
SHOPPING.....

MEDICAL..
RECREATIONAL..
SOCIAL/VISITING..
OTHER(WHAT?) _____

4. WHAT IS THE ADDRESS OR NEAREST STREET CORNER OF THAT PLACE?

_____ IN _____
(address or nearest corner) (city)

5. WHAT TIME DID YOU LEAVE THAT PLACE TO COME HERE? _____
AM/PM (CIRCLE ONE)

6. WHAT IS THE MAIN PURPOSE OF YOUR TRIP HERE? (CHECK ONE):

WORK.....
SHOPPING.....
MEDICAL....

RECREATIONAL..
SOCIAL/VISITING..
OTHER(WHAT?) _____

7. IF BUS SERVICE WERE FREE BETWEEN 10:00 AM AND 2:00 PM AND AFTER 6:00 PM ON WEEKDAYS AND SATURDAYS AND ALL DAY SUNDAY, DO YOU THINK YOU WOULD USE IT? (CHECK ONE):

YES..
NO..
NOT SURE..

(if the answer is "NO", skip to question #9.)

8. (if the answer to question #7 is "YES", ask the following):
WOULD YOU USE THE BUS FOR: (CHECK ONE)

	YES	NO	UNSURE	HOW OFTEN PER WEEK?
TRIPS TO WORK OR SCHOOL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
SHOPPING TRIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
OTHER TRIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

9. HOW MANY PEOPLE, INCLUDING YOURSELF, ARE IN YOUR HOUSEHOLD? (CHECK ONE):

1..
2..
3..
4..
5..
6 OR MORE..

10. HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS IN YOUR HOUSEHOLD? (CHECK ONE):

NONE..
1..
2..
3 OR MORE..

11. (Show the respondent the card which has age categories on it.)
WHICH OF THESE GROUPS INCLUDES YOUR AGE? (CHECK ONE):

(a) 16 OR UNDER..
(b) 17-24..
(c) 25-44..
(d) 45-64..
(e) 65 AND OVER..

12. (Show the respondent the card which has income categories on it.) WHICH OF THESE GROUPS INCLUDES THE COMBINED ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD? (CHECK ONE):

(a) \$ 0-\$5,000.....
(b) \$5,001-\$10,000..
(c) \$10,001-\$15,000..

(d) \$15,001-\$25,000..
(e) OVER \$25,001....

13. (Record whether the respondent is male or female.) MALE.. FEMALE..

14. WE MAY NEED ADDITIONAL INFORMATION ABOUT YOUR TRAVEL. MAY WE CONTACT YOU BY PHONE TO ASK ADDITIONAL QUESTIONS?

WHAT IS YOUR TELEPHONE NUMBER.. _____ DAY.. EVENING..

(area code)

WHOM SHOULD WE ASK FOR (FIRST NAME): _____

October 1978

ACTIVITY CENTER INTERVIEW

Date _____
Time of Interview _____

Introduction: To be read by the interviewer)

We are doing a travel survey for the New Jersey Department of Transportation.
I would like to take a couple of minutes to ask you a few questions about the trip you just made.

1. HOW OFTEN DO YOU COME TO QRM / COR? (CHECK ONLY ONE)

More than once a week Once every 1-2 weeks
 Once every 3-4 weeks Less than once a month

2. HOW DID YOU GET HERE? (CHECK ONLY ONE)

By walking Drove a car Passenger in a car
 By bus By taxi Other (What?) _____

2a. (IF WALK, BUS, OR TAXI ASK...) WAS AN AUTO AVAILABLE TO YOU FOR THIS TRIP?

Yes No

2b. (IF NOT BUS ASK...) WHY DID'T YOU USE THE FREE BUS SERVICE?

No bus route near the place I came from I can't carry packages easily
 Travelling by bus takes too long I don't like to ride with strangers
 I can't leave when I want to Buses are not comfortable/safe/clean
 I don't know routes or schedules Other: _____

3. WHAT TIME DID YOU LEAVE TO COME HERE? _____ AM/PM

4. WHAT IS THE MAIN PURPOSE OF YOUR TRIP HERE? (CHECK ONLY ONE)

Work Recreation Social/Visiting Medical
 Shopping Other (Explain: _____)

5. HOW MANY PEOPLE, INCLUDING YOURSELF, ARE IN YOUR HOUSEHOLD?

1 2 3 4 5 6 or more

6. HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS OF YOUR HOUSEHOLD?

None 1 2 3 or more

7. WHICH OF THESE GROUPS INCLUDES YOUR AGE?

16 or under 17-24 25-44
 45-64 65 and over

8. WHICH OF THESE GROUPS INCLUDES THE COMBINED ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD?

0-\$5,000 \$5,001-\$10,000 \$10,001-\$15,000 \$15,001-\$25,000 Over \$25,000

9. (RECORD: Male Female)

THANK YOU FOR YOUR COOPERATION:

There is also a possibility for interviewer biases to appear in the data. In a situation where an interviewer must approach the persons to be interviewed, there is a tendency to approach those persons he feels most comfortable talking to. This was seen as a potential problem, and thoroughly discussed with the interviewers and supervisors so that they would guard against it.

Passenger Counts:

During the study period, twelve sample passenger counts were performed; three before the demonstration started, eight during, and one after. These included three boarding counts taken in conjunction with the on-board surveys, and nine "corner counts". The purpose of these passenger counts was to estimate changes in ridership. Boarding counts on 100 percent of the route-blocks, together with a prior 100 percent passenger count, were considered to be fairly accurate counts of true ridership when reconciled with passenger revenue data. Corner counts were relied upon to indicate trends in patronage.

Corner Counts:

The procedure followed for corner counts was to stop buses at one of three corners in Trenton and to count the passengers, recording the information on the count sheet shown in Figure A.11. (This method was adopted after an earlier approach which attempted to count passengers on moving buses at eight different corners throughout Mercer County was shown to produce data with large and erratic errors.) In doing the counts, Mondays, Fridays, holidays, rainy days, and other events which may have caused abnormal ridership were avoided. Each corner count set included a full weekday at all three corners and free-fare periods on a Saturday and a Sunday at two corners, as shown below:

Corner Count Schedule

<u>Intersection</u>	<u>Weekday</u> 6AM-10PM	<u>Saturday</u> 10AM-2PM 6-10PM		<u>Sunday</u> 10AM-6PM
State/Clinton	X	X	X	X
Brunswick/Olden	X	X	X	X
State/Calhoun	X			

The primary purposes of these data were to identify initial and sustained ridership gains and monitor periodic

variations in ridership. Secondary purposes were to provide a source of calibration for the NBS modal split model, to check bus loading and crowding effects, and to investigate schedule adherence impacts.

The corner counts served as a sample which, when related to pre-demonstration ridership, allowed estimation of passenger volume changes. A detailed description of the expansion and ridership estimation methodology is presented in Appendix C.

On-Board Counts

Boarding counts on all buses not part of the on-board survey, were done once during the study period, during the pre-implementation phase in conjunction with the on-board survey. The procedure followed was to have a person ride each bus and keep a running count of the number of passengers and record the starting and ending times of each run. The boarding counts were primarily used to verify representativeness of survey passenger counts as a sample and to provide a one-hundred percent sample for estimating pre-implementation ridership. Data were recorded on sheets as in Figure A.12.

Other Data Sources:

Passenger Boarding Timings

This data set was collected to study the effect of fare-elimination on dwell-time. One hundred samples of boardings during peak and off-peak hours were taken during the fare-free demonstration. Boarding time was considered to be the time between when the first person boarded the bus until the last person passed the fare-box. Times were recorded on a sheet such as in Figure A.13.

Bus Drivers Interview

Since the Mercer Metro bus drivers were the persons in closest contact with the fare-free program, they were questioned about their attitudes and perceptions of it. The instrument shown in Figure A.14, was distributed to bus drivers during a safety training session; they were requested to complete and return it.

September 1978

Drivers Interview
Mercer Metro Free-Fare Demonstration

Since you are the people most closely in touch with the Mercer Metro Free-Fare Demonstration, we are asking you to answer the following questions to help us evaluate the effects of the program. We have tried to include the major issues which have been raised since the demonstration began. If, however, you have any additional comments, please feel free to write them in the space provided at the end of the questions.

- 1) What Free-Fare shifts have you driven?
- Weekday - AM Weekday - PM Saturday - AM
 Saturday - PM Sunday None

2) What route, or routes, have you driven during Free-Fare hours? _____

- 3) What effects, if any, has the Free-Fare Program had on the following factors for the routes you have driven?
- Trip times _____
Layovers _____
Schedule Adherence _____

4) Please indicate how often comments are made to you by passengers regarding the Free-Fare program.

- | | |
|-------------------------------------|-------------------------------------|
| <u>Good Comments</u> | <u>Bad Comments</u> |
| <input type="checkbox"/> Frequently | <input type="checkbox"/> Frequently |
| <input type="checkbox"/> Sometimes | <input type="checkbox"/> Sometimes |
| <input type="checkbox"/> Never | <input type="checkbox"/> Never |

- 5) Which of the following describes your feelings about the Free-Fare program?
- It has made my job more enjoyable
 It has made my job less enjoyable
 It has not affected my job

(Please turn the page)

September 1978

7) Listed below are a number of problems which occur on the buses; for each of the problems please check the box which most closely describes the frequency with which it happens on your bus now compared with before the Free-Fare program began.

	Much More Frequent Now	Somewhat More Now	About As Often	Somewhat Less Now	Much Less Frequent Now
Passenger argument or fight with driver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Passenger argument or fight with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smoking/Eating/or Drinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Offensive language/Behavior/Harassment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vandalism on the bus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Attempted personal property thefts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Joyriding/round tripping, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other _____ (explain)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please add any explanations or comments you may wish to make below:

Retail Merchants Survey

Surveys were distributed to merchants in the Trenton business district, and three suburban shopping malls; the instrument is shown in Figure A.15. Merchants were asked about the impacts of the fare-free program on their business and about their support of it.

Mercer Metro Historical Records

Mercer Metro keeps records of various items pertaining to bus operations. Of special interest are their on-board incident reports, corner counts and records of revenue, passengers, cost, extra-service, and maintenance.

On-board incident reports are valuable because before and during the demonstration it was perceived that youths might use the buses for joyriding and disturb other passengers. Drivers fill out incident reports when a disturbance occurs on a bus, which are useful in determining whether more incidents occurred during the demonstration than before or after, as well as changes in types of incidents.

Mercer Metro Corner Counts and records of revenue and passengers help to establish the changes in ridership caused by the fare-free program. Records of cost, extra service, and maintenance indicate changes in bus and driver utilization and differences in the amount of maintenance vehicles might have required due to vandalism or increased usage.

Mercer Metro Free-Fare Demonstration

RETAIL MERCHANT SURVEY

- 1) Where is your business located?
- Trenton Commons Lawrence Shopping Center
 Quaker Bridge Mall Mercer Mall
- 2) What is the nature of your business (type of service or product)?
- _____
- _____
- 3) How did the Mercer Metro Free-Fare Transit Demonstration affect your business? (Check all that apply)
- Increased the number of shoppers
 Increased the amount of sales
 Increased loitering
 Increased shoplifting
 It had no noticeable affect
 Other (please explain): _____
- _____
- _____
- 4) Do you support the free-fare program as a means of bringing additional people to retail centers?
- Yes No
- 5) Do you favor the use of general purpose tax revenue to support the free-fare program?
- Yes No
- 6) Would you be willing to participate in a merchant-funded free-fare program?
- Yes No

Thank you for your time and cooperation. If you would like to add any comments, please do so on the back of this form.

Appendix B ANALYSIS OF CONFIDENCE

The question of confidence (or alternatively risk) in inferences drawn from a given data set is essentially a function of the reliability of the raw data (absence of biases) and the significance of the individual observed changes. Data reliability is qualitatively discussed in Appendix A; in the absence of further quantitative adjustments to the data, general statistical significance and confidence are discussed below.

Table B.1 summarizes generalized confidence intervals for the respective data sets. In general, the on-board surveys, because of large sample sizes, have the smallest estimated errors. However, other considerations have entered into the selection of data for analytical tasks. As a rule, the need for accuracy in the estimate of the population parameters was subordinate to other considerations (including data processing costs); the more common and greater need was to be able to measure changes, with links among socio-economic and travel characteristics.

For example, the standard deviation of ages in the bus users population was estimated to be about 18. Based on that estimate, the on-board survey should be accurate to about ± 0.5 years of the true mean (at 95% confidence); the post-demonstration bus user follow-up survey would have a corresponding reliability of about ± 1.6 years. However, a significance test of the measured change in mean age before and during the demonstration (from about 33 to 31 years) based on the follow-up telephone survey data indicates that the change is significant at 99% confidence. We can, therefore, say based on the telephone survey data, regardless of the true average age of the population (bus users), we are 99% confident that the average age decreased about two years from before to during the demonstration. That is more than adequate for purposes of evaluating the effects of off-peak fare elimination. The need for a more "accurate" estimate of the mean is questionable.

Decisions regarding data selection were generally made on the basis of the availability of and utility of linked data. If a given data set was able to answer a primary question (e.g., age distribution of bus users), it was also qualitatively appraised to include consideration of its ability to provide before/during/after insights, linked travel characteristics (e.g., trip rates, trip purposes), or linked attitudes before proceeding with analysis. The results of these qualitative evaluations can be summarized as follows:

- The post-demonstration bus user follow-up survey seems to have been the best source for linked socio-economic/travel (trip rate) data and for selected behavioral and attitudinal analyses. It also provides the best before/during/after linkage of data.
- The follow-up telephone surveys (before and during the demonstration) are the best sources for transit awareness and general bus service attitudes, as well as general travel data. Public support for free-fare is also measured by these data.
- On-board surveys were most useful for origin-destination, group travel, and direction of travel analyses. They also served to provide and/or substantiate data on new Mercer Metro users (off-peak) because of sample size shortcomings in other data sets.
- Activity center interviews, the bus driver's interview, and the retail merchants survey addressed specific questions which could not be properly analyzed with the other data.

Table B.2 presents sample size data for each of the five primary data sets on the basis of common tabular breakdowns. The following is a discussion of typical reliability of the data sets on the basis of analytical subdivisions. With one exception, as noted, the presumptions for this general confidence analysis are conservative; the assumed proportion in the population equals 50% with a level of confidence equal to 95%.

In general, throughout the analysis inferences were commonly drawn from the on-board surveys on the bases of fare-free periods (10AM-2PM, after 6PM, etc.); whether the respondent was a "prior" or "new" user; and on the various socio-economic classifications (age, income, etc.). Fare-free period tabulations have reliabilities (at 95% confidence; 50% proportions) approximately as follows: weekdays, 10-2 : $\pm 2\%$, after 6 PM : $\pm 4\%$; Saturdays, 10-2 : $\pm 3\%$, after 6 PM : $\pm 4\%$; and Sundays, $\pm 3\%$. New user responses have reliability no worse than $\pm 5\%$, while for prior users it is $\pm 2\%$. Reliability within various socio-economic groups (i.e., "among people 17 to 24 years of age") is generally no worse than about $\pm 5\%$ and typically better than that. For breakdowns by "new" versus "prior" (in the 10/78 on-board survey), within socio-economic groups, the reliability falls to typically $\pm 10\%$. Further subdivision of the data would be done with considerable loss of reliability.

Socio-economic breakdowns, within individual groups, for the telephone surveys generally have wide confidence intervals ($\pm 15-20\%$) and were therefore not reliable for detailed intra-group (i.e., "among people 17 to 24 years of age") analyses. They were useful as order-of-magnitude checks on other data at that level and are typically reliable to about $\pm 15\%$ or better for analysis between socio-economic groups.

The post-demonstration bus-user survey was mostly analyzed on the basis of reported Mercer Metro use -- i.e., before, during, or after the demonstration. For those subdivisions the reliability is typically better than $\pm 5\%$. Among socio-economic groups, with the time-of-use breakdown, reliability falls to a minimum of about $\pm 10-15\%$. Reliabilities of "new" versus "prior" users in this survey are about $\pm 10-15\%$ and $\pm 5\%$, respectively.

Retail merchants survey data were generally analyzed on the basis of the total sample with a minimum reliability of about $\pm 10\%$; for more detailed analyses (i.e., by location or type of establishment), the confidence would probably be no worse than about $\pm 15\%$. Bus driver interviews were analyzed only on the basis of the entire sample; even at that level, the reliability is on the order of $\pm 10\%$ (95% confidence, proportions of 10% or 90%).

Table B.3 presents a summary of selected measurements which were shown to be not statistically significant with 99% confidence.

Table B.1
CONFIDENCE OF MEANS AND PROPORTIONS

	Sample Size ⁽¹⁾	Means ⁽²⁾	Reliability at 95% Confidence Proportions	
			P=50% ⁽³⁾	P=10% ⁽³⁾
On-Board Surveys	4651/4912	± 3% S	± 2%	± 1%
Activity Center Interviews	640/767	± 8% S	± 4%	± 3%
Bus User Telephone Follow-Up Surveys	150/150	±16% S	± 8%	± 5%
Random Household Telephone Surveys	300/296	±11% S	± 6%	± 4%
Post-Demonstration Telephone Survey	541	± 9% S	± 5%	± 3%
Bus Driver Interview	36	N/A	±16%	±10%
Retail Merchants Survey	107	N/A	± 9%	± 6%

(1) Sample Sizes: Before/After (if applicable).

(2) S = Standard Deviation.

(3) P = 50%: for proportions equal to 50%.

P = 10%: for proportions equal to 10% or 90%.

Table B.2
ONE-WAY SOCIO-ECONOMIC FREQUENCIES

Breakdown	OBS1	TS1		OBS3		TS2		TS3		
	All	Rndm	Bus	Prior	New	Rndm	Bus	Ber	Dur	Aft
Age: 16 or less	875	6 ⁽²⁾	32	744	108	7 ⁽²⁾	7 ⁽²⁾	67	77	66
17-24	1471	29	50	1425	187	32	52	170	190	148
25-44	731	109	15	735	108	105	49	112	123	106
45-64	656	136	19	428	44	91	28	82	89	79
65 or more	295	83	18	210	16	56	6	52	57	50
Income: 0-5K	944	44	32	174	15	36	32	74	79	70
5-10K	908	59	8	557	269	30	26	109	117	103
10-15K	476	73	11	691	65	35	25	65	74	60
15-25K	624	72	19	482	65	68	15	60	67	50
25K(+)	296	56	7	210	121	61	15	27	33	21
Household Size:										
One	554	61	19	404	56	36	16	54	59	53
Two	687	112	18	412	73	80	15	82	91	77
Three	635	71	17	558	63	53	20	62	66	57
Four	689	57	22	630	107	57	34	95	103	84
Five	575	28	23	470	66	40	20	68	76	61
Six(+)	868	28	35	969	100	25	27	114	128	107
Autos:										
Zero	1715	1	50	774	83	22	60	159	168	150
One	1159	141	41	1106	115	91	35	155	179	146
Two	737	131	28	899	123	127	23	99	114	93
Three(+)	417	57	15	478	77	69	25	54	59	45
Sex: Female	2357	247	90	1988	266	164	99	264	307	261
Male	1583	120	41	1548	201	102	43	222	232	191

(1) OBS1 - On-board survey, 10/77; TS1 - Telephone surveys, 11/77; OBS3 - On-board surveys, 10/78; TS2 - Telephone surveys, 11/78; TS3 - Post-demonstration telephone survey, 5/79.

(2) Age was deliberately biased to exclude people 16 or under.

Table B.3
 SELECTED VALUES OF STUDENT'S "t"(1)

<u>Observed Changes</u>	<u>"t"</u>
<u>Total off-peak household travel:</u>	
● Bus Users; Before to During	1.05
● General Population; Before to During	0.86
<u>Trip Rates; Before to During:</u>	
● One-person households	1.69
● Three-person households	1.16
● Five-person households	2.07
● Age, 45-64	1.69
● Income, 5-10K	1.69
● Income, over 25K	1.69
<u>Support Additional Tax for Free-Fare:</u>	
● General Population; Before to During	1.80
● Bus Users; Before to During	1.10
Mean User Income; Before to After	1.60
Mean User Auto Ownership; Before to After	1.60
Mean Household Size; Before to During	1.12

(1) Selected changes in observations which were found to not be significant at 99% confidence. Other observed changes which had practical significance, were also found to be statistically significant.

Appendix C
MERCER METRO RIDERSHIP ESTIMATES

The following summarizes the methodology used in estimating ridership on the Mercer Metro system for the periods before and after fare elimination. In general, the ridership estimates were developed principally using the demonstration corner counts, supplemented by Mercer Metro corner counts, revenue records, and on-board head counts. Demonstration corner counts were taken seven times during the demonstration; twice before fares were eliminated (11/77 and 2/78), and six times after (twice in 3/78 and once in 5/78, 7/78, 10/78 and 2/79). A post-demonstration corner count was also taken in March 1979. Counts were taken at three locations at various times as shown below:

COUNT LOCATIONS	TIME OF COUNTS			
	Weekdays	Saturdays		Sundays
	6a - 10p	10a-2p	6p-10p	10a-6p
State & Clinton	X	X	X	X
State & Calhoun	X			
Brunswick & Olden	X	X	X	X

In general, the methodology was a process of estimating ridership once for an initial base period; relating that estimate to a corresponding set of corner counts; and estimating ridership in subsequent periods by measuring changes in the corner counts and applying those changes to the base estimate. The following outlines the procedure used to expand and factor corner counts to estimate ridership.

RIDERSHIP ESTIMATION PROCEDURE

- Step 1 - Expand on-board passenger counts to estimate base off-peak ridership for 11/77.
- Step 2 - Adjust all (before and after) corner count sets for missing observations; tally by route and time period.
- Step 3 - Estimate 11/77 peak period ridership (by route and time period) by factoring corner counts:

$$PR_{ij} = \frac{OR_i}{OC_i} \times PC_{ij}$$

Where:

PR_{ij} = Peak period riderships for each route and time period
i = Each route
j = Peak period (am & pm)
OR = Sum of off-peak riderships (from Step 1)
OC = Sum of adjusted off-peak corner counts (from Step 2)
PC = Peak period corner counts (am & pm)

Step 4 - Estimate route - and time-specific ridership for remaining "before" corner count sets:

$$R_{ij} = \frac{CC_{ij}}{IC_{ij}} \times BR_{ij}$$

Where:

R_{ij} = Ridership by route and time period
i = Route
j = Time period (two peak and two off-peak)
CC = Corner Counts for new estimate period (2/78)
IC = Corner Counts for initial (base) estimate period (11/77)
BR = Base Ridership (11/77)

Step 5 - Aggregate "before" ridership estimates, adjust for seasonal variation:

$$AER = (R_1 + R_2) \div 2$$
$$TAR = 10(AER) + 2(AER)(0.8)$$

Where:

AER = Average Estimated Ridership
 R_1 = Estimated Ridership for 11/77
 R_2 = Estimated Ridership for 2/78
TAR = Typical Annual Ridership (10 months @ AER plus 2 summer months @ 80% of AER)

Step 6 - Reconcile adjusted ridership estimate with revenue experience:

- Weekday off-peak passengers equal 30% of total; Saturday off-peak passengers equal 45% of total.
- Weekday off-peak revenue equals 18% of total; Saturday off-peak revenue equals 29% of total.
- Average unit revenue per peak period passenger equals about \$0.24; average revenue per off-peak passenger equals about \$0.12.
- Using average unit revenue figures, adjust periodic passenger estimates, to reconcile with average revenue experience.

Step 7 - Repeat Step 4 for each "after" corner count set (excluding first 3/78), using respective counts.

Step 8 - Aggregate and seasonally adjust "after" ridership estimates by repeating Step 5, where:

$$\text{AER} = (R_3 + R_4 + R_6) \div 3$$

$$\text{TAR} = 10(\text{AER}) + 2(R_5)$$

Where:

R_3 = Ridership Estimate for 3/78

R_4 = Ridership Estimate for 5/78

R_5 = Ridership Estimate for 7/78

R_6 = Ridership Estimate for 10/78

Step 9 - Reconcile "after" ridership estimate with average revenue experience:

- Average unit revenue per peak period passenger remains the same; average revenue per off-peak passenger equals zero.

DISCUSSION OF PROCEDURE

Step 1 is the procedure to expand sample head counts based on the proportion of total service observed in the on-board surveys. "Minutes of service" were calculated for the free-fare hours for all bus runs. The observed route-specific passenger volumes were then factored upward by the ratio of total bus minutes to surveyed bus minutes for the respective routes. The opportunities for error or bias in this step were the chance of data collection error in the passenger counts and the presumption that ridership is evenly distributed within fare-free times. These biases were accounted for by checking the results for reasonableness of distribution with Mercer Metro estimates. In a few cases on-board timing counts were added to on-board survey counts if that seemed more reasonable than the expansion process. (On-board timing counts were not used as a primary data source for two reasons: 1) based on field observations during 1977 data collection, the general quality of the on-board timing counts was suspect; and 2) there were no comparable counts for 1978.)

Step 2 was a procedure to factor recorded corner counts (by route and hour) based on the ratio of the number of scheduled buses (for each route and hour) to the number of observed buses (for the same route and hour). This presumed that the buses which were not observed had passenger loads equal to the average of the ones which were observed. Given an average off-peak load of about

20 passengers, and an average of about 10 percent missed buses, at the worst case (i.e., all missed buses either full or empty) the potential error resulting from this presumption was only about three percent.

Step 3 was used to develop a relationship between the corner count data (samples) and the total system ridership. The opportunities for error result from common sampling error (using a few days to represent a "typical" day) and a presumption that the ridership-corner count relationship was the same during peak period as it was during off-peak periods. Daily variation (weekday) was accounted for in the data collection technique by staging corner counts over a three-day period (Tuesday through Thursday), and by a revenue-reconciliation procedure later in the procedure. The historical stability of the peak/off-peak ridership relationship on Mercer Metro tended to support the validity of the constant sample basis, to the extent major discrepancies had been encountered they would have been identified and corrected by revenue reconciliation.

Step 4 was a factoring procedure producing ridership estimates for each subsequent corner count set by factoring the November 1977 estimates on the basis of the changes in corner counts. It had the same uncertainties as in Step 3 and they were adjusted for in the same way.

Step 5 was included to account for gross seasonal variation between summer months and other months. Based on Mercer Metro corner counts, summer ridership (one-day) was typically 80 percent of the average of other months. Thus, Step 5 accounted for two months at 80 percent ridership before fares were eliminated.

Step 6 was a final seasonal adjustment based on farebox revenue. Once a "typical one-day ridership" (before) was estimated, the average annual one-day revenue was used to reconcile the estimate. In practice, the average revenue figure(s) used was for the nine months from March through November since they were the most stable months, with least exogenous effects, both before and after fare elimination. (January and February 1978 had new bus promotion efforts, and December through February 1979 all had a different peak period fare than other months.) This final adjustment, reconciling ridership estimates with reliably recorded revenue data, offsets and eliminates gross (i.e., total ridership) biases which may have resulted from sample expansion.

Steps 7, 8, and 9 were continuation of the procedure for "after" conditions. A summer corner count (7/78) was used as the measure of gross seasonal variation rather than the 80 percent factor. Revenue reconciliation was limited to the relationship

between average and estimated peak ridership. Sunday revenue reconciliation included elimination of extraneous (not-free-fare) revenue (about \$70).

It should be noted that the "before" estimates were in fact estimates of the "typical" ridership before fares were eliminated (i.e., basically 1977). They were used in the expansion of "before" survey data and do not represent projected baseline ridership (i.e., 1978 ridership without the fare-free program).

In order to evaluate the passenger volume impacts of the demonstration, it was necessary to account for what would be normal expected ridership growth if there had been no fare-free program. After examining historical ridership and revenue records, it was concluded that revenue would be the most reliable measure of annual change since it is a recorded figure, while Mercer Metro ridership was estimated. Between 1974 and 1977, Mercer Metro revenue increased from about \$1,287,000 to \$1,377,000, or about seven percent. This is equivalent to an average annual growth factor (compound factor) of about 2.3 percent. Presuming this growth was distributed evenly over all time periods, the "before" ridership figures were multiplied by a factor of 1.023 to estimate projected ridership had there been no free-fare program.

In general, the protections against bias in the sampling procedure were: 1) the spreading of corner counts over a few days; 2) correcting for missed observations; and 3) reconciling each corner count set to actual revenue experience. The corrections used for gross seasonal adjustment were derived from Mercer Metro historical records and finer seasonal adjustments resulted from revenue reconciliation. The revenue correction is considered to have been the best adjustment for linking the estimates with actual experience. Finally, the estimates were compared with Mercer Metro estimates and judgmentally evaluated for reasonableness.

Table A.1 presents summaries of the finally adjusted ridership estimates for the "with fare" and "without fare" conditions. Tables A.2 through A.14 present ridership estimates for individual count periods as outlined below. Deviations from the above described procedures for Saturday and Sunday estimates are noted on the respective tables.

COUNT PERIOD

PASSENGER ESTIMATE

	<u>WEEKDAY</u>		<u>SATURDAY</u>		<u>SUNDAY</u>	
	<u>Table</u>	<u>Page</u>	<u>Table</u>	<u>Page</u>	<u>Table</u>	<u>Page</u>
<u>Before:</u>						
● 11/77	A.2	C.8	A.10	C.16	A.18	C.24
● 2/78	A.3	C.9	A.11	C.17	A.18	C.24
<u>During:</u>						
● 3/78	A.4	C.10	A.12	C.18	A.19	C.25
● 5/78	A.5	C.11	A.13	C.19	A.19	C.25
● 7/78	A.6	C.12	A.14	C.20	A.19	C.25
● 10/78	A.7	C.13	A.15	C.21	A.19	C.25
● 2/79	A.8	C.14	A.16	C.22	A.19	C.25
<u>After:</u>						
● 3/79	A.9	C.15	A.17	C.23	A.20	C.25

Table A.1
ESTIMATED TYPICAL RIDERSHIP

<u>PERIOD</u>	<u>Projected⁽²⁾ With Fares</u>	<u>Estimated⁽³⁾ Without Fares</u>	<u>Percent Change</u>
Weekday:			
Before 10 AM	7,300	6,600	-10
10 AM- 2 PM	6,000	8,600*	+43
2 PM- 6 PM	8,900	8,300	- 7
After 6 PM	1,200	1,900*	+58
<u>TOTAL</u>	<u>23,400</u>	<u>25,400</u>	<u>+ 9</u>
Saturday:			
Before 10 AM	1,700	2,200	+29
10 AM- 2 PM	4,000	4,500*	+13
2 PM- 6 PM	4,600	5,900	+28
After 6 PM	1,200	2,300*	+92
<u>TOTAL</u>	<u>11,500</u>	<u>14,900</u>	<u>+30</u>
Sunday:	3,900	6,600*	+69
Weekly:			
Peak Periods	87,300	82,600	- 5
Off-Peaks	45,100	65,900*	+46
<u>TOTAL</u>	<u>132,400</u>	<u>148,500</u>	<u>+12</u>
Annual:			
Peak Periods	4,459,000	4,221,000	- 5
Off-Peaks	2,333,000	3,414,000*	+46
<u>TOTAL</u>	<u>6,792,000</u>	<u>7,635,000</u>	<u>+12</u>

- (1) Based on averages of "Before" and "After" corner counts, seasonally adjusted and reconciled with revenue experience.
(2) Projected "typical" ridership if there had been no free-fare program.
(3) Estimated "typical" ridership with free-fare program.
(4) * = Free-Fare periods.

Table A.2
ESTIMATED WEEKDAY BASE RIDERSHIP - 11/77

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	(2) Before 10 AM	(1) 10AM - 2PM	(2) 2PM - 6PM	(1) After 6 PM	
G(3)	590	260	700	20	1,570
H	500	230	600	20	1,350
K(3)	660	950	990	360	2,960
L	600	650	710	40	2,000
P(3)	1,020	1,050	1,460	350	3,880
Q(3)	740	480	800	100	2,120
R	650	430	670	20	1,770
S	840	650	820	130	2,440
T	1,520	1,170	1,440	220	4,300
X	100	40	160	-	300
POL	40	50	100	-	190
TOTAL	7,260	5,910	8,450	1,260	22,880

(1) Expanded passenger counts from 11/77 on-board surveys.

(2) Calculated by:

$$(TOPPi + (TOPCi) \times PPCij)$$

Where:

TOPPi = The sum of the off-peak (i.e., 10AM-2PM and after 6PM) passenger estimates for each route (i).

TOPCi = The sum of the adjusted off-peak corner counts for each route (i).

PPCij = The peak period corner count for each route (i) and the time period (j).

(3) Peak period estimates derived as factors of other similar routes as shown by historical Mercer Metro records:

- Route H = 85% of Route G
- Route L = 113% of Route R
- Route Q = 87% of Route S

Table A.3
ESTIMATED WEEKDAY RIDERSHIP - 2/78

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	All
G	510	280	750	20	1,560
H(2)	430	240	630	20	1,320
K	410	810	960	290	2,470
L(2)	710	610	900	40	2,260
P	950	910	1,490	290	3,640
Q(2)	650	580	900	90	2,220
R	630	550	790	40	2,010
S	750	670	1,030	100	2,550
T	2,110	1,100	1,650	110	4,970
X	90	30	110	-	230
POL	30	40	70	-	140
TOTAL	7,270	5,820	9,280	1,000	23,370

(1) Calculated by:

$$\frac{SCC_{ij}}{BCC_{ij}} \times TP_{ij}$$

Where:

SCC_{ij} = The adjusted corner counts for the specified month (2/78) for each route (i) and time period (j).

BCC_{ij} = The corresponding corner counts for the base period (11/77) for each route (i) and time period (j).

TP_{ij} = The estimated base ridership (11/77) for each route (i) and time period (j).

(2) See Note #3, Table A.2.

Table A.4
ESTIMATED WEEKDAY RIDERSHIP - 3/78⁽¹⁾

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽²⁾				All
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	650	530	540	70	1,790
H(3)	440	230	680	30	1,380
K	480	2,250	1,540	530	4,800
L(3)	540	860	490	100	1,990
P(3)	1,170	1,460	1,470	700	4,800
Q	880	600	860	140	2,480
R	480	1,090	700	50	2,320
S	720	1,460	880	260	3,320
T	910	1,770	1,410	230	4,320
X	100	60	150	-	310
POL	40	90	90	-	220
TOTAL	6,410	10,400	8,810	2,110	27,730

(1) From second March 1978 counts; at end of month.

(2) See Note #1, Table A.3.

(3) Calculated by:

$$\frac{C_1}{C_2} \times P_{ij}$$

Where:

C_1 = Mercer Metro Corner Counts for March 1978.

C_2 = Mercer Metro Corner Counts for October 1977.

P_{ij} = Base passenger estimate (11/77) for each route
($i=H,L&Q$) and time period (j).

Table A.5
ESTIMATED WEEKDAY RIDERSHIP - 5/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽¹⁾				All
	⁽²⁾ Before 10 AM	⁽¹⁾ 10AM - 2PM	⁽²⁾ 2PM - 6PM	⁽¹⁾ After 6 PM	
G	490	460	680	20	1,650
H ⁽²⁾	430	230	550	40	1,250
K	630	1,040	1,010	550	3,230
L ⁽²⁾	530	910	680	60	2,180
P	1,190	1,260	1,350	490	4,290
Q ⁽²⁾	810	530	560	140	2,040
R	470	790	790	110	2,160
S	770	970	840	140	2,720
T	1,360	1,590	1,520	200	4,670
X	180	50	120	-	350
POL	70	70	80	-	220
TOTAL	6,930	7,900	8,180	1,750	24,760

(1) See Note #1, Table A.3.

(2) See Note #3, Table A.4; $C_1 = 5/78$.

Table A.6
ESTIMATED WEEKDAY RIDERSHIP - 7/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽¹⁾				All
	⁽²⁾ Before 10 AM	⁽¹⁾ 10AM - 2PM	⁽²⁾ 2PM - 6PM	⁽¹⁾ After 6 PM	
G	570	440	680	20	1,710
H ⁽²⁾	450	210	580	30	1,270
K	520	1,160	1,150	520	3,350
L ⁽²⁾	430	730	800	100	2,060
P	1,140	1,500	1,170	590	4,400
Q ⁽²⁾	830	460	550	180	2,020
R	470	830	630	120	2,050
S	660	1,440	870	250	3,220
T	1,540	1,940	1,160	260	4,900
X	100	60	140	-	300
POL	40	90	90	-	220
TOTAL	6,750	8,860	7,820	2,070	25,500

(1) See Note #1, Table A.3.

(2) See Note #3, Table A.4; $C_1 = (5/78) \times (8/77)$, $C_2 = (5/77) \times (10/77)$.

Table A.7

ESTIMATED WEEKDAY RIDERSHIP - 10/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽¹⁾				All
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	470	430	530	10	1,440
H(2)	420	220	690	60	1,390
K	520	1,020	1,210	500	3,250
L(2)	600	900	1,000	120	2,620
P	1,140	1,330	1,520	600	4,590
Q(2)	780	660	790	130	2,360
R	580	700	590	70	1,940
S	600	900	840	150	2,490
T	1,300	1,430	1,340	260	4,330
X	140	50	220	-	410
POL	50	70	120	-	240
TOTAL	6,600	7,710	8,850	1,900	25,060

(1) See Note #1, Table A.3.

(2) See Note #3, Table A.4; $C_1 = 9/78$.

Table A.8
 ESTIMATED WEEKDAY RIDERSHIP - 2/79

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽¹⁾				All
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	540	350	620	20	1,530
H (2)	460	300	530	20	1,310
K	450	850	880	480	2,660
L (2)	700	590	650	50	1,990
P	1,050	1,010	1,330	610	4,000
Q (2)	530	680	670	120	2,000
R	620	530	580	40	1,770
S	620	790	770	140	2,320
T	1,470	1,140	1,480	270	4,360
X	120	40	160	-	320
POL	50	60	110	-	220
TOTAL	6,610	6,340	7,780	1,750	22,480

(1) See Note #1, Table A.3.

(2) See Note #3, Table A.4.

Table A.9

ESTIMATED WEEKDAY RIDERSHIP - 3/79

Post-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽¹⁾				
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	All
G	540	260	490	20	1,310
H(2)	460	210	420	20	1,110
K	510	840	770	260	2,380
L(2)	850	610	640	30	2,130
P	1,100	1,020	1,340	270	3,730
Q(2)	690	610	530	60	1,890
R	740	540	570	30	1,880
S	790	700	610	60	2,160
T	1,370	1,560	1,230	100	4,260
X	60	60	130	-	250
POL	40	60	80	-	180
TOTAL	7,150	6,470	6,810	850	21,280

(1) See Note #1, Table A.3.

(2) Full revenue reconciliation; see Note #3, Table A.4.

Table A.10
 ESTIMATED SATURDAY RIDERSHIP - 11/77

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	(2) Before 10 AM	(1) 10AM - 2PM	(2) 2PM - 6PM	(1) After 6 PM	
G	60	90	170	-	320
H (3)	50	10	140	10	210
K	130	660	970	180	1,940
L (3)	200	490	470	20	1,180
P	280	750	490	300	1,870
Q (3)	190	400	300	50	940
R	180	300	410	20	910
S	220	340	370	50	980
T	370	780	1,150	270	2,570
TOTAL	1,680	3,820	4,470	900	10,870

(1) See Note #1, Table A.2.

(2) See Note #2, Table A.2.

(3) See Note #3, Table A.2.

Table A.11
ESTIMATED SATURDAY RIDERSHIP - 2/78

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	(2) Before 10 AM	(1) 10AM - 2PM	(2) 2PM - 6PM	(1) After 6 PM	
G	70	180	180	-	430
H	60	10	160	20	250
K	150	870	1,120	230	2,370
L	230	530	540	30	1,330
P	320	660	570	410	1,960
Q	210	440	360	80	1,090
R	200	340	470	30	1,040
S	250	400	420	100	1,170
T	400	790	1,320	620	3,130
TOTAL	1,890	4,220	5,140	1,520	12,770

(1) For Routes G,K,P,R,S,T: See Note #1, Table A.2.
For Routes H,L,Q:

$$OP_{ij} = \frac{P_1}{P_2} \times P_{2ij}$$

Where:

OP_{ij} = Off-peak passengers for each route and off-peak time period.

i = Route

j = Off-peak period

P_1 = Sum of off-peak passengers in 2/78 for all routes except H,L & Q.

P_2 = Sum of off-peak passengers in 11/77 for all routes except H,L & Q.

P_{2ij} = Route and time-specific ridership for 11/77.

(2) Total peak revenue, divided by unit revenue, and distributed to period and route based on 11/77 proportions.

Table A.12

ESTIMATED SATURDAY RIDERSHIP - 3/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	Before 10 AM	(1) 10AM - 2PM	2PM - 6PM	(1) After 6 PM	
G	80	190	240	-	510
H	70	40	210	30	360
K	190	940	1,400	340	2,870
L	290	610	680	60	1,640
P	400	870	700	910	2,880
Q	270	510	450	120	1,350
R	250	490	600	60	1,400
S	320	510	530	110	1,470
T	520	700	1,660	650	3,530
TOTAL	2,390 ⁽²⁾	4,860	6,470 ⁽²⁾	2,280	16,010

(1) See Note #1, Table A.9; $P_i = 3/78$.

(2) See Note #2, Table A.9; Revenue = \$2,163.

Table A.13
ESTIMATED SATURDAY RIDERSHIP - 5/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	Before 10 AM	(1) 10AM - 2PM	2PM - 6PM	(1) After 6 PM	
G	80	140	220	-	440
H	60	40	190	30	330
K	170	820	1,280	360	2,630
L	260	500	620	50	1,430
P	370	690	640	580	2,280
Q	250	410	400	110	1,170
R	230	350	540	30	1,150
S	290	320	480	120	1,210
T	470	690	1,510	810	3,480
TOTAL	2,180 ⁽²⁾	3,960	5,880 ⁽²⁾	2,090	14,120

(1) See Note #1, Table A.9; P = 5/78.

(2) See Note #2, Table A.9; Revenue = \$1,967.

Table A.14
 ESTIMATED SATURDAY RIDERSHIP - 7/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	Before 10 AM	(1) 10AM - 2PM	2PM - 6PM	(1) After 6 PM	
G	70	150	190	-	410
H	60	40	170	30	310
K	150	830	1,140	250	2,370
L	230	580	560	50	1,420
P	330	880	570	800	2,580
Q	220	480	360	110	1,170
R	200	390	490	50	1,130
S	260	380	430	100	1,170
T	420	860	1,350	660	3,290
TOTAL	1,940 ⁽²⁾	4,590	5,260 ⁽²⁾	2,050	13,850

(1) See Note #1, Table A.9; P₁ = 7/78.

(2) See Note #2, Table A.9; Revenue = \$1,757.

Table A.15
 ESTIMATED SATURDAY RIDERSHIP - 10/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	Before 10 AM	10AM - 2PM	2PM - 6PM	(1) After 6 PM	
G	80	360	220	-	660
H	60	40	180	40	330
K	170	780	1,260	280	2,490
L	260	600	610	70	1,540
P	360	720	630	820	2,530
Q	240	500	400	140	1,280
R	230	530	540	60	1,360
S	290	360	480	80	1,210
T	460	880	1,490	1,290	4,120
TOTAL	2,150 ⁽²⁾	4,770	5,810 ⁽²⁾	2,780	15,520

(1) See Note #1, Table A.9; P = 10/78

(2) See Note #2, Table A.9; Revenue = \$1,943

Table A.16
 ESTIMATED SATURDAY RIDERSHIP - 2/79

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD ⁽¹⁾				All
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G(2)	60	310	180	-	550
H	50	20	140	20	230
K(2)	130	1,000	1,000	300	2,430
L(2)	210	810	480	30	1,530
P(2)	290	1,000	510	820	2,620
Q(2)	200	660	310	80	1,250
R	190	380	420	30	1,020
S	230	450	380	90	1,150
T	380	1,020	1,190	770	3,360
TOTAL	1,740 ⁽²⁾	5,650	4,610 ⁽²⁾	2,140	14,140

(1) See Note #1, Table A.9; P = 3/78.

(2) See Note #2, Table A.9; Revenue = \$2,064.

Table A.17

ESTIMATED SATURDAY RIDERSHIP - 3/79

Post-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				All
	Before 10 AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	80	190	240	-	510
H	60	10 (1)	180	10 (1)	260
K	170	700 (1)	1,310	270 (1)	2,450
L	270	500 (1)	630	20 (1)	1,420
P	370	610 (1)	670	480 (1)	2,130
Q	260	400 (1)	400	60 (1)	1,120
R	240	380	550	20	1,190
S	300	220	500	60	1,080
T	490	610	1,560	490	3,150
TOTAL	2,240	3,620	6,040	1,410	13,310

(1) $\frac{\text{Adj. Corner Count (3/79)}}{\text{Adj. Corner Count (2/79)}} \times \text{pax (2/79)}$

10AM - 2PM: $\frac{1493}{2313} \times \text{pax (2/79)}$

After 6 PM: $\frac{509}{713} \times \text{pax (2/79)}$

Table A.18

ESTIMATED SUNDAY RIDERSHIP - BeforePre-Free-Fare

<u>ROUTE</u>	<u>ESTIMATED PASSENGERS</u>	
	<u>11/77</u> ⁽¹⁾	<u>2/78</u> ⁽²⁾
K	1,050	960
P	1,060	1,210
QH ⁽³⁾	360	430
RL	100	70
S	530	650
T	640	770
TOTAL	3,740	4,090

(1) From on-board survey (11/77) control count expansion.

(2) See Note #1, Table A.3.

(3) 67% of Route S.

Table A.19

ESTIMATED SUNDAY RIDERSHIP - During

Free-Fare

ROUTE	ESTIMATED PASSENGERS				
	<u>3/78</u> ⁽¹⁾	<u>5/78</u> ⁽¹⁾	<u>7/78</u> ⁽¹⁾	<u>10/78</u> ⁽¹⁾	<u>2/79</u> ⁽¹⁾
K	1,110	1,720	910	1,200	1,330
P	1,860	2,170	1,380	2,110	1,850
QH ⁽²⁾	650	730	710	690	540
RL	170	240	140	210	210
S	970	1,090	1,050	1,030	800
T	1,180	1,230	1,310	1,510	1,180
TOTAL	5,940	7,180	5,500	6,750	5,910

(1) See Note #1, Table A.3.

(2) 67% of Route S.

Table A.20

ESTIMATED SUNDAY RIDERSHIP - After

Post-Free-Fare

ROUTE	ESTIMATED PASSENGERS ⁽¹⁾
K	910
P	1,280
QH ⁽²⁾	410
RL	130
S	600
T	1,020
TOTAL	4,350

(1) Full revenue reconciliation.

(2) 67% of Route S.

Appendix D
SUPPORTING DATA

LIST OF TABLES

PAGE

D.1	Mercer Metro Monthly Ridership.....	D.2
D.2	Estimated Temporal Ridership Change.....	D.3
D.3	Estimated Ridership Changes by Route.....	D.4
D.4	Relative Changes in Ridership by Route.....	D.5
D.5	Summary of Ridership Response by Socio-Economic Group.....	D.6
D.6	Attitudes Toward Mercer Metro Service.....	D.7
D.7	Mercer Metro Schedule Adherence.....	D.8
D.8	Average Bus Occupancy.....	D.9
D.9	Observed Capacity-Loaded Buses.....	D.10
D.10	Summary of Annual Ridership/Revenue Impacts.....	D.11
D.11	Merchants' Survey Responses.....	D.12
D.12	Mercer Metro Farebox Revenue.....	D.13
D.13	Monthly Mercer Metro Mileage.....	D.14
D.14	Fare-Free Route Mileage and Hours.....	D.15
D.15	Alternate Age Distribution Data.....	D.16
D.16	Linear Regression Analysis Summary.....	D.17

Table D.1
MERCER METRO MONTHLY RIDERSHIP

<u>Month</u>	<u>Mercer Metro Base Estimate</u>	<u>Estimated Passengers With Free-Fare</u> (2)	<u>Percent Difference</u>
1/77	524,800	--	--
2/77	504,400	--	--
3/77	596,600	--	--
4/77	526,700	--	--
5/77	551,600	--	--
6/77	535,700	--	--
7/77	547,700	--	--
8/77	532,000	--	--
9/77	566,600	--	--
10/77	570,700	--	--
11/77	529,100	--	--
12/77	540,900	--	--
1/78	511,000	--	--
2/78	518,500	--	--
3/78	613,400	725,600	+18%
4/78	595,300	631,300	+ 6%
5/78	591,700	654,700	+11%
6/78	586,800	652,800	+11%
7/78	504,500	632,300	+25%
8/78	530,700	680,200	+28%
9/78	591,500	619,400	+ 5%
10/78	614,300	647,200	+ 5%
11/78	565,400	652,300	+15%
12/78	504,100	703,900	+40%
1/79	519,000	647,500	+25%
2/79	483,700	529,800	+10%
3/79	641,800	--	--
4/79	565,600	--	--
5/79	600,600	--	--
6/79	591,900	--	--

(1) Source: Mercer Metro Revenue Formula; distributed estimated revenue loss for fare-free months.

(2) Expanded corner-count-based passenger estimates; peak revenue-based interpolation for non-sampled months.

Table D.2
ESTIMATED TEMPORAL RIDERSHIP CHANGES (WEEKDAYS)

Hour of Day	Average Estimated Passengers				Difference	
	Before	Free-Fare	During	Free-Fare	Number	Percent
6-7a	910		930		+ 20	+ 2
7-8	1880		1820		- 60	- 2
8-9	2950		2570		- 380	-13
9-10	1560		1280		- 280	-18
6-10		7300		6600	-700	-10
10-11	1440		1880		+ 440	+31
11-12p	1360		1900		+ 540	+40
12-1p	1330		2430		+1100	+83
1-2	1870		2390		+ 520	+28
10-2		6000		8600	+2600	+43
2-3	1830		1850		+ 20	+ 1
3-4	2530		2200		- 330	-13
4-5	2780		2450		- 330	-12
5-6	1760		1800		+ 40	+ 2
2-6		8900		8300	-600	- 7
6-7	510		810		+ 300	+59
7-8	270		510		+ 240	+89
8-9	200		310		+ 110	+55
9-10	220		270		+ 50	+23
6-10		1200		1900	+700	+58
TOTAL	23,400		25,400		+2000	+ 9

Source: Ridership estimates based on corner count data.

Table D.3
ESTIMATED RIDERSHIP CHANGES BY ROUTE

Route	Estimated Weekly Ridership					
	Peak Periods			Off-Peaks		
	Before	During	Change	Before	During	Change
G	6,500	6,100	- 6%	1,600	2,600	+63%
H	5,500	5,500	--	1,300	1,400	+ 8%
K	10,900	10,200	- 6%	8,200	11,800	+44%
L	7,900	7,200	- 9%	4,000	5,300	+33%
P	12,900	13,700	+ 6%	8,900	13,300	+49%
Q	8,100	8,300	+ 2%	4,100	4,800	+17%
R	7,400	6,600	-11%	3,100	5,400	+74%
S	8,800	8,500	- 3%	5,000	8,500	+70%
T	18,200	15,100	-17%	8,700	12,500	+44%
X	1,100	1,400	+27%	200	300	+50%
TOTAL	87,300	82,600	- 5%	45,100	65,900	+46%

Table D.4
RELATIVE CHANGES IN RIDERSHIP BY ROUTE

<u>ROUTE</u>	<u>Percent of Prior Off-Peak Ridership</u>	<u>Percent of Added Ridership</u>	<u>Ratio of Added/Prior</u>
G	3.5	4.8	1.37
H	2.9	0.5	0.17
K	18.2	17.2	0.95
L	8.9	6.3	0.71
P	19.7	21.2	1.08
Q	9.1	3.4	0.37
R	6.9	11.1	1.61
S	11.1	16.8	1.51
T	19.3	18.2	0.94
X	0.4	0.5	1.25

Table D.5
SUMMARY OF RIDERSHIP RESPONSE BY SOCIO-ECONOMIC GROUP⁽¹⁾

Socio-Economic Group	Percent Change In		
	Trip Proportion	Trip Rate	Total Trips
Age:			
16 or Less	+ 4	+66	+88
17-24	+ 4	+29	+62
25-44	- 5	+26 (*)	+18
45-64	- 2	+12 (*)	+27
65 or Over	- 1	None	+28
Sex:			
Male	+ 5	+35	+64
Female	- 5	+28	+34
Income:			
Under 5K	- 5	+31 (*)	+20
5K-10K	- 5	+ 9 (*)	+22
10K-15K	+ 9	+43	+141
15K-25K	- 4	+34	+19
Over 25K	+ 5	+14	+151
Autos:			
Zero	- 7	+16	+24
One	+ 2	+35	+56
Two	+ 2	+27	+54
Three(+)	+ 3	+35	+86
Household Size:			
One	+ 1	+13 (*)	+60
Two	- 3	+53 (*)	+22
Three	+ 1	+13 (*)	+57
Four	- 1	+27	+39
Five	None	+24	+46
Six(+)	+ 2	+37	+59

(1) The observed changes leading to the ratios reported above were found to be statistically significant with 99% confidence except for trip rate changes as noted with an asterisk(*). These changes were found to be significant with 95% confidence.

Table D.6
 ATTITUDES TOWARD MERCER METRO SERVICE

	Percent of Respondents (1)				
	<u>Cost of Service</u>	<u>Travel Time</u>	<u>Comfort of Bus</u>	<u>Convenience of Bus</u>	<u>Safety</u>
<u>Users:</u>					
Very Satisfied	61(40)	54(34)	47(37)	69(42)	48(37)
Satisfied	27(41)	28(42)	36(41)	22(39)	27(40)
Half/Half	-(1)	1(4)	2(6)	1(3)	4(5)
Unsatisfied	5(9)	12(14)	7(9)	1(11)	9(5)
Very Unsatisfied	4(6)	3(6)	6(6)	5(4)	6(5)
(Don't Know)	2(2)	2(1)	2(1)	2(1)	6(9)
<u>Population:</u>					
Very Satisfied	35(14)	28(10)	23(10)	33(20)	28(12)
Satisfied	8(27)	12(35)	18(38)	12(32)	13(36)
Half/Half	-(1)	1(2)	-(3)	-(1)	-(4)
Unsatisfied	2(2)	3(6)	3(4)	2(11)	3(5)
Very Unsatisfied	3(1)	4(2)	3(1)	9(4)	5(2)
(Don't Know)	52(55)	52(45)	53(44)	44(33)	50(41)

Source: Before and during telephone surveys.

(1) 61(40): During(Before)

Table D.7
MERCER METRO SCHEDULE ADHERENCE

<u>Performance</u>	<u>Percent Observed</u>	
	<u>Before</u>	<u>During</u>
<u>Late:(5 or more mins.)</u>		
6 AM - 10 AM	24	28
10 AM - 2 PM	26	44
2 PM - 6 PM	39	61
6 PM - 10 PM	16	44
● Peaks	32	47
● Off-Peaks	23	44
<u>Early:</u>		
6 AM - 10 AM	28	16
10 AM - 2 PM	28	19
2 PM - 6 PM	24	13
6 PM - 10 PM	26	25
● Peaks	26	14
● Off-Peaks	27	21
<u>On-Time:</u>		
6 AM - 10 AM	48	56
10 AM - 2 PM	46	37
2 PM - 6 PM	37	26
6 PM - 10 PM	58	31
● Peaks	42	39
● Off-Peaks	50	35

Source: Observed arrivals during corner counts.

Table D.8
AVERAGE BUS OCCUPANCY

	<u>Average Before</u>	<u>During</u>		<u>After</u>
		<u>Average</u>	<u>Change</u>	
<u>Weekday</u>				
Before 10 AM	19	19	--	20
10 AM - 2 PM	17	27	+59%	21
2 PM - 6 PM	21	23	+10%	20
After 6 PM	9	15	+67%	9
<u>Saturday</u>				
10 AM - 2 PM	17	24	+41%	16
After 6 PM	8	18	+125%	9
Sunday	14	20	+43%	13

Table D.9
OBSERVED CAPACITY-LOADED BUSES

	<u>Percent Observed At or Above Capacity</u>		
	<u>Before</u>	<u>During</u>	<u>After</u>
<u>Weekday</u>			
Before 10 AM	13	12	10
10 AM - 2 PM	2	22	9
2 PM - 6 PM	16	16	7
After 6 PM	1	5	2
<u>Saturday</u>			
10 AM - 2 PM	6	15	6
After 6 PM	2	12	4
Sunday	9	16	9

Table D.10
SUMMARY OF ANNUAL RIDERSHIP/REVENUE IMPACTS

Projected Without Free-Fare (Trends Extended):

	<u>Annual Passengers</u>	<u>Annual Revenue</u>
Off-Peak	2,280,000	\$ 280,000
Peak	<u>4,450,000</u>	<u>\$1,090,000</u>
TOTAL	6,730,000	\$1,370,000

Estimated With Free-Fare:

	<u>Annual Passengers</u>	<u>Annual Revenue</u>
Off-Peak	3,570,000	\$
Peak	<u>4,210,000</u>	<u>\$1,031,000</u>
TOTAL	7,780,000	\$1,031,000

Net Effects:

	<u>Annual Passengers</u>	<u>Annual Revenue</u>
Off-Peak	+1,290,000	-\$ 280,000
Peak	<u>- 240,000</u>	<u>-\$ 59,000</u>
TOTAL	+1,050,000	-\$ 339,000

Table D.11
 MERCHANTS' SURVEY RESPONSES (1)

	Number Responding	Positive Comments	Negative Comments	No Effect	Support Free-Fare	Support Tax For Free-Fare	Support Merchant Funding
<u>All Stores:</u> (2)							
CBD	25	10	23	7	9	9	2
RSM	57	27	64	12	21	18	2
SSC	29	13	17	10	16	14	2
Total	111	50	104	29	46	41	6
<u>Retail Stores:</u>							
CBD	22	7	23	6	7	7	2
RSM	46	24	54	8	17	14	1
SSC	21	9	15	7	12	10	1
Total	89	40	92	21	36	31	4
<u>Services:</u>							
CBD	3	3	0	1	2	2	0
RSM	11	3	10	4	4	4	1
SSC	8	4	2	3	4	4	1
Total	22	10	12	8	10	10	2

- (1) Conducted July 1979.
 (2) CBD = Trenton Commons.
 (3) RSM = Regional Shopping Mall.
 (4) SSC = Suburban Shopping Centers.

Table D.12
MERCER METRO FAREBOX REVENUE⁽¹⁾ (DAYS)

<u>Month</u>	<u>Weekdays</u>	<u>Saturdays</u>	<u>Sundays</u>	<u>Month</u>
1/77	94,156(21)	7,976(5)	2,280(5)	104,412(31)
2/77	93,022(20)	8,340(4)	2,086(4)	103,448(28)
3/77	107,034(23)	9,087(4)	2,271(4)	118,393(31)
4/77	99,756(21)	10,937(5)	2,154(4)	112,847(30)
5/77	99,559(21)	9,241(4)	3,265(6)	112,065(31)
6/77	103,875(22)	8,560(4)	2,140(4)	113,048(30)
7/77	93,106(20)	9,524(5)	5,153(6)	107,777(31)
8/77	102,125(23)	8,285(4)	2,071(4)	112,481(31)
9/77	103,027(21)	8,317(4)	5,031(5)	116,375(30)
10/77	100,386(21)	10,599(5)	2,650(5)	113,635(31)
11/77	97,480(21)	8,288(4)	2,319(5)	108,086(30)
12/77	97,282(21)	10,821(5)	4,226(5)	112,369(31)
1/78	88,979(21)	10,103(4)	4,719(6)	103,801(31)
2/78	96,464(20)	9,644(4)	2,238(4)	108,346(28)
3/78	84,660(23)	8,650(4)	192(4)	93,498(31)
4/78	76,882(20)	10,463(5)	351(5)	87,696(30)
5/78	80,286(22)	7,866(4)	353(5)	88,505(31)
6/78	77,289(22)	7,663(4)	214(4)	85,166(30)
7/78	70,474(20)	8,783(5)	468(6)	79,725(31)
8/78	78,171(23)	7,189(4)	411(4)	85,771(31)
9/78	75,417(20)	10,162(5)	476(5)	86,055(30)
10/78	81,860(22)	7,773(4)	274(5)	89,908(31)
11/78	76,589(21)	8,222(4)	254(5)	85,065(30)
12/78	89,637(20)	11,850(5)	387(6)	101,874(31)
1/79	93,617(22)	8,531(4)	300(5)	102,448(31)
2/79	93,274(20)	8,254(4)	211(4)	101,739(28)
3/79	152,126(22)	21,633(5)	5,664(4)	179,419(31)
4/79	137,177(21)	15,825(4)	6,843(5)	161,902(30)

(1) Source: Mercer Metro Daily Revenue Reports.

(*) Includes holiday.

Table D.13
MONTHLY MERCER METRO MILEAGE

<u>Month</u>	<u>Total Miles</u> ⁽¹⁾	<u>Charter Miles</u>
1/77	277,000	12,000
2/77	280,000	10,000
3/77	296,000	15,000
4/77	281,000	14,000
5/77	294,000	26,000
6/77	296,000	25,000
7/77	293,000	28,000
8/77	306,000	28,000
9/77	286,000	14,000
10/77	300,000	29,000
11/77	287,000	15,000
12/77	292,000	9,000
1/78	279,000	7,000
2/78	266,000	10,000
3/78	301,000	13,000
4/78	285,000	16,000
5/78	300,000	21,000
6/78	300,000	21,000
7/78	287,000	24,000
8/78	304,000	21,000
9/78	289,000	14,000
10/78	295,000	15,000
11/78	278,000	9,000
12/78	278,000	8,000
1/79	286,000	8,000
2/79	259,000	9,000
3/79	294,000	9,000
4/79	275,000	14,000
5/79	305,000	21,000
6/79	296,000	20,000

Source: Mercer Metro Monthly Income Statement.

(1) Includes inter-county routes which were not part of the fare-free demonstration.

Table D.14
 FARE-FREE ROUTE MILEAGE AND HOURS

<u>Route</u>	<u>Annual Service Miles</u>	<u>Off-Peak Miles</u>	<u>Annual Service Hours</u>
G	172,100	43,000	11,600
H	226,100	61,000	11,100
K	341,000	156,900	23,100
L	252,000	75,600	18,200
P	498,500	239,300	34,700
Q	299,800	77,900	16,500
R	228,600	84,600	18,700
S	222,000	117,700	15,800
T	380,000	133,000	41,300
X	67,100	12,100	5,400
Z	<u>4,300</u>	<u>1,200</u>	<u>800</u>
	2,591,500	1,002,300	197,200

Source: Trenton/Mercer Transit Development Study (1975).

Table D.15
 ALTERNATE AGE DISTRIBUTION DATA

	<u>Before</u>	<u>Prior</u>	<u>New</u>
		<u>During</u>	
16	20	18	21
17 - 24	38	40	41
25 - 44	19	21	25
45 - 64	16	14	9
65 +	8	7	4

Table D.16
 LINEAR REGRESSION ANALYSIS SUMMARY

Test 1 - Percent Change in Trip Rate and Elasticity by Age Group

<u>Age Group</u>	<u>Class Mark</u>	<u>% Change in Trip Rate</u> ⁽²⁾	<u>Elasticity</u> ⁽²⁾
16 or Less	15.0 ⁽¹⁾	+66	-0.31
17 - 24	20.5	+29	-0.24
25 - 44	34.5	+26	-0.08
45 - 64	54.5	+12	-0.12
65 or Over	71.0 ⁽¹⁾	0	-0.12

(1) Based on ungrouped data from on-board survey (10/78).

(2) Based on post-demonstration follow-up survey (recalled data).

	<u>Percent Change in Trip Rate</u>	<u>Elasticity</u>
Regression Results:	Slope = -0.94	Slope =
	Constant = +63.3	Constant =
	R ² = 0.78	R ² = 0.53

Test 2 - Elasticity by Household Autos

<u>Autos In Household</u>	<u>Elasticity</u>
0	-0.11
1	-0.22
2	-0.21
3 or more ⁽¹⁾	-0.30

(1) Used four.

Regression Results:	Slope = +0.04
	Constant = +0.14
	R ² = 0.86

Appendix E
BIBLIOGRAPHY

Abrams, Robert. "No More Tokenism -- the Case for Free Subways and Buses," New York, 4, No. 32, pp. 24-29, 1971

Aleshire, Robert A. "Sure the Cost Would be High: But Offsetting Economic, Social, and Environmental Benefits Abound," Nation's Cities, 9, No. 12, pp. 25-28, 1971.

Aleshire, Robert A. "The Case for Free Transit," Current, 135, pp. 19-22, 1971.

Amalgamated Transit Union. "Position Paper on Fare-Free Transit," unpublished mimeograph, Washington, D.C.: Amalgamated Transit Union, 1975.

Amalgamated Transit Union. "A Solution: No-Fare Transit," In Transit, 83, No. 10 (special section).

Batty, M.; P. G. Hall and D.N.M. Starkie. "The Impact of Fares-Free Public Transport Upon Urban Residential Location," Proceedings of the Transportation Research Forum, Oxford, Indiana: Richard B. Cross Company, 15, pp. 347-353, 1974.

Baum, Herbert J. "Free Public Transport," Journal of Transport Economics and Policy, 7, pp. 3-19, 1973.

Brosch, David Charles, "The Rationale for and the Establishment of a No-Fare Mass Transit System in the Washington Metropolitan Area," unpublished student paper, Washington, D.C.: Howard University, 1975.

Caruolo, John B. and Robert P. Roess, "The Effect of Fare Reductions on Public Transit Ridership," New York, New York: Polytechnic Institute of New York, 1974.

Charles River Associates, Inc., "An Evaluation of Free Transit Service," Report 125-1, Cambridge, Massachusetts: Charles River Associates, Inc., 1968.

Connor, David L., Findings of Preliminary Analyses of the Trenton Off-Peak Fare-Free Transit Demonstration, DeLeuw, Cather & Co. for the U.S. DOT Transportation Systems Center (UMTA Report No. NJ-52-0001-79-1) January 1979

Daly, A.J., K.G. Rogers and A.W. Whitbread, "Estimating the Use of Free Bus Passes in Reading," Report C174, Reading, UK: Local Government Operational Research Unit, 1973.

Daly, A.J. and S. Zachary, "The Effect of Free Public Transport on the Journey to Work" Supplementary Report 338, Transport and Road Research Laboratory, Crowthorne, Berkshire, UK, 1977.

Dillon, Robert W. and John A. Bailey, "Legal and Political Aspects of Free Transit in Major Metropolitan Areas," Evanston, Illinois: Northwestern University Transportation Center, 1970.

Domencich, Thomas A. and Gerald Kraft, Free Transit, Lexington, Massachusetts: D.C. Heath and Company, 1970.

Doxsey, Laurence B., "Elasticity Measures of Behavioral Response to Off-Peak Free-Fare Transit", paper prepared for presentation at the 59th Annual Meeting of the Transportation Research Board, Washington, D.C., January 1980.

Donnelly, E.P., "Preference Elasticities for Transit Fare Increases and Decreases by Demographic Groups," in Transportation Research Record 589, 1976.

Elliott, John M., "No-Fare: Key to the Transit Jam," American Federationist, 79, No. 8, pp. 9-15, 1972.

Goodman, Keith M. and Green, Melinda A., Low Fare and Fare-Free Transit: Some Recent Applications by U.S. Transit Systems. UMTA-DC-52-0002-77-1, by the Urban Institute for the Urban Mass Transportation Administration, February, 1977.

Goodwin, P.B., "Some Data on the Effects of Free Public Transport," Transportation Planning and Technology, 1, pp. 159-174, 1973.

Greenspan, H.P., "The Case for Prepaid Transit," Transit Journal, 1, No. 1, pp. 57-63, 1975.

Holland, D.K., A Review of Reports Relating to the Effect of Fare and Service Changes in Metropolitan Public Transportation Systems, Washington, D.C.: U.S. Department of Transportation, June, 1974.

Kemp, Michael A., "Reduced Fare and Fare-Free Urban Transit Services -- Some Case Studies," in UK Transport and Road Research Laboratory, pp. 37-54, 1974.

Kemp, Michael A., "The Consequences of Short Range Transit Improvements: An Overview of a Research Program," Working Paper No. 5050-5-1, Washington, D.C.: The Urban Institute, November, 1976.

Kemp, Michael A. and Cheslow, Melvyn D., "Transportation" in Gorham, William and Glazer, Nathan, editors, The Urban Predicament, pp. 281-356, Washington (D.C.), the Urban Institute, 1976.

Knight, Robert "Evaluation Plan for the Trenton Free-Fare Demonstration Project," DeLeuw, Cather and Company for the U.S. Department of Transportation, Transportation Systems Center, 1978.

Kraft, Gerald, "Free Transit Revisited," Public Policy, 21, pp. 79-105, 1973.

Kraft, Gerald and Domencich, Thomas, "Free Transit," in Edel, Matthew and Rothenberg, Jerome, Readings in Urban Economics, New York: The MacMillan Company, 1972.

Lovelock, Christopher and John Twichell, "No Fare and Low-Fare Transit: An Evaluation of Their Feasibility and Potential Impact in the San Francisco Bay Area," Berkeley, California: Metropolitan Transportation Commission, 1973.

Mercer County Improvement Authority, Annual Report to the Department of Public Utilities for the Year 1976, March 28, 1977.

Moses, Leon, and Harold Williamson, "Value of Time, Choice of Mode, and the Subsidy Issue of Urban Transportation," Journal of Political Economy, 1963.

Netzger, Dick, "The Case Against Low Subway Fares," New York Affairs 1, No. 3, pp. 14-25, 1974.

New Jersey Department of Transportation, "Application for Federal Assistance for the Mercer County Free Fare Demonstration," April, 1976.

Reish, Robert and Vasant H. Surti, "A Feasibility Study of Free Bus Service for a Street Corridor of Denver," Denver, Colorado: University of Colorado Center for Urban Transportation Studies, 1972.

Rhode Island Statewide Planning Program, "Evaluation of a 'No-Fare' System of Public Transit," Technical Paper 37, Providence, Rhode Island: Rhode Island Statewide Planning Program, 1973.

Scheiner, James I., "The Patronage Effects of Free Fare Transit," Traffic Quarterly, 29, pp. 19-27, 1975.

Scheiner, James I., "Exploding the Myths of Prepaid Transit," Transit Journal, 2, No. 1, pp. 57-64, 1976.

Scheiner, James I. and Grover Starling, "The Political Economy of Free-Fare Transit," Urban Affairs Quarterly, 10, pp. 170-184, 1974.

Schneider, Lewis M., "The Problem of Free Mass Transportation," Proceedings of the Transportation Research Forum, 9, (supplemental papers), Oxford, Indiana: Richard B. Cross Company, pp. 23-30, 1968.

Schneider, Lewis M., "The Fallacy of Free Transportation," Harvard Business Review, 47, pp. 83-87, 1969.

Spielberg, Frank, "Plan for a Demonstration of Off-Peak Fare-Free Bus Service in Mercer County, N.J.," Working Paper 5066-8-1, Washington, D.C.: The Urban Institute, February, 1977.

Spielberg, Frank and Milione, Vincenzo, "Free-Fare Transit-What Have We Learned?", paper presented at the Annual Meeting of the Institute of Transportation Engineers, Toronto, Ontario, September 1979.

Studenmund, A.H., Connor, D.L., Swan, S.S., "An Interim Analysis of the Free-Fare Transit Experiments", paper presented at the 58th Annual Meeting of TRB, Washington D.C., January 1979, pending publication.

Swan, Sherrill, "Early Evaluation Findings on the Denver Off-Peak Free Fare Public Transit Experiment," De Leuw, Cather and Company for the U.S. Department of Transportation, Transportation Systems Center.

U.S. Department of Transportation, Report to Congress Concerning the Demonstration of Fare-Free Mass Transportation, Washington (D.C.): U.S. Department of Transportation Urban Mass Transportation Administration, 1975.

Wachs, Martin, "The Feasibility of Fare-Free Transit for Los Angeles, Los Angeles, California: University of California at Los Angeles, Los Angeles, School of Architecture and Urban Planning, 1973.

Wall Street Journal, "A Free Ride for Transit," editorial, February 13, 1978, p. 7.

Waters, L. Leslie, "Free Transit - A Way Out of Traffic Jams," Business Horizons 2, 1959.

APPENDIX F
REPORT OF INVENTIONS

The work performed under this contract, while not leading to any significant inventions, discoveries, or innovations, has made use of state-of-the-art methodologies to complete an analysis of findings available on the implementation and operation of the demonstration project. These findings will be useful to other communities throughout the United States in the planning and design of improved public transportation services.

300 copies

F.1/F.2

HE 18.5 .A3
UMTA-82-1
Connor, Dav
oft-peak fa
Mercer Cou

Form DOT F 1720
FORMERLY FORM DO

DOT LIBRARY



E22201000

**Department of Transportation
Research and Special Programs Administration**

Washington, D.C. 20590
Boston, Massachusetts 02142

Postage and Fees Paid
Research and Special
Programs Administration
DOT 513



Official Business
Penalty for Private Use \$300