BENEFIT-COST ANALYSIS OF THE MILWAUKEE FREEWAY SYSTEM

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This study analyzed the effects of freeways on property taxpayers in Milwaukee. Right-of-way takings for the Milwaukee freeway system resulted in the removal of real estate property from the city's tax base. Total tax loss was estimated to be more than \$18 million. However, accident cost savings, savings in travel time and operating costs, and reduced capital expenses for arterial streets benefited city residents by more than \$37 million. Figures also are given for individual property owners. The scope of the analysis was limited to the quantifiable items for which data were available. For some items, available data were not fully adequate and many assumptions had to be made. A conservative approach was taken to ensure that benefits were not overestimated. A direct effect of freeways excluded from the analysis is environmental impact. Indirect effects that were not considered include the impact of freeways on the land development pattern and land value, which may be significant in many cases. It was concluded that the Milwaukee property tax loss due to freeway right-of-way takings was compensated for amply by the benefits attributable to the freeways.

•IN RECENT years freeway construction in metropolitan areas has been the cause of much controversy and has been opposed by various groups of people for different reasons. Environmentalists oppose freeways because of their impact on the landscape, quality of air and water, and noise level. Other opponents, particularly property owners, are upset about the dislocation of business and families, and the effect of the freeway on adjacent neighborhoods. In addition, city government officials, particularly those of the central city, are concerned about the lost tax base of their cities. The study to be discussed in this paper analyzed the effects of freeways on property taxpayers within a municipal area by examining the case of Milwaukee, Wisconsin.

The study used the traditional benefit-cost approach, but included only those benefits and costs that are related directly to city property taxpayers. Because of the difficulty of precisely quantifying the benefits that accrue to city residents from a freeway system, some approximations were made in a few cases. The quantified benefits in this study basically represent savings in road-user costs. One item, however, is related to capital costs that accrue to the city. Cost, for this study, was the city's lost tax base. The study did not attempt to deal with any particular group of property owners who were displaced or who suffered a reduction in the value of their property because of a freeway. All types of real estate and improvements (residential, manufacturing, mercantile, and agricultural) were included in the analysis. Personal property assessments, however, were not included.

In addition to estimating areawide totals, we converted benefits and costs to a unit property value for an owner of a real estate property with a market value of \$20,000, which approximated the median value of single-family homes in southeastern Wisconsin in 1970 (1). The objective of converting the total benefits and costs to a unit property basis was to provide information that would be more meaningful for individual residents and more helpful for comparisons.

All aspects of a freeway were not included in this study. The focus of the study was

on the extent of tax loss suffered by the city because of the freeways. The study also focused on the magnitude of direct or indirect benefits that accrue to residents and road users by reduced accidents, travel time, and vehicle operating costs and to the city by lowered demand for additional surface arterials. The positive effects of a freeway system on increased mobility and higher land value were not quantified, and possible negative effects, such as air pollution, noise, and dislocation of neighborhoods, were not included in the analysis.

FREEWAY CONSTRUCTION AND THE TAX BASE

The assessed value of property removed from the tax base of the city of Milwaukee by right-of-way takings for freeways was obtained from the Milwaukee Tax Commissioner's Office. Only that portion of the freeway system within the corporate limits of the city that was operational by January 1, 1971, was considered. The monetary valuation in each year of the analysis was based on the value of the dollar in that year. For estimating annual tax, we adjusted the value of previously acquired properties on a year-to-year basis to reflect the likely appreciation of property value. These increases were based on consumer price indexes. (Price indexes for housing could have been substituted. The difference was not significant for Milwaukee.) They applied to all properties even though much of the existing freeway system in Milwaukee was constructed through marginal and substandard neighborhoods.

The assessed values of annual right-of-way takings for freeway construction in the city of Milwaukee for 1953 to 1970 are given in Table 1. Assessed value of real estate properties in Milwaukee for tax purposes is approximately 55 percent of the market value. The cumulative value of the real estate tax base removed for freeways was \$26,316,486 for 1970 if individual annual values are not adjusted. No tax base was removed after 1967 because all land parcels were acquired before the end of 1967 for the freeway segments that were open to traffic on January 1, 1971. The table also indicates that, when inflation factors based on increases in the consumer price index (CPI) are applied, the cumulative value of the lost tax base increases to \$33,064,860 for 1970. The adjusted cumulative values were used for estimating the city's lost real estate tax dollars.

For this study, it was assumed that the city's operating costs were not diminished although services were not provided to those properties removed from the tax rolls. Thus, to maintain the same level of revenue, the city had to redistribute the entire amount of lost tax among the remaining real estate taxpayers. The lost revenue for the years 1953 to 1970 is given in Table 2. The total loss amounted to \$18,758,330. The lost tax dollars then were distributed over the entire city tax base, and a yearly cost in added taxes was determined for a property with a \$20,000 market value. The market value of all real estate for the city and the derived cost for a property with a \$20,000 market value also are given in Table 2. As shown by the data given in the table, the added property tax to the typical property owner would be \$107.56 or an average annual cost of \$5.98 for the 18-year period under investigation.

ACCIDENT COSTS-FREEWAYS VERSUS SURFACE STREETS

Much has been written on the accident reductions that result from the advanced design features of freeways across the nation, and, as revealed by this study, the accident cost savings in the Milwaukee area attributable to the freeway system were significant. In determining the accident rates for the city, we had to determine the total vehicle miles (kilometers) of travel (VMT) on Milwaukee streets. In 1963, total travel on the city's arterial street network during a typical weekday was estimated to be 4,804,000 vehicle miles (7 734 440 vehicle km) based on traffic counts and the length of roadway sections within Milwaukee corporate limits. The corresponding total daily travel on nonarterial streets was estimated to be 870,000 vehicle miles (1 400 700 vehicle km). Saturday and Sunday traffic was estimated to be 84.18 percent and 71.66 percent of

Table 1. Year-to-year values of freeway right-ofway takings for Milwaukee.

Year	Total Assessed Value (dollars)	Consumer Price Index Value (1957- 1959 dollars)	Increase in Consumer Price Index Over Previous Year (percent)	Cumulative Right-of-Way Takings (dollars)	Inflation of Previous Years (dollars)	Cumulative Right-of-Way Takings After Inflation (dollars)
1953	931,200	-				931,200
1954	389,300	-	1.0 ^ª	1,320,500	9,300	1,329,800
1955	46,800	0.9338	1.0 [*]	1,367,300	13,300	1,389,900
1956	121,350	-	1.0"	1,488,650	13,900	1,525,150
1957	602,450	0.979	1.0ª	2,091,100	15,250	2,142,850
1958	1,316,600	1,006	2.8	3,407,700	60,000	3,519,450
1959	2,050,610	1.0152	0.8	5,458,310	25,300	5,595,360
1960	666,380	1.0299	1.6	6,124,690	89,500	6,351,240
1961	405,640	1.0417	1.1	6,530,330	69,850	6,826,730
1962	2,801,540	1.0537	1.2	9,331,870	81,900	9,710,170
1963	3,676,420	1.0672	1.2	13,008,290	116,500	13,503,090
1964	3,936,650	1.0811	1.3	16,944,940	175,550	17,615,290
1965	2,711,930	1,0989	1.7	19,656,870	209,500	20,626,720
1966	4,008,050	1.1312	2.9	23,664,920	598,200	25,232,970
1967	2,651,566	1.1628	2.8	26,316,486	652,300	28,536,836
1968		1.2121	4.2		1,198,550	29,735,386
1969		1.2788	5,4		1,605,714	31,341,100
1970		1,3491	5.5		1,723,760	33,064,860

*From 1954 to 1957, an increase in the Consumer Price Index of 1.0 percent/year was assumed,

Table 2. Lost tax dollarsand annual cost to averageproperty owner.

Year	Assessed Value of Cumulative Right-of-Way Takings [#] (dollars)	Total Annual City Tax Rate ^b (dollars)	Total Tax Lost (dollars)	Market Value of City Real Estate (billions of dollars)	Cost per Individual ^e (dollars)
1953	931,200	47.51	44,240	2,206	0.40
1954	1,329,800	49.85	66,290	2.352	0.56
1955	1,389,900	51.29	71,290	2.489	0.57
1956	1,525,150	53.28	81,260	2.653	0.61
1957	2,142,850	55.26	118,410	2.821	0.84
1958	3,519,450	59.37	208,950	2,940	1.42
1959	5,595,360	58,20	325,650	3.002	2.17
1960	6,351,240	60.78	386,030	3.112	2.48
1961	6,826,730	63.68	434,730	3.144	2.77
1962	9,710,170	66.62	646,890	3.203	4.04
1963	13,503,090	68.57	925,910	3.199	5.79
1964	17,615,290	71.622	1,261,640	3.242	7,78
1965	20,626,720	72,512	1,495,680	3.287	9.10
1966	25,232,970	74,565	1,881,500	3.337	11.28
1967	28,536,836	80,969	2,310,600	3.492	13.23
1968	29,735,386	88.969	2,645,530	3.607	14.67
1969	31,341,100	88.140	2,762,400	3.774	14.64
1970	33,064,860	93.493	3,091,330	4.065	15.21

After inflation. Bate per \$1,000 assessed value. \$20,000 property owner.

Motor Vehicle Registrations

Table	3. Motor vehicle
regist	rations and vehicle
miles	(kilometers) of travel.

Year		Milwaukee		City Percent	VMT (in billions)		
	Milwaukee®	County	Wisconsin	Registration	Wisconsin	Milwaukee	
1962	247,215	370,693	1,666,853	14.83	16.86	1.870	
1963	256,640	384,826	1,785,149	14.37	17.51	1.941	
1964	260,854	391,144	1,793,305	14.54	18.14	1.973	
1965	278,002	412,238	1,893,867	14.67	19.19	2,102	
1966	281,991	422,838	1,945,848	14.49	20.15	2.133	
1967	295,035	442,397	2,055,009	14.35	20.92	2.231	
1968	301,429	453,981	2,135,711	14.11	21.81	2,279	
1969	301,515	454,621	2,153,407	14.00	23,89	2.280	
1970	307,302	461,230	2,210,492	13.90	24.50	2.324	

Note: 1 mile = 1.6 km

*Actual figures were available for 1965 and 1968 through 1970 only. Other years were estimated from Milwaukee County registration figures.

Table 4. Accident rates for Milwaukee.

Year		Accidents	Accidents			Accident Rate per Billion VMT		
	VMT (in billions)	Fatalities ⁴	Nonfatal Injuries	Property Damage Only	Fatalities	Nonfatal Injuries	Property Damage Only	
1962	1.870	52	6,163	10,224	27.8	3,296	5,467	
1963	1.941	61	6,864	10,142	31.4	3,536	5,225	
1964	1.973	75	7,230	10,713	38.0	3,664	5,430	
1965	2.102	61	8,193	12,078	29.0	3,898	5,746	
1966	2.133	59	8,358	12,259	27.7	3,918	5,747	
1967	2.231	65	8,762	12,287	29.1	3,927	5,507	
1968	2.279	73	8,671	12,172	32.0	3,805	5,341	
1969	2,280	71	8,927	14.105	31.1	3,915	6,186	
1970	2.324	67	8,955	12,332	28.8	3,853	5,306	

Note: 1 mile = 1.6 km. 1 accident/vehicle mile of travel = 0.625 accident/vehicle km of travel.

*Does not include fatalities on freeways inside the corporate limits of the city of Milwaukee,

the average weekday travel respectively according to information we received from the Transportation Division of the Southeastern Wisconsin Regional Planning Commission. Based on these data, total travel on the arterial and nonarterial streets of Milwaukee during 1963 was estimated to be 1,940,820,000 vehicle miles (3 124 720 200 vehicle km). The estimates of vehicle miles (kilometers) for the other years were derived on the basis of motor vehicle registration data as given in Table 3 (4, 5).

The procedure for calculating the city's VMT (vehicle kilometers of travel) was received from the Transportation Division of the Southeastern Wisconsin Regional Planning Commission. Accident rates for the city of Milwaukee are given in Table 4.

A summary of accident rates for the Milwaukee County freeway system for 1962 to 1970 is given in Table 5 (6). Accident rates for the city's arterial and nonarterial street system then were compared with those of the Milwaukee County freeway system, and the number of accidents eliminated in each category because of the freeway system was estimated. The underlying assumption of this procedure is that, in the absence of the freeway system, the travel that took place on the freeways would have been made on the other arterial and nonarterial streets. Although this assumption may be questioned because an improved transportation service often generates new traffic, the assumption was consistent with that underlying the current urban transportation planning methodology for number of trips. The results are given in Table 6.

When the number and types of accidents eliminated by the freeways in Milwaukee County were determined, the savings in monetary terms for each year were determined based on the values set by the National Safety Council. The National Safety Council information was available for 1963, 1964, and 1970, and the values for the other years were estimated on the basis of changes in the CPI. The yearly costs of accidents eliminated are given in Table 7. A portion of this savings then was assigned to Milwaukee based on the ratio of city to county motor vehicle registrations. The assigned amount was approximately 67 percent of the total accident savings and is given in Table 8. (The procedure adopted to assign accident savings to the city seemed to be reasonable because, from 1964 to 1969, when the County Sheriff's Department broke down accident occurrences by municipality, 73 percent of the total accidents within the county occurred within the city of Milwaukee.)

After obtaining the annual accident savings that accrued to the city of Milwaukee (\$25,361,114), we sought a method of estimating the amount of savings for a unit property taxpayer. The market value of total city real estate was known. Therefore, a simple ratio was used to apportion the total savings to a \$20,000 real estate property. The results of this analysis, given in Table 8, indicate a total return of \$138.30 to the individual taxpayer in reduced accident costs.

SAVINGS IN TRAVEL TIME COST

For this study, travel time savings that accrued to city residents were based on their use of freeways inside city limits. Time savings for the use of freeways outside the city were not considered. Because of the nature of the available data, a few assumptions had to be made about the volume of traffic for city residents and their routes of travel. Initially, the travel time savings were determined for the movements between the freeway entrance ramps in the city to the central business district (CBD) by comparing the travel time necessary to go from freeway entrance ramps to the CBD with the time necessary to go from alternative arterial routes to the CBD. The information on travel times was obtained from 1970 information provided by the Southeastern Wisconsin Regional Planning Commission. The time savings between CBD and freeway entrance ramps were used in estimating the travel time savings between appropriate pairs of entrance ramps for movements not having destinations in the CBD. Because the Marquette interchange near the CBD was opened in December 1968, the travel time data based on the 1970 network were valid for 1969 and 1970 only. A summary of the results is given in Table 9. Analysis for the other years will be discussed later.

For macroanalysis, the Southeastern Wisconsin Regional Planning Commission divided the 7-county region into 15 districts, and the travel information between these

Table 5. Accident rates for Milwaukee County freeways.

Year	VMT (in billions)	Accidents			Accident Rate per Billion VMT		
		Fatalities	Nonfatal Injuries	Property Damage Only	Fatalities	Nonfatal Injuries	Property Damage Only
1962	0.064	0	45	134	_	703	2.094
1963	0.116	1	150	296	8.6	1.293	2,552
1964	0.305	7	284	516	23.0	931	1.692
1965	0.300	3	288	603	10.0	960	2.010
1966	0.366	10	461	741	27.3	1.260	2.025
1967	0.577	8	751	1,203	13.9	1,302	2,085
1968	0,882	12	809	1,564	13.6	917	1.773
1969	1,106	19	1,301	2.417	17.2	1,176	2,185
1970	1.165	28	1,133	2,425	24.0	973	2,082

Note: 1 mile = 1.6 km, 1 accident/vehicle mile of travel = 0.625 accident/vehicle km of travel.

Table 6. Accidents eliminated by Milwaukee County freeways.

Year	VMT (in billions)	Difference in Rates (accidents per billion VMT)			Accidents Eliminated*		
		Fatalities	Nonfatal Injuries	Property Damage Only	Fatalities	Nonfatal Injuries	Property Damage Only
1962	0.064	27.8	2,593	3,373	2	166	216
1963	0.116	22.8	2,243	2,673	3	260	310
1964	0.305	15.0	2,733	3,738	5	834	1,140
1965	0.300	19,0	2,938	3,736	6	881	1,121
1966	0,366	0.4	2,658	3,722		973	1,362
1967	0.577	15.2	2,625	3,422	9	1.515	1.974
1968	0.882	18.4	2,888	3,568	16	2,547	3,147
1969	1.106	13.9	2,739	4,001	15	3.029	4,425
1970	1,165	4.8	2,880	3,224	6	3,355	3,756

Note: 1 mile = 1.6 km. 1 accident/vehicle mile of travel = 0.625 accident/vehicle km of travel.

*Determined by multiplying difference in rates by freeway vehicle miles (kilometers) of travel. *Milwaukee Police Department no longer sends squads to accidents involving property damage only, which has caused a significant de crease in the number of reported property damage accidents in the city.

Table 7. Accident cost savings for Milwaukee County freeways.

Year	Accidents E	Accidents Eliminated			Cost (dollars)		
	Fatalities	Injuries	Property Damage Only	Fatalities	Injuries	Property Damage Only	Savings (dollars)
1962	2	166	216	32,900	1,850	310	439,860
1963	3	260	310	33,300	1,900	310	690,000
1964	5	834	1,140	34,400	1,800	310	2,026,600
1965	6	881	1.121	35,000	1.850	310	2,187,360
1966		973	1,362	36.000	1,950	315	2,326,380
1967	9	1,515	1.974	36,900	2.050	320	4.069.530
1968	16	2,547	3.147	38,400	2,150	340	7,160,430
1969	15	3,029	4,425	40,100	2,300	360	9,161,200
1970	6	3,355	3,756	41,700	2,500	380	10,064,980

Table 8. Accident cost savings for Milwaukee.

Year	City Percent of County Vehicle Registration	Savings to County (dollars)	Savings to City (dollars)	Real Estate Market Value of Milwaukee (billions of dollars)	Accident Savings per Individual ^s (dollars)
1962	66.49	439,860	292,463	3,203	1.83
1963	66.49	690,000	458,781	3,199	2.87
1964	66.49	2,026,600	1,347,486	3.242	8.31
1965	67.43	2,187,360	1,474,937	3.287	8.97
1966	66.49	2,326,380	1,546,810	3.337	9.27
1967	66.49	4,069,530	2,705,830	3.492	15.50
1968	66.39	7,160,430	4,753,809	3,607	26.36
1969	66.32	9,161,200	6,075,708	3,774	32,20
1970	66.62	10,064,980	6,705,290	4.065	32,99

*\$20,000 property owner.

districts was used in this analysis. Districts 1, 2, 4, 14, and 15 include most of the city. Because of the number of city residents in each of the 5 districts and their expected travel pattern, we decided that the estimates of travel time savings that accrued to the city residents would be derived on the basis of travel to and from districts 2 and 4 only. It appeared that the limited analysis would not alter the results of the study significantly although it would understate the benefits to some extent.

Tables 10, 11, 12, and 13 give 1963 vehicle trip data between districts 2 and 4 and other districts. These trip volumes were assumed to remain constant throughout the analysis period (1962 through 1970). The assumption, of course, resulted in a conservative estimate of travel time savings; but, in the absence of reliable data for subsequent years, we considered this approach to be a reasonable compromise. The expected use of freeways and their ramps is given in Tables 11 and 13. The assumptions used in developing the travel data are as follows:

1. Only district-to-district movement oriented toward freeways in the city was considered;

2. Percentage of total trips involving ramp use in travel between 2 districts was based on the percentage of total 1970 ramp count for the districts;

3. The ramps within the area bounded by a line north of North Avenue, west of Twenty-Seventh Street, and south of Lincoln Avenue were assumed to be CBD ramps, and no travel time saving for CBD trips was considered for these ramps;

4. Percentage of freeway trips between 2 districts was based on total 1970 ramp count for the districts; and

5. All long trips outside Milwaukee County by city residents were made on the freeway.

The time savings estimated by using the vehicle trips in Tables 10, 11, 12, and 13 and the travel time data given in Table 9 represent the average weekday savings of travel time in vehicle minutes per day in 1969 and 1970. To obtain the travel time savings in vehicle hours per year, we assumed that

- 1. There were 260 weekdays per year;
- 2. Saturday traffic was 84.18 percent of weekday traffic;
- 3. Sunday traffic was 71.66 percent of weekday traffic; and
- 4. There are 52 Saturdays and 52 Sundays per year.

After obtaining the district-to-district travel time savings that accrued to all travelers, the amount of savings that could be assigned to Milwaukee residents was computed.

1. A set of city area factors was developed to reflect the amount of city land within each district and was expressed as a fraction of total district area. We assumed that the density of trip origins and destinations per square mile (square kilometer) was uniform throughout a given district. Accordingly, if 50 percent of the land area in the district being investigated was estimated to lie within the city of Milwaukee, then 50 percent of the district-to-district trips were assigned to city residents for computation of travel time savings.

2. A set of district-to-district factors was developed on the basis of 1963 county-tocounty work trips (<u>1</u>). The district-to-district factor indicated the ratio of work trips originating at Milwaukee to work trips originating at other districts. These factors were applied to all types of trips.

A summary of annual district-to-district travel time savings for districts 2 and 4 and the savings assigned to the city of Milwaukee are given in Tables 14 and 15. These time savings for the years 1969 and 1970 then were converted to monetary values by assuming the cost of travel time to be 1.75/vehicle hr and 1.85/vehicle hr for 1969 and 1970 respectively. The unit values for travel time were obtained by adjusting the value of 1.55/vehicle hr, which was used by the Southeastern Wisconsin Regional Planning Commission (2). The total dollar value of travel time savings that accrued to the city

Table 9.	Point-to-point travel time saved Milwaukee city
freeways	in 1969 and 1970.

Enter Freeway Ramp	Exit Freeway Ramp	Time Saved (min)	Enter Freeway Ramp	Exit Freeway Ramp	Time Saved (min)
Capitol	CBD 35th Hawley 68th 84th Holt Howard Layton College	1.10 1.50 3.00 3.15 3.20 1.70 2.10 2.75 3.25	Keele	CBD 35th Hawley 68th 84th Holt Howard Layton College	$\begin{array}{c} 0.90 \\ 1.30 \\ 2.80 \\ 2.95 \\ 3.00 \\ 1.50 \\ 1.90 \\ 2.55 \\ 3.05 \end{array}$
Locust	CBD 35th Hawley 68th 84th Holt	0.80 1.20 2.70 2.85 2.90 1.40	35th	CBD Holt Howard Layton College W. Good Hope	$0.40 \\ 1.00 \\ 1.40 \\ 2.05 \\ 2.55 \\ 2.60$
	Howard Layton College State	1.80 2.45 2.95 1.20	Hawley	CBD Holt Howard Layton	1.90 2.50 2.90 3.55
Lisbon	CBD College 84th	0.90 3.05 0.70		College 84th W. Good Hope	4.05 0.20 1.10
68th	CBD Holt Howard Layton College	2.05 2.65 3.05 3.60 4.20	84th	CBD Holt Howard Layton College	2.10 2.70 3.10 3.65 4.25
National	CBD Locusi Keefe	1.05 1.85 1.95	Lloyd	CBD College 84th	0.80 2.95 0.60
	Capitol W. Good Hope 84th	2.25 1.70 0.85	State	CBD Holt Howard	0.30 0.90 1.20
W. Good Hope	Hampton 68th 84th	0.90 0.90 0.90		Layton College 84th	1,95 2,45 0,30
College	CBD	2.15			

Table 10. Total district 2 vehicle trips in 1963.

District-to- District Trips	Total Vehicle Trips	Total Freeway Trips	Percent on Freeway
2 to 1	60,637	12,120	20
2 to 4	60,116	12,020	20
2 to 5	19,925	9,960	50
2 to 9 through 11	9,190	9,190	100
2 to 12	440	440	100
2 to 13	4,121	4,121	100

Table 11. Entering and exiting percentages for district 2 vehicle trips in 1963.

District-to- District Trips	D			Percer	Percent Exiting									
	Percent Entering Using On Ramp			Using Off Ramp							0.00	From City		
	Capitol	Keefe	Locust	CBD	35th	Hawley	68th	84th	National	Holt	Howard	Layton	84th	College
2 to 1	40	20	40	100									1	
2 to 4	40	20	40	25	25	20	10	5	15					
2 to 5	40	20	40							25	30	15		30
2 to 9														
through 11	40	20	40										100	
2 to 12	40	20	40										100	
2 to 13	40	20	40											100

Table 12. Total district 4 vehicle trips in 1963.

District-to- District Trips	Total Vehicle Trips	Total Freeway Trips	Percent on Freeway
4 to 1	74,078	18,520	25
4 to 3	4,075	4,075	100
4 to 6	4,245	4,245	100
4 to 7	4,770	4,770	100
4 to 9 and 11	39,750	39,750	100
4 to 12	1,789	1,789	100
4 to 13	8,581	8,581	100

Table 13. Entering and exiting percentages for district 4 vehicle trips in 1963.

										Percent Exiting				
District-to- District Trips	Descent Entering Using On Down									Using Off Ramp at CBD	From City			
	Atthe 68th Hawley 35th National Lisbon Lloyd						State CBI	CBD	Locust		W. Good Hope	84th	College	
				-,						• ~ -				•
4 to 1	10	12	9	12	17	19	12	9	0	100				
4 to 3	7	8	6	9	12	NT	NT	6	30		100			
4 to 6	7	8	6	9	12	NT	NT	6	30		100			
4 to 7	7	8	6	9	12	NT [*]	NT	NT	30			100		
4 to 9 and 11	NT	NT [*]	6	9	12	13	9	6	30				100	
4 to 12	NT [*]	NT	6	9	12	13	9	6	30				100	
4 to 13	7	8	6	9	12	13	9	6	30					100

residents of districts 2 and 4 in 1969 and 1970 was estimated to be \$713,641 and \$754,421 respectively. These savings for a \$20,000 property taxpayer were found to be \$3.78 and \$3.71 for 1969 and 1970 respectively.

As mentioned previously, freeway use before the opening of the Marquette interchange was relatively lower. The estimate of travel time savings for the first 7 years of operation of the partially completed freeway system, therefore, was made on the basis of a comparison of annual freeway VMT (vehicle kilometers of travel) in the county during different periods. VMT for 1962 through 1966 was 11.51×10^8 (18.53×10^8 vehicle km of travel). For 1967 to 1968 the VMT was 14.59×10^8 (23.49×10^8 vehicle km of travel) compared with 11.65×10^8 (18.76×10^8 vehicle km of travel) in 1970. The costs of travel time during the periods 1962 through 1966 and 1967 to 1968 were assumed to be 1.55/vehicle hr and 1.65/vehicle hr respectively. The dollar values of travel time savings during the 1962 through 1966 and 1967 to 1968 periods then were computed by applying ratios of freeway VMT (vehicle kilometers of travel) and the value of time. This analysis yielded a total savings of 624,486 for 1962 through 1966 and 842,665for 1967 to 1968. The savings for these 2 periods for the owner of a 20,000 property were 3.84 and 4.75 respectively.

SAVINGS IN VEHICLE OPERATING COSTS

One of the significant advantages of freeways over regular city streets is the smoother flow of traffic. This results in reduced vehicle operating costs per mile (kilometer). This aspect of freeway-related benefits was examined, and the estimated annual savings in vehicle operating costs due to the freeways in Milwaukee County are given in Table 16. It was assumed that the VMT (vehicle kilometers of travel) that actually occurred on freeways would have occurred on city streets if there were no freeways. This assumption may not be fully accurate because freeways might generate some new traffic, but the assumption was consistent with the approach used in current urban transportation planning studies except that the freeway-oriented routes may be longer than alternative arterial routes for some trips. It appeared, however, that the overestimation of savings in operating costs, if any, would be insignificant for this study and would be offset by the conservative approach used in estimating some of the other benefits.

The operating costs on freeways and arterial streets used in this analysis were 5.94 and 6.10 cents/vehicle mile (3.69 and 3.79 cents/vehicle km) respectively for 1963 and were the same as those used by the Southeastern Wisconsin Regional Planning Commission (2). Since freeway-caused savings in vehicle operating costs are greater for trucks than for automobiles, an adjustment factor for trucks (1.1228) was used (2). The freeway VMT (vehicle kilometers of travel) multiplied by the difference in operating costs and the truck factor yielded the savings in operating costs attributable to freeways.

Based on the annual operating cost savings that accrued to the users of the Milwaukee County freeway system, the savings that accrued to the city residents as a whole and to owners of \$20,000 properties were estimated by using a procedure similar to that used for the analysis of accident cost savings. The results are given in Table 16.

SAVINGS FROM REDUCED NEED FOR ADDITIONAL ARTERIALS

The cost of constructing the freeway segments in the city of Milwaukee was reported to be \$211 million. If utility costs are deducted, the total is \$200.3 million (7). The freeway system in the city of Milwaukee consisted of both Interstate and non-Interstate highways, and Milwaukee County participated in financing both classes of freeways. The total share of the cost of the freeways inside the city that was borne by the county was \$22,203,000 (7). Because city residents paid approximately 58 percent of the total county property tax, we assumed that the city's share of the county's participation in freeway construction inside the city of Milwaukee was \$12,900,000.

Table 14. District 2 annual travel time savings for 1969 and 1970.

District-to- District Trips	Time Saved (vehicle hr/year)	City Area Factor	District-to- District Factor	Time Saved City Residents (vehicle hr/year
2 to 1	64,750	0.75	1.00	48,560
2 to 4	194,775	0.65	1.00	126,605
2 to 5	130,295	0.75	0.50	48,860
2 to 9 through 11	158,695	0.75	0.20	23,805
2 to 12	7,605	0.75	0.50	2,850
2 to 13	72.305	0.75	0.50	27.115

Table 15. District 4 annual travel time savings for 1969 and 1970.

District-to- District Trips	Time Saved (vehicle hr/year)	City Area Factor	District-to- District Factor	Time Saved City Residents (vehicle hr/year)
4 to 1	120,695	0.50	1,00	60,350
4 to 3	28,540	0,50	0.20	2,855
4 to 6	29,880	0.50	0.25	3,735
4 to 7	41,685	0.50	0.14	2,920
4 to 9 and 11	231,860	0.50	0.20	23,185
4 to 12	10,735	0.50	0.50	2,685
4 to 13	124,615	0.50	0,55	34,270

Table 16. Vehicle operating cost savings for Milwaukee County freeways.

Year	VMT (in billions)	Annual Operating Cost Savings (1963 dollars)	Adjusted Annual Operating Cost Savings [*] (dollars)	Annual Operating Cost Savings Assigned to City (dollars)	Annual Operating Cost Savings per Individual (dollars)
1962	0.064	114,975	113,612	75,541	0.47
1963	0.116	208,392	208,392	138,560	0.87
1964	0.305	547,926	555,049	369.052	2.28
1965	0.300	538,944	555,112	374,312	2.28
1966	0.366	657,512	696,305	462,973	2,77
1967	0.577	1,036,569	1,126,751	749,177	4,29
1968	0.882	1,584,495	1,788,895	1,187,647	6.59
1969	1.106	1,986,907	2,350,511	1,558,859	8.26
1970	1.165	2,092,900	2,591,010	1,726,131	8,49
Total		8,768,620	9,985,637	6,642,252	36.30

Table 17. Savings due to reduced need for additional arterials.

Year	Percent of Total	Savings (dollars)	Savings fo Individual" (dollars)	
1962	0	0	0	
1963	10	290,000	1.81	
1964	10	290,000	1.79	
1965	5	145,000	0.88	
1966	5	145,000	0.87	
1967	5	145,000	0.83	
1968	5	145,000	0,80	
1969	20	580,000	3.07	
1970	40	1,160,000	5.71	
Total		2,900,000	15.67	

*\$20,000 property owner.

Note: 1 mile = 1_6 km.

*Adjusted for inflation based on consumer price indexes in Table 1... \$20,000 property owner.

Table 18. Summary of quantified costs and benefits.

	Total Tax Loss (dollars)		Accident Savings (dollars)		Time Savings (dollars)		Vehicle Op Savings (do	erating Cost llars)	Savings From Reduced Need for Arterials (dollars)	
Year	City	Individual*	City	Individual	City	Individual*	City	Individual*	City	Individual"
1953	44,240	0.40								
1954	66,290	0.56								
1955	71,290	0.57								
1956	81,260	0.61								
1957	118,410	0.84								
1958	208,950	1.42								
1959	325,650	2,17								
1960	386,030	2.48								
1961	434,730	2.77								
1962	646,890	4.04	292,463	1.83			75,541	0.47	0	0
1963	925,910	5,79	458,781	2.87			138,560	0.87	290,000	1.81
1964	1,261,640	7.78	1,347,486	8.31			369,052	2.28	290,000	1.79
1965	1,495,680	9,10	1,474,937	8.97			374,312	2.28	145,000	0.88
1966	1,881,500	11,28	1,546,810	9.27	624,486	3.84	462,973	2.77	145,000	0.87
1967	2,310,600	13.23	2,705,830	15.50			749,177	4.29	145,000	0.83
1968	2,645,530	14.67	4,753,809	26,36	842,665	4.75	1,187,647	6,59	145,000	0.80
1969	2,762,400	14.64	6,075,708	32,20	713,641	3.78	1,558,859	8,26	580,000	3.07
1970	3,091,330	15.21	6,705,290	32,99	754,421	3.71	1,726,131	8.49	1,160,000	5.71
Total	18,758,330	107.56	25,361,114	138.30	2,935,213	16.08	6,642,252	36.30	2,900,000	15.76

\$20,000 property owner.

If no freeways had been built in the city, then an additional burden would have been imposed on the existing street system. To maintain reasonable service, the city would have had to construct additional arterial streets. For this paper, we assumed that, in the absence of the freeway system, only 50 percent of the freeway travel volume would have had to be serviced by new surface arterial streets and that the other 50 percent would have used either existing surface arterials or public transit facilities. Based on these assumptions, we estimated that approximately 40.5 miles (65.21 kilometers) of additional 6-lane arterial surface streets costing approximately \$54,475,000 for engineering, construction, and rights-of-way would have been required by 1970 within the city limits. This cost estimate is conservative and was based on average cost data for the county (3). If we assume a funding breakdown of 50 percent for state and federal sources and 50 percent for the county, then the share of the cost for Milwaukee County would be \$27,237,500. The city's portion (58 percent of total county property tax) would be \$15,797,750. A comparison of this cost for additional arterials with that for the freeways (\$12,900,000) shows that freeways saved the city taxpayers approximately \$2,900,000 in engineering, rights-of-way, and construction costs. The estimated distribution of this saving over the 9-year period and the savings that accrued to each \$20,000 property taxpayer are given in Table 17.

CONCLUSIONS

Right-of-way takings for the freeway system in the city of Milwaukee resulted in the removal of real estate property leading to a tax loss of \$18,758,330 from 1953 through 1970. However, a number of identifiable benefits accrued to the city residents that can be attributed to freeway construction. One of the significant benefits is increased traffic safety resulting in fewer accidents. The accident cost savings from 1962, when the first section of the freeway system was opened, through 1970 were estimated to be \$25,361,114. The freeway system also contributed toward savings in travel time and vehicle operating costs, which were estimated to be \$2,935,213 and \$6,642,252 respectively for 1962 through 1970. In addition, it was estimated that the requirement for the city's capital improvement funds for the 9-year period, 1962 to 1970, was reduced by \$2.9 million because the freeway system rather than additional arterial streets was constructed. Thus quantified benefits amounting to \$37,838,579 were more than twice as much as the tax loss of \$18,758,330. On an individual basis, the total benefit that accrued to a \$20,000 property owner was estimated to be \$206.44; the hypothetical tax increase was \$107.56.

A summary of the freeway costs and benefits considered in this study is given in Table 18. The results show that, although the hypothetical tax loss became fairly stable in the later years of the analysis period, some of the benefits increased significantly during the last 2 years. Benefits increased during 1969 and 1970 because all of the major freeway segments were connected in December 1968, when the Marquette interchange was opened. Thus a comparison of the costs and benefits for 1969 to 1970 reveals more than a comparison for the entire 1953 to 1970 period. For the year 1970, the quantified benefits amounted to \$10,345,842 and were more than 3 times greater than the corresponding tax loss of \$3,091,330.

The scope of the analysis was limited to the quantifiable items for which data were available. Even for some of the items included in the analysis, the available data were not fully adequate, and many assumptions had to be made. However, a conservative approach was taken to ensure that the benefits were not overestimated. One of the direct effects of freeways excluded from the analysis is their environmental impacts, which include air and noise pollution. Among the indirect effects that also were not considered are impacts of freeways on the land development pattern and land value. An interesting phenomenon related to the tax base is the reinvestment by the displaced household, business, or industry in real estate property within the city limits. Such reinvestments offset the tax loss and thus reinforce the findings of this study.

It should be mentioned that in the recent years much attention has been focused on the question of the possible revitalization of Milwaukee's central business district by the freeway. A study indicated that, from the standpoint of property values, the Milwaukee CBD suffered no adverse effects because of the freeway (8). Considering all the facts and figures presented in this study, we concluded that the loss in the property tax for the city of Milwaukee due to freeway right-of-way takings was amply compensated for by benefits attributable to the freeway.

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DISCUSSION

Floyd I. Thiel, Federal Highway Administration

Batchelor, Sinha, and Chatterjee provided an interesting and unique approach to the question of highway effects on local taxes. They calculated that the average property taxpayer in Milwaukee receives freeway benefits in the form of fuel, time, and accident savings that exceed any additional property taxes he or she might pay as a result of taxable properties being lost because of freeway construction.

The study seems useful in several ways. For example, it estimates the savings a city government realizes when a limited-access highway (financed from noncity revenues) reduces costs for arterial streets. The study also provides a good perspective by noting that freeway acquisition reduced tax rolls by only 1.5 percent and by demonstrating that freeway-user benefits exceed tax roll losses without regard to the tax roll gains associated with freeways.

However, to deal with the problems the authors cite-property owners' concern about freeway effects on adjacent neighborhoods and city officials' concern for the lost tax base of their cities—the study needs to analyze some of the secondary effects Milwaukee freeways have on tax rolls. In fact, ignoring all but the initial freeway effects on the tax base and relating user savings to this initial tax base loss raise problems.

One problem is that credence may be given to a common misapprehension that highway construction lowers tax rolls. Another problem is that arraying freeway-user benefits to cover tax roll losses may result in counting these benefits twice because user benefits typically are considered to justify user costs.

I feel that a tax base study should deal with secondary or net effects of freeway construction and not only the initial loss that ordinarily accompanies right-of-way acquisition. Typically, such initial effects are offset by development or redevelopment near the highway or elsewhere. In Milwaukee, for example, the \$33 million reduction in the tax rolls that occurred with right-of-way acquisition for freeways was accompanied by a gain in Milwaukee tax rolls of over \$500 million during the period when right-of-way was being acquired. To some extent, the gains as well as the losses in tax rolls are related to freeway construction.

An analysis of Milwaukee tax records by Alice Randill of the Federal Highway Administration indicates that tax rolls near I-94 are increasing significantly faster than they are elsewhere. This is based primarily on tax roll changes for a 20-block area on both sides of I-94 compared with tax roll changes for a 19-block area of Milwaukee removed from I-94. The area studied extends along I-94 for about 1 mile (1.6 km) and is bounded generally by Third Street on the east side of I-94, Sixth Street on the west, Greenfield on the north, and Lincoln on the south. The control area also extends from Greenfield on the north to Lincoln on the south and from Fifteenth to Sixteenth Streets.

From 1959, before right-of-way acquisition began, to 1973, some time after I-94 opened, assessed values for residential and commercial properties changed from \$2.8 to \$3.9 million in the study area and from \$3.0 to \$3.3 million in the control area. This was a change in tax rolls of about 41 percent in the study area and 9 percent in the control area. The overall change for Milwaukee was 39 percent. Analysis and inspection of the study and control areas showed that the increase in tax rolls in the study area resulted from redevelopment and development of land parcels in the study area. This property improvement activity is especially apparent west of I-94. It probably is related partly to the construction of a new high school about halfway between the study and control areas. Both the study and control areas are substantially developed; most are residential; some are commercial. It seems significant that the rate of tax roll growth in the study area matches or exceeds that for Milwaukee as a whole where a higher portion of the land (about 25 percent) is undeveloped.

This apparent experience in Milwaukee appears fairly typical. Several studies have indicated that development and redevelopment and revaluation of land near highways often quickly offset tax roll losses that result from right-of-way acquisition (9, pp. 34-36). For officials concerned with taxes for public services, understanding these secondary effects on tax rolls seems more important than understanding the nature and calculation of benefits that accrue to individuals as highway users.

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AUTHORS' CLOSURE

We appreciate Thiel's discussion. The main purpose of our paper was to present benefit-cost analysis of an urban freeway system. Accordingly, we considered primarily those conventional benefit items such as savings in operating cost and travel time, accident cost reduction, and the elimination of costs such as those necessary for constructing additional surface arterials. The residents of a central city were taken as the affected group, and the possible loss in tax base was included as the only cost. The analysis, as mentioned in the paper, did not deal with the secondary benefits and costs associated with urban freeway construction. It was, however, recognized in the paper that, perhaps, a significant reinvestment by the displaced household, business, or industry in real estate property within the city occurred that offset the assumed tax loss. Furthermore, there is evidence, as mentioned in the paper and as supported by the data given by Thiel, that urban freeways have, in fact, increased adjacent property values. On the other hand, the urban freeways also may have contributed to air and noise pollution. However, in our paper a conservative approach was taken to ensure that the benefits were not overestimated and that the costs were not underestimated.

The remarks made by Thiel further reinforce the conclusions made by the authors that the freeway system has provided, in fact, some tangible benefits for the residents of the city of Milwaukee. We acknowledge that detailed research should be conducted to make a more complete benefit-cost analysis of urban freeway systems.