Chapter V

Effects of Alternative Economic Conditions on Transit

This chapter presents the findings of several approaches used by this study to determine the effects on transit of past economic downturns. All of the approaches indicate that a very large increase in the unemployment rate results in a small decrease in transit ridership. Thus for an increase in unemployment from 5 percent to 8 or 9 percent, as assumed in the two economic features discussed in Chapter IV, a decrease in ridership of about 2-1/2 percent should be assumed, all other factors being equal, In absolute numbers, an increase in unemployment from 4.6 to 7.5 or 8.4 million will be accompanied by a decrease in ridership of less than 400,000 average daily trips.

Chapter V completes the evaluation of the impact of economic conditions on transit. Chapter VI presents the relationship between the transit industry and the economy, by examining the capability of the industry to expand output and employment and thus reduce unemployment and help alleviate recession conditions. Subsequent chapters examine the relationship between energy and transit, including the effects on transit of the energy futures discussed in Chapter IV.

General Approaches Used To Determine the Effect of Recession Conditions on Transit Ridership

Studies on the effect of economic conditions on transit ridership are few and far between. In fact, the work conducted in this study is probably the first significant effort on the subject. The relationship between ridership and economic conditions is not obvious and a generally accepted methodology for determining this effect has not been developed. In order to properly study such an uncharted subject it has been necessary to pursue several approaches. Although the results of each of the approaches cannot be assumed to be conclusive on their own, the fact that each of the approaches produced amazingly similar results tends to confirm the conclusions reached.

The economic effects on ridership were investigated by three general approaches:

1. A study of changes in travel patterns and transit trip generation rates resulting from increases in the number of employed persons.
2. An examination of personal expenditures on transit service to determine income elasticities during recessions:
   a. by using consumer expenditure data, and
   b. by using national income and national transit service purchase data.
3. Multiple regression techniques correlating changes in national economic indicators with changes in national transit ridership since 1953.

The Effect on Transit Ridership of Increasing Unemployment

This section examines the limited data available on the differences in transit trip generation rates between employed and unemployed individuals in order to determine the impact of the increased unemployment levels associated with recessions on transit ridership.

This approach examined post-1950 trip generation data by occupation class at two levels: (1) locally, using CATS (Chicago Area Transportation Study) data and (2) nationally, using several data sources. A description of the procedures and results of these two analyses is presented below, along with a brief examination of the national experience during the Great Depression.

Analysis of CATS Data

One alternative approach for estimating the impact on transit ridership of changes in unemployment is to examine trip generating factors (e.g., trips per household) by occupation classification, and compare the trip rates for the unemployed versus the employed. Unfortunately, most studies estimating trip generation factors do not include the unemployed category so that very limited data is

available for analysis. In this context, 1956 home interview data from the Chicago Area Transportation Study (CATS) developed as part of a study of household trip production and occupational status was available and is summarized in Table 16. In this study, in-depth interviews were conducted at about 60,000 dwelling units in the Chicago Metropolitan Area. Adult household members were asked to describe the origin, destination, purpose, and mode of trips made by all household members on the previous day. Households were classified according to the occupation of the person designated by the interviewees as the head of the household.

Before moving on to an analysis of this data, it is essential to understand some (not all) of the most critical problems associated with the data—problems that make unambiguous conclusions difficult.

1. The category "Unemployed" really should be considered as "nonemployed" since it includes housewives, students, retirees, and others whose trip-making characteristics might be (and are likely to be) different than those of the unemployed. For example, as will be seen, the housewives, students, and retirees generate a high proportion of shopping, social, and recreation trips not likely to be generated by the "unemployed'' -at least to the same extent. In this context the "unemployed" category must be considered, at best, as only a crude indication because of the distortions these nonemployed groups introduce.

2. The "unemployed" category in Table 16 accounts for only a small part of total households (4.7 percent) and may therefore not be representative of the behavior patterns of a large sample of the same group. On the other hand, the fact that this percentage is not overwhelmingly greater than the unemployment rate tends to indicate that most of the people in the "unemployed" category are members of the labor force presently out of work, and therefore that the data may be reasonably representative of the unemployed.

3. The data are somewhat outdated since there have been significant changes in income, travel patterns, and behavior since **1956.**

4. The modal split between public transportation and automobile transportation in the Chicago area, reflects the presence of a relatively ubiquitous transit system-a condition not shared by many other parts of the country. However, it is a condition shared by the transit oriented of large metropolitan areas such as New York, Boston, San Francisco, Washington, D. C., and Philadelphia, and to a lesser extent some other cities. These large metropolitan areas do collectively include more than half of the transit ridership, but substantially less than half the urbanized area population,

TABLE 16

TRIP PRODUCTION PER DWELLING UNIT BY ALL MODES AND BY PUBLIC TRANSIT TYPICAL WEEKDAY CHICAGO AREA 1956 BY OCCUPATIONAL CLASS

Occupational Class	By All Modes	Estimated Number by Public Transit
Professional	7.07	1.36
Managers	7.29	.96
Clerical	4.90	1.75
Sales	7,40	1.35
Craftsmen	5.70	1.20
Operatives	5,04	1.50
Service	4.80	1.85
Laborers	4.61	1.95
Unemployed*	4,47	1.68
Unknown**	3.56	1.59
All Classes	5.59	1.42

● **Actually is the "non-employed" category and includes housewives, students, retired, incapacitated for employment, and the unemployed.**

● ***A dwelling unit was assigned to this class in cases where the interviewer could not obtain sufficient information to classify the occupation of the head of the household in one of the other classes or in cases of errors or omissions by the interviewer.**

SOURCE **Stowers, Joseph R., *Occupational Status and Household Trip Production,* Master's Thesis, Northwestern University, Evanston, Ill., June 1962, page 12 and page 65.**

In view of the difficulties described above, conclusions derived from the data in Table 16 must be interpreted with considerable caution and can only be considered suggestive of the order of magnitude.

Review of the data in Table 16 indicates that in terms of total trips per day per dwelling unit for all modes on a typical weekday, trip production ranged from a high of 7.4 trips a day for sales workers to a low of 3.6 for the "unknown" category. The average for all occupational groups combined was 5,6 trips per day. Using modal distribution data from the same study as a basis for estimating the number of trips by public transit (Table 17), it maybe seen that

TABLE 17

DISTRIBUTION OF TRIPS BY MODE OF TRAVEL AND BY OCCUPATION CLASS CHICAGO AREA 1956

	Auto-Drivers and Passengers and Truck Passengers Percent	Public Transit Percent	Taxi Percent	Total Percent
Sales	79.9	18.3	1.8	100
Managers	86.1	13.3	0.6	100
Professional	79.4	19.3	1.3	100
Craftsmen	78.8	21.1	0.1	100
Operatives	69.7	29.9	0.4	100
Clerical	64.0	35.8	0.2	100
Service	60.5	38.7	0.8	100
Laborers	57.3	42,5	0.2	100
Unemployed	59.7	37.5	2.8	100
Unknown	54.5	44.8	0.7	100
All Classes	73.3	25.5	0.8	100

SOURCE **Stowers, Joseph R.,** Occupational Status and *Household Trip Production,* OP. Cit., **Table 2, page 20.**

the number of trips by public transit in 1956 in the Chicago metropolitan area was on the average about 25 percent of the total trips, although the proportion varied substantially by occupational class,

To the extent that (I) the "unemployed" may be representative of the degree to which trips, regardless of mode, would be reduced as a result of unemployment, and (2) all occupational classes as a whole can be characterized as being representative of the behavior pattern of the unemployed before they become unemployed, then Table 16 suggests a reduction of about 20 percent (i. e., 4.47 trips per dwelling unit for the unemployed as compared to 5.59 for all classes) in total trip making, However, in terms of transit trip reductions the situation is quite different, In the case of transit, the data in Table 16 show that the "unemployed" category in Chicago in 1956 made about 1.68 transit trips per dwelling unit on a typical weekday-almost 20 percent higher than the average for all occupational categories. The data in Table 16 suggest that the "unemployed" or nonemployed are important transit users and may not tend to reduce their transit trips at all—in fact they might even tend to increase them as they shift from employed to unemployed status.

However, to more accurately appraise the extent of transit trip" reductions or increases by the "unemployed" (nonemployed) group, it is desirable to examine trip purpose data since it is the work trip that is likely to be most affected as individuals become unemployed.

Table 18 shows, for the Chicago area in 1956, the percentage distribution of trips by trip purpose and compares the unemployed category with the distribution of aIl occupational classes combined, As may be seen the work trip accounts for only about 7 percent of all trips for the unemployed in contrast to about 26 percent of all occupations combined.1 Even slightly higher percentages of work trips are shown if the separate occupational classes are examined, ranging from a high of 35 percent for the sales category, 28 percent for the services, clerical, and operatives classes, and about 30 percent for laborers.

The data in Table 18 taken in conjunction with that in Table 17 suggest that, as far as nonwork trips are concerned, recessionary, or even depression, conditions may not result in much, if any, change in transit use (e.g., shopping and other trips may still be made) and that the sharpest cutbacks are likely to come in work trips.

TABLE 18

DISTRIBUTION OF TRIPS BY PURPOSE FOR THE "UNEMPLOYED" AND "ALL" OCCUPATION CLASSES, CHICAGO AREA 1956

(percent)

Trip Purpose	Unemployed	All Occupation Classes
Home	45.1	43.9
Work	7.3	25.8
Shop	13.8	7.0
School	2.3	2.6
Social/Recreation	14.1	8.6
Eat Meal	0.9	1.6
Personal Business	13.8	6.9
Serve Passenger	2.1	2.6
Ride	0.5	1.1
Total	99.9	100.1

SOURCE, **Stowers, J. R.,** ***Occupational*** Status ***and Household Trip Production,*** **Table 3, page** *29.*

I Recalling that the classification of dwelling units is by Occupation of the head of the household, it is possible for some household members to be employed despite the fact that the dwelling unit is in the "Unemployed" category.

In Stowers' thesis he essentially reached this conclusion, What he did was to relate the trip generation rates to various household characteristics and then to statistically hold the most important related factors, household size and auto ownership, constant. He found that, at constant household size and auto ownership, the unemployed actually made more nonwork trips than the population as a whole. Because of the reduction in work trips, however, they did make fewer total trips than all others, ceteris paribus.

The previous data also suggest, however, that in overall terms there are likely to be important cutbacks in trip making generally because of economic decline reflected in unemployment. Because of the importance of the private automobile in the modal split, however, many of these trip reductions (including work trips) are likely to result in reduced auto usage (i.e., decline in automobile work trips and, with lower incomes, perhaps reduced auto ownership). The data do not, of course, establish that there would be no reduction in transit usage, but there is a clear implication that if there were cutbacks in transit use, they might be quite small for nonwork trips and be concentrated largely in work trips. In addition, the public transit share of trip-making in the Chicago area is unquestionably higher than the national average, and on a national basis, it might be anticipated that the decline in transit trips, associated with increasing unemployment is likely to be even smaller than indicated by the above analysis.

National Data Analysis

With the above conclusions in mind, an examination of national travel data was undertaken. In view of the importance of the work trip and the fact that nonwork trips are likely to be relatively unaffected, or affected only indirectly through income reduction and other secondary impacts, particularly in terms of transit usage and particularly in the short term, the analysis was focused largely on the work trip,

Using (I) national data on work trips and travel characteristics developed by the 1970 Census, (2) the Department of Transportation's Nationwide Personal Transportation Study and (3) data provided by the American Public Transportation Survey, two alternative approaches were taken for estimating the trip reduction in transit that might occur with rising unemployment.

Table 19 summarizes the key variables used in the two alternative estimating models along with the specific source from which the data were derived, Tables 20 and 21 summarize the method and results of each approach.

Using the factors shown in Table 19, this study estimated the number of work trips that would have been taken by the estimated **2.5** million incrementally unemployed; estimated the transit share of these trips (assuming a modal split of 8-10 percent for transit); and then related these transit work trips by the incrementally unemployed to total transit ridership in 1974.

The first set of calculations is summarized in Table 20. As shown, the range of transit work-trip reductions that would be associated with the incrementally unemployed was estimated to be between 280 and 450 thousand or between 1.2 and 2 percent of total transit ridership in 1974. This percentage is probably slightly overestimated since the method assumes that all of the daily work trips made by the incrementally unemployed (3.5 to 4.5 million) would be eliminated, and does not take into account the fact that many would have to make some new types of trips-e.g,, searching for employment, collecting unemployment checks, and even social and recreational trips not possible when employed,

As an alternative model to check the general order of magnitude of the results shown in Table 20, it was assumed that the 2.5 million incrementally unemployed persons since October 1973 roughly correspond to the number of households with an incrementally unemployed person. This assumption is, of course, not quite accurate since several of the unemployed may come from the same household. Using national household trip data shown in Table 19, an estimate was made of the total number of trips that would be made by the households of the incrementally unemployed, The work trip proportion was then estimated, along with the share of these work trips made by transit. The value thus derived (i.e., daily transit work trips) was related to total transit work trips to arrive at an estimated percentage measure of the reduction in work trips that potentially might be associated with the unemployment generated since October 1973.

These calculations are shown in Table 21. The estimate indicates a decline in transit trips between 1.5 and 1,9 percent, This estimated decline is probably slightly overestimated by the extent to which the 2.5 million incrementally unemployed do not correspond with households.

TABLE 19

FACTORS USED FOR ESTIMATING TRANSIT TRIP REDUCTIONS ASSOCIATED WITH INCREMENTAL UNEMPLOYMENT

Line No.	Variable	Period	Value	Source*
1.	Work Trips Per Employed Person/Day	1 969/70	1.0	N.P.T.S. No. 8 Tables A-1 and A-10
2.	Household Trip Rate, "To Earn a Living' '/Day	1969/70	1.4	N.P.T.S. No. 7
3.	Daily Trip Rate per Employed Person	1 969/70	5.6	Same as Line 1
4.	Daily Household Trip Rate	1 989/70	3.8	Same as line 2
5.	Incrementally Unemployed (million)	1973/74	2.5	Bureau of Labor Statistics
6.	Public Transit Usage for Work Trip (%)			
	SMSA'S of 250,000+	1970	11.8	1970 Census J.T.W. Table 2 page 233
	All Areas & Places (Home-to-Work)	1969/70	0.4	N.P.T.S. No. 8 Table 5, p. 23
7.	Work Trips as Percent of All Trips	1960/64	31.3%	W.B.S. Average of Ten Cities

● SOURCES shown in the table are as follows:

N.P.T.S. = U.S. Department of Transportation Federal Highway Administration," *Nationwide Personal Transportation Study,* Report No. 7 "Household Travel," published December 1972 and August 1973 respectively.

J.T.W. = U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population, *Subject Reports: Journey To Work,* PC(2)-6D, June, 1973.

W.B.S. = Wilbur Smith Associates, Patterns *of Car Ownership, Trip Generation and Trip Sharing in Urbanized* Areas, June 1968, Table 2.1, page 7.

Comparison of the results of the two approaches indicates relatively close correspondence and tends to confirm the conclusion that the impact of rising unemployment on transit ridership is likely to be small. The major reason is, of course, the relatively high level of auto usage for work trips throughout the country-although it must be cautioned that for any specific location or urban area the impact could, of course, be substantial (e.g., in high transit usage areas such as New York City the impact of unemployment on transit could be much more serious).

On a national basis, however, it would appear that, at least at levels of unemployment of about 7.1 percent (e. g., 2.5 million incrementally unemployed), the impact on transit ridership is small, and even if unemployment were to rise to 12 percent (a 70 percent increase, and a level well above any that has been forecast by most economic analysts) the level of ridership losses for transit would not likely be over 4 percent.

The possibility exists that in the long run transit usage might increase if income declined and auto ownership and usage become difficult.

In summary, reductions in transit ridership due to recessionary or depression conditions, as assumed for this analysis, are not likeIy to have substantial impact on a national basis, although the impacts in the most transit-oriented cities will be more severe. Based on the previous analysis for the

TABLE 20

ESTIMATED REDUCTION IN TRANSIT TRIPS BY THE INCREMENTALLY UNEMPLOYED

Work Trip Method

Line No.	Description of Computational Step (1)	Source or Calculation (2)	Results (Range) (3)
1.	Incrementally Unemployed × Work Trips per Day	2.5 million × 1.4 and 1.8	3.5–4.5 million
2.	Transit Share of Work Trips	Line No. 2 above × 8% and 10%	280,000–360,000 350,000–450,000
3.	Total 1974 Transit Revenue Trips	From APTA	21.54 million
4.	Percentage Ratio of Transit Work Trips Not Made by Incrementally Unemployed to Total 1974 Transit Trips (Upper and Lower Limit)	280,000 and 450,000 – Line 3	1.2%–2.0%

TABLE 21

ESTIMATED REDUCTION IN TRANSIT TRIPS BY THE INCREMENTALLY UNEMPLOYED

Household Trip Method

Line No.	Description of Computational Step (1)	Source or Calculation (2)	Results (Range) (3)
1.	Estimated number of households represented by 2.5 million incrementally unemployed	Bureau of Labor Statistics	2.5 million
2.	Number of daily trips by the incrementally unemployed household (IUH)	Line 1 × 5 trip/household (Table 19, Avg. of 3 lines 3 and 4)	12.5 million trips per day
	umber of work trips by IUH	Line 2 × 31% (Table 19, line 7)	3.9 million work trips per day
4.	Percentage ratio of transit work trips not made by IUH to total 1974 transit trips	378,000 and 585,000 (Table 20, line 3)	1.5%–1.9%

2.5 million incrementally unemployed since October 1973, representin, an approximate unemployment rate of 7.1 percent, it would appear unlikely that transit ridership will decline by more than 4 percent even at levels of 12 percent unemployment, Furthermore, since some trips by the unemployed that would not otherwise be made (e.g., searching for jobs and other personal business trips) might be during transit's off-peak period, there could be some favorable cost impacts.

Experience of the Thirties

Table 22 summarizes key economic and transit ridership data for the ***1930's.*** As may be readily seen, transit ridership declined from a peak of 13.9 million revenue passengers in 1926 to a low of 9.1 by 1933, after which point there was an upturn, When compared to changes in GNP and unemployment over the period, it appears that the percentage change in transit ridership roughly corresponds, in

general direction and approximate magnitude, to the percentage declines in GNP in real terms. However, critically significant in the changes in transit ridership is the fact that (1) some declining trend may have set in before 1929, (2) automobile ownership during the early thirties was considerably lower than the present period, (3) transit ridership was considerably higher (more than double the 5.3 million in 1973) and (4) perhaps most significant of all the unemployment rates in the 1920's were far higher than any forecast for the present period, in the range of well over 20 percent during the period 1929-33, In light of these unemployment rates and the relatively high transit dependence of that period, transit ridership declines of 9-10 percent do not seem unreasonable. With unemployment rates of as much as 12 percent and GNP declines of 2 to 5 percent, and with the substantially reduced transit usage and greater auto dependence of the present period, a forecast impact of a transit ridership reduction of under 4 percent also seems reasonable and realistic. Similarly, an estimate of under 2 percent loss in ridership developed in Tables 20 and 21 appears reasonable with unemployment at the December 1974 level of 7.1 percent.

Income Elasticity of Local Public Transportation Expenditures

Income elasticity of local public transit expenditures, in the straightforward sense, measures the relationship between the percent change in personal expenditures on local public transit and the percent change of income. The nature of this relationship is important to determine whether there is

TABLE 22

TRANSIT RIDERSHIP AND SELECTED ECONOMIC VARIABLES UNITED STATES—1928-36

Year	Revenue Passengers (Millions)	Annual Change (Year-to-Year) (Percent)	GNP in 1958 $ (Billions)	Annual Change (Year-to-Year) (%)	Unemployment Rate	Annual % Change in Rate
9928	13.9	—	—	—	—	—
1027	13.9	—	—	—	—	—
1928	13.6	- 2.2	—	—	—	—
1929	13.6	—	203.6	—	3.2	—
1930	12.5	- 8.1	183.5	- 9.9	8.7	+171.9
1931	11.2	-10.4	169.3	- 7.7	15.9	+ 82.8
f932	9.6	-14.3	144.2	-14.9	23.6	+ 48.4
1933	9.1	- 5.3	141.5	- 1.9	24.9	+ 5.5
1934	9.6	+ 5.4	154.3	+ 9.1	21.7	- 12.9
1935	9.8	+ 2.0	169.5	+ 9.9	20.1	- 7.4
1936	10.5	+ 7.1	193.0	+13.9	16.9	- 15.9
Annual Average Rate of Change 1929-1933 (%)	- 9.5	—	-8.7	—	15.3*	5.3*

Unweighted average of unemployment rates for 1929-33 inclusive.

SOURCE: Council of Economic Advisors, *Economic Report of the* (Printing *February 1970,* Government Office: 1970, Table C-22, page 302 and Table C-5, page 183; American Public Transit Association.

any significant impact of economic conditions on expenditures for transit, which are highly correlated to transit ridership in the short run,

Two analyses have been conducted for this general approach to determine the effect upon transit ridership of income changes (the income elasticity of transit expenditures). The first analysis examined the expenditures on local public transit for a cross-section of households at different income levels. These raw cross-sectional data were analyzed and income elasticities calculated. These elasticities supplemented the information gathered in the second analysis, which calculated the income elasticity of transit expenditures by comparing the changes in total personal consumption expenditures on transit (assumed to equal transit passenger revenue) with changes in total disposable personal income over time.

The basic assumption of the cross-sectional analysis is that as income levels decline (as in a depression) the household expenditures on local transit would tend to resemble the expenditure patterns of lower income households, Thus a family making $10,000 which has its income reduced to $5,000 during a depression would tend to change its transit expenditures to resemble a $5,000/year family. ‘

The difficulty with this assumption is that life style and behavior patterns are unlikely to be modified to resemble the behavior of the lower income group in the short term. For example, a former $15,00()/year family with three cars will not behave like a $5,00()/year family with no cars, even if the unemployment payments for the former $15,000 family total only $5,000. Over the long run families with lowered income levels may tend to modify their behavior to resemble more the behavior of the families who have been at the lower income level all along. This long-term assumption must be qualified with the standard qualifier—’’All other factors being equal” (which they never are in the long run).

Table 23 indicates the amount of household expenditures on local public transit by income level. The data in this table are derived from the 1960/61 Survey of Consumer Expenditures, the only available data of good quality,

These data confirm the common assumption that as income goes up the percent spent on transit declines. It also shows a weak and erratic trend of increasing absolute amounts of transit expenditure as income rises. However, the most significant information, so far as this study is concerned, is that over a very wide range of income levels the expenditures on transit remain almost the same. The average transit expenditures for families in the five earning categories between $2,000 and $7,500/year varied only between $26.91 and $34.o7. It can be concluded that any shift in household income levels within this range would result in very little, if any, change in transit expenditures. The majority of the population fell within these five income categories in 1961. Note also that the amount of the increases and decreases at the upper and lower income levels is quite modest. These conclusions tend to indicate that a change in income would tend to have very little effect on expenditures on local public transit.

From these data, and the time series data used in our second analysis conducted under this general approach, the income elasticity of transit expenditures has been calculated.

Income elasticity is the percent change in expenditures for a particular good or service for a unit percent change in income. An income elasticity of +1.00 (unit elasticity) indicates 1 percent increase in transit expenditures for every 1 percent increase in income. Goods and services which are in increasing demand as income rises, such as most luxury goods, will have income elasticities of more than +1.00. Expenditures for some goods and services (called inferior goods) actually decline as income rises and result in negative elasticities. It should be noted that based upon this relationship, declines in income should result in increases in expenditures for these inferior goods. Thus, if transit is an “inferior good,” it would experience increased demand during periods of income declines.

The results of income elasticity of local transit expenditures as derived from cross-sectional analysis are shown in Table 24 “Income Elasticity of Transportation Expenditures by Urban Household Size.” As expected, the income elasticity of local public transportation expenditures is less than unity for all household sizes. The income elasticity coefficient is about 0.5 for all household sizes except for households with six or more persons, for whom the elasticity jumps 0.7. A 10 percent increase in household income results in expected increases of between 4.3 and 5.1 percent in local public transit outlays for the various categories of household size from one to five persons.

This would indicate that under conditions of household income growth, transit expenditures do not keep pace with the percentage increase in income. On the other hand, in periods of recession,

TABLE 23

HOUSEHOLD EXPENDITURES ON LOCAL, PUBLIC AND TOTAL TRANSPORTATION BY INCOME LEVEL AND FAMILY SIZE, 1961

Money Income After Taxes	ALL URBAN FAMILY UNITS					URBAN FAMILIES OF 2 PERSONS					URBAN FAMILIES OF 4 PERSONS				
	Total Transportation		Local Public Transportation			Total Transportation		Local Public Transportation			Total Transportation		Local Public Transportation		
	Expenditures	Percent of Income*	Expenditures	Percent of Income*	Percent of Transportation Expenditures	Expenditures	Percent of Income*	Expenditures	Percent of Income	Percent of Transportation Expenditures	Expenditures	Percent of Income*	Expenditures	Percent of Income*	Percent of Transportation Expenditures
$ 1,000-$ 1,999	$ 90.53	6.0	$21.94	1.5	24.2	$ 133.91	8.9	$24.92	1.7	18.6	$ 248.28	16.6	$10.37	0.7	4.2
$ 2,000-$ 2,999	222.29	8.9	32.14	1.3	14.5	212.05	8.5	26.06	1.0	12.3	384.46	15.4	16.88	0.7	4.4
$ 3,000-$ 3,999	459.54	13.1	33.18	0.9	7.2	529.30	15.4	31.80	0.9	6.0	522.69	14.9	35.09	1.0	6.7
$ 4,000-$ 4,999	672.63	14.9	34.07	0.8	5.1	725.75	16.1	34.41	0.8	4.7	642.99	14.3	22.44	0.5	3.5
$ 5,000-$ 5,999	848.78	15.4	26.91	0.5	3.2	768.52	14.0	36.45	0.7	4.7	918.01	16.7	22.12	0.4	2.4
$ 6,000-$ 7,499	947.47	14.0	30.93	0.5	3.3	1,013.71	15.0	32.47	0.5	3.2	1,003.84	14.9	23.80	0.4	2.4
$ 7,500-$ 9,000	1,132.70	12.9	42.45	0.5	3.8	1,215.64	13.9	41.72	0.5	3.4	1,179.17	13.5	31.73	0.4	2.7
$10,000-$15,000	1,558.39	12.5	65.44	0.5	4.2	1,514.56	12.1	55.87	0.4	3.7	1,619.04	13.0	75.04	0.6	4.6
Average ($6,050.51)	781.50	12.9	35.37	0.6	4.5	742.83	12.3	34.84	0.6	4.7	1,019.00	16.8	32.24	0.5	3.2

when household income declines, expenditures on transit do not decline as fast, e.g., a 2 percent decline in household income results in only a 1 percent or less decline in transit expenditures. The data used here were collected during a period of national economic decline (the recession of 1960), thus adding validity to findings based upon assumptions of declining income, These data tend to indicate that recessionary declines in income on the order of 2 percent have only a minor effect on transit expenditures—less than 1 percent,

The second analysis uses National Income Account data to estimate elasticity of local public transit expenditures, using total United States local transit passenger revenues as a proxy. Table **25** presents annual series data for Disposable Personal Income, Public Transit Expenditures, and Income Elasticity of Local Public Transit Expenditures, as derived from the annual percent changes in Income and Transit Revenues, for 1952 through 1973.

Two conclusions can be reached from an examination of the income elasticity figures in Table 25, First, to the extent that any general observation can be made from this apparently erratic series, the income elasticity of public transit expenditures appears to be less than unity (the average of all of the 22 values is 0,04). Second, the income elasticity shows no consistency over the years. The inference from the second conclusion is that other factors besides national Disposable Personal Income are more significant in affecting transit ridership,

In conclusion, with the absence of fuel shortages (i.e., pre-l974 conditions) the number of transit riders is significantly not responsive to recession conditions. The transportation expenditures represent on the average 13 to 15 percent of household budgets, while local transit expenditures represent much less than 1 percent. A decline in personal income of 2 percent during a recession will result in a decrease in transit expenditures of about I percent,

TABLE 24

INCOME ELASTICITY OF TRANSPORTATION EXPENDITURES BY URBAN HOUSEHOLD SIZE
1960/61

Transportation Expenditure Items	Number of Persons in Household					
	1	2	3	4	5	6+
All Transportation Expenditures	1.57 (0.14)	1.16 (0.12)	1.09 (0.12)	0.85 (0.11)	0.96 (0.15)	1.12 (0.05)
1. automobile purchases	2.70 (0.16j	(0.20)	t *28 (0.16)	0,91 (0.15)	1.20 (0.33)	1.27 (0.17)
2. automoblle variable costs	1.68 (0.23}	(0.15)	(0.14)	0.69 (0.18)	0.79 (0.19)	0.92 (0.09)
3. gasoline	1.67 (0.23)	1.01 (0.16)	0.90 (0.14]	0.68 (0.17)	0.76 (0.18)	0.95 (0.10)
4. boat public transportation	0.51 (0.12)	.0.49 (0.06)	0.4$ ' (0.10}	&47 (0.22)	0.43 (0.19)	0.71 (0.17)
5 non-local public transportation	0.94 (0.16)	1.02 (0.21)	1.58 (0.21)	1.20 (0.47)	1.59 (0.48)	1. 52 (0.36)
6. car pool	0.16	0.18	0.15	0.16	0.20	0.14

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Survey of Consumer Expenditures 1960/61, Consumer Expenditures and Income, Detail of Expenditures and Income, Urban United States, 1961,* Supplement 3, Part C to BLS Report 237-28 (July 1964)

Standard errors of income elasticity are shown in parentheses under each estimate of elasticity except for car pools.

TABLE 25

DISPOSABLE PERSONAL INCOME, PUBLIC TRANSIT PASSENGER REVENUES, AND INCOME ELASTICITY OF LOCAL PUBLIC TRANSIT EXPENDITURES: 1951-74

Year	Disposable Personal Income			Public Transit Passenger Revenues			Income Elasticity of Local Public Transit Expenditures
	Amount	Absolute Change [$ Billion]	Percent Change	Amount	Absolute Change [$ Million]	Percent Change	
1951	226.6			1*41 1.6			
1952	238.3	11.7	5.16	1,438.1	26.5	1.88	0.3643
1953	252.6	14.3	6.00	1,448.6	10.5	0.73	0.1217
1954	257.4	4.8	1.90	1,410.0	-38.6	-2.66	-1.4000
1255	275.3	17.9	6.36	1,358,9	-51.1	-3.62	-0.5201
1956	293.2	17.9	6.50	1,351,1	- 7.8	-0.57	-0.0877
1357	306.5	15.3	5.22	1,319.6	-31.3	-2.32	-0.4444
1958	318.8	10.3	3.34	1,262.2	-37.6	-2.86	-0.8533
1959	337.3	16.5	5.80	1,308.3	26.1	2.04	0.3517
1960	350.0	12.7	3.63	1,334.9	28.6	2.03	0.5592
1961	364.4	14.4	4.11	1,320.9	-14.0	-1.05	-0.2555
1382	385.3	20.9	5.74	1,330.2	9.3	0.70	0.1222
1263	404.6	19.3	5.01	1,318.3	-13.9	-1.04	-0.2076
1964	436.1	33.5	8.28	1,326.0	0.7	0.74	0.0894
1265	473.2	35.1	8.01	1,340.1	14.1	1.06	0.1323
1286	511.9	36.7	8.18	1,385.4	45.3	3.38	0.4132
1967	5463	34.4	8.72	1,457.4	72.0	5.20	0.7738
1968	591.0	44.7	8.18	1,470.2	12.8	0.38	0.1076
1969	634.4	43.4	7.34	1,564.7	84.5	5.75	0.7834
1970	691.7	57.3	9.03	1,639.1	84.4	8.43	0.6013
1971	746.4	64.7	7.91	1,881.9	22.8	1.39	0.1757
1972	802.5	58.1	7.52	1,660.7	-11.2	-0.87	-0.0891
1973	903.7	101.2	12.61	1,683.7	33.0	2.00	0.1586
1974	979.7	76.0	8.41	N/A			NIA

SOURCES . U.S. Department of Commerce, Bureau of Economic Analysis. *1973 Business Statistics,* 19th Biennial Edition, GPO, Washington. D. C., 1973, page 7 for Disposable Personal income during 1951-70 period.

2. Ibid. *Survey of Current Business, volume* 54. No. 11 (November 1974), page S-2 for Disposable Personal Income in 1971 through 1973.
3. U.S. Department of Commerce, Bureau of Economic Analysis, Personal Income Division, for Disposable Personal Income in 1974.
4. American Transit Association, *Transit* Fact *Book,* Washington. D.C., various years, Tabfe 7.

which, assuming no change in fares, will result in a decrease in transit ridership of about 1 percent.

Multiple Regression Analysis

Two time series analyses were carried out to assess the relationship between transit ridership and energy and economic conditions. These are discussed in detail in Appendix A. The first used quarterly data from ***1952*** to ***1974*** and the second used monthIy data from 1971 to 1974. The intent of these analyses was to determine which energy and economic variables are most closely related to transit ridership and to develop equations using these variables to predict transit ridership under various assumed future conditions.

The analytic procedure used for this purpose was a computer-based stepwise regression analysis. The computer tested equations of the form

$$Y = (x_1)^{b_1} (x_2)^{b_2} \ldots\ldots$$

where Y represents the annual growth or decline in transit ridership and the X's represent the ***annual*** growth or decline in other variables. The variables with the strongest (positive or negative) relationship to transit ridership were then selected using statistical criteria. z

The need for two different time series was based on the assumption that energy conditions have exerted a significant influence on transit ridership only in the recent past, particularly during and after the oil embargo, while the effects of economic conditions could be better estimated over a longer time period which included the several post-war recessions. Energy and economic variables were input to both the shortrun (1971-74) and longrun (1952-74) analyses. In the shortrun, highway vehicle miles of travel was found to be the variable most strongly

[2] An F-ratio was calculated at each step for each variable not currently in the equation and the variable with the largest F-ratio was entered.

related to transit ridership;[3] This analysis is discussed in Chapter VII. In the longrun analysis, average fare and the unemployment rate were found to be most significant as indicated below:

Longrun Analysis (1952-74)

Step) No.	Variable Entered	Resulting Equation	R^2
1	Average Fare (AF)	$TRP = (AF)^{-.708}$	.56
2	Unemployment Rate (UR)	$TRP = (AF)^{-.640}(UR)^{-.04g}$	.60

TRP = Transit Revenue Passengers

Equations produced by subsequent steps of the regression procedure were suspect for use in interpreting historical trends due to the high degree of colinearity between the variables entered, the lower levels of significance of the coefficients and because the direction and magnitude of some of the coefficients were questionable.

From 1952 to 1974, the variable most strongly related to transit ridership was average fare, The negative coefficient indicates that increases in average fare are associated with decreases in ridership, as would be expected, However, the magnitude of the coefficient is larger than expected, It suggests that the price elasticity of transit ridership is –.64 while other studies have indicated a price elasticity of about –.3 or slightly higher. A likely reason for this discrepancy is that the computer procedure does not distinguish ridership declines due to fare increases from fare increases by transit agencies to compensate for declining revenues. Thus, the decline in ridership actually caused by a 1 percent fare increase should be less than the .64 percent indicated in the above equation.

After average fare, the unemployment rate proved to be the variable most strongly related to transit ridership. However, despite the (statistical) significance of the relationship between unemployment and transit ridership, the actual decrease in ridership which would be predicted from an increase in unemployment is relatively small. Assuming that the fare remains constant, an increase in the unemployment rate from 5.o percent to 7.5 percent would cause a decline in transit ridership of about 2 percent.

Impact of Economic Futures on Transit

The equation used to forecast the effect upon transit ridership of alternative economic conditions is:

$$TRP = (UR)^{-0.4g}$$

where

TRP = the year-to-year growth (or decline) factor for transit revenue passengers and

UR = the year-to-year growth (or decline) factor for the unemployment rate.

This relationship between transit ridership and the unemployment rate was taken directly from the second step of the long run regression (1952-74) analysis, assuming the average fare remains constant (i.e., AF=l), When this relationship is applied to estimate the effect of the increase in unemployment which occurred between October 1973 and December 1974, the result is virtually identical to the result of the analysis of national data using incremental unemployment described earlier in this chapter. Both the multiple regression analysis and the analysis using incremental unemployment indicate that the increase in the unemployment rate from 4.6 percent to 7,1 percent caused about a 2 percent decrease in transit ridership,

With the recession future, the unemployment rate was assumed to increase to 8 percent by April 1976. This increase in unemployment is predicted to cause a slightly greater than 2 percent decline in transit ridership from 1974 to 1976,

With the depression future, the employment rate was assumed to increase to 9.o percent by November 1976. This increase in unemployment is predicted to cause a 2.5 percent decline in transit ridership.

The declines in ridership of about 2.5 percent which are expected under recession and depression conditions will worsen the financial position of the United States transit industry, Revenues can be expected to decline proportionately to ridership loses; operating costs will probably rise compared to current conditions, due to the current inflationary trend, The net effect of the economic conditions on

[3] Highway vehicle miles of travel were used as a proxy for gasoline consumption to measure the effects of energy shortages on transit ridership. Gasoline consumption data were not used because the only available data are based on wholesale sales which tend to lead consumption by an unknown and variable amount and **because** the series tends to be somewhat erratic at the monthly level. The vehicle miles of travel data do not have these problems.

costs of operations, would probably be to cause a very slight decrease in operating costs, assuming some curtailment of peak service, but probably less than in proportion to the revenue losses due to ridership declines. The net effect on overall transit fiscal conditions is likely to be a loss of about 2 percent i.e., slightly under the 2.5 percent ridership loss.

Buses would not be replaced quite as fast, thus impacting negatively on the bus manufacturing industry to a moderate extent. These conditions are similar to past trends in the industry.

Based upon these assumptions it would be somewhat more difficult to justify new fixed rail systems because of the net ridership losses caused. Justification would have to rely more on the employment created. The recession or depression effects on the transit operator, however, would only be temporary, and therefore would have no effect on traffic, revenue, or operating costs by the time any new fixed guideway system would be complete and open to traffic. The jobs created in the construction of such a system would be substantial locally, as discussed in the next chapter. It should also be noted that the short-run ridership forecasts are national ones and are based on a transit service level approximating past service levels. Obviously, a new fixed guideway system would be a significant improvement in the level of service in a metropolitan area and might be justified on the basis of local patronage resulting from the improved service.

SUMMARY

Several analyses of changes in transit ridership as a function of changes in economic conditions (expressed as the unemployment rate) have revealed a relationship between the two. However, this relationship indicates that only a very small change in transit ridership results from rather large changes in the unemployment rate. The significance of these economically induced changes in ridership is far overshadowed by the changes in ridership induced by changing energy conditions.

Three different analyses were conducted to determine the effect on ridership of large increases in the level of unemployment. The three analyses yielded surprisingly similar results. An increase of 2.5 percent in the unemployment rate (i.e., from 5 percent to 7.5 percent unemployed) is accompanied by a decline in transit ridership of 2 percent or less,

In the first analysis, it was assumed that newly unemployed individuals would reduce their work trips to zero, and thus the proportion of those work trips formerly made on transit would be eliminated. The elimination of these transit work trips on transit results in a decline in national transit ridership of between 1.2 and 2.0 percent for a 2.5 percent increase in unemployment.

The second analysis examined the income elasticity of transit expenditures. This analysis indicated that, on a national level, a decline in personal income of about 2 percent during a recession (which is roughly equal to a 2.5 percent increase in unemployment) will result in a decrease in transit expenditures of about 1 percent. Assuming no change in fares, this will result in a decrease in transit ridership of about 1 percent.

The third analysis calculated the relationship between the change in national transit ridership and the change in the national unemployment rate (and other factors) using regression analysis techniques. The annual change in national transit ridership was the factor to be predicted. Among the variables considered which could influence transit ridership were change in average fare, several measures of changes in economic conditions (including gross national product, personal consumption expenditures, number of unemployed, and unemployment rate), and several measures of changes in transportation energy consumption (including vehicle miles traveled, urban vehicle miles traveled, and highway fuel consumed).

The analysis revealed that the factor statistically most significant for changes in transit ridership was the change in average fare with change in the national unemployment rate next in importance,

Using the equation derived from this regression analysis, the predicted change in transit ridership would decrease about 2.5 percent for both the recession and depression futures. This slight change in ridership wouId have little effect on transit operations.