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Southern Pacific Fare Subsidy Program Evaluation Project

Final Report
July 1981

Service and Methods Demonstration Program

U.S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration and
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16. Abstract

Starting January 1978, transit authorities in three counties participated in a 30 percent discount on Southern Pacific (SP) Railroad's multiple-ride commuter fares in the San Jose-San Francisco corridor. The discount was funded through a special allocation of gasoline sales tax (TDA) monies. The purpose of the evaluation was to monitor changes in multi-ride sales and SP ridership to determine the fare subsidy's effectiveness as a use incentive. This evaluation was based upon ridership and discount ticket sales data supplies by Southern Pacific Railraod, San Mateo County Transit and the Santa Clara County Transit District, supplemented by survey data collected from SP riders and non-riders, provided by Caltrans.

SP ridership had been declining since the 1950's, although a stabilization had begun to appear during 1977. Ridership 15 months into the discount indicated a small but steady upturn attributable to the fare discount program. This change was far surpassed, however, by the rapid rise in SP and areawide transit use with the onset of the gasoline crisis in mid-April 1979. The report also attempts to adduce several factors which help to explain the limited effectiveness of the discount in the absence of pressures such as the gas crisis.

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PREFACE

This report presents findings of the evaluation of the Southern Pacific Railroad commuter fare subsidy demonstration. The demonstration began on January 1, 1978, and continues currently. The evaluation included monitoring changes in SP ridership and multi-ride ticket sales, user and non-user characteristics and implementation issues.

The evaluation was sponsored under the Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstration (SMD) program, although the demonstration was locally-sponsored. The fare discount was derived from a special allocation of Transportation Development Act (TDA 1971, as amended) monies allocated by the Metropolitan Transportation Commission to the participating counties. This evaluation was conducted by De Leuw, Cather & Company for the Transportation Systems Center (TSC) of the U.S. Department of Transportation under Technical Task Directive DOT-TSC-1409-02. The principal author of this report was Pat M. Gelb, with technical assistance from Steven B. Colman, Robert M. Donnelly, Robert Knight, Gordon Shunk, and Sherrill Swan.

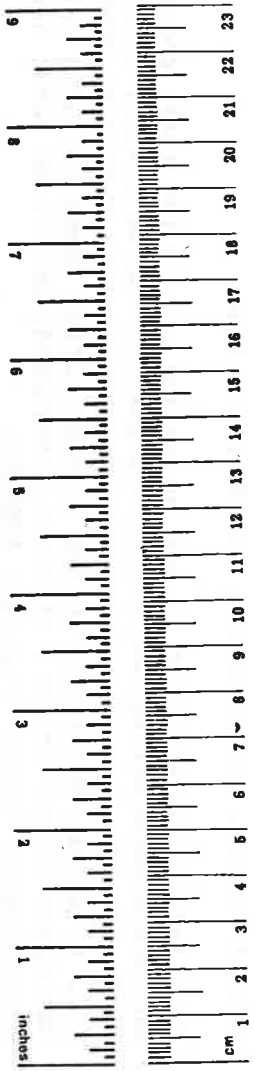
Grateful acknowledgement is due to several people for their cooperation and assistance during the evaluation period: Carla Heaton, Technical Evaluation Monitor, Transportation Systems Center; Gerald D. Pera and J.A. Loveland, Southern Pacific Transportation Company; James Gallagher, San Mateo County Transit District (SAMTRANS); and Frank Lara, Santa Clara County Transit District (SCCTD).

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

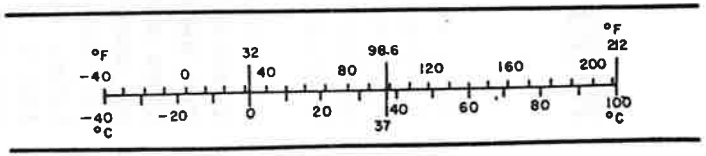
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2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

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

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



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EXECUTIVE SUMMARY

Starting in January 1978, and continuing through the present, transit authorities in the three Southern Pacific rail service counties participated in a 30 percent discount on SP's multiple-ride commute fares in the San Jose-San Francisco corridor. The discount was funded through a special allocation of gasoline sales tax (TDA) monies. One of the transit providers extended the subsidy demonstration by offering free SP-oriented feeder bus service. Nearly two years into the program, additional TDA funds were allocated for a 40 percent discount on one-way and round-trip fares for one month only, September 1979. The purpose of the evaluation was to monitor changes in multi-ride sales and SP ridership to determine the fare subsidy's effectiveness as a use incentive.

SP ridership had been declining gradually since the 1950's, although a stabilization had begun to appear during 1977. Changes in ridership 15 months into the discount indicated a small but steady upturn attributable to the fare subsidy program. Regression analysis of the various factors participating in ridership changes corroborated the discount program's effect.

These changes were far surpassed, however, by the rapid rise in SP and areawide transit use with the onset of the gasoline crisis in mid-April 1979. An average annual increase of over 40 percent characterized the second trimester of 1979, in contrast to typically low summer ridership. Final September ridership figures were not available to assess the effect of the 40 percent discount on occasional fares, but preliminary estimates approach 47 percent over September 1978.

Several factors help to explain the limited effectiveness of the 30 percent discount in the absence of pressures such as the gas crisis. First, high-income Peninsula commuters may be relatively insensitive to fare changes. Transit authorities point to several SP service features which limit its ability to compete with the automobile. The SP terminus in San Francisco is relatively far from the City's principal employment centers, necessitating an additional transit link for many commuters. SP's headways lengthen rapidly on both sides of relatively narrow morning and evening peak periods, inhibiting work travel flexibility. And little reverse-commute service is available. Thus, if SP is to compete with the automobile for a larger share of the commute market, perhaps it must achieve improvements elsewhere than in its fare structure. The recent large increases in ridership on SP and all other transit systems during the gas crisis when the automobile was relatively inconvenient, corroborates this conclusion.

1 INTRODUCTION

1.1 THE FARE SUBSIDY PROGRAM

This report presents an evaluation of the Southern Pacific Passenger Fare Subsidy Program. The Southern Pacific Railroad (SP) operates passenger rail service in the San Jose - San Francisco corridor, catering primarily to peak period commuters traveling into San Francisco. Beginning in January 1978, the price of SP multiple-ride tickets was reduced by 30 percent. In addition, free feeder bus service was provided to SP stations in one of the three counties in the corridor.

The 30 percent subsidy program is being administered by the transit authorities in each of the three counties, in cooperation with SP and the region's Metropolitan Transportation Commission, using Transportation Development Act (TDA) funds. The subsidy was extended to include a discount of 40 percent off one-way and round-trip fares for one month only, during September 1979. The California State Department of Transportation (CALTRANS) and the two peninsula transit districts shared equally in this additional subsidy, also using TDA funds.

1.2 EVALUATION ISSUES

The evaluation addresses several issues of interest to federal government and policy-making agencies, the transit industry at large and the state and local agencies involved in the subsidy program. These are:

- Whether a 30 percent fare reduction stabilizes or increases the declining use of SP passenger rail services.
- Whether free feeder bus service to SP stations in San Mateo County induces more SP riders to use bus service.
- If there is no change in SP or feeder bus ridership, what are some of the reasons for the program's lack of response?
- Are operators' costs or operations affected by the demonstration?

In the original Evaluation Plan, another issue had been specified: if SP or feeder bus ridership increases, what are the characteristics of the new riders? Because the surveys intended to collect information on new rider characteristics were not completed, an alternative issue was substituted:

- Does the information collected during the program provide a basis for assessing the differences between SP users and non-users?

The evaluation project was subsequently extended to monitor and report on several events during the demonstration's second year. The first of these is the national gasoline shortage which produced very sharp increases in ridership on all transit services throughout the Bay Area and the rest of the country, starting in April. The second is a mid-year ruling by an ICC administrative law judge that SP be compensated for its estimated operating deficit or be allowed to terminate its commute service. Last is the extension of the fare subsidy program to include a 40 percent discount on one-way and round-trip tickets for one month only, September 1979.

1.3 EVALUATION METHODS AND DATA SOURCES

The evaluation of changes in ridership of SP and feeder bus services was based upon data collected and supplied by the transit providers. This includes monthly SP ridership and sales of discounted commuter tickets by county and ticket type, high counts on peak hour commute trains, transfer counts including discount users on San Mateo County Transit District (SAMTRANS) feeder buses, market data on a sample of peninsula residents living within five miles of SP stations and results of an on-board survey of SP riders. In addition, representatives of the transit operators and other institutional actors in the fare subsidy program were contacted for information concerning the program's operation, costs and overall effects.

Before and after comparisons were used to evaluate changes in SP and feeder bus ridership and discount sales. A regression model was used relatively early in the demonstration to investigate the cause-and-effect relationship between SP ridership and a variety of other factors. No attempt was made to separate the effect of the gasoline shortage from that of the discount program on ridership since April 1979.

1.4 ORGANIZATION OF THE REPORT

This report is organized into five sections. Following this introduction is a background chapter describing SP and feeder bus services. Chapter 3 describes the fare subsidy demonstration. Chapter 4 presents the evaluation findings, including impacts on travel behavior, supply-side effects, secondary impacts and a discussion of some of the factors related to SP ridership generally. The final chapter discusses the transferability of the demonstration.

2 BACKGROUND AND SETTING

2.1 OVERVIEW

This chapter provides brief descriptions of the SP market area, auto commuter links and characteristics, SP commuter rail operations and feeder bus services provided by the three counties involved in the fare subsidy program.

2.2 POPULATION AND EMPLOYMENT CHARACTERISTICS IN THE SAN FRANCISCO PENINSULA

San Francisco is historically the primary employment center for the West Bay region. Since World War II, however, urbanization has spread rapidly southward, with San Francisco losing population, while San Mateo and Santa Clara Counties (especially the latter) have grown.* San Fancisco's share of the region's employment has also decreased from 57 percent to 40 percent during the past 15 years, although the absolute number of San Francisco jobs has grown. Table 2.1 presents recent population and employment figures and projections for the three counties.

TABLE 2.1
POPULATION AND EMPLOYMENT
1960 - 1990
WEST BAY COUNTIES

	POPULATION			EMPLOYMENT		
	1960	1975	1990	1960	1975	1990
San Francisco	740,300	672,700	621,900	476,200	495,400	467,400
San Mateo	444,400	576,000	609,400	131,200	225,100	248,200
Santa Clara	642,300	1,169,700	1,482,400	228,000	517,800	619,200
	1,820,700	2,418,400	2,713,700	835,400	1,238,300	1,334,800

Source: CALTRANS, Market Study for an Upgraded Peninsula Rail Service from SF to South San Jose, Phase I (n.d.).

Development densities within the corridor are generally low, especially in Santa Clara County, where large areas contain from zero to eight housing units per acre. Higher densities of from 8 to 20 units per acre cluster closer to the railway and highway arterials in both Santa Clara and San Mateo Counties. Densities become progressively higher in the northerly direction.**

*CALTRANS, Market Study for An Upgraded Peninsula Rail Service from San Francisco to South San Jose, Phase I (Sacramento: n.d.), p.2.
**Ibid., p.23.

2.3 AUTO COMMUTER LINKS AND VOLUMES

Two major freeways serve the San Francisco-San Jose corridor: U.S. Highway 101, the Bayshore Freeway; and Interstate Route I-280, the Junipero Sierra Freeway. Route 101 appears to carry a larger percentage of long-distance commuters, while Route 280 carries a greater percentage of medium-distance commuters. The peak periods on these routes are generally between 7:00 and 9:00 AM, and between 3:00 and 7:00 PM. In general, the greatest traffic volumes occur at the San Francisco and San Jose ends of the corridor, with the greatest congestion at the San Francisco end.* Traffic volumes on Highway 101 are generally near capacity during the peak periods and heavy all day. The average annual daily traffic on Highway 101 is 95,000 vehicles in San Jose and 199,000 in San Francisco north of the I-280 interchange.** Average annual daily traffic on I-280 is 151,000 vehicles in San Jose and 120,000 in San Francisco, with a minimum of 42,000 vpd midway between the two cities.

CALTRANS has estimated that some 207,666 work trips from within the corridor could potentially be served by SP. Of these, some 27,856 trips were to the San Francisco Central Business District.***

2.4 SOUTHERN PACIFIC (SP) RAILROAD

The following information on SP operations, ridership characteristics and management orientation toward passenger services is derived from a recent environmental impact report prepared for SP.****

2.4.1 Operations

Southern Pacific (SP) has provided passenger rail services in the 47-mile Peninsula corridor between San Francisco and San Jose since 1870. Rail service is provided seven days a week to 26 stations in the corridor. The SP route and stations on the Peninsula corridor are shown in Figure 2.1.

Trains operate from 5:05 AM to 11:20 PM on Mondays through Saturdays, and 5:30 AM to 11:20 PM on Sundays and holidays. Service is designed mainly to provide line haul transportation for Peninsula residents between their home areas and San Francisco work places during the morning and evening peaks on weekdays. Of the total 44 weekly scheduled trips, 28 are during the morning and afternoon peak hours. The peak hours are sharply defined: between 6:15 and 7:15 AM and between 4:40

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*Ibid., p.11.

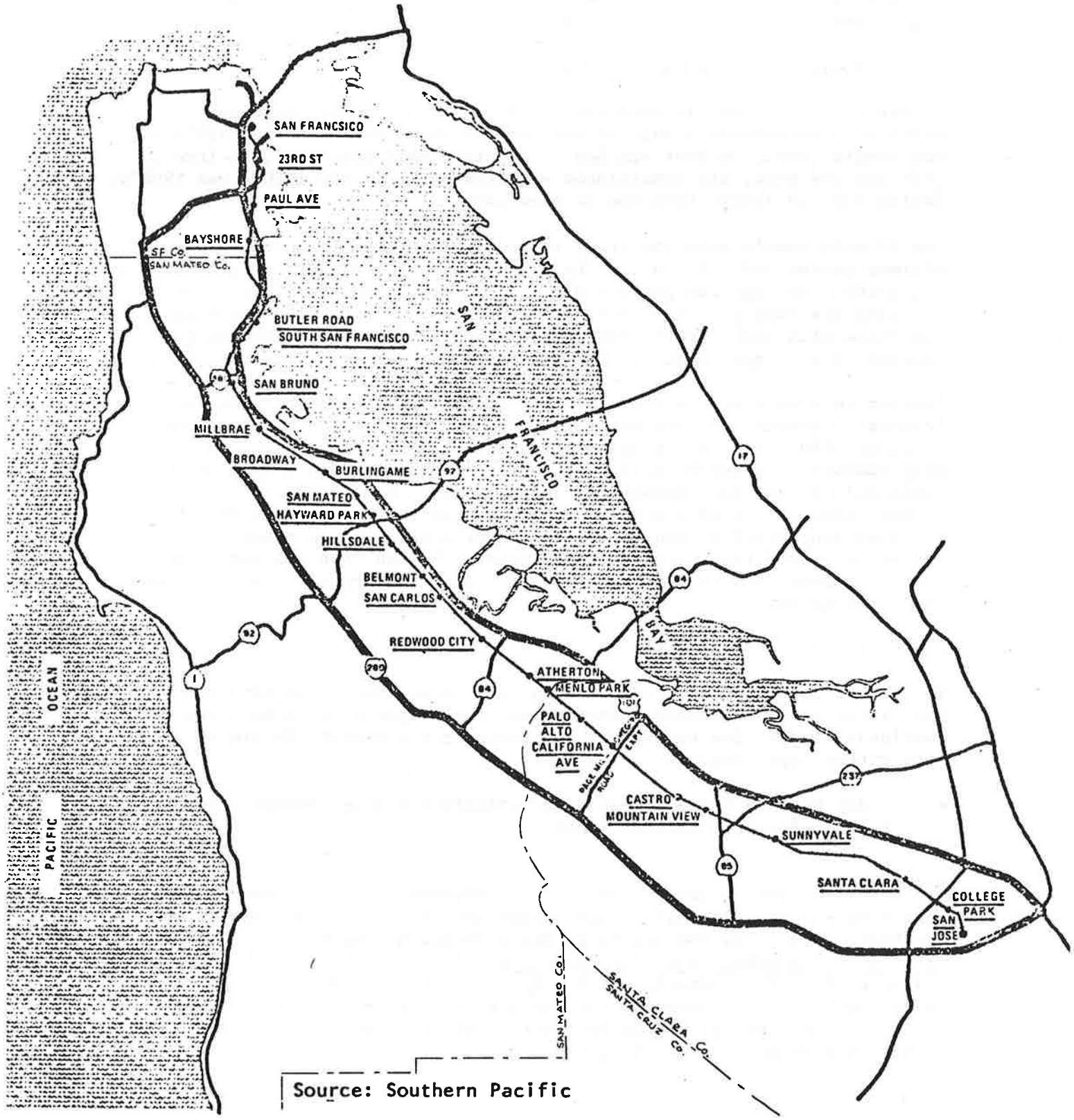
**Ibid., p.5.

***Ibid., pp. 17-19. The SP trip potential for this corridor was estimated on the basis of data from the Santa Clara Corridor Evaluation Study (February 1978), and the MTC FCAST test run for the PENTAP study. Zone-to-zone trips were qualified for inclusion in the estimate according to their overall length, and the zone-of origin distance to the SP station.

****Weimer Associates, Detailed Environmental Impact Report, Southern Pacific Transportation Company, San Francisco - San Jose Discontinuance, November 1977, p. 7-19.

Figure 2.1

SOUTHERN PACIFIC PASSENGER SERVICE
RAILROAD ROUTE AND STOPS



and 6:00 PM. During peak hours, train headways are three to four minutes, while station headways are approximately ten minutes. On both shoulders of the peak headways are 15-30 minutes; off-peak headways increase up to two hours between trains. The San Jose to San Francisco trip takes approximately 75 minutes.

2.4.2 Equipment, Crews and Facilities

SP uses twenty diesel locomotives and 83 cars to provide passenger service. Approximately half of the cars -- those built in the 1920's -- are single-level, 96-seat coaches. The other half are newer, bi-level, 145- and 164-seat, air conditioned vehicles built in the 1950's and 1960's. Trains vary in length from one to nine cars.

The 47-mile double mainline track is in excellent condition and has minimum grades and curvature. The track crosses 65 streets at grade; all grade crossings are protected by gates with flashing lights. The 26 stations are evenly divided between terminals having station buildings and those with shelters of lighter construction. Most stations have parking lots. Approximately 3500 all-day parking spaces are available.

Station terminals are located in San Francisco and San Jose. The San Francisco terminal is located over 10 blocks from the Central Business District (CBD), necessitating use of an additional transit link for many commuters to reach their workplace.* (Connecting San Francisco Municipal Railway bus headways vary from 5 to 15 minutes.) The environment immediately adjacent to the station and between it and the CBD contains many deteriorated or abandoned buildings, old warehouses, vacant lots, and few convenience services. The San Jose station is also several blocks from the downtown area. Light industry is located adjacent to this station.

2.4.3 Fares

The SP stations are deployed over six fare zones, and fares vary with the distance between zones. Four types of multiple-ride tickets are available in addition to one-way and round-trip tickets. Multiple-ride ticket types include:

- 5-day Monthly Tickets - good for unlimited riding, Monday through Friday, for the calendar month;

*In contrast, nearly two-thirds (64%) of NYC-employed rail commuters arriving at Grand Central Terminal from Westchester/Putnam origins walk to their workplaces (Metropolitan Transportation Commission, The Feasibility of Upgrading Peninsula Passengers Rail Service, Final Report, 1975, p. III-40). Mapping of Penn-Central (SEPTA) riders' in-city work locations, furthermore, indicated that very few used the trains unless their work was within 10 minutes walk or transit travel time from the arrival terminal (Ibid., p. III-37).

- 7-day Monthly Tickets - good for unlimited riding, Sunday through Saturday, for the calendar month

- 7-day Weekly Tickets - good for unlimited riding throughout one week

- Twenty-ride Tickets - good for twenty rides during a one-month period

Multi-ride tickets prices also vary by distance travelled, and offer substantial savings over one-way or round-trip fares. (Round-trip prices are twice the one-way fare.) Multi-ride ticket prices are calculated on the expectation of riders' making two one-way trips per travel day -- although the tickets permit unlimited riding on eligible days -- and riders' usual practice conforms to this pattern. Prices by ticket type and fare zone are presented in Table 2.2. Along with the ticket price, the table also shows the break-even trip frequency, the number of trips at regular one-way fare which the buyer would have to take before it became economical to buy a multi-ride ticket.

2.4.4 Patronage

Southern Pacific's patronage prior to the implementation of the fare subsidy program is described in the Metropolitan Transportation Commission's report evaluating the feasibility of upgrading SP services.*

Daily weekday commute ridership on the Peninsula is approximately 7,500** passengers in each direction. Some 85 percent of the riders have destinations in San Francisco. Only small numbers of passengers ride during off-peak periods, during the peak but between non-San Francisco points, or during the peak but in the light direction. During the morning peak, about 5,000 commuters arrive in San Francisco; during the same period, less than 150 arrive in San Jose.***

The temporal ridership peak is narrow and very sharp, particularly in comparison to similar rail commute operations in other metropolitan areas. More than ten percent of the daily passengers are carried on one single train. The average ride is long and appears to be increasing; more than two-thirds of commuters come from Santa Clara and southern San Mateo Counties and travel more than 25 miles by train.

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*Metropolitan Transportation Commission, The Feasibility of Upgrading Peninsula Passenger Rail Service, Final Report, 1975, p. 14-15.

**Figure adjusted by SP to reflect 1976 ridership.

***Northbound and southbound Peninsula train check, Southern Pacific, October 12-13, 1976.

TABLE 2.2
SP MULTI-RIDE TICKET PRICES AND BREAK-EVEN TRIP FREQUENCIES
(BASED UPON ONE-WAY FARES) BETWEEN FARE ZONES

Between SF and	MULTI-RIDE TICKET PRICES				SINGLE RIDE FARES	
	5-Day (M-F) Monthly Commutation (38-46 trips)[a]	7-Day Monthly Commutation (56-62 trips)[b]	7-Day Weekly Commutation (14 trips)[c]	20-Ride (20 trips)	One-Way (1 trip)	Round Trip (2 trips)
Zone 1: 8.6 to 13.7 miles						
Butler Road South San Francisco San Bruno Millbrae	$33.75[d] 23 trips[e]	$36.55 25 trips	$9.70 6 trips	$24.40 16 trips	$1.45	$2.90
Zone 2: 15.2 to 18.9 miles						
Broadway Burlingame San Mateo Hayward Park	$39.40 23 trips	$42.80 25 trips	$11.05 6 trips	$27.90 16 trips	$1.70	$3.40
Zone 3: 20.3 to 25.4 miles						
Hillsdale Belmont San Carlos Redwood City	$45.00 21 trips	$49.05 23 trips	$12.50 6 trips	$31.45 15 trips	$2.10	$4.20
Zone 4: 27.8 to 31.8 miles						
Atherton Menlo Park Palo Alto California Avenue	$50.60 20 trips	$55.30 21 trips	$14.60 5 trips	$36.60 14 trips	$2.55	$5.10
Zone 5: 34.8 to 38.8 miles						
Castro Mountain View Sunnyvale	$56.25 18 trips	$61.90 20 trips	$16,50 5 trips	$41.25 13 trips	$3.00	$6.00
Zone 6: 44.3 to 46.9 miles						
Santa Clara College Park San Jose	$60.60 19 trips	$65.95 20 trips	$18.45 5 trips	$46.05 14 trips	$3.20	$6.40

[a] Number of trips represented is calculated on the basis of 2 trips per day for each working day in the month. Ticket allows unlimited riding, Monday through Friday.

[b] Number of trips calculated on the basis of 2 trips per day, every day in the month. Ticket allows unlimited riding every day during the month.

[c] Number of trips calculated as 2 trips per day, seven days a week. Ticket allows unlimited riding Sunday through Saturday, for the week.

[d] Multi-ride ticket price before 30 percent discount.

[e] Break-even trip frequency for that price; ticket price divided by one-way fare.

Ridership has declined gradually over the past 20 years from about 9 million passengers per year in the early 1950's to about 4.3 million in 1976.* During the same time period, however, population, employment, and travel in the West Bay corridor have all increased substantially (see Figures 2.2 and 2.3). Thus, the SP rail share of the transportation market has declined drastically. The 7,500 estimated daily commute trips represent only 4.0 percent of the total Peninsula work trips CALTRANS estimates SP could potentially serve.

2.4.5 Management Policy Toward Commute Service

Essential to an understanding of the fare subsidy program is an appreciation of SP management attitudes toward the commuter service. SP has repeatedly appealed to get out of the passenger business in the corridor. Examples of recent Southern Pacific actions are:

- September, 1976: SP offered to give away 1,000 eight-passenger vans to SP commuters in exchange for discontinuance of rail service. Commuters joining vanpools were to be responsible for operation, maintenance, and eventual replacement of vehicles. Only a very few commuters experimented with the idea; none of the original vanpools are currently continuing.

- August, 1977: Southern Pacific filed application with the California Public Utilities Commission to discontinue passenger services.

- November, 1977: Southern Pacific appealed to Interstate Commerce Commission to discontinue passenger services.

According to SP, it is suffering heavy losses on the service, due largely to track and car maintenance and crew requirements for passenger service beyond what is required for freight operations. Its loss estimates approach $11.6 million per year. The railroad has historically not been willing to accept a direct subsidy to pay for its passenger services.

2.5 FEEDER BUS OPERATIONS

San Mateo County and Santa Clara County Transit Districts and the San Francisco Municipal Railway provide bus service to Southern Pacific stations in their respective counties. All three systems are tax-supported and operated by public agencies. Information on operations is compiled from a variety of materials supplied by the transit operators.

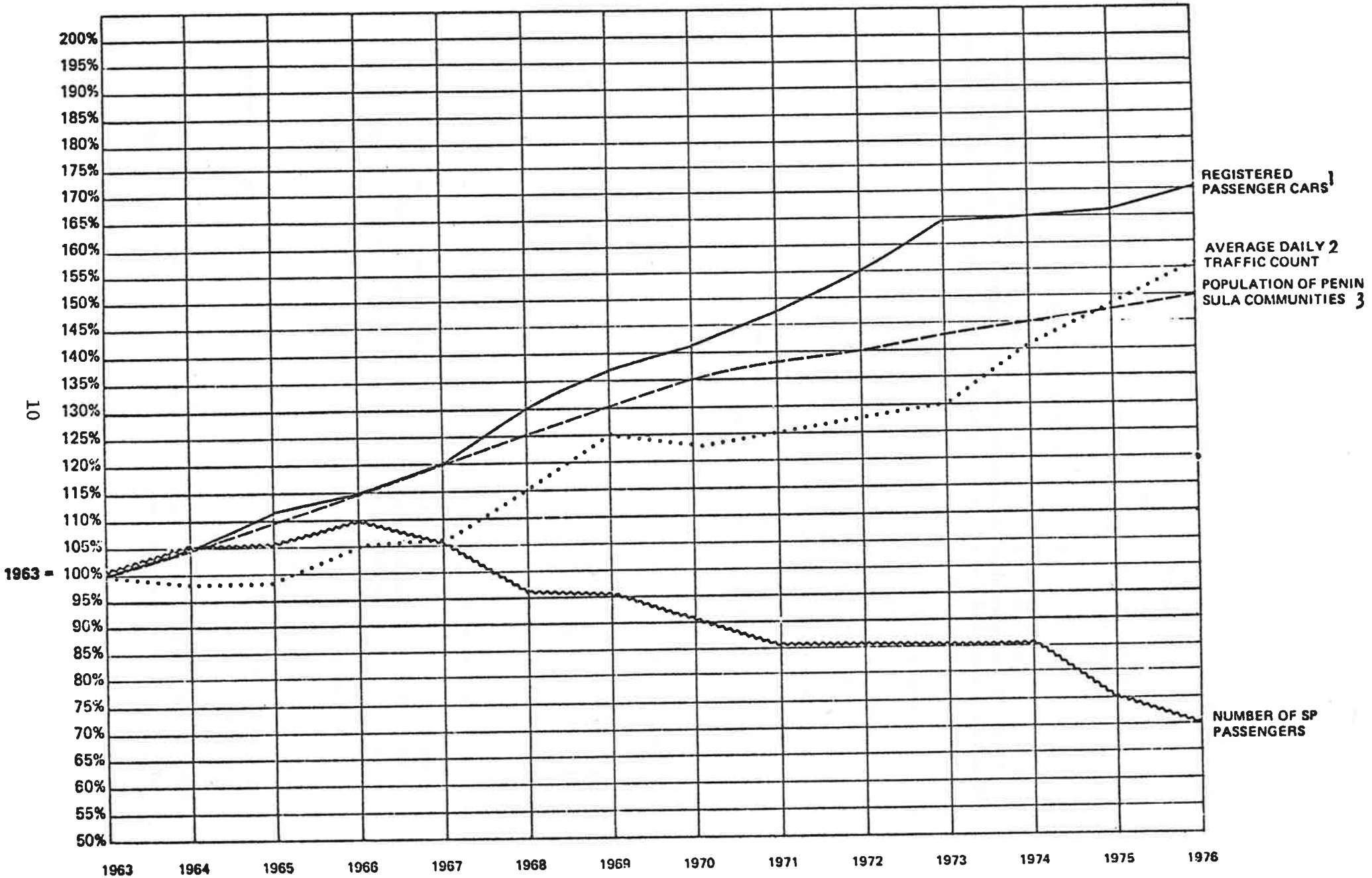
2.5.1 Santa Clara County Transit District (SCCTD)

Various bus lines serve the Southern Pacific stations within the Santa Clara County Transit District, as follows:

*Northbound and southbound Peninsula train check, SP, October 12-13, 1976, and G.D. Pera testimony before Calif. PUC, Application No. 57289.

Figure 2.2

PERCENTAGE GROWTH IN POPULATION OF PENINSULA COMMUNITIES, NUMBER OF REGISTERED AUTOMOBILES, AVERAGE DAILY AUTOMOBILE TRAFFIC COUNT AND NUMBER OF SP PASSENGERS-INDEXED TO 1963



Source: Southern Pacific

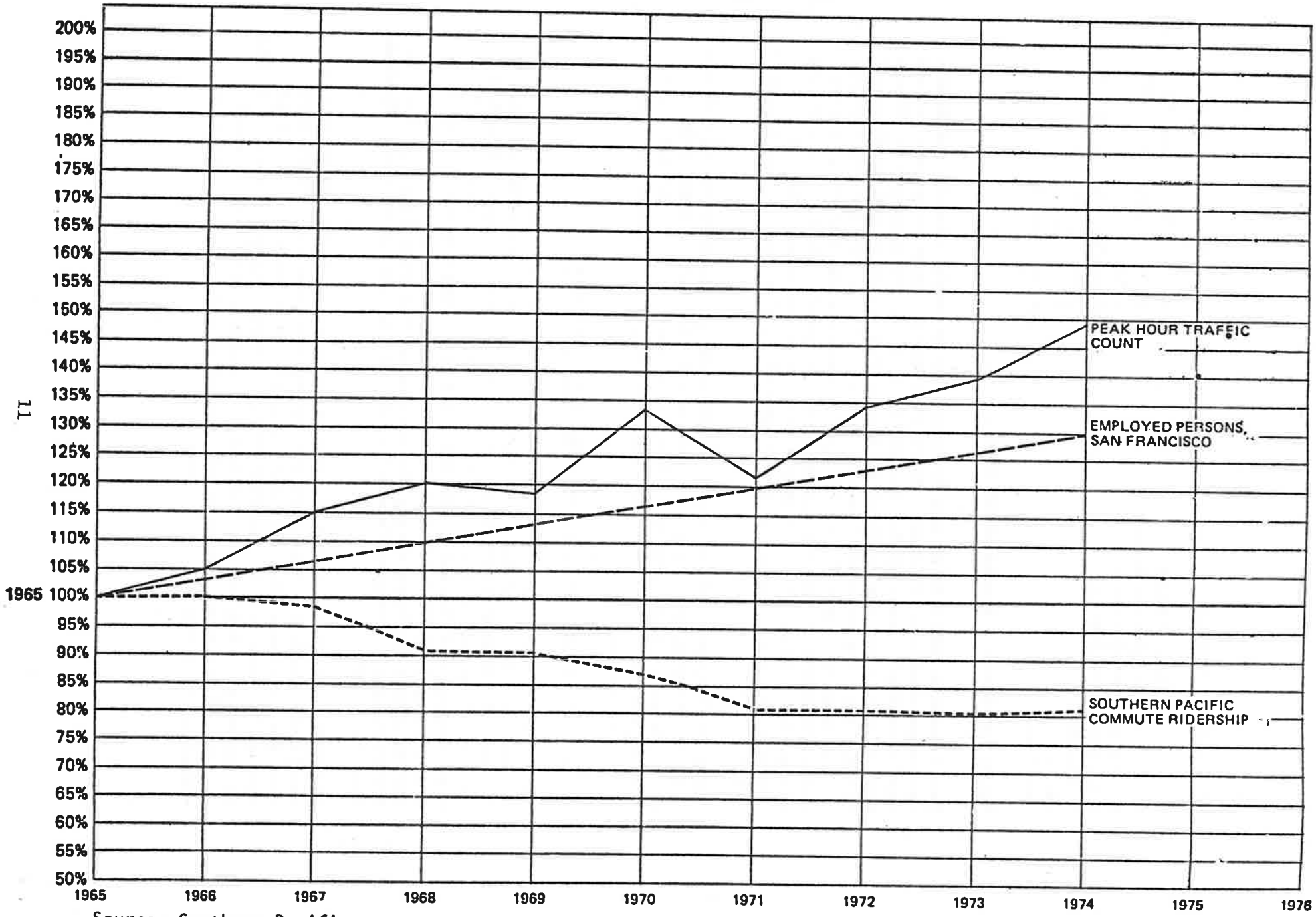
1. San Mateo and Santa Clara Counties Only

2. At 5 Check Points of Highways 101 and 280

3. Excludes San Francisco

Figure 2.3

PERCENTAGE CHANGE IN THE NUMBER OF EMPLOYED PERSONS IN SAN FRANCISCO AND PEAK HOUR TRAFFIC COUNTS COMPARED TO SOUTHERN PACIFIC COMMUTE RIDERSHIP-INDEXED TO 1965



Source: Southern Pacific

SP Station Location	SCCTD Route
Palo Alto (Alma Street)	18*, 22, 23, 24, 86, 88
Palo Alto (California Street)	Express 2, Express 4, 88
Mountain View (Castro)	10, 92, 97
Mountain View (Evelyn)	Express 2, 20, 52, 92, 97
Sunnyvale	Express 2, 54, 98, 99
Santa Clara	22*, 64, 81
San Jose	22*, 63, 64, 81

*Stop is within 3 blocks of SP Depot.

Local service adult fares are 25 cents, while youth, elderly and handicapped persons pay 10 cents. Multi-ride ticket books or passes include the "Blue Key" Pass ($10 for one month of unlimited rides); the "Orange Key" Pass ($4 for one month of unlimited youth, senior and handicapped fares); the 22-ride adult commute ticket ($5); the 10-ride youth senior or handicapped ticket ($1); and the Day Pass for one day of unlimited rides (50 cents for adults and 20 cents for youth, elderly and disabled persons). Express (i.e., limited) service to major employers and activity centers (not including SP depots) is also provided at higher fares.

Buses run between 6:00 AM and 11:00 PM weekdays and between 8:00 AM and 6:00 PM weekends and holidays. Headways during both weekday peak and off-peak periods are generally long, with most buses 30 minutes apart. Evening and weekend service is less frequent, with headways ranging from 30 to 90 minutes.

2.5.2 San Mateo County Transit District (SAMTRANS)

SAMTRANS provides both local and mainline bus service over 5 fare zones between Palo Alto and San Francisco. Mainline service competes with SP for the SF-oriented commuter market. Four routes are operated between Palo Alto/Redwood City and SF, with an additional route between the S.F. Airport and the Daly City BART station. Buses operate between 5:00 AM and 1:50 AM, with 15 to 30 minute headways during peak hours and 30 minute headways during the off-peak. The ride from Palo Alto to San Francisco's Transbay Terminal takes an hour and 20 minutes. Maximum fare is $1.10.

SAMTRANS local buses serve all of the SP stations in San Mateo County except the South San Francisco and Butler Road stations, which have very low ridership over the short trip to San Francisco. Most buses operate between 6:00 AM and 7:00 PM, with night service (until 10:00 PM) in San Mateo, Pacifica and San Bruno. Headways are 15 to 30 minutes during commute hours and 30 to 60 minutes at other times. Fares are identical to those for SCCTD buses.

2.5.3 San Francisco Municipal Railway (MUNI)

Buses, streetcars and cable cars provide extensive local service in San Francisco and northern Daly City. Several buses, including the 15, 19, 30, 32, 40 and 80, serve the San Francisco SP depot at Fourth and Townsend Streets. This SP station is about ten blocks from San Francisco's downtown shopping district and twelve blocks from the Financial District. Although MUNI connectors are an integral link in the SP commute trip to and from San Francisco workplaces, only about 150 to 200 San Francisco residents daily use MUNI feeders to SP in the reverse direction to Peninsula employment.

Vehicles operate 24 hours daily with modified service on weekends and holidays. Headways range from 3 to 10 minutes during commute hours and from 5 to 20 minutes during other times on most routes. The basic fare is 25 cents with a 5 cent fare for children, seniors, and handicapped persons. MUNI "Fast Pass" multi-ride tickets allow unlimited travel for one month at $11 (regular fare) and $2.50 (seniors).

2.6 OTHER TRANSIT SERVICES

In addition to SP (and mainline express service to San Francisco provided by SAMTRANS) intercity passenger transportation is also provided by Greyhound Lines, Inc., by Trailways, and by various charter bus companies. In general, these operators do not compete for a significant share of the commuter market in the San Francisco-San Jose corridor. Greyhound has recently abandoned its San Mateo County service on authority of the State PUC in favor of a purchase-of-service agreement with SAMTRANS. This decision continues Greyhound's responsibilities of service to Santa Clara County with both route and stations in close proximity to those of SP. The northern sectors of the remaining Greyhound route through San Mateo County were converted to express service.*

*MTC, op. cit., 1975, pp. 9-10

3 DEMONSTRATION PROGRAM

This section begins with a chronology of the events leading up to implementation of the demonstration program. This is followed by a brief description of the program and the agencies involved.

3.1 EVOLUTION OF THE FARE SUBSIDY PROGRAM

Major events related to fare reduction program planning and implementation are presented in chronological order.

January 1977: Consultant efforts on the Peninsula Transit Alternatives Project (PENTAP), a study of short- and long-term transportation development alternatives for the San Francisco Peninsula, were completed. The study's primary recommendation was to upgrade Southern Pacific service. During the PENTAP study, the General Manager of the San Mateo County Transit District (SAMTRANS) recommended public subsidization of SP fares. This recommendation was made in response to an anticipated Public Utilities Commission (PUC) award of a 25 percent fare increase to SP.

March 9, 1977: The SAMTRANS General Manager's recommendation was adopted by the PENTAP project implementation committee.

May 1977: Southern Pacific filed application with the state PUC for discontinuance of rail passenger service. MTC adopted the PENTAP committee's subsidy recommendation. San Mateo, Santa Clara, and San Francisco counties were asked to subsidize the passenger service for the next two years until a long-term financing proposal could be devised.

June 1977: The SAMTRANS Board passed a resolution supporting a 30 percent discount of SP fares for San Mateo County residents purchasing multi-ride tickets. SAMTRANS began planning program implementation.

July 12, 1977: Southern Pacific was granted a 25 percent increase in fares, effective August 1.

August, September, 1977: SAMTRANS' General Manager approached SP to ask for their cooperation in the subsidy program. SP asked for state legislature approval and stated its preference not to be involved in the reduced fare ticket distribution.

PUC hearings on SP's request to discontinue passenger service began in August. Public hearings were held in September.

September 1977: Initiated by MTC, Assembly Bill 1853, authorizing subsidization of SP fares, was signed by the Governor.

October 1977: SAMTRANS began its marketing program to attract commuters to apply for reduced fares. The City of San Francisco endorsed the idea of the fare subsidy.

November 1977: The Santa Clara County Board of Supervisors passed a resolution for a 30 percent discount for a two-year period, and approved the agreement to be signed with Southern Pacific. SP reversed its position on its non-involvement in the ticketing process, agreeing in principle to distribute tickets through its mail distribution system and ticket outlets. SP appealed to the federal Interstate Commerce Commission to allow it to discontinue passenger service, however. This action was in response to PUC staff recommendation to the State PUC to deny SP's request to terminate services.

January 1978: Fare reduction began in San Mateo County.

February 1978: Agreements were signed so that the program could begin in San Francisco and Santa Clara Counties.

April 1979: The transit providers agreed on an extension of the subsidy program to include a 40 percent fare discount for one-way and round-trip ticket purchases. This extension was to begin June 1.

May 1979: Experience of gas shortages throughout the Bay Area produced a sharp rise in transit use and standing room only conditions on many SP runs. Given current capacity constraints, it was decided to postpone the 40 percent fare discount incentive until a later date.

July 1979: An ICC administrative law judge ruled that SP be compensated for its $11.6 million annual losses on Peninsula commute service, or allowed to terminate that service in 1980. The State PUC, CALTRANS, MTC, SAMTRANS, and SCCTD resolved to appeal the ruling.

September 1979: In the face of the administrative law judge's finding and given stabilizing ridership following increased availability of gasoline, CALTRANS, SAMTRANS, and SCCTD decided to proceed with the 40 percent discount on one-way and round-trip fares. The subsidy, to be shared equally by the three authorities, was offered for one month only.

October 1979: SP and CALTRANS announced their agreement in principle to continue Peninsula commute service for at least the next ten years under a purchase of service agreement between the two. Contract preparation was begun, with necessary ratification by supervisors in the three counties, the ICC, and the PUC expected by year's end.* The PUC probe into the adequacy of SP's Peninsula service was suspended indefinitely.

*Local TDA monies would be applied to offset operating losses under this agreement. The method of calculating the deficit -- SP's estimate of its losses exceeds that of the PUC, for example -- is expected to be a major point in the negotiations. SAMTRANS and SCCTD have expressed their commitment to continue some form of fare discount under the new service.

3.2 DESCRIPTION OF PROGRAM CHARACTERISTICS

3.2.1 Amount and Beneficiaries of Discount

The fare discount program has two features: a 30 percent reduction in current fares applicable to multi-ride (commute) tickets, starting January 1978 and continuing over a two-year period; and a 40 percent discount on one-way and round-trip fares for one month only, September 1979. These discounts are available to San Mateo, Santa Clara, and San Francisco County residents upon proof of county residency to their respective transit districts. If qualified, applicants receive an ID card or voucher which they then present at the SP ticket windows to purchase tickets with the discount. Discounted multi-ride tickets can also be obtained with the voucher by mail.

The savings afforded by the program to commuters are substantial. Table 3.1 presents multi-ride ticket prices and break-even trip frequencies before and after the 30 percent discount for a representative trip length (between San Francisco and Zone 3). As the table shows, the 30 percent reduction on 5-day Monthly Tickets, for example, is nearly $15 per month, or over $150 per year.

TABLE 3.1
MULTI-RIDE TICKET PRICES AND BREAK-EVEN TRIP FREQUENCIES BEFORE AND AFTER THE 30 PERCENT DISCOUNT FOR A REPRESENTATIVE TRIP LENGTH

	5-Day Monthly Commutation	7-Day Monthly Commutation	7-Day Weekly	20-Ride
Without Discount	$45.00 21 trips	$49.05 23 trips	$12.50 6 trips	$31.45 15 trips
With Discount	$31.50 15 trips	$34.34 16 trips	$ 8.75 4 trips	$22.02 10 trips

The 30 percent discount on multi-ride purchases also provides a substantial incentive to SP use by lowering the break-even trip frequency. That is, patrons using the discount not only incur a lower advance payment, but also need to make fewer trips to pay off the ticket price before realizing its savings. It should be noted that the 40 percent discount on single ride tickets provided during September 1979, represented no disincentive to multi-ride purchases. The multi-ride ticket prices in all categories offer substantial savings (and lower break-even trip frequencies) over the comparable numbers of trips purchased on a single-ride basis at 40 percent off.

SAMTRANS also expanded the fare subsidy by providing free feeder bus services on its local routes serving SP stations. The free rides were provided only for county residents purchasing multi-ride tickets under the discount program.

3.2.2 Discount Payment

On the basis of SB 325 authorization for the transit districts to engage in sales of subsidized discount tickets, MTC allocated Transportation Development ACT (TDA, 1971 as amended) funds from gasoline sales taxes for fiscal years 1977/78 and 1978/79 to finance the fare reduction. The annual allocation for each of the three counties in which SP operates is:

	FY 1977-78	Fy 1978-79
San Francisco City and County:	$ 50,000	$100,000
San Mateo County:	600,000	700,000*
Santa Clara County:	500,000	600,000**

Source: SAMTRANS, SCCTD, MTC.

*Additional monies; draw-down of unused funds from previous fiscal years is presumed.
**As per SCTD's request on the basis of previous years' expenditures.

Sufficient funds were allocated to cover revenue losses which would occur if very large majorities of current riders as well as new ridership were to take advantage of the reduced fares. Subsidy monies are held by the bank for the individual counties, and SP is compensated for its revenue losses in discount ticket sales on submission of its sight draft for that day's sales. (SP summarizes and bills for the comparatively small number of discount tickets sold to San Francisco residents only on a monthly basis. An additional one percent surcharge compensates SP for its bookkeeping costs.)

The 40 percent discount on one-way and round-trip fares was funded with TDA monies in equal shares from CALTRANS, SAMTRANS, and SCCTD. The $102,000 actual cost of the promotion exceeded the $75,000 estimate by 36 percent. SAMTRANS acted as principal broker in administering the one-month discount, reimbursing SP and billing CALTRANS and SCCTD.

3.3 INSTITUTIONAL INVOLVEMENT

Several agencies have been directly involved in the coordinated planning and implementation of the fare reduction program. The following paragraphs describe each institution's role in the program. The recent agreement in principle between SP and CALTRANS on a purchase of service arrangement heightens several of these agencies' roles for participation in continued SP service.

The California State Legislature

In September 1977, the Governor of California approved Assembly Bill 1853, allowing subsidy of SP fares by cities, counties, and transit districts. The bill directs the state PUC, CALTRANS, and the MTC to (a) adopt certain roles in the fare subsidy program, and (b) make decisions related to future ownership and financing of passenger rail services. MTC prompted introduction of the legislation to the State Assembly.

The California Department of Transportation (CALTRANS)

Under AB 1853, CALTRANS has the following responsibilities:

- Required to furnish information concerning the availability of public subsidies or other support for passenger rail service, upon request of the State PUC.
- Has authorization and funds to undertake a program to extend passenger rail services and upgrade commuter services (fiscal years 1976-77 and 1978-79).
- Authorized to negotiate or enter into contract with SP to provide rail passenger service.
- Required to acquire abandoned portions of the SP right-of-way for development for public transportation.

As part of its interest and involvement in the SP fare subsidy program, CALTRANS sponsored a market research survey in the SP market area. (This survey, conducted during July, 1978, provides one of the key data pieces for analysis of the program's impact on ridership and is discussed in Section 4.1 of this report).

The California Public Utilities Commission (PUC). The State PUC is the regulator of SP operations. AB 1853 requires the PUC to consider the availability of public subsidies in "proceedings related to rates charged by a railroad or the extent of such services." These proceedings include SP's applications for passenger fare increases and discontinuance of services.

Metropolitan Transportation Commission (MTC). MTC was created by statute and is the Bay Area's regional transportation planning organization (MPO). Its role is to work with local transit agencies to insure coordination of efforts in accordance with its regional plan. Thus MTC has encouraged different jurisdictions to participate in the SP fare program. According to AB 1853, MTC is required to (1) conduct a study to determine the extent to which transit dependents' needs are met by SP service; (2) insure coordination between transit operators so that there

is adequate feeder service to SP; and (3) submit a financing plan to the State Legislature to support upgrading of SP service. MTC's policy position has been against discontinuance of Southern Pacific services.

San Mateo County Transit District (SAMTRANS). SAMTRANS is the public transit operator for San Mateo County. SAMTRANS has expressed its commitment to an integrated system of local and express buses combined with SP passenger service for the San Francisco-San Jose corridor. As part of its advocacy of continued SP services, SAMTRANS initated the fare reduction program. Its commitment to the program's success is also witnessed in SAMTRANS' intensive marketing efforts for the discount tickets, its extension of the fare subsidy to include free SAMTRANS feeder bus service to SP stations, and its role as broker for the 40 percent discount offered in September 1979.

Santa Clara County Transit District (SCCTD). The Santa Clara County Transit District is the public transit operator for the County. In November 1977, the County's Board of Supervisors voted to follow SAMTRANS' example in support of the 30 percent SP fare discount for the two-year period. SCCTD is similarly committed to continuation of SP Peninsula commute service. San Francisco Municipal Railway (MUNI). The transit operator for the City and County of San Francisco, MUNI was the latest of the three authorities to join in the fare discount program. MUNI's contractural agreement with SP was approved in January of 1978; its participation in the program began in February.

Southern Pacific Railroad (SP). SP provides commuter service in the San Francisco-San Jose corridor in addition to its rail freight operations. In recent years, SP has progressively cut back its passenger operations. Implementation of the fare subsidy program came on the heels of SP's latest appeal to discontinue its commuter services.

3.4 EXPECTED DISCOUNT PROGRAM EFFECTS

The general concensus among these institutional participants was that the fare discount program would contribute to reversing the decline in SP patronage which began during the 1950's. SAMTRANS had long contended that SP failed to develop its ridership by neglecting to market aggressively using effective sales promotion and incentive strategies. Some agencies anticipated an actual increase in ridership, while others considered the program merely a stop-gap measure. Not surprisingly, SAMTRANS has been the most sanguine about the program's potential effects, while SP has been the most doubtful.

CALTRANS, SAMTRANS, and SCCTD's belief in the potential market for Peninsula commute service also underlay their participation in the 40 percent discount on one-way and round-trip fares. These authorities hoped that this second discount would counter SP's contention to the ICC (and supported by the administrative law judge's ruling) that it had saturated the Peninsula commute market.

4 EVALUATION FINDINGS

4.1 OVERVIEW

The following section presents findings on SP ridership changes since the discount program and related issues. Note that the evaluation formally terminated with the onset of the gasoline crisis in April 1979. This report was subsequently extended to include discussion of ridership changes throughout the gas crisis, implementation of the 40 percent discount on occasional fares, and the pending purchase of service of agreement between CALTRANS and SP.

4.1.1 Notes on Data Sources

The original Evaluation Plan anticipated a broader and deeper data base (to be collected by the transit operators) than that which was ultimately available for study. Data on monthly sales of discount tickets was readily available from the transit operators. Before and after comparisons of weekday commuter (San Francisco-bound) passengers, however, were limited to SP high counts (passengers on the ten morning peak hour lead trains) for January, February, and March of 1977 and 1978. These figures were collected in wet weather and may have been taken too early to capture the effects of the fare subsidy program on SP ridership.

Data on ridership of feeder bus services was too limited to permit determining the characteristics of ridership on free services (SAMTRANS) as opposed to that on regularly charged services (SCCTD). Riders showing discount vouchers for free passage on SAMTRANS feeder buses were counted during two comparable weeks in November (1977 and 1978). The discount riders were counted as "transfers" along with those actually making a transfer onto the feeder from another SAMTRANS route. Survey data to describe new and continuing SP riders also proved to be unavailable; thus it was not possible to compare characteristics of these groups.

4.1.2 Data Sources and Methods of Evaluation

Changes in SP Ridership. The following data sources were used to monitor changes in SP ridership:

1. Monthly records of overall SP ticket sales and rides taken prior to and during the fare subsidy program (supplied by SP);

2. Monthly discount sales of multi-ride tickets to residents of the individual counties and estimates of rides taken (provided by the respective transit districts) -- note that the discount tickets (and therefore, their respective sales by county) were unavailable before the fare subsidy program; and

3. SP's "high counts" of passengers on ten peak-hour westbound trains for selected days in January, February and March of 1977 and 1978.

Estimation of monthly ridership from multi-ride ticket sales is based upon the potential value, in rides, of each ticket type. Estimation methods varied in practice among the three primary operators. Therefore, DCCO re-estimated the ridership totals to achieve comparability between the data sources.

A regression model was also used to investigate the cause-and-effect relationship between SP ridership and a variety of other factors.

The PUC took a sample of on/off counts for weekday and weekend ridership during the 40 percent discount in September 1979. Final figures were unavailable at the time this report was prepared. When available, these counts may be compared with SP's September 1978 average daily ridership in order to assess the change from the 40 percent discount.*

Changes in Bus Feeder Ridership. It was possible to estimate the change in SP-oriented ridership on free-fare SAMTRANS feeders via special counts taken by SAMTRANS bus drivers: passengers showing their discount voucher for free-fare bus passage to and from SP stations are counted as "transfers" along with passengers actually making a transfer from another SAMTRANS route. In the absence of system changes or other factors contributing to an increase in the number of transfers, an increase in these passengers provides an indicator of growth in free feeder ridership.

Impacts on Operators' Costs and Supply-Side Changes. Changes in operators' costs for administering the program and in the supply-side characteristics of their services have been monitored through contacts with representatives of the transit providers. These contacts have also provided for a continuing update on changes in operators' marketing efforts or in the overall program. The representatives have discussed their assessments of the program's performance and suggested improvements for its continuation under the purchase of service agreement now pending.

4.2 IMPACTS ON TRAVEL BEHAVIOR

Trendwise comparisons of monthly SP ridership since before the initiation of the fare subsidy program indicated that the program participated in stabilizing ridership prior to the gas crisis. This result is reflected in the generally upward trend in discount ticket sales to San Mateo and Santa Clara County residents, in SP's monthly and annual ridership totals, in operator representatives' appraisals of project performance, and in the results of DCCO's regression model. Each of these results is discussed in turn below.

*It should be noted that the PUC sample on/off counts are not strictly comparable with the SP 24-hour on/off counts taken each fall.

4.2.1 Changes in Discount Sales and SP Ridership

Figure 4.1 shows changes in monthly discount ticket sales to San Mateo and Santa Clara County residents, separately and combined, and as compared with changes in overall SP ridership since the initiation of the fare subsidy program. Although all three estimates show considerable month-to-month variation and some seasonal lows, e.g., ridership appears to drop during the summer months and December, the general pattern is upward.*

The first five months of the program, January through May, 1978, show a sharp increase in discounted multi-ride sales. This high volume of sales during the program's early months may reflect commuters' experimentation with SP and the program, as a result of intensive early marketing efforts. Both the 1978 and 1979 results show increasing ridership at the start of the year, followed by a decline during the 1978 summer months, with a substantial recovery later on. Ridership jumps sharply with the gas crisis in April-May, 1979, with some stabilization (in contrast to previous summer decline) indicated through August. San Mateo residents account for the largest share of discount sales (an average 56 percent over the life of the program).

Changes in SP ridership since the discount are more clearly illustrated in contrast with the previous sixteen months as shown in Figure 4.2 or the previous decade (Figure 4.3). Both figures show the similar monthly variation, with a gradual but steady decline in ridership (continuing since the 1950's), and a comparatively recent levelling off, including the discount program. It should be noted that the ridership changes since the discount are generally small, though upward, especially in contrast to the dramatic changes during the gasoline crisis.

Table 4.1 summarizes monthly and annual percentage changes in SP ridership from January 1970 to the present. The 1978-1979 figures through March 1979 show a 2.6 percent overall increase in ridership since the program began. This is SP's strongest recovery since the first third of 1974, with its gasoline crisis. This modest increase is far outpaced, however, by the dramatic rise in ridership on SP and other Bay Area transit systems as well as nation-wide during the 1979 gasoline crisis, SP ridership changes since April have averaged over 44 percent, including the typically low-ridership summer months. Final figures for September 1979 were not yet available as this report was being prepared, but early estimates indicate a similar increase over September of the previous year. Note that the September figures will include ridership induced by the 40 percent discount on one-way and round-trip fares, in addition to the 30 percent discount on multi-ride tickets.

*Some of the monthly variation may be attributable to the differing numbers of commuter travel days in each reporting period. Also, the transit operators/districts report sales periods differently; SP records sales by calendar month of ticket use, while the county transit districts report discount sales on the basis of the fiscal month.

Figure 4.1

MONTHLY CHANGES IN SP DISCOUNT SALES AND TOTAL RIDERSHIP SINCE THE SUBSIDY PROGRAM

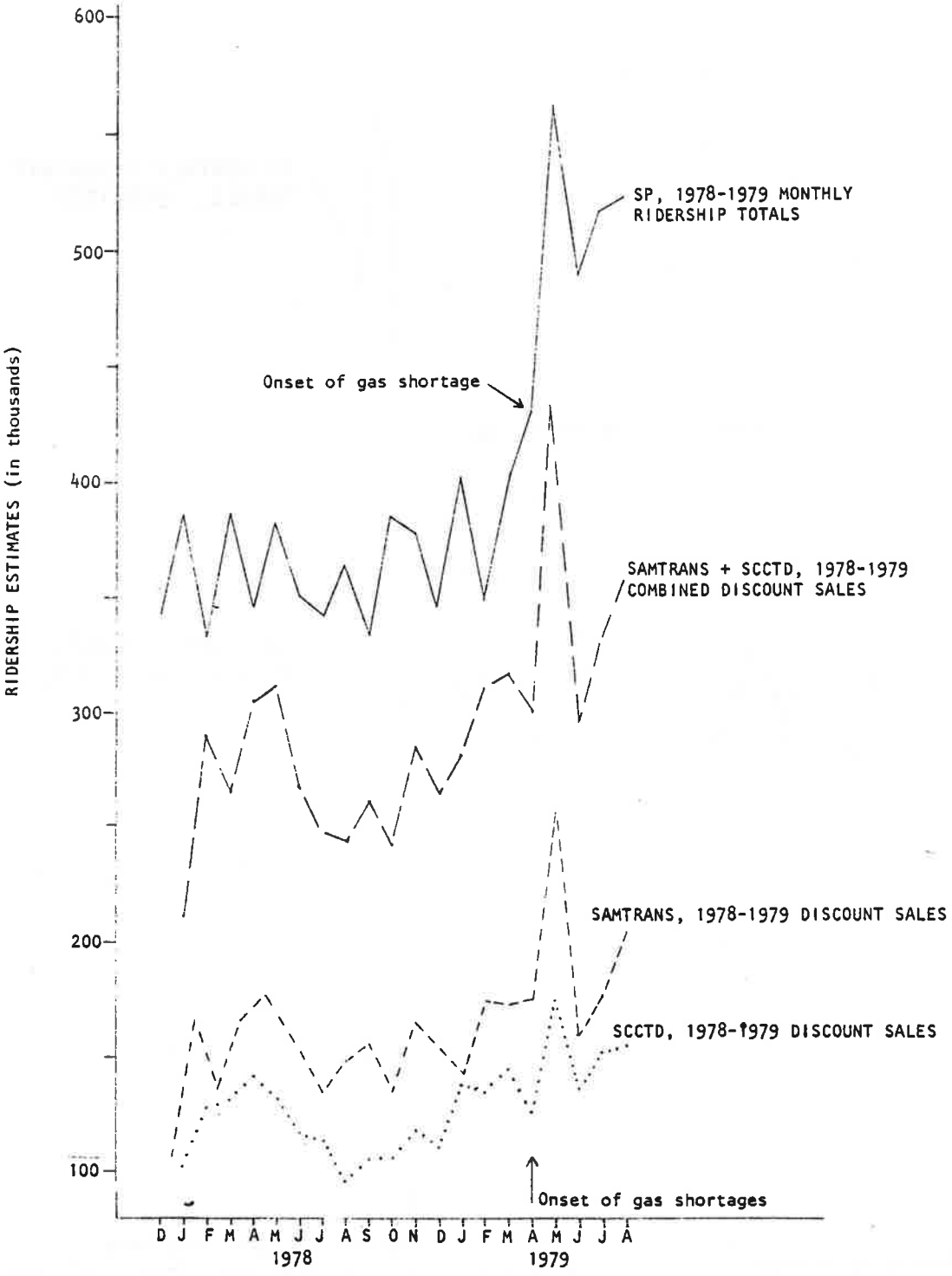


Figure 4.2

MONTHLY SP RIDERSHIP SINCE DISCOUNT PROGRAM COMPARED WITH PREVIOUS SIXTEEN MONTHS

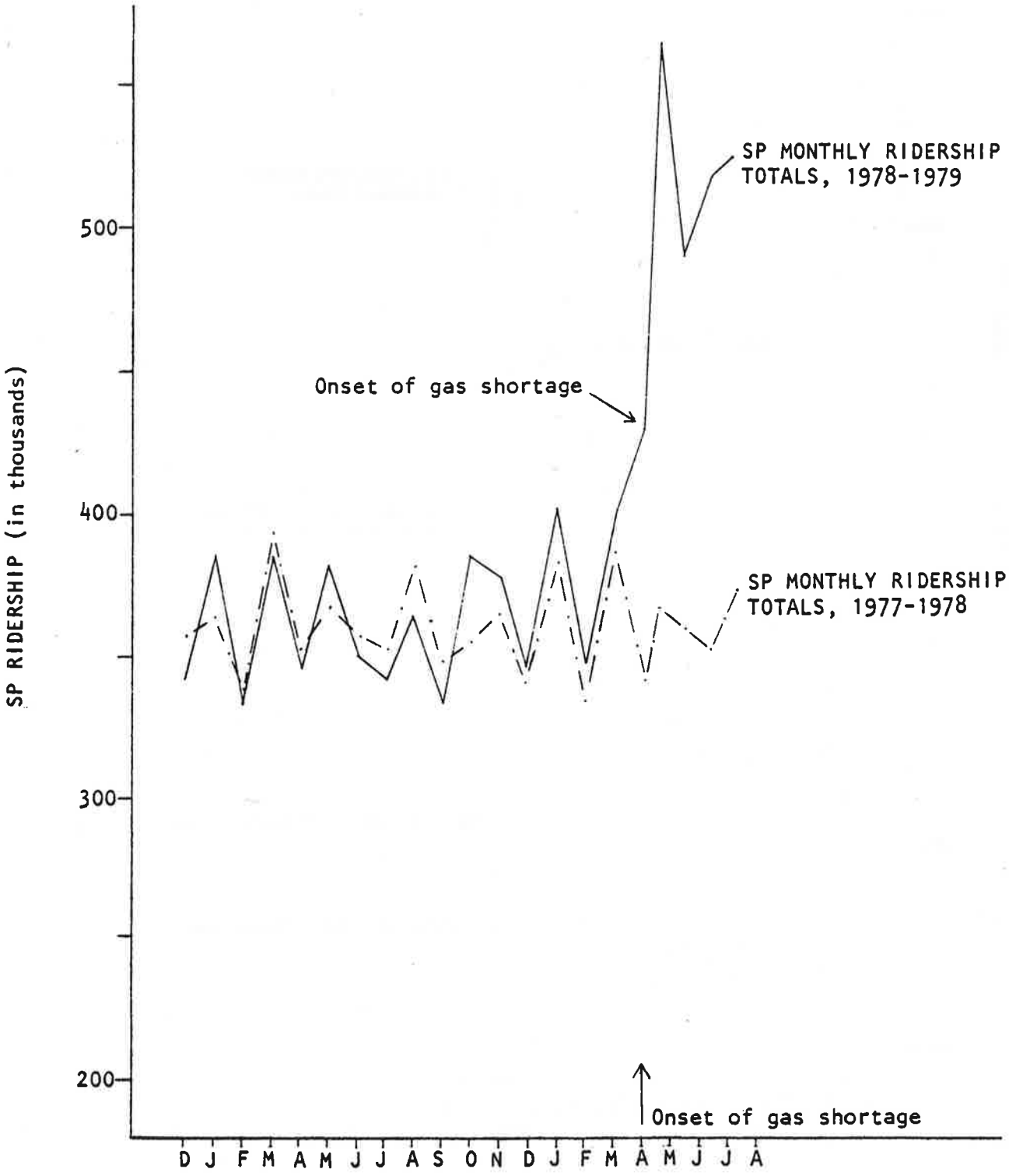


Figure 4.3

MONTHLY SP RIDERSHIP DURING THE 1970'S, Showing Discount Sales Since January, 1978

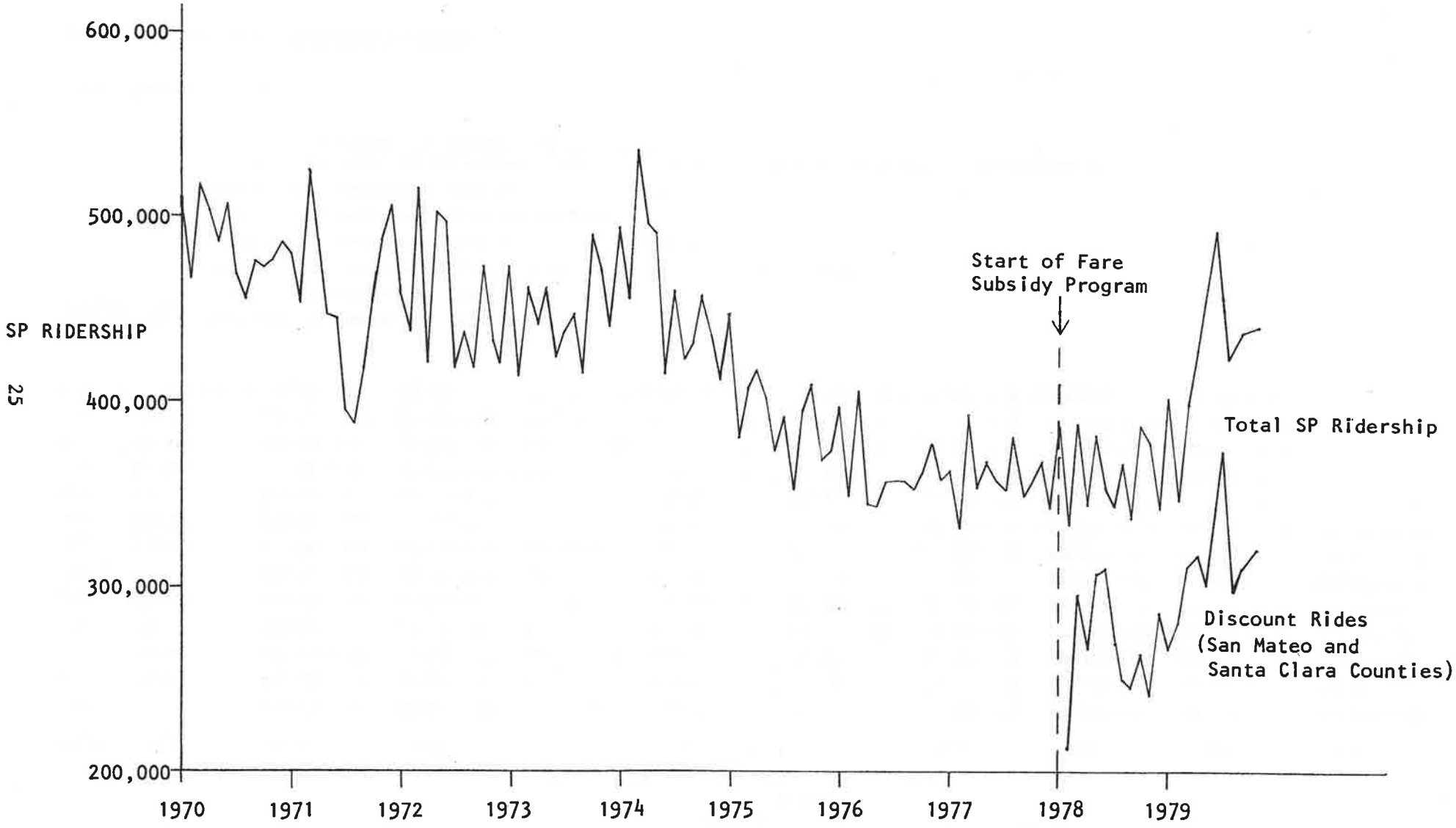


TABLE 4.1
SP PENINSULA COMMUTE SERVICE
MONTHLY RIDERSHIP AND ANNUAL PERCENTAGE CHANGE

MONTH	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
JAN	511,492	480,075 - 6%	458,635 - 4%	473,486 + 3%	495,226 + 5%	447,204 -10%	395,750 -12%	363,544 - 8%	386,356 -6.3%	403,074+4.3%
FEB	460,832	454,289 - 1%	438,993 - 3%	412,067 - 6%	456,510 +11%	380,198 -17%	349,773 - 8%	331,054 - 5%	333,559 + #%	348,883+4.6%
MAR	517,262	526,006 + 2%	516,005 - 2%	462,809 -10%	536,702 +16%	407,587 -24%	407,525 - #%	394,338 - 3%	388,750 -1.4%	400,195+2.9%
APR	503,254	489,533 - 3%	421,130 -14%	442,182 + 5%	496,804 +12%	416,534 -16%	345,841 -17%	352,375 + 2%	344,392 -2.3%	430,082+25%
MAY	486,492	445,681 - 8%	502,469 +13%	462,138 - 8%	492,746 + 7%	401,960 -18%	345,190 -14%	369,869 + 7%	383,148 +3.6%	562,058+46.7%
JUN	507,187	445,453 -12%	498,103 +12%	424,561 -15%	416,884 - 2%	373,220 -11%	355,961 - 5%	357,862 + #%	351,601 -1.7%	489,530+39.2%
JUL	469,481	395,444 -16%	418,836 + 6%	438,315 + 5%	461,775 + 5%	391,576 -15%	356,949 - 9%	353,214 - 1%	342,889 -2.9%	517,916+51.0%
AUG	454,888	388,504 -15%	437,629 +13%	448,490 + 2%	424,614 - 5%	352,766 -17%	356,101 + 1%	382,831 +7.5%	366,342 -4.3%	522,446+42.6%
SEP	476,326	417,053 -12%	419,982 + 1%	415,981 - 1%	432,330 + 4%	396,386 - 8%	352,515 -11%	349,558 - #%	336,367 -3.8%	
OCT	471,515	454,003 - 4%	474,216 + 4%	490,852 + 4%	459,822 - 6%	410,375 -11%	361,985 -12%	356,297 -1.6%	386,332 +8.4%	
NOV	479,493	487,044 + 2%	431,227 -11%	472,827 +10%	437,070 - 8%	367,901 -16%	379,861 + 3%	367,033 - 3%	378,230 +3.1%	
DEC	487,331	500,677 + 3%	421,778 -16%	441,876 + 5%	412,702 - 7%	373,972 - 9%	358,313 - 4%	341,998 -4.6%	343,045 + #%	
YEAR	5,825,553 - 5%	5,483,762 - 6%	5,439,053 - 1%	5,385,584 - 1%	5,523,185 + 3%	4,719,679 -15%	4,365,764-7.5%	4,319,973 - 1%	4,341,011 + #%	

RATE INCREASES: 10/07/70 - 5% GENERAL FARE INCREASE.
12/18/71 -10% GENERAL FARE INCREASE.
10/25/73 - 6% OFFSET INCREASE TO RECOUP FROM RAILROAD RETIREMENT TAX CHANGE.
12/22/73 -11% GENERAL FARE INCREASE (FILED IN OCTOBER 1972).
9/18/74 - 8% OFFSET INCREASE ACCOUNT RISE IN COST OF FUEL.
8/06/77 -25% GENERAL FARE INCREASE (FILED IN AUGUST 1974).
1/01/78 - FARE STABILIZATION PROGRAM STARTED. 30% DISCOUNT ON COMMUTE TICKETS OFFERED TO COMMUTERS BY SAN FRANCISCO, SAN MATEO AND SANTA CLARA COUNTIES.

= LESS THAN ONE PERCENT.

SOURCE: SOUTHERN PACIFIC TRANSPORTATION COMPANY

TABLE 4.2
SANTA CLARA AND SAN MATEO DISCOUNT RIDES
COMPARED WITH TOTAL SP RIDERSHIP

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1978:												
SANTA CLARA COUNTY RIDES	104,606	128,296	130,906	141,114	132,798	116,922	114,070	96,132	105,272	105,762	118,804	110,850
SAN MATEO COUNTY RIDES	106,926	167,398	134,736	166,148	178,068	152,926	134,244	148,144	156,002	136,376	165,936	154,374
COMBINED DISCOUNT RIDES (1)	211,532	295,694	265,642	307,256	310,866	269,848	248,314	244,276	261,274	242,138	284,740	265,224
TOTAL SP RIDERSHIP (2)	386,356	333,559	388,750	344,392	383,148	351,601	342,889	366,342	336,367	386,332	378,230	343,045
1979:												
SANTA CLARA COUNTY RIDES	138,744	135,386	144,660	126,140	174,938	136,516	152,564	155,942				
SAN MATEO COUNTY RIDES	142,940	175,360	173,032	174,770	257,450	159,276	177,360	200,484				
COMBINED DISCOUNT RIDES	281,684	310,746	317,692	300,910	432,388	295,792	329,924	356,426				
TOTAL SP RIDERSHIP	403,074	348,883	400,195	430,082	562,058	489,530	517,916	522,446				

(1) San Francisco County Ridership (reverse commute) would probably account for a maximum additional 500 daily trips.

(2) Total SP ridership includes discounted commuter and other commute trips as well as one-way and round trips.

Table 4.2 presents monthly discount rides by county and compared with SP ridership overall.

Although the figures since October of 1978 and prior to the 1979 gas crisis indicate a stabilization of the previous decade's continually declining ridership, these results must be interpreted cautiously. First, a gradual stabilization began to appear during 1977. That is, ridership declined by only 1 percent during 1977, compared with 7.5 percent for the previous year. And, this stabilization occurred despite a 25 percent general increase in fares (see Table note).

Currently available data permits an assessment of the proportion of total commute riders who use the discount for the first eight months of the program. This proportion is calculated without the MUNI share of discount sales, reverse commuters who represent about 300 to 500 daily SP trips (up to 6 percent of the total). Table 4.3 presents the combined San Mateo and Santa Clara County ridership share of total SP commuter rides for these eight months.

TABLE 4.3
DISCOUNT RIDERS' SHARE OF TOTAL SP COMMUTE RIDES
JAN - AUG, 1978

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG
Discount Riders	211,532	295,694	265,642	307,256	310,866	269,848	248,314	244,276
Total Commute Riders	327,432	290,400	336,270	301,748	333,342	301,248	292,964	310,984
Discount Riders' Share of Commuter Ridership (%)	64.6	*	79.0	*	93.2	89.6	84.8	79.0

*Non-conformity of figures must be attributed to error or the difference in reporting periods used by the three transit operators.

Discount ticket holders' share of total commuter rides has been generally high since full participation of the two primary counties in February. Representatives of SAMTRANS and SP estimate that only 1 to 2 percent of commute riders do not currently avail themselves of the discount program. Data was not available at the time this report was prepared to estimate the proportion of occasional riders using the 40 percent discount during September 1979.

4.2.2 Regression Results

During November of 1978, ten months into the program and prior to the more recent ridership increases, the evaluation sought to quantify the effects of the fare subsidy program and to determine some of the factors involved in commuters' transportation choices. A number of possible causes were adduced which might constitute disincentives to SP ridership, including:

- rising personal incomes (and the resultant increase in automobile ownership)
- declining real costs of gasoline and parking (adjusted for income increases)*
- commuters' increasing valuation of personal time, resulting in higher premiums on travel and wait time, number of transfers, and other impedances
- the progressive shift of residential communities further south and away from the SP line
- improvements in competing transit services, including express buses and to some extent, BART

Factors which may have tended to enhance SP ridership include:

- improved SAMTRANS feeder bus service
- increased employment in San Francisco
- increased population in Peninsula communities served
- the discount program

Multiple regression analysis of time-series data appeared to offer an approach for assessing the impact of the program and separating its effect from effects of these other factors. The regression model would permit estimation of the magnitude of the program's effects as well as of the statistical confidence limits of its conclusions.

Independent variables were included in the model to capture the effects on SP ridership of such factors as seasonal fluctuation in ridership, average monthly employment in San Francisco, personal income changes, availability of BART or SAMTRANS service, SP fare increases, and gasoline shortages as well as the discount program.

Average monthly employment by quarter in the City and County of San Francisco was calculated from information provided by the California Employment Development Department. Separate figures for the downtown

*Note that this analysis was performed before the recent gasoline shortages and price increases.

area were unavailable; however, downtown employment constitutes the overwhelming share of total jobs. A personal income series for Peninsula residents was developed from a variety of federal, state, and county sources. A variable was included for the quarter of the year to take account of seasonal variation. Dummy variables were included to take account of the effects of the gasoline shortage, BART service between Daly City and San Francisco begun in 1974, competing SAMTRANS express bus service begun in 1977, the 14 percent increase in SP fares which went into effect during the fourth quarter of 1977, and the discount program itself. The model used ridership divided by employment as its dependent variable.

4.2.2.1 Functional Form of the Model

While the ultimate objective of the model is to predict SP ridership, it is not possible to do so without going through a transforming step of dividing by the number of jobs in San Francisco. We know that employment has been rising while ridership has been declining (refer back to Figures 2.3 and 2.4). Regression will associate these two trends, resulting in a parameter on employment which will associate increases in employment with decreases in ridership. This is opposite to what we would normally expect -- increases in employment should result in increases in ridership. In more formal terms, there was a possibility of heteroscedasticity in the error terms which would bias the estimates of model parameters. Therefore, the monthly ridership term was divided by employment to obtain a "quasi-mode split" term, i.e., the fraction of San Francisco employees using the train to commute.

A number of functional variations of the model were tested, including a simple linear form, a log transformation on the dependent variable, and log transformations on both dependent and independent variables. Comparison of these different models showed no appreciable improvement in predictive accuracy, and log transformations are considerably more difficult to interpret than a simple linear model. While there may be some theoretical reasons for preferring a log model, for the period over which the model is operating, there should be (and was) very little difference between the linear and logarithmic functional forms. As in most time-series data, significant autocorrelation between error terms of adjacent time periods was found.* This was corrected using a Cochrane-Orcutt regression on first differences.

4.2.2.2 Model Results and Interpretation

The results of several model runs are shown in Table 4.4, including estimated model parameters, as well as other summary statistics. The most important term for our analysis here is STABPRO, the dummy variable used to indicate the period of the fare discount program. In all cases,

*See Appendix for further discussion.

Table 4.4
RESULTS OF REGRESSION MODEL RUNS

$$\text{Model Form} = \frac{\text{Ridership}}{\text{Employment}} = {}^{a}\text{INCOME} + {}^{b}\text{ECRISIS} + {}^{c}\text{STABPRO} + {}^{d}\text{QTR2} + {}^{e}\text{QTR3} + {}^{f}\text{QTR4} + {}^{g}\text{FAREINC} + {}^{h}\text{BUSSVC} + {}^{j}\text{BART} + {}^{k}\text{CONSTANT}$$

Model Version	a INCOME	b ECRISIS	c STABPRO	d QTR2	e QTR3	f QTR4	g FAREINC	h BUSSVC	j BART	k CONSTANT	R^2	DURBIN-WATSON
I	-.000119 (10.82)	.040 (1.20)	.041 (1.15)	-.022 (1.60)	-.045 (2.43)	-.030 (1.96)	-.003 (0.09)	.054* (1.54)	.033* (0.70)	1.83 (10.82)	.96	1.87
II	-.000115 (5.14)	.052 (2.00)	.040 (1.19)	-.023 (1.72)	-.047 (2.75)	-.029 (2.00)	-.009 (0.26)	.052* (1.53)	-	1.83 (9.44)	.96	1.73
III	-.000100 (4.34)	.057 (2.12)	.045 (1.27)	-.022 (1.67)	-.038 (2.30)	-.025 (1.72)	.007* (0.02)	-	-	1.71 (8.46)	.95	1.63
IV	-.0000998 (4.90)	.057 (2.21)	.045 (1.35)	-.022 (1.74)	-.038 (2.42)	-.025 (1.82)	-	-	-	1.70 (9.43)	.95	1.63
V	-.000116 (5.57)	.053 (2.11)	.039 (1.20)	-.022 (1.77)	-.046 (2.86)	-.029 (2.16)	-	.050* (2.16)	-	1.84 (10.12)	.96	1.73

Notes: t-statistics are included below parameter estimates in (). Significance levels are: 80%:1.33; 90%:1.73; 95%:2.09; 99%:2.83.

21 observations in sample.

- indicates variable not included in regression run.

Critical value for the Durbin-Watson statistic is approximately 2.1.

*Indicates the sign of the parameter is opposite from what is expected a priori.

this variable has the expected positive sign and a fairly stable value as different combinations of variables are used. The values of the parameter are from .039 to .045, indicating that the "quasi-modal split" has been raised by that amount over what it would have been had the stabilization program not been in effect.

In order to assess the percentage increase in ridership, we multiply this term by the employment figure, and divide by the ridership which would have occurred in the absence of the program. As an example, take ridership for the second quarter of 1978, which had a quasi-mode share of .7172. In the absence of the stabilization program, the model implies that this mode share would have been .672 - .678. Multiplying the difference by employment during this quarter (501,567) indicates that the program was responsible for inducing between 20,000 and 22,600 trips per month or 300-400 one-way trips per day. Since the average monthly ridership during that quarter was 359,714, this represents an increase of 5.6 to 6.3 percent in ridership. In other words, the model implies that, in the absence of the discount program, ridership during this quarter would have been 5.6 to 6.3 percent lower than it actually was.

The regression model was calibrated on the basis of a linear extrapolation of the decline in ridership which had been experienced over the decade. Thus the model's estimate of the ridership change attributable to the program (new ridership plus ridership which would have been lost in the absence of the program) may somewhat overestimate the program's actual impact.* The model results are in keeping with commonly found elasticities for transit fare changes, however. The model indicates that ridership would have been about 6 percent lower than it is if the program had not been in effect, while the fare subsidy represents a 30 percent discount for regular commute riders (who form the bulk of the system's patronage). A simple arc elasticity calculation is:

$$\text{Mean Elasticity} = \frac{\%\ \text{Change in Ridership}}{\%\ \text{Change in Fare}} = \frac{.056}{-.30} \text{ to } \frac{.063}{-.30} = -.19 \text{ to } -.21$$

Since this result is remarkably close to the elasticities common to express and commuter-oriented public transit systems, it provides a corroboration of the more recent results demonstrating the modest participatory role the fare subsidy program had in stablizing SP ridership prior to the more recent increases as a result of the gas crisis.

*If the true relationship between ridership and time is a parabolic curve as the more recent stabilization appears to indicate, the straight line extrapolation will overestimate the ridership change.

4.2.3 Changes in Free Feeder Bus Ridership

Analysis of free SAMTRANS bus feeder ridership (based upon counts of "transfer" passengers as previously described) revealed no consistent pattern of change, between SP-serving and non-serving lines over the period November 1977 to November 1978. Table 4.5 presents the results by SP fare zone. SP ridership counts by station or within fare zones were not available for comparison. SAMTRANS staff, moreover, report no significant change in SP-oriented free feeder bus ridership to date.* This conclusion stands despite a general increase in SAMTRANS mainline and local (non-SP-oriented) ridership. The transit operator has made no subsequent transfer counts, however.

Ridership throughout the Santa Clara bus system has increased since SCCTD service began, but no separate counts or estimates of SP-oriented passengers were made by the transit district.

4.2.4 Transit Operators' Appraisals of Program Performance

Institutional representatives generally agreed that the fare subsidy program helped to stabilize declining SP ridership. Assessments varied from the view that ridership was already stabilizing and would have leveled off eventually even without the program to the opinion that the program achieved its full objectives. Several points are noteworthy.

The concensus was that ridership would decline if the fare subsidy were withdrawn. There are several qualifying points of view: some felt that a new (lower) level of ridership would be maintained. Gasoline and San Francisco parking prices were mentioned as factors here. Only one informant predicted that the present level of ridership would continue without the fare subsidy. Representatives therefore spoke of the need to continue the fare subsidy under the pending purchase of service agreement between SP and CALTRANS. Most likely the subsidy would go toward decreased fares across the board rather than for any specific discount promotion.

Representatives agreed that the regular commute market for multi-ride tickets had been saturated by the discount programs, but argued that aggressive marketing could induce added ridership. Service modifications were emphasized as the primary means for increasing SP usership, however, including additional reverse-commute service and other schedule changes as initial objectives.

*SAMTRANS' Director of Marketing and Communications estimates that about 10 percent of all San Mateo County resident SP riders originally used SAMTRANS buses to reach SP stations, and that the proportion under the high transit use conditions of the recent gasoline crisis only increased to between 12 and 15 percent. Further discussion of the relationship of feeder bus service and SP ridership is presented in Section 4.3.

TABLE 4.5
COMPARISON OF SP-ORIENTED FREE FEEDER BUS RIDERSHIP
NOVEMBER 1977 & 1978

LINES SERVING SP STATIONS BY FARE ZONE

SP Fare Zone	Line #	Serving (Station Name)	NUMBERS OF TRANSFERS 1977	1978	% Change
1	33B	Millbrae	166	206	+24
	33C	Millbrae	97	61	-59
			266	267	+2%*
2	34D	Burlingame	229	259	+13
	43D	San Mateo	1537	1124	-27
			1766	1383	-33%*
3	6A	Redwood City	2750	2632	- 4
	22D	San Carlos	449	228	-51
	44B	Hillsdale	397	296	-25
	51B	Redwood City	676	440	-46
	51R	Redwood City	363	541	+49
	51S	Redwood City	612	720	-18
			5247	4857	-7%*
4	50B	Menlo Park	226	538	+138
	50C	Palo Alto	1674	1714	+ 2
	50V	Palo Alto	1465	1781	+22
			3365	4033	+20%*

LINES NOT SERVING SP STATIONS

Line #	Area Served	NUMBERS OF TRANSFERS 1977	1978	% Change
10L	Coast Linda Mar	481	662	+38
21A	Colma-Daly City	1088	1160	+7
30A	San Bruno	153	47	-225
90H	Daly City-Half Moon Bay	468	382	-18

* Average % change over all lines within fare zone.

4.2.5 Supply-side Impacts on Transit Operators

Information on the supply-side effects of the subsidy program on transit operators has been gathered via conversational contacts. Transit supplier spokesmen report no change in SP-oriented feeder bus usage, and no noticeable impact of the program in terms of equipment usage, costs or manpower, nor in administrative costs.

Marketing the program has been achieved inexpensively, largely through news coverage and newspaper advertisements. Existing SAMTRANS staff incorporated the tasks of administering the discount into their regular work schedules. SCCTD reported that administrative costs for the program, including computer, printing and mailing costs, amounted to $27,800, which was specially earmarked to cover these expenses. The potentially much larger item of labor costs was not estimated.

The only substantial supply-side impacts on transit operators since the subsidy began occurred during the recent gas shortage. The period of May-August, 1979, saw very sharp increases in usage of all transit systems areawide. Ridership increases caused shifts in the numbers and frequencies of runs on many lines and the deployment of five SP cars already withdrawn from service for their annual "winterizing" maintenance, to provide for expanding that consists of commute trains. But these effects are not attributable to the fare subsidy program.

4.2.6 Secondary Impacts

As Table 4.1 shows, SP ridership increased by some 21,000 trips during 1978, or an average of 1750 trips per month. The 1979 results through March, and prior to the recent gas crisis, show an average increase of about 4 percent (43,487 trips), or about 14,000 added trips per month during this first quarter. Assuming that all of these are work trips, and that there were an average of 21.5 working days per month during this quarter, this increase is equivalent to about 670 one-way trips per day. Rapid ridership increases since the gas crisis are nearly four times as great as those of the first quarter, averaging an additional 2600 one-way trips per day through August 1979. The overall change since program initiation is an 11 percent increase in ridership. Even if these trips are presumed to be wholly diverted from auto travel, their impacts on daily traffic congestion, automobile miles travelled, gasoline consumption and air quality in the corridor are nonetheless minor. Daily vehicle volumes on Highway 101 at Army Street in San Francisco and on Highway 280 in Daly City are 200,000 and 136,000, respectively.*

*CALTRANS, Market Study for Upgraded Peninsula Rail Service (San Francisco-San Jose), Phase I, March 1978, pp. 12 ff.

4.2.7 Costs of Subsidy*

Fare subsidy costs have ranged from $37,000 to $59,000 per district per month since the beginning of the program. Total discount claims to date amount to $1,894,740. The combined monthly subsidy claims average about $94,740, while ticket sales under the program have averaged 8,900 per month, representing some 291,600 average monthly rides. The average discount per ride is $0.33. The average discount per ticket is $10.68.

Since the discount is 30 percent of the ticket price, the average ticket sold under the program can be estimated to cost $35.60. Average monthly sales under the program, thus, produce an estimated $317,410 in revenue.

Total ridership revenue between January 1978 and April 1979, prior to the gas crisis, can be estimated at $4,492,750. Since ridership increased 2.6 percent overall during this period, the new riders' share of this revenue is $116,812.** If all of the new ridership is attributed to the fare subsidy and this revenue share is subtracted from subsidy claims over this period, the net cost of program subsidies up until April can be estimated at $1,231,021. Dividing by new ridership estimates the net cost per rider (re-)attracted at $8.20.***

Transit operator contacts report their funds sufficient to cover their fare subsidy claims. In the SAMTRANS case (which represents the major share of allocations and discount sales), less than $300,000 (50%) of the $600,000 TDA funds allocated for Fiscal Year 1977-78 had been used when the program received its $700,000 allocation for FY 78-79. SAMTRANS reports its monthly subsidy payment amount had maintained a fairly consistent pattern, until the sharp increases in ridership (and subsidy payments) since April 1979. SCCTD spent some $541,000 in subsidies for the program during calendar year 1977-78, and therefore, requested $600,000 (rather than $500,000) for Fiscal Year 1978-1979. The District spokesman estimates that this allocation will easily see them through their reimbursement requests for the program's second year.

SAMTRANS, SCCTD, and CALTRANS shared equally in the 40 percent discount on one-way and round-trip fares. The total value of discount claims was estimated at nearly $102,000 (36% over the $75,000 estimated cost of the one-month program), making each transit property's share about $35,000,

*These estimates do not include the San Francisco County share of discount sales, plus the 1 percent administrative charge MUNI pays to SP for its compilation of a monthly rather than daily account.

**Since ridership appeared to be stabilizing prior to implementation of the fare subsidy, the change in ridership is not estimated to include ridership which would have been lost in the absence of the program. The potential error here is about 1 percent.

***The sharp ridership increases since April 1979, however, have been producing added new ridership revenues to offset the discount claims. Total ridership revenue for April through August, 1979, is $1,821,820. The new ridership share (given an average annual increase of 44 percent during these months) is $728,730, or $182,040 over the discount subsidy funds extended during the same period. The gasoline crisis accounts for the large majority of added riders, however.

TABLE 4.6
SUMMARY STATISTICS
FOR THE MULTI-RIDE TICKET DISCOUNT PROGRAM

	# Discount Tickets Sold (San Mateo & Santa Clara)	Value of Discount Claims($)	Average Discount per Ticket($)	# Rides Represented by Discount Sales	Average Discount Per Ride($)
1978 Jan	6189	74797	12.08	211532	0.354
Feb	9049	91649	10.13	295694	0.310
Mar	8183	91716	11.21	265642	0.398
Apr	8979	97715	10.88	307256	0.318
May	8655	94559	10.93	310866	0.304
Jun	8085	87363	10.81	269848	0.323
Jul	7954	85774	10.78	248314	0.345
Aug	7877	79284	10.07	244276	0.324
Sep	7969	83662	10.50	261274	0.320
Oct	7563	81695	10.80	242138	0.337
Nov	8529	96109	11.27	284740	0.337
Dec	9017	90203	10.00	265224	0.340
1979 Jan	8399	93781	11.17	281684	0.333
Feb	9451	102257	10.82	310746	0.330
Mar	9459	97268	10.28	317692	0.306
Apr	9257	98455	10.64	300910	0.327
May	11970	118941	9.94	432388	0.275
Jun	9753	105969	10.87	295792	0.358
Jul	10650	111211	10.44	329924	0.337
Aug	11330	112331	9.90	356426	0.315
Monthly Avg.	8916	94737	10.68	291618	0.329

Summary Statistics

Average Ticket Cost: $35.60

Average Subsidy per Ticket: $10.68

Average Subsidy per Ride: $0.33

Value of Claims to Date: $1,894,740

Estimated Revenue to April 1979: $4,492,750

New Ridership Share of This Revenue (2.6%): $116,812

NET COST IN SUBSIDIES TO APRIL 1979: $1,231,021

including printing costs. (It was not possible to obtain complete ridership data, or to estimate the shift between multi-ride and one-way and round-trip sales during September 1979.)

4.3 OTHER FACTORS RELATED TO SP RIDERSHIP

Several factors may help to explain why the fare subsidy program had only a modest impact in comparison with the gasoline crisis. As has been mentioned, SP and related feeder bus schedules do not offer high levels of flexibility or convenience. The location of the San Francisco SP terminal necessitates an additional transit link for most riders to reach their jobs. Thus, persons who work other than the 8:30 or 9:00 AM to 5:00 or 5:30 PM shift, or who (even occasionally) work late or who work beyond a certain distance from the San Francisco terminal can not really ride SP on a regular basis.

In addition are the results of two surveys conducted in conjunction with the fare subsidy program. The first is the CALTRANS-assisted on-board survey of SP riders conducted during November and December, 1977, prior to program implementation.* The second is the Southern Pacific Market Study, a home telephone interview conducted in mid-1978 with 501 respondents sampled from areas within five miles of SP stations in the San Francisco-San Jose corridor.**

4.3.1 Appeal of Hypothetical Inducements

The SP Market Study asked respondents to judge how effective each of five hypothetical SP use incentive programs would be for them. Over 50 percent of the 435 non-riders in the sample said low-cost shuttle buses or vans to SP stations would get them to try the train (compared to 32 percent negative responses).*** It should be noted, however, that the telephone survey was conducted after implementation -- and marketing -- for the subsidy and free feeder bus programs had begun. The SAMTRANS free feeder services appear to have had little effect on SP ridership, however. (Other survey results in Section 4.3.4 shed some additional light on this relationship.)

The remaining incentives exerted no definite appeal; Table 4.6 presents the results for all five suggested inducements.

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*SP Train User Survey, Draft, 4/6/78. This survey collected 4,725 usable responses, representing 60 percent of SP riders, with a response rate of 75 percent. Responses were not adjusted to account for possible overrepresentation of high frequency riders.

**Drossler Marketing Research and Counsel, SP Market Survey, n.d. Selection criteria also included a daily commute trip at least 10 miles northbound. The survey was conducted during June and July, 1978.

***Ibid., p.2, p.23; difference is significant at 95 percent level.

TABLE 4.7*
MARKET RATING OF SP RIDERSHIP INDUCEMENTS

	(Sample Base)	Positive %	Uncertain %	Negative %
Greater sutttle service	(435)	54	15	32
Family day for $5	(435)	45	17	48
Free commute week	(435)	42	15	43
Free week with friend	(435)	36	18	46
Improved passenger comfort	(435)	27	52	22

4.3.2 Ratings for SP Characteristics

The Drossler survey also asked respondents to rate SP on thirteen characteristics of its service, and revealed striking differences between rider and non-rider appraisals. Not unexpectedly, SP riders were generally pleased with SP service, rating the system as very good or excellent on all characteristics but one, convenience of non-commute hour schedules. On the other hand, non-users rated the system generally low on all characteristics.* The following results are noteworthy in the context of the fare subsidy evaluation: 54 percent of SP riders rated the system highly on "has reasonable fares," compared with 19 percent of auto riders; similar differences resulted regarding SP's connections with other systems (54 percent and 18 percent respectively), and the ease of reaching SP stations (64 percent compared with 27 percent). Table 4.8 presents the results for all thirteen characteristics. Drossler cautions that the non-user responses are largely conjectural; only 38 percent of the auto commuters had ever used SP.**

4.3.3 Distance from Home to SP Stations

The SP on-board (large sample) survey found that two-thirds of its rider-respondents lived within 2.5 miles of an SP station. Some 31 percent, moreover, lived within one mile of the station, while 10 percent lived within four blocks.***

4.3.4 Mode to SP Stations

In keeping with the generally short SP-to-home distances reported above, the on-board survey found mode-to-SP-station distribution shown in Table 4.9.****

*Differences are significant at 95 percent level.
**Ibid., p.6.
***SP, op. cit., p.14.
****Ibid., p.13.

TABLE 4.8
POSITIVE RATINGS OF SP CHARACTERISTICS WITH DIFFERENCES BY MODE TO WORK

	SP Riders	Auto Riders	% Difference	Rank Order of Difference
Sample Base:	(66)	(390)		
Factor:	%	%		
Convenient commute schedules	64	27	37	(8)
Convenient off-peak schedules	12	11	1	(13)
Makes good connections with other Systems	54	18	36	(10)
Has pleasant, helpful employees	65	23	42	(4)
Has stops/stations easy to reach	64	27	37	(9)
Has a comfortable ride	68	30	38	(7)
Has adequate parking near stops	76	25	51	(1)
Has clean well-maintained equipment	27	16	9	(12)
Operates on time	81	36	45	(2)
Is roomy/not crowded	64	26	38	(6)
Has reasonable fares	54	19	25	(11)
Does not take unreasonable time	67	27	40	(5)
Carries passengers feel comfortable with	72	28	44	(3)

Source: Drossler Marketing Research and Counsel, SP Market Survey, 1978, p. 17.

TABLE 4.9
SP USERS' MODE TO SP STATIONS

Auto (Drive	48.6%	Bicycle	3.6
Walk	19.7	Carpool	3.2
Auto (Dropped Off)	18.0	Other	0.5
Bus	6.1		

*Ibid., p. 13.

Note that most of the 31 percent of riders who lived within one mile of the station (1,414 people) walked to get there (928 persons), while a rather small proportion of all riders used local bus transportation. The comparative infrequency of local bus feeders may contribute to the larger proportions of both walkers and those using cars to reach the station. In any case, a free feeder bus link cannot reasonably be expected to induce large increments in SP ridership in the absence of system changes which would first induce added bus use.

4.3.5 Income Characteristics of Riders and Non-Riders

Fare subsidy and free introductory SP or feeder service incentives are predicated on the argument that SP fare rates and increases pose a major disincentive to commuter ridership. It has been shown that SP riders include higher percentages of white collar and upper income persons than non-riders.*

The SP on-board survey produced the following household income distribution.**

TABLE 4.10
INCOME DISTRIBUTION OF SP RIDERS

Under $5,000	3.9%
$5,000 to 9,999	8.6
$10,000 to 14,999	16.2
$15,000 to 24,999	31.0
$25,000 to 49,999	33.4
$50,000 and over	6.2

But the Drossler results also show comparatively minor income differences between SP and auto commuters, or between SP users ranked according to their frequency of SP use (see Tables 4.11 and 4.12). SP riders, more than non-riders, do include greater proportions of white collar workers and persons 55 years of age and over; however, "the demographic profile of the Peninsula commuter traveling ten or more miles northbound to work is (also) older, affluent and white collar." And, these commuters are overwhelmingly dependent on the automobile.

In summary, if SP is to compete with the automobile for a larger share of the commuter market, perhaps it must achieve improvements elsewhere than in its fare structure. Survey and transit operator responses highlight two major deterrents to added ridership: the lack of frequent origin- and destination-end connections to SP, and the relative lack of convenience and flexibility implied by SP's schedules. Changes in

*Drossler, pp. 9-10.
**SP, p.17.

schedules and additional reverse-commute runs are two priorities mentioned for service improvements under the pending purchase-of-service agreement between SP and CALTRANS. This conclusion is corroborated by the most recent data. When the convenience of the automobile was greatly reduced -- as in the recent gas crisis -- ridership on all transit modes, including SP, increased sharply.

Table 4.11
DEMOGRAPHIC PROFILE OF SP MARKET AREA RESPONDENTS
BY MODE TO WORK

	Total Sample	SP Commuters	Auto Commuters
Base:	(501) %	(66) %	(390) %
Occupation:			
White Collar	74	89	72
Blue Collar	26	11	28
Years in Bay Area:			
Less than 1	2	-	2
1-5	13	12	14
Over 5	84	88	84
Income:			
Under $15,000	16	14	16
$15 - 30,000	42	38	41
$30,000 or more	25	26	26
No Answer	17	23	17
Age:			
Under 35	37	26	38
35-55	42	39	42
55 or more	20	33	19
No Answer	1	2	1
Distance to SP Station:			
0 - .5 Miles	8	8	8
.6 - 3.0 Miles	60	77	57
3.7 Miles or more	21	8	24
No Answer	11	8	11

Source: Drossler Marketing Research and Counsel, SP Market Survey, 1978, p. 11.

Table 4.12
DEMOGRAPHIC PROFILE OF SP MARKET AREA RESPONDENTS
BY FREQUENCY OF SP USE

	Use SP Most Often	Use SP Occasionally	Have Used SP But Don't Use It Most Or Occasionally
Base:	(66) %	(67) %	(98) %
Occupation:			
White Collar	89	79	69
Blue Collar	11	21	31
Years in Bay Area:			
Less than 1	-	1	-
1-5	12	7	13
Over 5	88	91	87
Income:			
Under $15,000	14	10	21
$15 - 30,000	38	37	38
$30,000 or more	26	31	31
No Answer	23	21	10
Age:			
Under 35	26	40	39
35-55	39	43	38
55 or more	33	16	21
No Answer	2	-	2
Distance to SP Station:			
0 - .5 Miles	8	7	13
.6 - 3.0 Miles	77	66	55
3.1 Miles or more	8	19	22
No Answer	8	7	9

Source: Drossler Marketing Research and Counsel, SP Market Survey, 1978, p. 14.

TABLE 4.13
PENINSULA COMMUTERS' MODE TO WORK*

SP	13%
Other Transit	2
Auto (alone or shared)	81
No one Mode	4
	100%

*Ibid., p. 12.

5 TRANSFERABILITY OF THE DEMONSTRATION

After resolving the initial political and fiscal obstacles to the fare subsidy program, implementation was not procedurally difficult. The transit districts have apparently been able to incorporate the added administrative tasks of conducting the program, or to allocate sufficient funds to cover the incremental administrative costs. Marketing efforts may have achieved saturation of the target population segments. All of these characteristics of the demonstration suggest transferability to other areas.

The evaluation's overall finding, that fare reductions by way of revenue subsidy had only a limited effect on increasing ridership, has implications for other systems. Although the subsidy may have been an important first step toward stabilizing ridership, the SP case demonstrates that it may be more cost effective to improve the services provided commuters than to concentrate on fare discounts.

On the other hand, the SP system may not be the most appropriate model for demonstrating the effects of a fare subsidy program because of inherent service constraints. The SP terminus location away from primary downtown and financial district employment centers and the lack of frequent origin and destination end connections are not characteristics of other major urban rail systems, such as those in New York, Philadelphia or Chicago. And this atypical characteristic is apparently an important weakness which served to limit the effects of the fare subsidy. This demonstration, therefore, shows that transit planners should consider all of their system's apparent weaknesses before investing exclusively in a fare subsidy program.

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APPENDIX

A. Underlying Theory of Model Specification

The initial departure point for the regression was a specification of the demand for Southern Pacific service in the corridor. The model was:

$$Q_t = (CR_t, CA_t, SR_t, SA_t, C_t, E_t)$$

where: Q = number of trips demanded during the time period "t"

t = an arbitrary time period (say, one quarter)

CR_t = the user cost of a rail trip during time period t

CA_t = the user cost of a similar auto trip at t

SR_t = some indicator of rail quality of service during t

SA_t = some indicator of auto quality of service during t

C_t = an indicator of the socio-economic characteristics of the market population

E_t = a measure of the attractiveness of destinations served by the SP

The method by which each of these explanatory variables was incorporated into the actual regression model is described below:

t = Assumed to be a quarter's total ridership divided by 3.

CR_t = There was only one fare change; this was incorporated through the use of a dummy variable to represent quarters with the pre-increase and post-increase fare. The fare discount program, of course, represents a decrease in fares, and this was also allowed for through a dummy variable. Real fares (adjusted for income increases) declined, but the model is consistent in that both income and fares are entered with their nominal values.

CA_t = Quarterly data was not available. Implicitly, it was assumed that the real costs of automobile operation remained relatively constant over the ten-year period.

SR_t = Rail service was constant during the period examined. There were no changes in schedules, and no indication that service reliability changed. Therefore, this variable was safely eliminated from the regression.

SA_t = The quality of automobile service in the corridor generally declined over the past decade, due to increased congestion. It was extremely difficult to measure this decline in service quality, particularly on a quarterly basis. Unfortunately, the only choice was to assume no change over the period.

C_t = Nominal personal income per capita in San Mateo County (where most SP riders come from) was chosen as the indicator of socio-economic characteristics of SP riders during the period "t."

E_t = This variable measured the attractiveness of the destinations served. Since the SP's market is mostly made of San Francisco-destined work trips, total employment in the City was used as a surrogate attractiveness measure here.

B. Autocorrelation Adjustments to the Regression Model[1]

In its simplest form, the regression model takes the form:

$$Y_t = a + bX_t + E_t$$

where: Y_t = The dependent variable at time "t" to be explained by changes in X (say, ridership)

a = A constant

b = A coefficient estimate of the marginal impact of a change of X on Y

X_t = An independent (causative) variable at time "t" (e.g., income, employment, fare)

E_t = An error residual, which may be caused by measurement or other errors.

One of the assumptions required for the estimates of a and b to be valid is that the error terms (E_t) are independently distributed (i.e., there is no correlation between successive error terms from quarter to quarter.[2] In time series, successive errors are more likely to be correlated than are errors several periods apart, although exceptions to this are more likely to occur when monthly or quarterly data involve regular seasonal fluctuations. One cause of autocorrelation between error terms is the effect of omitted variables. The complexity of relationships between cause and effect in the social sciences is generally so great that it is inevitable that some explanatory variable has been omitted from the equation. The best the researcher can hope for is that the relative importance of such an omitted variable is small.

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[1] Much of this material was adapted from Ralph Beals, Statistics for Economists (Chicago: Rand McNally Publishing Co., 1972) p. 343 ff.

[2] Error terms are independently distributed if a positive residual is equally likely to be followed by another positive or by a negative residual.

Another possibility is that the form of the function is incorrectly specified. For instance, if a quadratic function is approximated by a straight line, the pattern of residuals is likely to show autocorrelation. Trial and error[3] with various functional forms is the only way to resolve this problem.

If autocorrelation is the only problem, the least-squares coefficient estimates (a and b) are still unbiased and correct. However, the standard errors of the coefficient estimators and standard error of estimate will be underestimated. If autocorrelation goes undetected, confidence intervals for the parameters will be incorrectly stated as being narrower (shorter) than they really are.

The most commonly accepted test of autocorrelation, the Durbin-Watson (D-W) statistic, indicated significant autocorrelation of residuals.[4] The first corrective action considered was respecifying the functional form. As noted in 4.2.2, various functional forms were applied to the data without a significant improvement in the D-W statistic. Complicated polynomial forms were deliberately avoided, because they often yield misleading results, particularly for a limited data set.[5] Second, consideration was given to omission of any important explanatory variable from the model. This is more likely to be the case; the limitations of this evaluation precluded extensive research. Time series data on other variables which would affect the total number of SP trips were not readily available, however.

Use of the Cochrane-Orcutt method made a substantial improvement in the value of the D-W statistic, to the point where it was between 1.6 and 1.9. The D-W statistic allows us to test the hypothesis of no autocorrelation versus the alternative hypothesis of positive autocorrelation. The traditional test is of a 5 percent significance level of the null hypothesis that the errors are not correlated. A D-W value of 2.1 or greater allows us to confirm the hypothesis (although the critical value varies somewhat with the number of independent variables in the regression). None of the model formulations allow us to conclude that there is no autocorrelation at the 5 percent level. Thus, the test is inconclusive as to the presence of serial correlation (autocorrelation) in the error terms. Fortunately, it makes little difference for the purpose of analyzing the impact of the discount program, as noted before. While the absolute value of the t-statistics will be overstated, the parametric estimates of the coefficients will not be biased, so that the estimate of the program's impact is not affected.

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[3] The researcher is also likely to have a theoretically-based notion of what the shape of the function is.

[4] The reader is referred to Beals, op. cit. pp. 348 ff., for further discussion of the Durbin-Watson statistic.

[5] There was also no a priori reason for using such forms.

As none of these techniques improved the D-W statistic, the Cochrane-Orcutt iterative technique was applied in an attempt to reduce the serial correlation of residuals.[6] This procedure is available on the widely-utilized Time Series Processor (TSF) application library.[7] The procedure uses an ordinary least squares regression to form an initial guess of $\hat{\rho}$, the first order serial coefficient. The following iteration then occurs:

1. All data are transformed by ρ (e.g.: $X_t - \hat{\rho}X_{t-1}$).

2. The regression is run on transformed data.

3. The regression coefficients are multiplied into the original dependent variables to recalculate the autocorrelated errors.

4. A new estimate of ρ is formed.

When ρ changes by less than .005 from one iteration to the next, or when 20 iterations have occurred, iteration terminates and regression output is produced. The results of this analysis, applied to the third and fourth quarters of 1978, is shown in Table A-1.

Table A-1
ESTIMATED VS. ACTUAL SP PATRONAGE

	Quarter (1978) III	IV
Estimated per capita nominal income (Y/capita)	$ 11,470	$ 11,770
Estimated quasi-mode split with discount program	.5623	.5454
without discount program	.5173	.5004
Employment Forecast*	507,000	511,800
Estimated ridership - with program	285,100	279,100
without program	262,300	256,100

*Data had not yet been tabulated for these quarters by the Employment Development Department. Therefore, employment for the two quarters was forecast using the growth rates in employment between quarters in 1977 applied to 1978.

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[6] The Cochrane-Orcutt condition for convergence of ρ is identical to the condition for a local minimum of the error sum of squares in the Hildreth-Lu scanning procedure.

[7] TSP was developed by the Harvard Institute of Economic Research, Cambridge, Massachusetts. It has been modified to run at UC Berkeley by the Department of Economics. See "TSP: Time Series Processor, Version 2.6/2.7" (monograph).

C. Discussion of Individual Causative Variables

The energy crisis variable (ECRISIS) shows a modest increase in the quasi-mode share attributable to this phenomenon, ranging between .040 and .057. The variable is statistically significant at the 5 percent confidence level in most model versions.

Variation in ridership due to seasonal fluctuation turns out to be fairly small, and in most cases not highly statistically significant. These were left in, however, on the grounds that they should explain some of the fluctuation during the year. One would expect a commuter-based system such as this one, which has a fairly steady clientele of riders making non-discretionary trips, to have fewer seasonal fluctuations than one that catered to students or users making discretionary (recreational, shopping) trips.

The fare increase variable (FAREINC) did not turn out to be highly significant in any of the model runs. It was always statistically insignificant, and in version III had the incorrect sign. Given that the increase was rather small (14 percent), it is not surprising that its impact is undiscernible from other variations in the data. But at the same time, we would expect that if a 30 percent decrease in fare produced an increase in ridership, the 14 percent increase should have created some measurable decrease in ridership. Unfortunately, this was not the case.

There were problems with both variables dealing with BART and the start-up of SAMTRANS bus service (BUSSVC). The BART variable had an incorrect sign, probably attributable to the start-up occurring during the same quarter as the energy crisis. Collinearity between these two variables caused it to be statistically insignificant, so it was dropped from futher analysis. The variable dealing with SAMTRANS bus service, while more significant statistically, had an incorrect sign. This is possibly attributable to collinearity between the start-up of SAMTRANS service, and the third quarter dummy term. Normally, third quarter ridership dips furthest below the annual average, but for unknown reasons, ridership did not drop as much as usual during the third quarter of 1977. Therefore, the model incorrectly attributes what is merely an artifact of the data to the start-up of competing bus service.

In all cases, the R^2 term is quite high, as is typical in time series models. No R^2 stands out as being particularly higher than any other, however.

REPORT OF NEW TECHNOLOGY

The work performed under this contract, while not leading to any new inventions or patents, has provided new information on the effects of the fare discount demonstration on Southern Pacific and feeder bus ridership. These findings will be useful to other communities throughout the United States in the planning and design of improved transportation services.

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