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16. Abstract

This report presents some findings on the evaluation of bond financing for use in highway finance in Texas. It provides information that can be used by the Texas Department of Transportation (TxDOT) and others in deciding whether or not to include the issuance of bonds in the mix of funding that is available for highway investment. Use of bond financing is not, ultimately, a way of financing expenditures. It is merely a way of changing the timing of expenditures or reallocating the use of revenues over time. Eventually, the bonds plus interest and other charges associated with the bond issue must be repaid with revenues from either existing taxes or, possibly, new revenue sources. Because bond financing is an expenditure strategy as opposed to being a basic revenue source, the criteria for evaluating bonds are somewhat different from those typically used for evaluating alternative revenue sources. This report presents two main findings on the use of bonds. First, new analyses of the impact of bonds on the highway system and motorists are made using the Highway Performance Monitoring System investment analysis. These findings indicate that use of bonds will lead to deterioration of the highway system over time if available revenues remain at current levels, in real dollars. The negative impact is forecasted to increase dramatically at higher levels of bond use. Second, a public opinion survey of Texas residents was conducted to determine public attitudes toward bond financing and other means of highway finance. This survey indicates that the public supports the use of bonds by the State to finance highways in Texas. There is some indication that they are less favorably inclined toward bonds when they realize that use of bonds reduces future funding by about twice the level of the bond issue because of interest and other bond costs. There also is some indication that the public may support bonds more for specific facilities, as opposed to facilities in general. Research findings suggest that the Texas Department of Transportation should be very cautious in using bonds to finance transportation, unless new basic revenue sources are available to pay for the bonds.

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IMPLEMENTATION STATEMENT

This report presents some findings on the evaluation of bond financing for use in highway finance in Texas. It provides information that can be used by the Texas Department of Transportation (TxDOT) and others in deciding whether or not to include the issuance of bonds in the mix of funding that is available for highway investment.

Use of bond financing is not, ultimately, a way of financing expenditures. It is merely a way of changing the timing of expenditures or reallocating the use of revenues over time. Eventually, the bonds plus interest and other charges associated with the bond issue must be repaid with revenues from either existing taxes or, possibly, new revenue sources. Because bond financing is an expenditure strategy as opposed to being a basic revenue source, the criteria for evaluating bonds are somewhat different from those typically used for evaluating alternative revenue sources.

This report presents two main findings on the use of bonds. First, new analyses of the impact of bonds on the highway system and motorists are made using the Highway Performance Monitoring System investment analysis. These findings indicate that use of bonds will lead to deterioration of the highway system over time if available revenues remain at current levels, in real dollars. The negative impact is forecasted to increase dramatically at higher levels of bond use. Second, a public opinion survey of Texas residents was conducted to determine public attitudes toward bond financing and other means of highway taxation/finance. These findings indicate that the public is somewhat divided on the use of bonds. There is some indication that they are less favorably inclined toward bonds when they realize that use of bonds reduces future funding by about twice the level of the bond issue because of interest and other bond costs. There also is some indication that the public may support bonds more for specific facilities, as opposed to facilities in general.

Research findings suggest that the Texas Department of Transportation should be very cautious in using bonds to finance transportation unless new basic revenue sources are available to pay for the bonds.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation.

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SUMMARY

This report presents findings on the evaluation of bond financing for use in highway finance in Texas. It includes estimates of the impacts of using different levels of bond financing, as compared to a no bonds strategy. Estimated impacts include effects on overall user benefits, where benefits are measured as reductions in motorists' costs, and effects on pavement condition, average travel speeds, and vehicle operating costs. The report also presents the results of a public opinion survey that measures attitudes of Texans on bond financing and other selected financing methods. It provides information that can be used by the Texas Department of Transportation (TxDOT) and others in deciding whether or not to include the issuance of state bonds in TxDOT's overall finance and expenditure strategy.

CRITERIA FOR EVALUATING TAXATION AND BOND FINANCING

Researchers developed detailed criteria for evaluating different revenue sources in previous research. These criteria were considered for use in a logical evaluation of bond financing alternatives for Texas. The interim report included a brief review of the six criteria that were developed for evaluating alternative taxation and revenue sources: (1) equity considerations; (2) economic efficiency; (3) revenue potential and stability; (4) acceptability; (5) administrative feasibility; and (6) applicability.

This research concludes, however, that use of bond financing is not, ultimately, a way of financing expenditures. It is merely a way of changing the timing of expenditures or reallocating the use of revenues over time. Eventually, the bonds, plus interest and other charges associated with the bond issue, must be repaid with revenues from either existing taxes or new revenue sources. Because bond financing is an expenditure strategy as opposed to being a basic revenue source, this research develops a new multiple-period expenditure analysis to study the impacts on highway users of different magnitudes of bond issues.

RATES-OF-RETURN AND HIGHWAY FINANCING

Among the factors that may influence the decision about the appropriate level of highway spending is the rate-of-return from the increased spending. A spreadsheet program was used with output from the Highway Performance Monitoring System (HPMS) program to develop rates-of-return for different levels of funding. Using the latest available (1992) HPMS data set for Texas, simulation runs were made for several levels of funding. The base level of funding was set at a relatively low level, indicated by expected state highway revenues for construction categories covered by the HPMS model and several alternative levels, and were run representing the situation if current spending were supplemented with funds from new sources.

The rate-of-return analysis suggests several implications for level of highway spending on state highways in Texas. Projections of funds available for contract construction spending in the period from 1992 through 2002 indicate that about $1.4 billion to $1.6 billion will be available in most years. However, it appears that only about $1.0 billion will be available for the types of expenditures included in the rate-of-return analysis. This indicates that funding will be available for Strategy 3, as discussed in Chapter II of the report. Therefore, additional funding from new revenue sources would give an incremental rate-of-return similar to that shown for Strategy 4, or over 32 percent per year for amount of funds used in Strategy 4, or about $0.25 billion per year. The incremental rate-of-return decreases to about 16 percent for Strategy 5. This increment is much larger, however, amounting to about $1.0 billion per year in the period 1992-1997.

Researchers noted in the interim report on this project that: "incremental spending from issuing bonds would initially give very large returns; this would also imply less funding in future years, which would mean giving up even higher returns in future years, when the bonds plus interest would have to be repaid." It was further noted that additional study in the second year would include specific funding strategies over time. These analyses were made and support the quoted statement more dramatically than expected, as noted in the next section of this summary. Importantly, the new findings developed since the interim report support a conclusion that was not understood fully at the time the interim report was published. That conclusion is that rate-of-return analysis does not appear to be a good technique for evaluating bond strategies. The first inadequacy of rate-of-return analysis relates to the nature of criteria for comparing revenue-raising alternatives. The second relates to the use of rate-of-return analysis for evaluating expenditure strategies.

Researchers concluded that what is needed is an analysis method that evaluates the impact on the highway system and users of reallocating revenues over time using bond financing. Such a method was developed in this study and can be described as a multiple-period, net benefit method. This new method uses the same basic Highway Performance Monitoring System (HPMS) analytical models and data that are used in the rate-of-return analysis. The next section summarizes the results from this new method.

NET BENEFITS OF ALTERNATIVE BOND STRATEGIES

The most important finding from this research is the analysis of the impact on the overall highway network from using bond finance. New analyses of the impact of bonds on the highway system and motorists are made using the HPMS investment analysis. These findings indicate that use of bonds will lead to deterioration of the highway system over time if available revenues remain at current levels. The negative impact is forecasted to increase dramatically at higher levels of bond use.

Description of Bond Strategies

In this project, researchers evaluate four bond funding strategies and compare each to a no bonds strategy. These four strategies include the original strategy discussed in the report by Texas Comptroller John Sharp, which is to issue $150 million of bonds in each of five years, resulting in a total bond issue of $750 million. To test the effect of issuing different magnitudes of bonds, multiples of the amount of bonds for this strategy were used. These multiples are two, four, and eight, giving other strategies with total bond issues of $1.5 billion, $3.0 billion, and $6.0 billion. Like the basic Sharp strategy, these bonds are assumed to be issued over a five-year period.

Cash Flows from Bond Sales

In each of the bond strategies, bonds are issued in the first five years. Each issue is paid off over time starting immediately after it is issued, following the same pattern as assumed in the Sharp report. The bond issue for each year is paid out over 20 years, covering an overall time period of 25 years from the first issue to the final payment on the bond issue for the fifth

Table S-1. HPMS Funding Period Amounts by Period, by Bond Strategy

HPMS Period	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Funds Available for Highway Improvement (Millions of Dollars)				
1992-1996	5,000.0	5,527.7	6,055.3	7,110.7	9,221.3
1997-2006	10,000.0	9,273.3	8,546.6	7,093.3	4,186.5
2007-2016	10,000.0	9,425.6	8,851.1	7,702.3	5,404.6
2017-2026	10,000.0	10,000.0	10,000.0	10,000.0	10,000.0

year. The following table shows the effects of the alternative bond strategies on available funds in different HPMS funding periods. The values listed in the table are HPMS funding period amounts, in millions of dollars, by strategy. Four HPMS periods are used in the analysis. The lengths of these periods are changed from the four five-year periods typically used in HPMS analysis. The first period in the bond strategy analysis is five years long, and each of the other three periods are ten years long, giving an overall analysis of 35 years. The first five-year period covers the time when bonds are being issued, so during this period the four bond funding strategies have larger amounts of funds available for highway investment than does the no bonds strategy. For example, the $0.75 billion bond strategy has an extra $527.7 million available during the period. Only $527.7 million of extra funds are available for highway investment out of the $750 million of bonds issued because interest payments, which begin soon after the first year's bonds are issued, that are made during the first five years and costs of issuing and managing the bonds take the difference.

In the second two HPMS periods, the bond funding strategies have less funds available for highway investment, since the bonds are paid off during these periods. The last HPMS period, for years 2017-2026, shows each strategy with $10 billion, since all bonds have been paid off during the previous two periods. This fourth period is included in the analysis for purposes of modeling and evaluating the effects of bond strategies that continue even after the bonds are paid off. The reduction in the amount of total funds available for highway improvements during the previous periods are seen to continue having major effects during this fourth period.

In the first basic $0.75 million strategy, the amounts available for highway investment during the second two periods, the years 1997-2006 and 2007-2016, are reduced from $10,000.0 million (or $10 billion) per period to $9,273.3 million and $9,425.6 million. Overall the bond issue gives an extra $527.7 million in the first five years but reduces the amount available in the next two periods by $1,301.1 million, for a net reduction in the amount of highway funds available of $773.4 million. This means that some improvements can be made earlier, but the total funds available for highway improvements are considerably lower if bond financing is used.

Effects of Bonds On Net Benefits

The table on the next page shows the change in user benefits for the four bond-issuing strategies and for the no bonds strategy. In this table, positive values represent increases in user benefits (reductions in user costs). Negative values represent decreases in user benefits (increases in user costs). For each strategy, the change in user benefits is shown by rural, urban, and total. Values in the table show the effects of bond strategies on user benefits for the entire 35 year analysis period in present worth terms, with future benefits being discounted to the present using a seven percent discount rate. These values are calculated as the change in user costs for each bond strategy compared to the no bonds strategy of constant expenditures of $1.0 billion per year. All of these strategies use the same amount of revenues, equal to $1.0 billion per year for the period from 1992 through 2026. The no bonds strategy is included in

Table S-2. Effects of Bond Strategies on User Benefits, by Rural, Urban, and Total, in Millions of Dollars, Discount Rate = 7.0 Percent

Area Type	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Change in User Benefits (Millions of Dollars)				
Rural	0.0	23.0	59.0	-611.8	-12,644.3
Urban	0.0	-167.2	-953.4	-2,406.4	-51,107.1
Total	0.0	-144.2	-894.4	-3,018.2	-63,751.4

the table, showing that the change in benefits for it are zero since it is the base condition.

The next two strategies, for $0.75 billion and $1.50 billion show positive net benefits for spending on rural highways, but these positive values are more than offset by negative net benefits in urban areas. For example, the $0.75 billion strategy shows $23 million of user benefits in rural areas but this is offset by negative user benefits of $167 million in urban areas, for a net reduction in user benefits of $144.2 million. The $6.00 billion bond strategy shows a very large negative user benefit of over $63 billion.

Based on this analysis, it is concluded that all of the bond strategies result in a reduction in user benefits as compared to the no bond strategy. Researchers performed a sensitivity analysis to determine the impact of using alternate discount rates of 3.5 percent and zero percent. Using lower discount rates results in even larger estimated negative values for impacts on users.

Additional information is developed on the effects of the bond funding strategies during the 35-year analysis period on: (1) pavement condition; (2) average overall travel speeds; and (3) vehicle operating costs. All of these measures affect the user benefits summarized in the preceding table. However, a separate presentation of these effectiveness measures provides

additional information on how the bond strategies are predicted to affect highways and motorists. All of these measures indicate that the use of bonds improves pavement and operating conditions during early years of the analysis period. After this initial improvement, the pavement and operating conditions deteriorate rapidly and are especially bad for the higher bond funding strategies.

PUBLIC OPINION SURVEY RESULTS

Researchers conducted a public opinion survey of Texas residents to determine public attitudes toward bond financing and other means of highway taxation and finance. These findings indicate that the public supports the use of bonds. Over 56 percent of the survey participants support the State issuing bonds to build highways as compared to only seven percent opposing use of bonds, with slightly over 36 percent of those surveyed being neutral, having no opinion, etc. Answers to another question indicate that Texans are less favorably inclined toward bonds when they realize that use of bonds reduces future funding by about twice the level of the bond issue, due to interest and other bond costs that must be paid in the future. There is also some indication that the public may support bonds more for specific facilities, as opposed to facilities in general.

CONCLUSION

Overall, these research findings suggest that the Texas Department of Transportation should be very cautious in using bonds to finance transportation unless new basic revenue sources are available to pay for the bonds. Although use of bond funding reduces user costs during the first ten to fifteen years of the analysis period, conditions deteriorate rapidly during the periods when bonds are being paid off. The negative impacts on user benefits continue even after the bonds are paid off. The deterioration during the latter years of the analysis period more than offsets the benefits during the early years, even though all effects are discounted using a seven percent discount rate.

I. INTRODUCTION

Recently, there have been recommendations that bond financing be used in Texas in order to complete important highway projects. The use of bonds has been advanced as a means to finance projects during times of economic shortfall while delaying payment for these projects until future years. There is a need to look at all aspects of bond financing so the Texas Department of Transportation can more fully evaluate this type of financing. Also, a report published in July 1991 by John Sharp, the Comptroller of Public Accounts for Texas, entitled *Breaking the Mold: A Report From the Texas Performance Review* [*45*], has numerous recommendations for changing transportation policies in Texas. Although the Sharp report provides some background information on these recommendations, the analysis needs to be extended. The objective of this study is to provide a more comprehensive analysis of bond financing of state highways in Texas. This report presents the findings of the study.

USE OF BOND FINANCING IN TEXAS

The Texas constitution generally prohibits the creation of debt "by or on behalf of the State" except as specifically authorized within the constitution or as amended by the voters of Texas. Because of this, Texas is regarded as a "pay as you go" state and has not used debt as extensively as many other states, even though Texas state agencies had issued about $7.5 billion of bonds as of December 31, 1990. Bonds are not used for financing highways at the state level in Texas, except for highways constructed by the Texas Turnpike Authority. These bonds typically are revenue bonds and are repaid with toll revenues. Municipalities and counties in Texas have relied heavily upon bond issues. While the Constitution restricts the state from using bonds to finance highway investment except for toll roads, Texas local jurisdictions as a whole borrowed more money than local governments in any other state during the 1980s. As shown in Table 1, Texas local jurisdictions lead the nation in accumulation of highway associated debt.

This may be due partially to the limited state funds available for local road building, as well as to the rapid growth of the 1970s and early 1980s, both of which resulted in a backlog of road projects and unrealistic expectations that growth would continue indefinitely. One danger is that debt service and maintenance requirements of an expanded local road system may come to tax the resources of some localities in coming years.

Another aspect of bond financing is road utility districts. The combination of a decline in funds, due partially to the oil price rise of 1979-1980, and rapid growth, especially in the five major metropolitan areas, led the Texas legislature to authorize the creation of road utility districts (RUD) in 1984. RUDs encourage private participation in local road development. RUDs may issue bonds up to the value of 25 percent of the assessed value of the real property within the district supported by property taxes on assessing fees.

Table 1. Total Highway-Associated Debt by Selected States: Municipal, County, and State Level, in 1989 ($1000)

State	State Debt	County Debt	Municipal Debt	Total Debt
California	85,140	145,441	550,546	781,127
Florida	1,873,129	313,062	114,838	2,301,027
Illinois	1,750,555	36,763	173,920	1,961,238
Michigan	294,900	37,441	82,524	414,865
Minnesota	112,593	47,161	659,307	819,061
New York	1,732,098	380,475	2,296,033	4,408,606
Ohio	271,938	23,232	294,519	589,689
Pennsylvania	2,750,904	44,995	79,379	2,875,278
Virginia	605,182	180,410	458,938	1,244,530
Texas	567,225	1,992,586	2,597,203	5,157,014
National	28,066,297	5,621,423	11,608,430	45,296,150

Source: Federal Highway Administration [*24*]

The major advantage of RUDs is that they reduce the burden on a private developer to pay the full costs of roadway improvements. Instead, tax-free bonds are sold and paid for through the special ad valorem tax to spread the costs both over time and among affected users. It is limited by its applicability to major arterial and feeder roadways only. The Texas Department of Transportation Commission has recently approved two RUDs: the Denton County Road District and Northgate Crossing in Harris County.

THE TEXAS PERFORMANCE REVIEW

As a result of forecasted shortfalls in state revenues and to increase efficiency in state government, the 72nd Legislature of the State of Texas passed Senate Bill 111, which initiated a comprehensive review of Texas state government. "With less than five months to deliver a report to the Legislature, the Comptroller of Public Accounts assembled a team of more that 100 auditors to identify and analyze issues and compile recommendations. The audit teams, in turn, began intensive interviews with agency and legislative staff and other experts, both inside and outside state government" [*45*]. The result of this effort is a two-volume set of recommendations covering almost every aspect of state government spending [*45*].

Capital Finance and Debt Management

One of the areas that was extensively evaluated in the performance review was capital finance and debt management [*45*]. The review notes that the State of Texas has the lowest state debt burden and the highest local debt burden among the largest ten states. Although the state debt burden is low, it has been growing, and the Review sees an increased role for debt management in the future.

The performance review states that different types of bonds put varying amounts of pressure on state finances, with the two most significant types of bonds being general obligation bonds and bonds that are payable from the state's General Revenue Fund, some of which are general obligation and some of which are not. Although many general obligation bonds are designed to be paid from revenue sources other than the General Revenue Fund, "... a constitutional draw is made from state revenues to pay the debt service" [*45*]. The two principal types of bonds that fall into these categories are general obligation bonds issued to finance loan programs and capital expenditures. The general obligation bonds used to finance loan programs will not be a drain on general revenues unless there is extensive default in these loan programs. The bonds used to finance capital expenditures are quite different, and all of the debt service for these comes from the General Revenue Fund.

As of March 31, 1991, the amount of Texas general obligation and general revenue-backed bonds had grown to $3.1 billion from a level of $2.4 billion at the end of fiscal year 1986. The bonds for state capital investment had grown to $1.4 billion, an increase of 45 percent over 1986. This increase in bonds outstanding for capital expenditures is mainly related

to funding for prison construction and for the Superconducting Super Collider [*45*].

The performance review noted the increasing needs for infrastructure investment and that the state "... should begin to plan now so that the required capital expenditures can be made without threatening Texas' financial strength" [*45*]. To accomplish this goal, the performance review recommended that the state "... through the Bond Review Board, develop and the Legislature adopt a broad set of debt indicators to help establish state debt limits" [*45*]. The performance review made several recommendations for better managing capital expenditures and debt.

Transportation Recommendations

The Texas performance review made numerous specific recommendations for improving efficiency in the State's transportation agencies and functions, including consolidating functions, reducing the number of highway districts, changes in various fees and tolls, and other changes. A separate section of the Volume 2 report includes these recommendations. The performance review noted that the funding levels for state transportation expenditures were sufficient for funding only about 38 percent of all authorized highway projects planned for the next ten years. Because of this lack of funding, the performance review recommended that TxDOT:

> ... be statutorily authorized to use limited obligation bonds of up to 15 percent of construction spending not to exceed $150 million per year, and $750 million in the aggregate at any one time. The debt service on these bonds would be payable by a priority dedication of the motor fuels tax revenues as deposited in the State Highway Fund. The bonds would be issued by the Bond Review Board. If additional federal highway construction funds are made available to Texas (which is presently being considered in Congress), the revenue from the sale of highway bonds could be used to match Texas' share of these federal funds [*45*].

CRITERIA FOR EVALUATING BOND FINANCING

Research in this study has involved several "stops and starts" in that the original methods that we expected to use turned out to be somewhat inadequate and misdirected. The first inadequacy relates to the nature of criteria for comparing revenue-raising alternatives. The second relates to the use of rate-of-return analysis for evaluating expenditure strategies.

First of all, researchers anticipated that the general criteria typically used in evaluating highway finance alternatives could be applied to bonds. After trying to apply these criteria, which were summarized in the interim report, researchers concluded that they did not apply very well to bond financing because bond financing is not really a method of financing at all; rather, it is an expenditure strategy that reallocates available revenues over time through issuing bonds and paying them off. The price of obtaining funds for earlier expenditure is the interest that

must be paid on the bonds plus any costs associated with issuing and managing the bonds.

Secondly, after attempting to use rate-of-return analysis to compare bond financing strategies, researchers concluded that rate-of-return analysis is inadequate for evaluating bond financing strategies, as use of bonds does not really result in additional expenditures. Use of bonds simply reallocates funds over time, so issuing bonds cannot be evaluated in the same way as, say, new revenues from increased taxes, because there is no increase on which to calculate the rate of return. It was further concluded that what is needed is an analysis method that evaluates the impact on the highway system and users of reallocating revenues over time using bond financing. Such a method was developed in this study and can be described as a multiple-period, net benefit method. This new method uses the same basic Highway Performance Monitoring System (HPMS) analytical models and data used in the rate-of-return analysis.

New Multiple-Period, Net Benefit Method

The new multiple-period, net benefit method used in this study to evaluate bond financing is a multiple period analysis in that the four standard HPMS periods are used in the analysis. The typical HPMS analysis uses four periods of five years each. However, the new analysis method is different from the typical HPMS analysis in that the lengths of the periods are increased so that the longer-term impact of the bond issue can be analyzed.

The HPMS analytical package does not include calculation of rates of return or net benefits from alternative expenditure strategies. It does, however, produce output that can be used to develop such estimates. Researchers developed two separate programs to calculate rates of return and net benefits from alternative expenditure strategies using the HPMS output files. The first program is the rate-of-return program used to produce the results reported in Chapter II, evaluating several levels of expenditure. Chapter II also includes some description of the HPMS data and assumptions used in the analyses in both Chapters II and III. The second program, which covers a longer time period, uses the new multiple-period, net benefit method. Chapter III reports its use in comparing bond strategies.

It should be emphasized, however, that the rate-of-return analysis presented in the interim report is still a valid method for evaluating the rate of return from new expenditures, such as additional tax revenues or additional federal funds. Therefore, the rate-of-return results are included in this report, in Chapter II, since this analysis provides interesting information on the benefits that could be gained from increasing funds available for transportation.

Public Opinion Survey

Another criterion for evaluating bond financing in Texas is public opinion and desires on types of financing used. To obtain some idea of how Texans feel about bond financing, researchers conducted a public opinion survey with a random sample of Texans. Chapter IV

presents the results of this survey.

II. RATE-OF-RETURN ANALYSIS

One of the objectives of this study is to obtain rates-of-return for highway investment in Texas using the 1992 Highway Performance Monitoring System (HPMS) sample data. The estimation procedures very closely follow a previous study, TxDOT Project 1221, entitled *An Assessment of Transportation Infrastructure Needs* [*1*]. To develop estimates of user cost savings and internal rates-of-return for highway investment in Texas, researchers studied a range of investment scenarios using 1992 Texas HPMS sample data. Originally, researchers had hoped to be able to obtain some rates-of-return for highway investment at the district level; however, because of lack of sufficient HPMS sections in some of the districts, there was not enough meaningful data for analyses. Therefore, a rural versus urban area type of investigation is developed to partially serve this role of the study.

USER COST CALCULATIONS

The output from the HPMS Impact Analysis and Needs Analysis includes average travel speed in miles per hour and vehicle operating costs and accident rates (for fatal, injury, and property damage) per 1,000 vehicle miles traveled for the last year of each analysis period. In this research, the HPMS output was converted to metric units: distances in kilometers; speeds in kilometers per hour; and costs in dollars per 1,000 kilometers. These metric units are used in all tables and figures reporting the HPMS output. Using accident rate factors, the three accident rates are first converted into number of fatalities, number of nonfatal injuries, and number of damaged vehicles.

In multiplying unit accident costs by the respective accident numbers, accident costs by accident type per 1000 vehicle kilometers traveled are obtained, and the summation of the three types of accident costs yields the total accident costs per 1000 vehicle kilometers traveled. Amounts of travel time for 1000 vehicle kilometers traveled for each of the seven vehicle types is calculated by dividing vehicle kilometers traveled by the average travel speed. By applying the vehicle mix, also an output item, and the respective unit travel time costs by vehicle type to the travel times, time costs per 1000 vehicle kilometers traveled are obtained. This gives the three described user costs: operating costs, accident costs, and time costs, in dollars per 1000 vehicle kilometers traveled. Multiplying daily vehicle kilometers traveled, another HPMS output item, to the user costs per 1000 vehicle kilometers traveled gives the daily user costs of the three categories, which are further multiplied by 365 days to yield the annual user costs of each category. The summation of the three annual user costs categories yields the total user costs. Since defaults used in the development of user cost relationships in the 1987 version of the HPMS Program are based on 1980 data, updating factors developed in the recent National Cooperative Highway Research Program (NCHRP) Project 7-12 [*2*], MicroBENCOST, and some national indexes are used to bring all costs to 1992 dollars. A brief discussion follows on updating each of the user costs categories.

Operating Costs

Defaults used for determining relationships between highway characteristics and the resulting vehicle operating costs output from the 1987 HPMS Impact Model were based on 1980 data. Therefore, the unit operating costs output from the Impact Analysis of HPMS are updated from 1980 to 1992 using the Gross National Product implicit price deflator, using an update factor of 1.7.

Time Costs

Unit time costs for the seven vehicle types used in HPMS were taken from NCHRP Study 7-12 [*2*], and were updated to 1992 dollars using the Consumer Price Index (CPI). The following list contains the 1992 updated unit time costs:

	- $ -
Small Passenger Cars	10.46
Large Passenger Cars	10.46
Pickup/Van	10.46
Single Unit Truck, 2-Axle	14.64
Single Unit Truck, 3+-Axle	17.47
Multi Unit Truck, 4-Axle	21.78
Multi Unit Truck, 5+-Axle	24.17

Accident Costs

Conversion factors to change fatal, nonfatal injury, and PDO (Property Damage Only) accident rates into numbers of fatalities, non-fatal injuries, and damaged vehicles were taken from *The Economic Cost to Society of Motor Vehicle Accidents* by the National Highway Traffic Safety Administration (NHTSA) [*16*] published in 1983, but based on 1980 data. A previous study [*1*] calibrates these factors. The current study used these same calibrated factors for the different accident types, which are listed below.

Fatalities per Fatal Accident	1.128
Nonfatal Injuries per Fatal Accident	1.081
Injuries per injury Accident	2.209
Damaged Vehicles per PDO	1.700

Unit accident costs adopted were from NCHRP Study 7-12 [*2*] and are updated from 1990 to 1992 dollars using the CPI. They are as follows:

	Rural - $ -	Urban - $ -
Per Fatality	1,192,103	1,049,394
Per Nonfatal Injury	26,718	15,344
Per Damaged Vehicle	2,296	1,363

Note that the cost per fatality represents only the economic cost and not the full loss from accident fatalities.

DATA ITEMS

In the HPMS Investment and Impact Analyses, there are several data items that are essential in running these analyses. These include traffic growth rate, initial funding allocation, and the analysis periods.

Traffic Growth Rates

From the 1992 HPMS sample data, an average traffic growth rate of 2.29 percent is calculated. This growth rate is used for forecasting the funding levels for the 10-year period, 1992-2002.

Initial Budget Levels

Researchers studied six funding strategies. The initial budget levels are set as follows to allow for variations in the funding levels. Strategy 1 starts in year 1 at an annual budget of $0.5 billion dollars; Strategy 2, $0.75 billion; Strategy 3, $1.0 billion; and Strategy 4 has an initial budget of $1.25 billion. These four funding levels are assumed to grow at 2.29 percent, the average traffic growth rate described above. The projected funding amounts in 1997 and 2002 are then distributed across the functional classes by area type. The distribution percentages are based on the funding distribution obtained using the constrained full needs with no lane restriction on the 1992 Texas HPMS data. Strategies 5 and 6 represent the unconstrained full needs strategies with the former having a 12-lane restriction, while the latter has a 16-lane restriction.

Analysis Period

The analysis period used in running the HPMS analyses is 20 years, covering the period from 1992 to 2012; however, funds are allocated only to the first 10 years, that is, the first and second periods of the analysis, with third and fourth periods each receiving no funding at all.

As stated above, in an attempt to capture a more realistic situation, user benefits at the end of the analysis period are assumed to grow for five additional years at the same rate as the traffic growth rate. Therefore, the internal rates-of-return obtained for the study are based on a total of 25 years.

INVESTMENT ANALYSIS OUTPUT

From the HPMS Investment Analysis, actual funding levels used to produce the user cost data items are output in the Investment Summary, and the user costs items such as accident numbers, vehicle-miles traveled, vehicle mix, average speeds, and operating costs are output from the Impact Analysis.

Actual Funding Levels

The six funding strategies used in this study have the following total investment levels. Strategy 5 represents constrained full needs with the number of lanes restricted to 12 at the maximum, while Strategy 6 is restricted to 16 lanes. Each funding level is assumed to grow over the 10 years -- that is, the first and second periods covering the period from the base year 1992 to the year 2002 -- at 2.3 percent annually, the traffic growth rates discussed above. Table 2 gives the cumulative funding levels for the six strategies. Table 3 shows the funding allocation by rural/urban and by functional class used in the analyses for the first and second periods. From the first four strategies in Table 2, it is apparent that funding for the rural area represents about one-third of the total funding invested while urban projects capture the remaining two-thirds. However, as funding is increased beyond that of Strategy 4, these ratios change. The additional amount of funding would be spent on urban projects, indicating funding of $5.2 billion to be the maximum amount needed to carry out all the rural improvements. The increase in funding in going from Strategy 5 to Strategy 6 is for allowing additional lanes above 12 lanes per facility in urban areas. Therefore, the increased funding from $17.05 billion of Strategy 5 to $19.42 billion of Strategy 6 represents funding spent on urban projects expanding some existing facilities from 12 to 16 lanes.

Further funding breakdown by functional class and by period, as indicated in Table 3, reveals that among functional class categories, the major part of the funding is invested in the major arterial category in the rural area and the interstate category in the urban area. Comparing across time periods, all functional categories almost invariably receive higher funding for the first period than the second. The only exceptions are the major arterial category in the rural area and collector in the urban area. The most prominent funding investment increases are from the urban interstate and other freeway categories under the unlimited budgets of Strategies 5 and 6.

Table 2. Texas Investment Costs of Six Funding Strategies, 1992-2002

	Investment Costs* 1992-2002, Billions $		
Funding Strategy	Rural	Urban	Total
Strategy 1	2.20	3.99	6.19
Strategy 2	3.27	5.99	9.26
Strategy 3	4.38	7.97	12.35
Strategy 4	5.11	9.73	14.84
Strategy 5	5.15	11.90	17.05
Strategy 6	5.15	14.27	19.42

*Investment costs each year are assumed to grow proportionally to traffic growth. Costs are in constant 1992 dollars.

Table 3. Texas Funding Distribution, by Period and by Functional Class, 1992-2002

Functional class	First Period Investment Level, 1992-1997, in Billions $					
	Strgy 1	Strgy 2	Strgy 3	Strgy 4	Strgy 5	Strgy 6
Rural						
Interstate	0.15	0.22	0.30	0.37	0.41	0.41
Oth Prin Art	0.31	0.47	0.63	0.73	0.74	0.74
Min Art	0.11	0.16	0.21	0.21	0.21	0.21
Maj Art	0.40	0.60	0.80	0.85	0.85	0.85
Min Col	0.16	0.24	0.32	0.39	0.42	0.42
Subtotal	1.13	1.69	2.26	2.55	2.63	2.63
Urban						
Interstate	0.86	1.29	1.72	2.15	4.90	6.48
Oth Exp/Fwy	0.57	0.86	1.14	1.43	3.12	3.87
Oth Prin Art	0.39	0.59	0.79	0.99	1.44	1.45
Min Art	0.13	0.19	0.26	0.32	0.43	0.43
Collect	0.10	0.15	0.19	0.22	0.22	0.22
Subtotal	2.05	3.08	4.10	5.11	10.11	12.45
Total	3.18	4.77	6.36	7.66	12.74	15.08

Table 3. Texas Funding Distribution, by Period and by Functional Class, 1992-2002 (Continued)

Functional class	Second Period Investment Level, 1998-2002, in Billions $					
	Strgy 1	Strgy 2	Strgy 3	Strgy 4	Strgy 5	Strgy 6
Rural						
Interstate	0.14	0.21	0.28	0.32	0.27	0.27
Oth Prin Art	0.30	0.44	0.59	0.70	0.70	0.70
Min Art	0.10	0.15	0.20	0.25	0.28	0.28
Maj Art	0.38	0.56	0.75	0.92	0.97	0.97
Min Col	0.15	0.22	0.30	0.37	0.30	0.30
Subtotal	1.07	1.58	2.12	2.56	2.52	2.52
Urban						
Interstate	0.81	1.22	1.62	1.99	0.19	0.21
Oth Exp/Fwy	0.54	0.81	1.08	1.32	0.20	0.21
Oth Prin Art	0.37	0.56	0.75	0.82	0.79	0.79
Min Art	0.12	0.18	0.24	0.27	0.24	0.24
Collect	0.10	0.14	0.18	0.22	0.37	0.37
Subtotal	1.94	2.91	3.87	4.62	1.79	1.82
Total	3.01	4.49	5.99	7.18	4.31	4.34

User Costs and Savings

Operating costs, accident costs, and time costs per 1,600 vehicle kilometers traveled for the end year of each analysis period are calculated for each functional class following the same procedures and updating factors used by the Federal Highway Administration [*6*] and described above. Each is then multiplied by the vehicle kilometers traveled for the respective year and functional class, as shown in Table 4, to yield the total operating costs, total accident costs, and total time costs for the end year of each period. The sum of the three costs constitutes total user costs for the end year of each period. Total user savings are the difference between the user costs of a funding strategy and the "no maintenance" strategy. Table 5 shows user savings calculated for rural and urban areas as well as for all areas for the end year at each of the four analysis periods. Since benefits from improvements performed in the earlier periods typically continue for long periods of time, the annual user savings are the greatest in the 4th period. Although more funds are allocated to urban improvements, rural improvements produce greater user savings in the years that are analyzed. Nevertheless, the urban investments probably would produce greater overall user savings if the improvements were studied for a longer time period. Large amounts of urban investments go to the improvement of adding lanes that have very long service lives of 30 or even 50 years. Benefits of these improvements are not fully captured in the user savings during the 20 analysis years and the additional five extended years. Incremental user savings are calculated by comparing savings of consecutive strategies to the savings of their previous strategies. Table 6 shows incremental total investments of the six strategies and their incremental user savings of the end year of each of the four periods. Table 7 shows the breakdown of the total investments over all periods of each strategy by two improvement types: (1) added capacity and (2) pavement, reconstruction, and resurfacing. It also shows the incremental investment costs of the two improvement types. The incremental cost breakdown clearly shows as investment increases, most of the additional costs go into urban added capacity improvement projects.

Rates-of-Return

Internal rates-of-return (IRR) of each strategy for rural, urban, and overall area, are calculated using the user savings obtained earlier, daily vehicle-miles traveled, a discount rate of 2.29 percent, and a duration of 25 years. Incremental internal rates-of-return are obtained similarly by replacing user savings with incremental user savings. Table 8 gives the internal rates-of-return and the incremental rates-of-return of the six strategies. Figure 1 illustrates the relationship of the ten-year investment costs and the incremental internal rates-of-return for rural, urban, and overall area. Investments for rural area produce the highest incremental rates-of-return.

Table 4. Texas Daily Vehicle Kilometers Traveled, in Millions

Functional class	1992	1997	2002	2007	2012
Rural					
Interstate	55.0	61.2	69.2	77.2	85.3
Oth Prin Art	71.3	78.9	88.5	98.2	109.4
Min Art	28.2	30.6	33.8	38.6	41.8
Maj Art	73.1	82.1	93.3	104.6	119.1
Min Col	8.2	9.7	11.3	12.9	14.5
Subtotal	235.3	262.3	296.1	331.5	370.1
Urban					
Interstate	105.4	117.5	130.4	144.8	160.9
Oth Exp/Fwy	66.3	74.0	83.7	95.0	107.8
Oth Prin Art	67.9	75.6	83.7	93.3	104.6
Min Art	17.2	19.3	22.5	25.7	29.0
Collect	8.9	9.7	11.3	14.5	16.1
Subtotal	265.7	296.1	331.5	373.4	418.4
Total	501.5	558.4	627.6	704.9	788.6

Table 5. Texas User Savings of Six Funding Strategies, for 1997, 2002, 2007, and 2012

Funding Strategy	User Savings,* Dollars per 1000 Vehicle Kilometers			
	1997	2002	2007	2012
Rural				
Strategy 1	35.0	134.0	222.5	237.4
Strategy 2	41.9	157.2	256.6	271.9
Strategy 3	45.7	168.0	274.3	291.7
Strategy 4	47.5	171.9	281.1	301.3
Strategy 5	47.7	172.0	281.2	301.2
Strategy 6	47.7	172.0	281.2	301.2
Urban				
Strategy 1	40.7	126.1	181.8	200.5
Strategy 2	47.4	147.7	213.2	237.4
Strategy 3	52.1	160.1	231.5	261.1
Strategy 4	54.7	164.7	239.2	272.2
Strategy 5	64.1	168.9	243.4	274.3
Strategy 6	64.4	169.6	244.8	277.0
Overall				
Strategy 1	38.1	129.8	200.9	217.9
Strategy 2	44.9	152.2	233.6	253.6
Strategy 3	49.2	163.8	251.7	275.5
Strategy 4	51.4	168.1	258.9	285.9
Strategy 5	56.4	170.4	261.2	287.0
Strategy 6	56.6	170.8	261.9	288.4

*Savings represent savings in the last year of each period when compared with no maintenance strategy in the same period.

Table 6. Texas Incremental Investment Costs and Incremental User Savings of Six Funding Strategies for 1997, 2002, 2007, and 2012

Funding Strategy	Incremental Investment Billion $	Incremental User Savings,* Dollars per 1000 Vehicle Kilometers			
		1997	2002	2007	2012
Rural					
Strategy 1	2.20	35.0	133.9	222.4	237.3
Strategy 2	1.07	6.8	23.2	34.1	34.4
Strategy 3	1.11	3.8	10.7	17.6	19.8
Strategy 4	0.73	1.8	3.9	6.7	9.5
Strategy 5	0.04	0.1	0.1	0.1	-0.1
Strategy 6	0.00	0.0	0.0	0.0	0.0
Urban					
Strategy 1	3.99	40.7	126.0	181.7	200.5
Strategy 2	2.00	6.7	21.6	31.4	36.8
Strategy 3	1.98	4.7	12.3	18.3	23.7
Strategy 4	1.76	2.6	4.5	7.6	11.1
Strategy 5	2.17	9.3	4.2	4.2	2.1
Strategy 6	2.37	0.3	0.6	1.3	2.6
Overall					
Strategy 1	6.19	38.0	129.8	200.8	217.8
Strategy 2	3.07	6.7	22.3	32.7	35.7
Strategy 3	3.09	4.2	11.6	18.0	21.8
Strategy 4	2.49	2.2	4.2	7.2	10.4
Strategy 5	2.21	5.0	2.2	2.2	1.0
Strategy 6	2.37	0.1	0.3	0.6	1.4

*Savings represent savings in the last year of each period when compared with no maintenance strategy in the same period.

Table 7. Total Investment Costs and Incremental Investment Costs by Improvement Type and by Area Type

Funding Strategy	Investment million $		Incremental Investment million $	
	Added Capacity	Pavement Reconstruction, Resurfacing	Added Capacity	Pavement Reconstruction, Resurfacing
Rural				
Strategy 1	296	1,905	296	1,905
Strategy 2	485	2,784	189	879
Strategy 3	853	3,530	368	746
Strategy 4	1,009	4,096	156	566
Strategy 5	1,013	4,146	4	50
Strategy 6	1,013	4,146	0	0
Urban				
Strategy 1	2,874	1,115	2,874	1,115
Strategy 2	4,613	1,377	1,739	262
Strategy 3	6,411	1,557	1,798	180
Strategy 4	7,979	1,760	1,568	203
Strategy 5	10,226	1,657	2,247	-103
Strategy 6	12,587	1,660	2,361	3
Overall				
Strategy 1	3,170	3,020	3,170	3,020
Strategy 2	5,098	4,161	1,928	1,141
Strategy 3	7,264	5,087	2,166	926
Strategy 4	8,988	5,856	1,724	769
Strategy 5	11,239	5,803	2,251	-53
Strategy 6	13,600	5,806	2,361	3

Table 8. Internal Rates-of-Return (IRR) and Incremental Internal Rates-of-Return on Texas Investments

Funding Strategy	Incremental Investment Billion $	IRR	Incremental IRR
Rural			
Strategy 1	2.20	116.4	116.4
Strategy 2	1.07	102.7	68.9
Strategy 3	1.11	92.7	50.3
Strategy 4	0.73	88.8	44.2
Strategy 5	0.04	87.7	19.9
Strategy 6	0.00	87.7	0.0
Urban			
Strategy 1	3.99	96.3	96.3
Strategy 2	2.00	84.3	53.7
Strategy 3	1.98	76.3	42.9
Strategy 4	1.76	69.9	28.1
Strategy 5	2.17	53.6	16.3
Strategy 6	2.37	48.5	4.0
Overall			
Strategy 1	6.19	104.0	104.0
Strategy 2	3.07	91.4	59.7
Strategy 3	3.09	82.7	45.8
Strategy 4	2.49	77.0	32.7
Strategy 5	2.21	62.9	16.4
Strategy 6	2.37	58.2	4.0

Note: Internal rates-of-return are calculated using a traffic growth rate of 2.29 percent and estimated user benefits over a total of 25 years, with user benefits per 1,000 vehicle kilometers in the last five years assumed to be the same as year 20.

Results

The analysis of the impacts of various investment levels on the highway network in Texas shows some interesting results. Each of the limited budget strategies, from 1 to 4, would yield an extremely high return for the investment in highway infrastructure. In Table 15, Strategy 4 has an incremental rate-of-return of 32.7 percent, for both rural and urban areas combined. This funding level would represent a substantial increase in current funding for highways in Texas and would yield very high benefits for motorists using those highways. A substantial part of that additional funding would go to pavement resurfacing and reconstruction. As can be seen in Table 14, Strategy 4 represents over $4 billion in pavement related expenditures over the 10-year period in rural areas and about another $1.8 billion in urban areas, for a total of about $5.9 billion. About $9 billion would be spent on added capacity in Strategy 4.

Strategies 5 and 6 represent unconstrained budget scenarios, with Strategy 5 having a 12-lane restriction and Strategy 6 having a 16-lane restriction. The additional or incremental investment for both of these strategies is almost exclusively for added capacity in urban areas, as shown in Table 14. Strategy 5 has a very favorable 16.3 percent incremental return, with a lower but positive 4 percent for Strategy 6. Strategy 5 represents an investment of over 17 billion dollars over the 10-year period covered by the analysis for added capacity and pavement rehabilitation.

The results of the analysis demonstrate the high return the citizens of Texas could receive by increasing the investment into the state's transportation network. The 16.3 percent annual return for Strategy 5 compares very favorably to current yields on long-term government bonds or spending in other areas by the state. It should be kept in mind that the HPMS analysis package used in this study does not cover all areas of transportation expenditures. For example, it does not cover bridges, highways built on new location, routine maintenance, intersections or interchanges, safety improvements, or any administrative expenses. Therefore, the $17 billion over 10 years estimated for Strategy 5, would be principally for adding capacity on existing highways, pavement resurfacing and reconstruction, and some geometric improvements. Figure 1 depicts the incremental rates-of-return for the different spending strategies.

Implications for Highway Financing

The rate-of-return analysis suggests several implications for use of bond financing of State highways in Texas. Projections of funds available for contract construction spending in the period from 1992 through 2002 indicate that about $1.4 billion to $1.6 billion will be available in most years. However, it appears that only about $1.0 billion will be available for the types of expenditures included in the rate-of-return analysis. This indicates that funding will be available for Strategy 3. Therefore, additional funding from bond financing would give an incremental rate-of-return similar to that shown for Strategy 4, or over 30 percent per year for

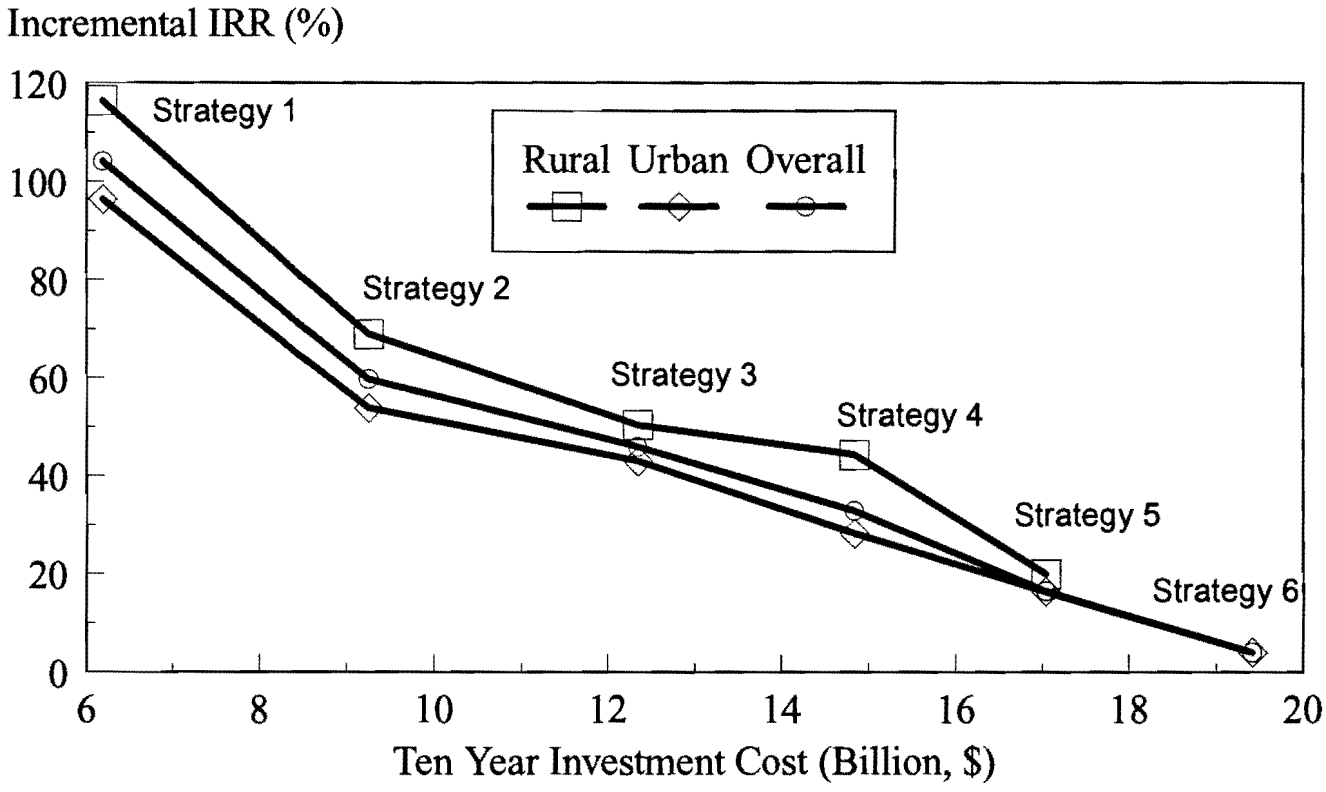


Figure 1. Texas Incremental Internal Rates of Return for Six Funding Strategies Using 1992 HPMS Data

the amount of funds used in Strategy 4, or about $0.25 billion per year. The incremental rate-of-return decreases to about 16 percent for Strategy 5. This increment is much larger, however, amounting to about $1.0 billion per year in the period 1992-1997.

Although incremental spending from issuing bonds would initially give very large returns, the bonds plus interest must be paid off in future years. Due to limited highway funding, there is a risk that the overall highway system will deteriorate in future years as a result of inadequate funding.

Researchers concluded that rate-of-return analysis is inadequate for evaluating bond financing strategies as use of bonds does not really result in additional expenditures. Use of bonds simply reallocates funds over time, so issuing bonds cannot be evaluated in the same way as, say, new revenues from increased taxes because there is no increase on which to calculate the rate of return. Researchers further concluded that what is needed is an analysis method that evaluates the impact on the highway system and users of reallocating revenues over time using bond financing. Such a method was developed in this study and can be described as a multiple-period, net benefit method. This new method uses the same basic Highway Performance Monitoring System (HPMS) analytical models and data used in the rate-of-return analysis.

Nevertheless, the rate of return analysis results are useful in showing the high returns that would result from an overall increase in highway spending.

III. NET BENEFIT ANALYSIS OF BOND STRATEGIES

LIMITATIONS OF RATE-OF-RETURN ANALYSIS

During the first phase of the research reported in the interim report, researchers tentatively concluded that rate of return analysis could be used to evaluate bond financing. Following this approach, researchers developed a rate of return analysis, which was essentially the analysis reported in the preceding chapter, even though the conclusions have been modified. After completion of the first phase of this research and presentation of the results to the Area I Research Committee, it was concluded that the preliminary results based on rate-of-return analysis, which were reported in the interim report, were inadequate for making specific recommendations on bond financing. The preliminary findings based on rate-of-return analysis were inadequate for three related reasons.

1. Although the rate-of-return presented in the interim report gave a good indication that additional spending on highways would give a high rate of return, it did not indicate the effect of the timing of expenditures.

2. Second, and more important, the rate-of-return analysis did not give a clear indication of the expected effects on the Texas highway system of reduced future funds during times when bonds would be paid off.

3. It also was concluded that rate of return analysis cannot be used for analyzing bond financing because the amount of revenues really do not increase with bond financing. Instead, bond financing only reallocates revenues over time (with the payment of issuance costs and interest to reallocate some revenues to more immediate expenditures). Since use of bonds does not result in additional investment, there is no "rate-of-return on additional investment." Because of this limitation of rate-of-return analysis, it is necessary to simply use a net benefit analysis.

Because of these limitations in rate-of-return analysis, it was concluded that additional analyses of specific bond financing strategies were needed. A method of doing additional analyses was developed and is presented in the remainder of this chapter.

MULTIPLE-PERIOD, NET BENEFIT ANALYSIS

The limitations of rate-of-return analysis were not fully appreciated at the beginning of this study. After further consideration, it was concluded that additional analysis of bond financing was needed. It was further concluded that the HPMS data and analysis package could be used to analyze specific bond financing strategies. However, the way in which the HPMS package was used differs somewhat from the way it was used in the rate-of-return analysis

reported in Chapter II. The standard HPMS analysis typically covers four time periods of five years each, for a total analysis period of 20 years. To analyze the effects of different hypothetical bond issues over time, the standard HPMS analysis was changed to cover four periods for the following years, for a total analysis period of 35 years: 1992-1996; 1997-2006; 2007-2016; and 2017-2026. The first period, from 1992 through 1996, covers the years when it is assumed that bonds are issued. The next two periods of ten years each, together going from 1997 through 2016, cover the twenty years when the bonds are still being paid off. The last ten-year period, from 2017 through 2026, is considered so that the continuing, forecasted effects of the bond issue can be evaluated. The analysis begins in the year 1992 since the base HPMS data that were used in the analysis are available for that year. This multiple-period analysis is used to estimate the expected net impact on motorist benefits, or reductions in "user" costs; therefore, it is called a multiple-period, net benefit analysis.

ALTERNATIVE BOND STRATEGIES

Description of Bond Strategies

Four strategies are studied. These represent the original strategy discussed in the Sharp report, which is to issue $150 million of bonds in each of five years, resulting in a total bond issue of $750 million. To test the effect of issuing different magnitudes of bonds, multiples of the bonds for this strategy are used. These multiples are two, four, and eight, giving other strategies with total bond issues of $1.5 billion, $3.0 billion, and $6.0 billion. Like the basic Sharp strategy, these bonds are assumed to be issued over a five-year period, with each issue being paid off over 20 years beginning in the middle of the first year for the first year's bond issue.

Cash Flows from Bond Sales

As noted, in each of the bond strategies, bonds are issued in the first five years. Each issue is paid off over time starting immediately after it is issued, following the same pattern as assumed in the Sharp report. This cash flow is shown in Table 9 and is also depicted in Figure 2. The second page of Table 9 only shows the cash flow through the year 2022, but the analysis period extends through the year 2026 with each year from 2023 through 2026 being the same as year 2022 -- that is, $1.0 billion per year for each strategy. Table 10 gives a summary of the effects of the cash flows from Table 9 when they are summarized by the HPMS funding periods used in the analysis of bond strategies. Table 11 shows the net effect on available funds by HPMS funding period.

Table 9. Cash Flow Over Time for Different Bond Strategies, Thousands of Dollars

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Borrowing	150,000	150,000	150,000	150,000	150,000											
Costs of Issuance (1.5%)	2,250	2,250	2,250	2,250	2,250											
Admin. Expenses	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165
Debt Service																
(20yr, 7.5%, pymt month)																
(1st Issue Middle of Yr.)																
(Other Issues 1st of Yr.)																
1st Bond Issue	7,250	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501
2nd Bond Issue		14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501
3rd Bond Issue			14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501
4th Bond Issue				14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501
5th Bond Issue					14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501
Net Cash Flow	140,335	118,584	104,083	89,582	75,082	-72,668	-72,668	-72,668	-72,668	-72,668	-72,668	-72,668	-72,668	-72,668	-72,668	-72,668
Amounts for Bond Financing																
No Bonds	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
.75 Bill Bonds	1,140,335	1,118,584	1,104,083	1,089,582	1,075,082	927,332	927,332	927,332	927,332	927,332	927,332	927,332	927,332	927,332	927,332	927,332
1.5 Bill Bonds	1,280,669	1,237,167	1,208,166	1,179,165	1,150,163	854,663	854,663	854,663	854,663	854,663	854,663	854,663	854,663	854,663	854,663	854,663
3.0 Bill Bonds	1,561,339	1,474,335	1,416,332	1,358,329	1,300,326	709,326	709,326	709,326	709,326	709,326	709,326	709,326	709,326	709,326	709,326	709,326
6.0 Bill Bonds	2,122,677	1,948,669	1,832,664	1,716,658	1,600,653	418,653	418,653	418,653	418,653	418,653	418,653	418,653	418,653	418,653	418,653	418,653

Table 9. Cash Flow Over Time for Different Bond Strategies, Thousands of Dollars (Continued)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Borrowing															
Costs of Issuance (1.5%)															
Admin. Expenses	165	165	165	165	165	165	165	165	165						
Debt Service															
(20yr, 7.5%, pymt month)															
(1st Issue Middle of Yr.)															
(Other Issues 1st of Yr.)															
1st Bond Issue	14,501	14,501	14,501	14,501	7,250										
2nd Bond Issue	14,501	14,501	14,501	14,501	14,501	14,501									
3rd Bond Issue	14,501	14,501	14,501	14,501	14,501	14,501	14,501								
4th Bond Issue	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501							
5th Bond Issue	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501	14,501						
Net Cash Flow	-72,668	-72,668	-72,668	-72,668	-65,418	-58,168	-43,667	-29,166	-14,666						
Amounts for Bond Financing															
No Bonds	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
.75 Bill Bonds	927,332	927,332	927,332	927,332	934,582	941,832	956,333	970,834	985,334	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
1.5 Bill Bonds	854,663	854,663	854,663	854,663	869,164	883,665	912,666	941,667	970,669	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
3.0 Bill Bonds	709,326	709,326	709,326	709,326	738,328	767,329	825,332	883,335	941,337	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
6.0 Bill Bonds	418,653	418,653	418,653	418,653	476,656	534,658	650,664	766,669	882,675	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000

Table 10. HPMS Funding Period Amounts by Period, by Bond Strategy

HPMS Period	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Millions of Dollars				
1992-1996	5,000.0	5,527.7	6,055.3	7,110.7	9,221.3
1997-2006	10,000.0	9,273.3	8,546.6	7,093.3	4,186.5
2007-2016	10,000.0	9,425.6	8,851.1	7,702.3	5,404.6
2017-2026	10,000.0	10,000.0	10,000.0	10,000.0	10,000.0

Table 11. Net Effect on Total Revenues of Bond Strategies, Relative to the No Bond Strategy, by Bond Strategy

HPMS Period	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Millions of Dollars				
1992-1996	0.0	527.7	1,055.3	2,110.7	4,221.3
1997-2006	0.0	-726.7	-1,453.4	-2,960.7	-5,813.5
2007-2016	0.0	-574.4	-1,148.9	-2,297.7	-4,595.4
2017-2026	0.0	0.0	0.0	0.0	0.0
All combined	0.0	-773.4	-1,546.9	-3,093.8	-6,187.6

Note: These columns show the net effect of the different bond-issuing strategies relative to no bonds strategy, by HPMS funding period.

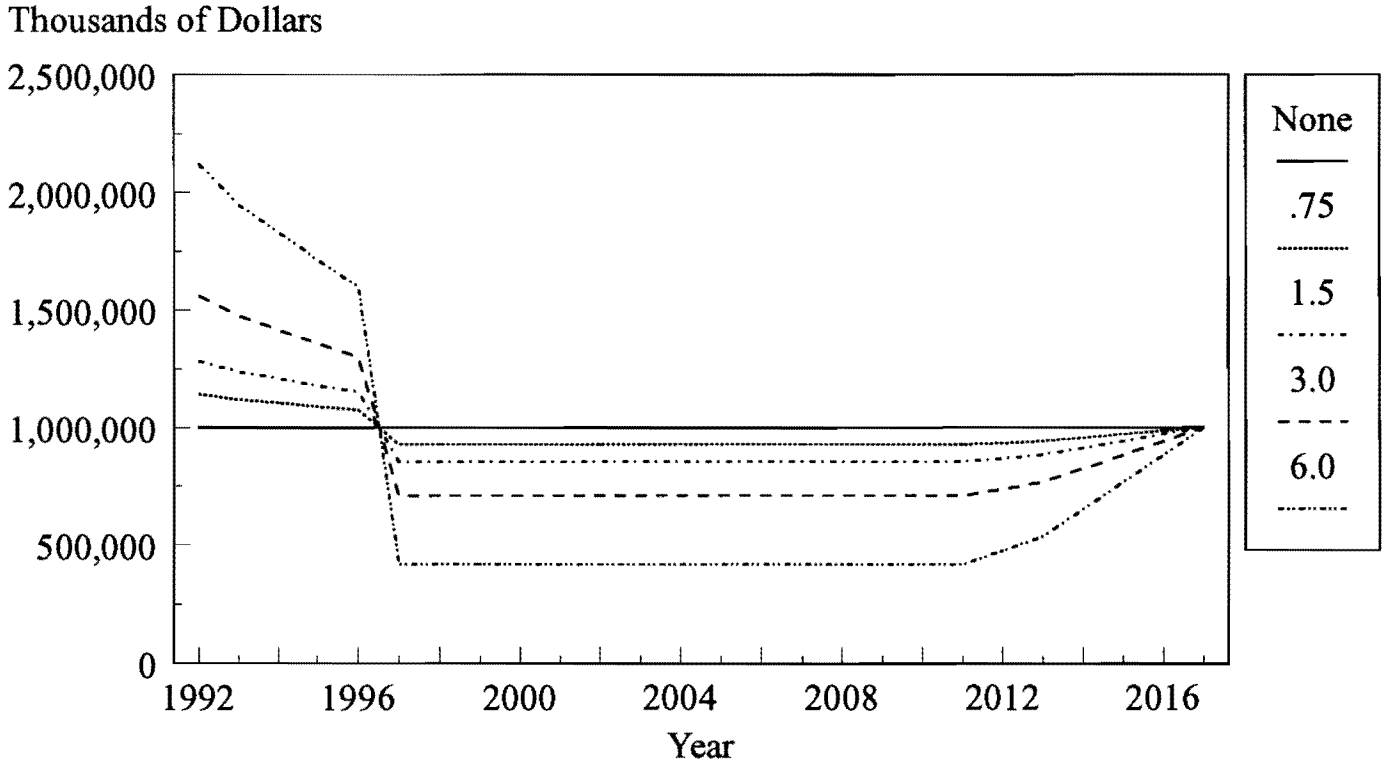


Figure 2. Cash Flow from Bond Sales, by Bond Stategy

RESULTS OF ANALYSIS

Researchers studied the impacts of each of the bond strategies using the HPMS analysis package. The overall effects on motorists are measured by calculating the net benefit of each strategy. Other impacts of bond strategies that are estimated include impact on pavement condition, as estimated by percent of pavements that deteriorate to very bad condition; effect on average vehicle speeds; and effects on vehicle operating costs per 1000 kilometers of travel.

Net Benefits

Table 12 shows the effects of different bond strategies on user benefits (reductions in user costs) for highways in rural areas, for highways in urban areas, and for total highways. These values are calculated as the change in user costs for each bond strategy compared to the no bonds strategy of constant expenditures of $1.0 billion per year. As mentioned previously, all of these strategies use the same amount of revenues, equal to $1.0 billion per year for the period from 1992 through 2026. However, the timing and amount of expenditures are different because of the different amounts of bond financing used in each strategy.

Although the two lowest bond strategies show positive net user benefits for spending on rural highways, these positive values are more than offset by negative net benefits in urban areas. Therefore, it is estimated that all of the bond strategies result in a reduction in user benefits as compared to the no bonds strategy.

Tables 13 through 17 show the detailed results for rural areas by year for each strategy. Tables 18 through 22 show the detailed results for urban areas. Future benefits are calculated as reductions, or increases if the sign is negative, in user costs for a specific strategy as compared to results for the no bonds strategy, shown in Tables 13 and 18. In these tables, user costs are not shown for the first four years, 1992-1995, because the HPMS program does not calculate values for these years. It is assumed, however, that benefits grow from zero in 1992 to the amount calculated for 1995, the first year for which HPMS calculates user costs. Future benefits are discounted to present worth terms using a discount rate of seven percent for presentation in the summary in Table 12.

Table 12. Effects of Bond Strategies on User Benefits, by Rural, Urban, and Total, in Millions of Dollars, Discount Rate = 7.0 Percent

Area Type	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Millions of Dollars				
Rural	0.0	23.0	59.0	-611.8	-12,644.3
Urban	0.0	-167.2	-953.4	-2,406.4	-51,107.1
Total	0.0	-144.2	-894.4	-3,018.2	-63,751.4

Table 13. Millions of Daily Vehicle Kilometers Traveled, User Cost per 1000 Vehicle Miles, and Total User Cost, for No Bond Strategy, Rural Highways

Year	DVkmT	User Cost per 1000vkm, $	Total User Cost, million $
1992	235.8		
1993	241.2		
1994	246.6		
1995	252.1		
1996	257.5	514.7	48,377.4
1997	263.9	514.5	49,562.0
1998	270.4	514.2	50,745.5
1999	276.8	514.0	51,927.7
2000	283.2	513.7	53,108.7
2001	289.7	513.5	54,288.5
2002	296.1	513.2	55,467.1
2003	302.5	512.9	56,644.4
2004	309.7	513.2	58,008.2
2005	316.8	513.5	59,373.2
2006	323.9	513.7	60,739.7
2007	331.1	514.0	62,107.5
2008	338.2	514.2	63,476.6
2009	345.3	514.5	64,847.1
2010	352.4	514.8	66,219.0
2011	362.5	516.9	68,397.7
2012	372.6	519.1	70,592.5
2013	382.6	521.3	72,803.3
2014	392.7	523.5	75,030.2
2015	402.7	525.7	77,273.0
2016	412.8	527.9	79,532.0
2017	422.8	530.1	81,806.9
2018	432.9	532.2	84,097.9
2019	443.0	534.4	86,404.9
2020	453.0	536.6	88,728.0
2021	463.1	538.8	91,067.1
2022	473.1	541.0	93,422.2
2023	483.2	543.2	95,793.4
2024	493.3	545.3	98,180.6
2025	503.3	547.5	100,583.8
2026	513.4	549.7	103,003.1

Table 14. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #1, Discount Rate = 7.0 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			22.8	21.3
1994			45.6	39.8
1995			68.3	55.8
1996	513.8	48,286.3	91.1	69.5
1997	513.6	49,475.1	86.9	61.9
1998	513.4	50,663.1	82.3	54.9
1999	513.2	51,850.2	77.5	48.3
2000	513.0	53,036.4	72.3	42.1
2001	512.8	54,221.6	66.8	36.3
2002	512.6	55,406.0	61.0	31.0
2003	512.4	56,589.5	54.9	26.1
2004	512.9	57,973.9	34.3	15.2
2005	513.4	59,360.5	12.7	5.3
2006	513.8	60,749.5	-9.9	-3.8
2007	514.3	62,140.9	-33.5	-12.1
2008	514.7	63,534.7	-58.1	-19.7
2009	515.2	64,930.8	-83.7	-26.5
2010	515.6	66,329.3	-110.3	-32.6
2011	517.8	68,511.9	-114.2	-31.6
2012	520.0	70,710.7	-118.2	-30.5
2013	522.2	72,925.5	-122.2	-29.5
2014	524.4	75,156.4	-126.2	-28.5
2015	526.6	77,403.4	-130.3	-27.5
2016	528.8	79,666.4	-134.5	-26.5
2017	530.9	81,945.6	-138.6	-25.5
2018	533.1	84,240.8	-142.9	-24.6
2019	535.3	86,552.1	-147.1	-23.7
2020	537.5	88,879.4	-151.4	-22.8
2021	539.7	91,222.9	-155.8	-21.9
2022	541.9	93,582.4	-160.2	-21.0
2023	544.1	95,958.0	-164.6	-20.2
2024	546.3	98,349.6	-169.1	-19.4
2025	548.5	100,757.4	-173.6	-18.6
2026	550.7	103,181.2	-178.1	-17.9

Table 15. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #2, Discount Rate = 7.0 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			51.8	48.4
1994			103.7	90.5
1995			155.5	126.9
1996	512.5	48,170.1	207.3	158.2
1997	512.4	49,362.4	199.7	142.4
1998	512.3	50,554.0	191.4	127.5
1999	512.2	51,745.2	182.5	113.7
2000	512.0	52,935.7	173.0	100.7
2001	511.9	54,125.6	162.8	88.6
2002	511.8	55,315.0	152.1	77.3
2003	511.7	56,503.8	140.7	66.8
2004	512.4	57,912.2	95.9	42.6
2005	513.0	59,324.3	49.0	20.3
2006	513.7	60,739.9	-0.2	-0.1
2007	514.4	62,159.1	-51.6	-18.7
2008	515.1	63,581.8	-105.2	-35.6
2009	515.8	65,008.1	-161.0	-51.0
2010	516.5	66,438.0	-219.0	-64.8
2011	518.7	68,632.6	-234.9	-65.0
2012	521.0	70,843.9	-251.4	-65.0
2013	523.2	73,071.7	-268.4	-64.8
2014	525.5	75,316.0	-285.9	-64.5
2015	527.8	77,577.0	-303.9	-64.1
2016	530.0	79,854.5	-322.5	-63.6
2017	532.3	82,148.6	-341.7	-63.0
2018	534.5	84,459.2	-361.3	-62.2
2019	536.8	86,786.5	-381.5	-61.4
2020	539.0	89,130.2	-402.3	-60.5
2021	541.3	91,490.6	-423.5	-59.5
2022	543.5	93,867.5	-445.3	-58.5
2023	545.8	96,261.1	-467.7	-57.4
2024	548.1	98,671.1	-490.6	-56.3
2025	550.3	101,097.8	-514.0	-55.1
2026	552.6	103,541.0	-537.9	-53.9

Table 16. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #3, Discount Rate = 7.0 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			102.3	95.7
1994			204.7	178.8
1995			307.0	250.6
1996	510.4	47,968.0	409.4	312.3
1997	510.5	49,175.7	386.4	275.5
1998	510.6	50,383.8	361.7	241.0
1999	510.7	51,592.2	335.4	208.9
2000	510.7	52,801.2	307.5	179.0
2001	510.8	54,010.5	278.0	151.2
2002	510.9	55,220.2	246.9	125.5
2003	511.0	56,430.3	214.1	101.7
2004	512.1	57,881.5	126.6	56.2
2005	513.2	59,338.3	34.9	14.5
2006	514.2	60,800.8	-61.1	-23.7
2007	515.3	62,268.8	-161.3	-58.5
2008	516.4	63,742.4	-265.8	-90.0
2009	517.5	65,221.7	-374.6	-118.6
2010	518.6	66,706.6	-487.6	-144.3
2011	521.0	68,928.7	-531.0	-146.8
2012	523.4	71,168.5	-576.1	-148.9
2013	525.8	73,426.1	-622.7	-150.4
2014	528.2	75,701.2	-671.1	-151.5
2015	530.6	77,994.1	-721.0	-152.1
2016	533.0	80,304.6	-772.6	-152.3
2017	535.4	82,632.8	-825.9	-152.2
2018	537.8	84,978.6	-880.7	-151.7
2019	540.2	87,342.2	-937.2	-150.8
2020	542.6	89,723.4	-995.4	-149.7
2021	545.0	92,122.2	-1,055.1	-148.3
2022	547.4	94,538.8	-1,116.6	-146.7
2023	549.8	96,973.0	-1,179.6	-144.8
2024	552.2	99,424.9	-1,244.3	-142.8
2025	554.7	101,894.4	-1,310.6	-140.5
2026	557.1	104,381.6	-1,378.6	-138.2

Table 17. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #4, Discount Rate = 7.0 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			161.9	151.3
1994			323.8	282.8
1995			485.7	396.5
1996	507.9	47,729.7	647.7	494.1
1997	508.7	49,008.1	554.0	395.0
1998	509.6	50,290.5	454.9	303.1
1999	510.5	51,577.2	350.5	218.3
2000	511.4	52,868.0	240.7	140.1
2001	512.3	54,162.9	125.6	68.3
2002	513.2	55,462.0	5.1	2.6
2003	514.0	56,765.2	-120.8	-57.4
2004	516.8	58,417.7	-409.6	-181.9
2005	519.6	60,084.8	-711.5	-295.3
2006	522.4	61,766.4	-1,026.7	-398.2
2007	525.2	63,462.4	-1,355.0	-491.1
2008	528.0	65,173.0	-1,696.4	-574.6
2009	530.8	66,898.2	-2,051.1	-649.3
2010	533.6	68,637.8	-2,418.8	-715.6
2011	536.9	71,031.4	-2,633.7	-728.2
2012	540.1	73,449.1	-2,856.6	-738.2
2013	543.4	75,891.0	-3,087.7	-745.7
2014	546.7	78,357.0	-3,326.8	-750.9
2015	550.0	80,847.1	-3,574.1	-753.9
2016	553.3	83,361.4	-3,829.4	-755.0
2017	556.6	85,899.7	-4,092.8	-754.1
2018	559.9	88,462.2	-4,364.3	-751.5
2019	563.1	91,048.9	-4,643.9	-747.3
2020	566.4	93,659.6	-4,931.6	-741.7
2021	569.7	96,294.5	-5,227.4	-734.8
2022	573.0	98,953.5	-5,531.3	-726.6
2023	576.3	101,636.6	-5,843.3	-717.4
2024	579.6	104,343.9	-6,163.3	-707.2
2025	582.9	107,075.3	-6,491.5	-696.1
2026	586.1	109,830.8	-6,827.7	-684.3

Table 18. Millions of Daily Vehicle Kilometers Traveled, User Cost per 1000 Vehicle Kilometers, and Total User Cost, for No Bond Strategy, Urban Highways

Year	DVkmT	User Cost per 1000vkm, $	Total User Cost, million $
1992	501.5		
1993	512.9		
1994	524.3		
1995	535.7		
1996	547.2	502.3	100,326.2
1997	560.7	503.7	103,081.0
1998	574.3	505.0	105,848.9
1999	587.9	506.3	108,629.7
2000	601.4	507.6	111,423.4
2001	615.0	508.9	114,230.1
2002	628.5	510.2	117,049.8
2003	642.1	511.5	119,882.4
2004	657.7	511.6	122,826.2
2005	673.4	511.7	125,771.3
2006	689.0	511.8	128,717.6
2007	704.6	511.9	131,665.0
2008	720.3	512.0	134,613.7
2009	735.9	512.1	137,563.5
2010	751.5	512.2	140,514.6
2011	773.2	519.2	146,511.7
2012	794.8	526.1	152,618.1
2013	816.4	533.0	158,833.9
2014	838.0	539.9	165,158.9
2015	859.7	546.9	171,593.2
2016	881.3	553.8	178,136.8
2017	902.9	560.7	184,789.8
2018	924.5	567.6	191,552.0
2019	946.2	574.6	198,423.5
2020	967.8	581.5	205,404.4
2021	989.4	588.4	212,494.5
2022	1,011.0	595.3	219,693.9
2023	1,032.7	602.3	227,002.7
2024	1,054.3	609.2	234,420.7
2025	1,075.9	616.1	241,948.0
2026	1,097.5	623.0	249,584.7

Table 19. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #1, Discount Rate = 7.0 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			56.5	52.8
1994			112.9	98.6
1995			169.4	138.3
1996	501.2	100,100.3	225.9	172.3
1997	502.6	102,865.7	215.3	153.5
1998	504.0	105,644.9	203.9	135.9
1999	505.4	108,437.9	191.8	119.4
2000	506.8	111,244.5	178.9	104.1
2001	508.2	114,064.9	165.2	89.9
2002	509.5	116,899.0	150.7	76.6
2003	510.9	119,746.9	135.4	64.3
2004	511.2	122,725.0	101.2	44.9
2005	511.5	125,706.1	65.2	27.1
2006	511.7	128,690.1	27.5	10.6
2007	512.0	131,677.1	-12.1	-4.4
2008	512.2	134,667.1	-53.4	-18.1
2009	512.5	137,660.1	-96.6	-30.6
2010	512.8	140,656.1	-141.5	-41.9
2011	519.8	146,693.0	-181.3	-50.1
2012	526.9	152,841.2	-223.1	-57.6
2013	533.9	159,100.7	-266.9	-64.5
2014	541.0	165,471.6	-312.7	-70.6
2015	548.0	171,953.7	-360.5	-76.0
2016	555.1	178,547.1	-410.3	-80.9
2017	562.1	185,251.8	-462.1	-85.1
2018	569.2	192,067.8	-515.8	-88.8
2019	576.2	198,995.2	-571.6	-92.0
2020	583.3	206,033.8	-629.4	-94.7
2021	590.3	213,183.7	-689.2	-96.9
2022	597.4	220,444.9	-751.0	-98.7
2023	604.4	227,817.5	-814.8	-100.0
2024	611.5	235,301.3	-880.6	-101.0
2025	618.5	242,896.4	-948.3	-101.7
2026	625.6	250,602.8	-1,018.1	-102.0

Table 20. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #2, Discount Rate = 7.0 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			123.5	115.4
1994			247.0	215.7
1995			370.4	302.4
1996	499.9	99,832.2	493.9	376.8
1997	501.3	102,608.3	472.7	337.1
1998	502.8	105,398.9	449.9	299.8
1999	504.3	108,204.1	425.5	265.0
2000	505.8	111,023.9	399.5	232.5
2001	507.2	113,858.3	371.8	202.2
2002	508.7	116,707.2	342.5	174.1
2003	510.2	119,570.7	311.7	148.1
2004	510.8	122,621.9	204.4	90.7
2005	511.3	125,679.7	91.6	38.0
2006	511.9	128,744.1	-26.6	-10.3
2007	512.5	131,815.3	-150.2	-54.5
2008	513.1	134,893.0	-279.4	-94.6
2009	513.7	137,977.5	-413.9	-131.0
2010	514.3	141,068.6	-554.0	-163.9
2011	521.4	147,139.5	-627.8	-173.6
2012	528.5	153,323.0	-704.8	-182.1
2013	535.6	159,619.0	-785.1	-189.6
2014	542.8	166,027.5	-868.6	-196.1
2015	549.9	172,548.6	-955.4	-201.5
2016	557.0	179,182.2	-1,045.4	-206.1
2017	564.2	185,928.4	-1,138.6	-209.8
2018	571.3	192,787.1	-1,235.1	-212.7
2019	578.4	199,758.3	-1,334.8	-214.8
2020	585.6	206,842.1	-1,437.7	-216.2
2021	592.7	214,038.4	-1,543.9	-217.0
2022	599.8	221,347.3	-1,653.3	-217.2
2023	606.9	228,768.7	-1,766.0	-216.8
2024	614.1	236,302.6	-1,881.9	-215.9
2025	621.2	243,949.1	-2,001.0	-214.6
2026	628.3	251,708.1	-2,123.4	-212.8

Table 21. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #3, Discount Rate = 7.0 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			190.2	177.7
1994			380.4	332.2
1995			570.6	465.7
1996	498.5	99,565.4	760.7	580.4
1997	500.0	102,330.3	750.7	535.2
1998	501.4	105,109.6	739.3	492.6
1999	502.9	107,903.2	726.5	452.4
2000	504.3	110,711.2	712.2	414.5
2001	505.8	113,533.5	696.6	378.9
2002	507.2	116,370.2	679.6	345.5
2003	508.7	119,221.2	661.2	314.1
2004	509.7	122,371.7	454.6	201.8
2005	510.8	125,533.9	237.4	98.5
2006	511.8	128,708.0	9.6	3.7
2007	512.8	131,893.8	-228.8	-82.9
2008	513.8	135,091.4	-477.7	-161.8
2009	514.9	138,300.8	-737.3	-233.4
2010	515.9	141,522.0	-1,007.4	-298.1
2011	523.3	147,670.6	-1,158.9	-320.4
2012	530.6	153,935.4	-1,317.3	-340.4
2013	538.0	160,316.4	-1,482.5	-358.0
2014	545.3	166,813.5	-1,654.6	-373.5
2015	552.7	173,426.7	-1,833.5	-386.8
2016	560.1	180,156.2	-2,019.3	-398.1
2017	567.4	187,001.7	-2,212.0	-407.6
2018	574.8	193,963.5	-2,411.5	-415.2
2019	582.1	201,041.4	-2,617.8	-421.3
2020	589.5	208,235.4	-2,831.0	-425.8
2021	596.9	215,545.6	-3,051.1	-428.9
2022	604.2	222,971.9	-3,278.0	-430.6
2023	611.6	230,514.4	-3,511.8	-431.2
2024	618.9	238,173.1	-3,752.4	-430.6
2025	626.3	245,947.9	-3,999.9	-428.9
2026	633.6	253,838.9	-4,254.2	-426.4

Table 22. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #4, Discount Rate = 7.0 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			311.8	291.4
1994			623.6	544.7
1995			935.4	763.6
1996	496.1	99,079.0	1,247.2	951.5
1997	498.3	101,985.5	1,095.5	781.1
1998	500.5	104,913.8	935.0	623.1
1999	502.7	107,864.0	765.7	476.8
2000	504.9	110,835.9	587.5	341.9
2001	507.1	113,829.6	400.5	217.9
2002	509.3	116,845.1	204.7	104.0
2003	511.5	119,882.4	0.0	0.0
2004	516.3	123,961.9	-1,135.7	-504.3
2005	521.2	128,096.7	-2,325.4	-964.9
2006	526.0	132,286.6	-3,569.0	-1,384.1
2007	530.8	136,531.7	-4,866.7	-1,763.9
2008	535.7	140,832.0	-6,218.3	-2,106.4
2009	540.5	145,187.5	-7,623.9	-2,413.5
2010	545.4	149,598.1	-9,083.5	-2,687.5
2011	554.3	156,414.5	-9,902.8	-2,738.2
2012	563.2	163,371.4	-10,753.2	-2,778.8
2013	572.1	170,468.7	-11,634.9	-2,810.0
2014	581.0	177,706.6	-12,547.7	-2,832.2
2015	589.9	185,085.0	-13,491.8	-2,846.0
2016	598.8	192,603.9	-14,467.0	-2,852.1
2017	607.7	200,263.3	-15,473.5	-2,851.0
2018	616.6	208,063.2	-16,511.2	-2,843.2
2019	625.5	216,003.6	-17,580.1	-2,829.2
2020	634.4	224,084.5	-18,680.2	-2,809.5
2021	643.3	232,306.0	-19,811.5	-2,784.8
2022	652.2	240,667.9	-20,974.0	-2,755.3
2023	661.1	249,170.3	-22,167.7	-2,721.6
2024	670.0	257,813.3	-23,392.6	-2,684.1
2025	678.9	266,596.7	-24,648.7	-2,643.2
2026	687.8	275,520.7	-25,936.0	-2,599.3

Sensitivity Analysis

Because the analysis results are sensitive to the discount rate used to discount future user cost savings, or user benefits, researchers performed a sensitivity analysis to determine the impact on the analysis of using a discount rate of 3.5 percent instead of 7.0 percent. Table 23 summarizes these results. For comparative purposes, Table 24 shows the results if a zero discount rate is used -- that is, if there is no discounting of benefits.

The annual values of user costs, benefits, and discounted benefits for the 3.5 percent sensitivity analysis are shown in Tables 25 through 28 for rural areas and Tables 29 through 32 for urban areas.

Table 23. Effects of Bond Strategies on User Benefits, by Rural, Urban, and Total, in Millions of Dollars, Discount Rate = 3.5 Percent

Area Type	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Millions of Dollars				
Rural	0.0	-470.1	-1,174.1	-3,850.2	-31,384.4
Urban	0.0	-1,992.3	-5,474.5	-11,268.0	-122,165.5
Total	0.0	-2,462.4	-6,648.5	-15,118.2	-153,550.0

Table 24. Effects of Bond Strategies on User Benefits, by Rural, Urban, and Total, in Millions of Dollars, Discount Rate = 0.0 Percent

Area Type	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
	Millions of Dollars				
Rural	0.0	-1,845.9	-4,704.5	-12,854.0	-79,865.6
Urban	0.0	-7,339.3	-18,222.5	-36,267.5	-305,688.3
Total	0.0	-9,185.2	-22,296.9	-49,121.5	-385,553.9

Table 25. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #1, Discount Rate = 3.5 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			22.8	22.0
1994			45.6	42.5
1995			68.3	61.6
1996	513.8	48,286.3	91.1	79.4
1997	513.6	49,475.1	86.9	73.2
1998	513.4	50,663.1	82.3	67.0
1999	513.2	51,850.2	77.5	60.9
2000	513.0	53,036.4	72.3	54.9
2001	512.8	54,221.6	66.8	49.0
2002	512.6	55,406.0	61.0	43.3
2003	512.4	56,589.5	54.9	37.6
2004	512.9	57,973.9	34.3	22.7
2005	513.4	59,360.5	12.7	8.1
2006	513.8	60,749.5	-9.9	-6.1
2007	514.3	62,140.9	-33.5	-20.0
2008	514.7	63,534.7	-58.1	-33.5
2009	515.2	64,930.8	-83.7	-46.6
2010	515.6	66,329.3	-110.3	-59.4
2011	517.8	68,511.9	-114.2	-59.4
2012	520.0	70,710.7	-118.2	-59.4
2013	522.2	72,925.5	-122.2	-59.3
2014	524.4	75,156.4	-126.2	-59.2
2015	526.6	77,403.4	-130.3	-59.1
2016	528.8	79,666.4	-134.5	-58.9
2017	530.9	81,945.6	-138.6	-58.7
2018	533.1	84,240.8	-142.9	-58.4
2019	535.3	86,552.1	-147.1	-58.1
2020	537.5	88,879.4	-151.4	-57.8
2021	539.7	91,222.9	-155.8	-57.4
2022	541.9	93,582.4	-160.2	-57.1
2023	544.1	95,958.0	-164.6	-56.7
2024	546.3	98,349.6	-169.1	-56.2
2025	548.5	100,757.4	-173.6	-55.8
2026	550.7	103,181.2	-178.1	-55.3

Table 26. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #2, Discount Rate = 3.5 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			51.8	50.1
1994			103.7	96.8
1995			155.5	140.2
1996	512.5	48,170.1	207.3	180.7
1997	512.4	49,362.4	199.7	168.1
1998	512.3	50,554.0	191.4	155.7
1999	512.2	51,745.2	182.5	143.5
2000	512.0	52,935.7	173.0	131.4
2001	511.9	54,125.6	162.8	119.5
2002	511.8	55,315.0	152.1	107.8
2003	511.7	56,503.8	140.7	96.4
2004	512.4	57,912.2	95.9	63.5
2005	513.0	59,324.3	49.0	31.3
2006	513.7	60,739.9	-0.2	-0.1
2007	514.4	62,159.1	-51.6	-30.8
2008	515.1	63,581.8	-105.2	-60.7
2009	515.8	65,008.1	-161.0	-89.7
2010	516.5	66,438.0	-219.0	-117.9
2011	518.7	68,632.6	-234.9	-122.2
2012	521.0	70,843.9	-251.4	-126.3
2013	523.2	73,071.7	-268.4	-130.3
2014	525.5	75,316.0	-285.9	-134.1
2015	527.8	77,577.0	-303.9	-137.8
2016	530.0	79,854.5	-322.5	-141.3
2017	532.3	82,148.6	-341.7	-144.6
2018	534.5	84,459.2	-361.3	-147.7
2019	536.8	86,786.5	-381.5	-150.7
2020	539.0	89,130.2	-402.3	-153.5
2021	541.3	91,490.6	-423.5	-156.2
2022	543.5	93,867.5	-445.3	-158.7
2023	545.8	96,261.1	-467.7	-161.0
2024	548.1	98,671.1	-490.6	-163.2
2025	550.3	101,097.8	-514.0	-165.2
2026	552.6	103,541.0	-537.9	-167.0

Table 27. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #3, Discount Rate = 3.5 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			102.3	98.9
1994			204.7	191.1
1995			307.0	276.9
1996	510.4	47,968.0	409.4	356.8
1997	510.5	49,175.7	386.4	325.3
1998	510.6	50,383.8	361.7	294.2
1999	510.7	51,592.2	335.4	263.6
2000	510.7	52,801.2	307.5	233.5
2001	510.8	54,010.5	278.0	204.0
2002	510.9	55,220.2	246.9	175.0
2003	511.0	56,430.3	214.1	146.6
2004	512.1	57,881.5	126.6	83.8
2005	513.2	59,338.3	34.9	22.3
2006	514.2	60,800.8	-61.1	-37.7
2007	515.3	62,268.8	-161.3	-96.3
2008	516.4	63,742.4	-265.8	-153.3
2009	517.5	65,221.7	-374.6	-208.7
2010	518.6	66,706.6	-487.6	-262.5
2011	521.0	68,928.7	-531.0	-276.2
2012	523.4	71,168.5	-576.1	-289.5
2013	525.8	73,426.1	-622.7	-302.4
2014	528.2	75,701.2	-671.1	-314.8
2015	530.6	77,994.1	-721.0	-326.8
2016	533.0	80,304.6	-772.6	-338.4
2017	535.4	82,632.8	-825.9	-349.5
2018	537.8	84,978.6	-880.7	-360.1
2019	540.2	87,342.2	-937.2	-370.2
2020	542.6	89,723.4	-995.4	-379.9
2021	545.0	92,122.2	-1,055.1	-389.1
2022	547.4	94,538.8	-1,116.6	-397.8
2023	549.8	96,973.0	-1,179.6	-406.1
2024	552.2	99,424.9	-1,244.3	-413.8
2025	554.7	101,894.4	-1,310.6	-421.2
2026	557.1	104,381.6	-1,378.6	-428.0

Table 28. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #4, Discount Rate = 3.5 Percent, Rural Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			161.9	156.4
1994			323.8	302.3
1995			485.7	438.1
1996	507.9	47,729.7	647.7	564.4
1997	508.7	49,008.1	554.0	466.4
1998	509.6	50,290.5	454.9	370.1
1999	510.5	51,577.2	350.5	275.5
2000	511.4	52,868.0	240.7	182.8
2001	512.3	54,162.9	125.6	92.1
2002	513.2	55,462.0	5.1	3.6
2003	514.0	56,765.2	-120.8	-82.7
2004	516.8	58,417.7	-409.6	-271.1
2005	519.6	60,084.8	-711.5	-455.0
2006	522.4	61,766.4	-1,026.7	-634.3
2007	525.2	63,462.4	-1,355.0	-808.8
2008	528.0	65,173.0	-1,696.4	-978.3
2009	530.8	66,898.2	-2,051.1	-1,142.9
2010	533.6	68,637.8	-2,418.8	-1,302.2
2011	536.9	71,031.4	-2,633.7	-1,369.9
2012	540.1	73,449.1	-2,856.6	-1,435.7
2013	543.4	75,891.0	-3,087.7	-1,499.3
2014	546.7	78,357.0	-3,326.8	-1,560.8
2015	550.0	80,847.1	-3,574.1	-1,620.1
2016	553.3	83,361.4	-3,829.4	-1,677.1
2017	556.6	85,899.7	-4,092.8	-1,731.9
2018	559.9	88,462.2	-4,364.3	-1,784.3
2019	563.1	91,048.9	-4,643.9	-1,834.4
2020	566.4	93,659.6	-4,931.6	-1,882.2
2021	569.7	96,294.5	-5,227.4	-1,927.6
2022	573.0	98,953.5	-5,531.3	-1,970.7
2023	576.3	101,636.6	-5,843.3	-2,011.4
2024	579.6	104,343.9	-6,163.3	-2,049.9
2025	582.9	107,075.3	-6,491.5	-2,086.0
2026	586.1	109,830.8	-6,827.7	-2,119.9

Table 29. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #1, Discount Rate = 3.5 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			56.5	54.6
1994			112.9	105.4
1995			169.4	152.8
1996	501.2	100,100.3	225.9	196.8
1997	502.6	102,865.7	215.3	181.3
1998	504.0	105,644.9	203.9	165.9
1999	505.4	108,437.9	191.8	150.8
2000	506.8	111,244.5	178.9	135.8
2001	508.2	114,064.9	165.2	121.2
2002	509.5	116,899.0	150.7	106.8
2003	510.9	119,746.9	135.4	92.8
2004	511.2	122,725.0	101.2	67.0
2005	511.5	125,706.1	65.2	41.7
2006	511.7	128,690.1	27.5	17.0
2007	512.0	131,677.1	-12.1	-7.2
2008	512.2	134,667.1	-53.4	-30.8
2009	512.5	137,660.1	-96.6	-53.8
2010	512.8	140,656.1	-141.5	-76.2
2011	519.8	146,693.0	-181.3	-94.3
2012	526.9	152,841.2	-223.1	-112.1
2013	533.9	159,100.7	-266.9	-129.6
2014	541.0	165,471.6	-312.7	-146.7
2015	548.0	171,953.7	-360.5	-163.4
2016	555.1	178,547.1	-410.3	-179.7
2017	562.1	185,251.8	-462.1	-195.5
2018	569.2	192,067.8	-515.8	-210.9
2019	576.2	198,995.2	-571.6	-225.8
2020	583.3	206,033.8	-629.4	-240.2
2021	590.3	213,183.7	-689.2	-254.1
2022	597.4	220,444.9	-751.0	-267.6
2023	604.4	227,817.5	-814.8	-280.5
2024	611.5	235,301.3	-880.6	-292.9
2025	618.5	242,896.4	-948.3	-304.7
2026	625.6	250,602.8	-1,018.1	-316.1

Table 30. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #2, Discount Rate = 3.5 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discounted Benefits, million $
1992			0.0	0.0
1993			123.5	119.3
1994			247.0	230.5
1995			370.4	334.1
1996	499.9	99,832.2	493.9	430.4
1997	501.3	102,608.3	472.7	398.0
1998	502.8	105,398.9	449.9	366.0
1999	504.3	108,204.1	425.5	334.4
2000	505.8	111,023.9	399.5	303.4
2001	507.2	113,858.3	371.8	272.8
2002	508.7	116,707.2	342.5	242.8
2003	510.2	119,570.7	311.7	213.5
2004	510.8	122,621.9	204.4	135.3
2005	511.3	125,679.7	91.6	58.6
2006	511.9	128,744.1	-26.6	-16.4
2007	512.5	131,815.3	-150.2	-89.7
2008	513.1	134,893.0	-279.4	-161.1
2009	513.7	137,977.5	-413.9	-230.6
2010	514.3	141,068.6	-554.0	-298.2
2011	521.4	147,139.5	-627.8	-326.5
2012	528.5	153,323.0	-704.8	-354.2
2013	535.6	159,619.0	-785.1	-381.2
2014	542.8	166,027.5	-868.6	-407.5
2015	549.9	172,548.6	-955.4	-433.1
2016	557.0	179,182.2	-1,045.4	-457.8
2017	564.2	185,928.4	-1,138.6	-481.8
2018	571.3	192,787.1	-1,235.1	-505.0
2019	578.4	199,758.3	-1,334.8	-527.3
2020	585.6	206,842.1	-1,437.7	-548.7
2021	592.7	214,038.4	-1,543.9	-569.3
2022	599.8	221,347.3	-1,653.3	-589.0
2023	606.9	228,768.7	-1,766.0	-607.9
2024	614.1	236,302.6	-1,881.9	-625.9
2025	621.2	243,949.1	-2,001.0	-643.0
2026	628.3	251,708.1	-2,123.4	-659.3

Table 31. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #3, Discount Rate = 3.5 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discount Benefits, million $
1992			0.0	0.0
1993			190.2	183.8
1994			380.4	355.1
1995			570.6	514.6
1996	498.5	99,565.4	760.7	662.9
1997	500.0	102,330.3	750.7	632.1
1998	501.4	105,109.6	739.3	601.4
1999	502.9	107,903.2	726.5	571.0
2000	504.3	110,711.2	712.2	540.9
2001	505.8	113,533.5	696.6	511.1
2002	507.2	116,370.2	679.6	481.8
2003	508.7	119,221.2	661.2	452.9
2004	509.7	122,371.7	454.6	300.8
2005	510.8	125,533.9	237.4	151.8
2006	511.8	128,708.0	9.6	5.9
2007	512.8	131,893.8	-228.8	-136.5
2008	513.8	135,091.4	-477.7	-275.5
2009	514.9	138,300.8	-737.3	-410.8
2010	515.9	141,522.0	-1,007.4	-542.3
2011	523.3	147,670.6	-1,158.9	-602.8
2012	530.6	153,935.4	-1,317.3	-662.0
2013	538.0	160,316.4	-1,482.5	-719.9
2014	545.3	166,813.5	-1,654.6	-776.3
2015	552.7	173,426.7	-1,833.5	-831.1
2016	560.1	180,156.2	-2,019.3	-884.4
2017	567.4	187,001.7	-2,212.0	-936.0
2018	574.8	193,963.5	-2,411.5	-985.9
2019	582.1	201,041.4	-2,617.8	-1,034.1
2020	589.5	208,235.4	-2,831.0	-1,080.5
2021	596.9	215,545.6	-3,051.1	-1,125.1
2022	604.2	222,971.9	-3,278.0	-1,167.9
2023	611.6	230,514.4	-3,511.8	-1,208.9
2024	618.9	238,173.1	-3,752.4	-1,248.0
2025	626.3	245,947.9	-3,999.9	-1,285.3
2026	633.6	253,838.9	-4,254.2	-1,320.8

Table 32. User Cost per 1000 Vehicle Kilometers, Total User Cost, Benefits, and Discounted Benefits, for Bond Strategy #4, Discount Rate = 3.5 Percent, Urban Highways

Year	User Cost per 1000vkm, $	Total User Cost, million $	Benefits, million $	Discount Benefits, million $
1992			0.0	0.0
1993			311.8	301.3
1994			623.6	582.1
1995			935.4	843.7
1996	496.1	99,079.0	1,247.2	1,086.9
1997	498.3	101,985.5	1,095.5	922.4
1998	500.5	104,913.8	935.0	760.6
1999	502.7	107,864.0	765.7	601.8
2000	504.9	110,835.9	587.5	446.2
2001	507.1	113,829.6	400.5	293.9
2002	509.3	116,845.1	204.7	145.1
2003	511.5	119,882.4	0.0	0.0
2004	516.3	123,961.9	-1,135.7	-751.6
2005	521.2	128,096.7	-2,325.4	-1,486.9
2006	526.0	132,286.6	-3,569.0	-2,204.9
2007	530.8	136,531.7	-4,866.7	-2,904.9
2008	535.7	140,832.0	-6,218.3	-3,586.1
2009	540.5	145,187.5	-7,623.9	-4,248.1
2010	545.4	149,598.1	-9,083.5	-4,890.2
2011	554.3	156,414.5	-9,902.8	-5,151.0
2012	563.2	163,371.4	-10,753.2	-5,404.2
2013	572.1	170,468.7	-11,634.9	-5,649.6
2014	581.0	177,706.6	-12,547.7	-5,886.8
2015	589.9	185,085.0	-13,491.8	-6,115.6
2016	598.8	192,603.9	-14,467.0	-6,335.9
2017	607.7	200,263.3	-15,473.5	-6,547.6
2018	616.6	208,063.2	-16,511.2	-6,750.4
2019	625.5	216,003.6	-17,580.1	-6,944.3
2020	634.4	224,084.5	-18,680.2	-7,129.4
2021	643.3	232,306.0	-19,811.5	-7,305.4
2022	652.2	240,667.9	-20,974.0	-7,472.6
2023	661.1	249,170.3	-22,167.7	-7,630.8
2024	670.0	257,813.3	-23,392.6	-7,780.1
2025	678.9	266,596.7	-24,648.7	-7,920.7
2026	687.8	275,520.7	-25,936.0	-8,052.5

Effects on Pavement Condition

To show the effects of the different bond funding strategies on pavement condition, researchers developed a set of tables and figures showing the percent of statewide miles on the State System with very low serviceability index. An index of less than 2.0 was judged to represent extremely bad pavements. The percent of pavement in this category was calculated for each strategy. Several tables and figures show the effects of different bond strategies on pavements in the years at the end of each of the four analysis periods, as forecasted by the HPMS analytical models. The four years represented are 1996, 2003, 2010, and 2026.

Tables 33 through 36 show the percent of state highway kilometers with pavement serviceability below 2.0 in the years 1996, 2003, 2010, and 2026, respectively. This same information is depicted in Figures 3 through 12. Each figure shows the results for each bond strategy for each of the four end-of-period years for a separate functional class, as follows:

Figure 3	Rural Interstate
Figure 4	Rural Other Principal Arterial
Figure 5	Rural Minor Arterial
Figure 6	Rural Major Collector
Figure 7	Rural Minor Collector
Figure 8	Urban Interstate
Figure 9	Urban Other Freeway and Expressway
Figure 10	Urban Other Principal Arterial
Figure 11	Urban Minor Arterial
Figure 12	Urban Collector

In almost all of the functional classes, the pavement is slightly improved (smaller percent of pavements in the very bad category) in 1996, the final year of the first time period, with increased use of bonds. However, in the final year of the next three periods, the percent of very bad pavements almost always gets progressively higher over time and is much higher with the strategies using higher levels of bond financing.

Table 33. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, at End of First Period in Year 1996

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	1%	1%	1%	1%	1%
Oth Prin Art	9	7	7	5	0
Min Art	8	8	7	5	0
Maj Art	12	12	10	9	5
Min Col	22	20	19	16	10
Urban					
Interstate	3%	3%	1%	1%	0%
Oth Exp/Fwy	2	2	2	2	0
Oth Prin Art	3	3	3	2	0
Collect	7	7	6	4	2
Min Art	18	15	14	10	0

Table 34. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, at End of Second Period in Year 2003

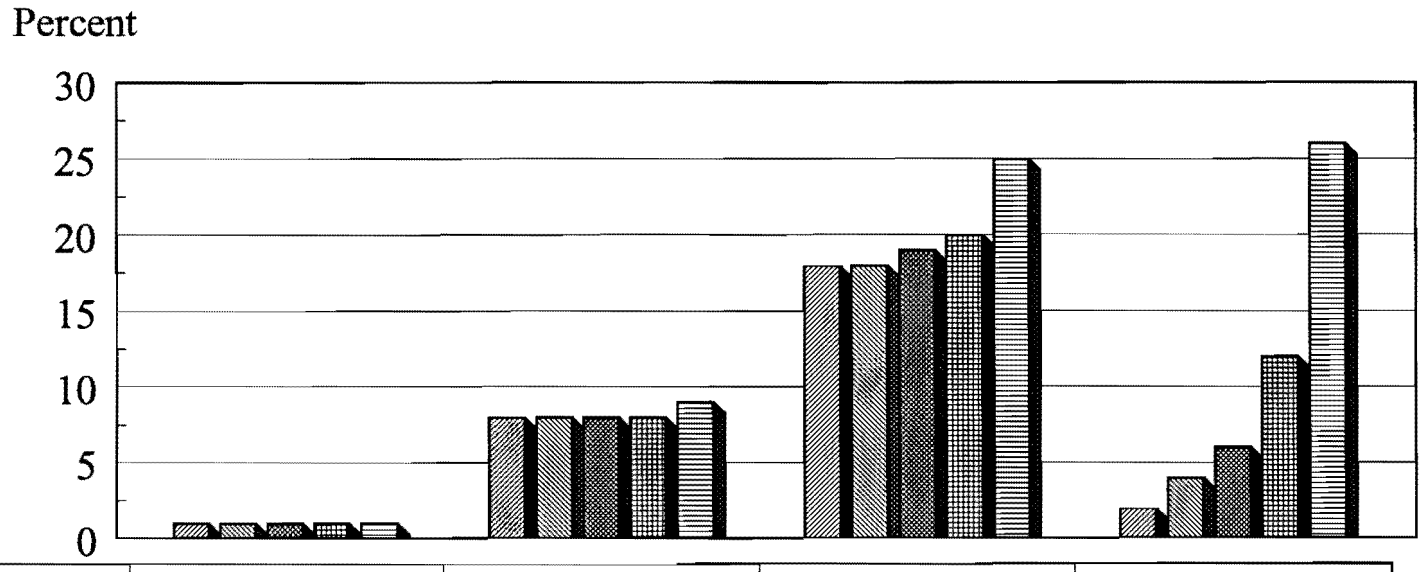
Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	8%	8%	8%	8%	9%
Oth Prin Art	10	9	9	7	9
Min Art	12	12	13	15	20
Maj Art	10	9	10	12	22
Min Col	9	9	11	17	25
Urban					
Interstate	4%	4%	2%	1%	2%
Oth Exp/Fwy	6	6	5	4	3
Oth Prin Art	9	9	9	9	12
Collect	10	10	10	9	13
Min Art	33	33	31	32	32

Table 35. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, at End of Third Period in Year 2010

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	18%	18%	19%	20%	25%
Oth Prin Art	10	10	9	9	17
Min Art	6	6	7	9	22
Maj Art	6	6	7	9	19
Min Col	5	6	8	14	25
Urban					
Interstate	4%	5%	5%	8%	38%
Oth Exp/Fwy	6	7	7	8	28
Oth Prin Art	9	9	9	11	22
Collect	13	13	13	14	21
Min Art	25	25	26	27	52

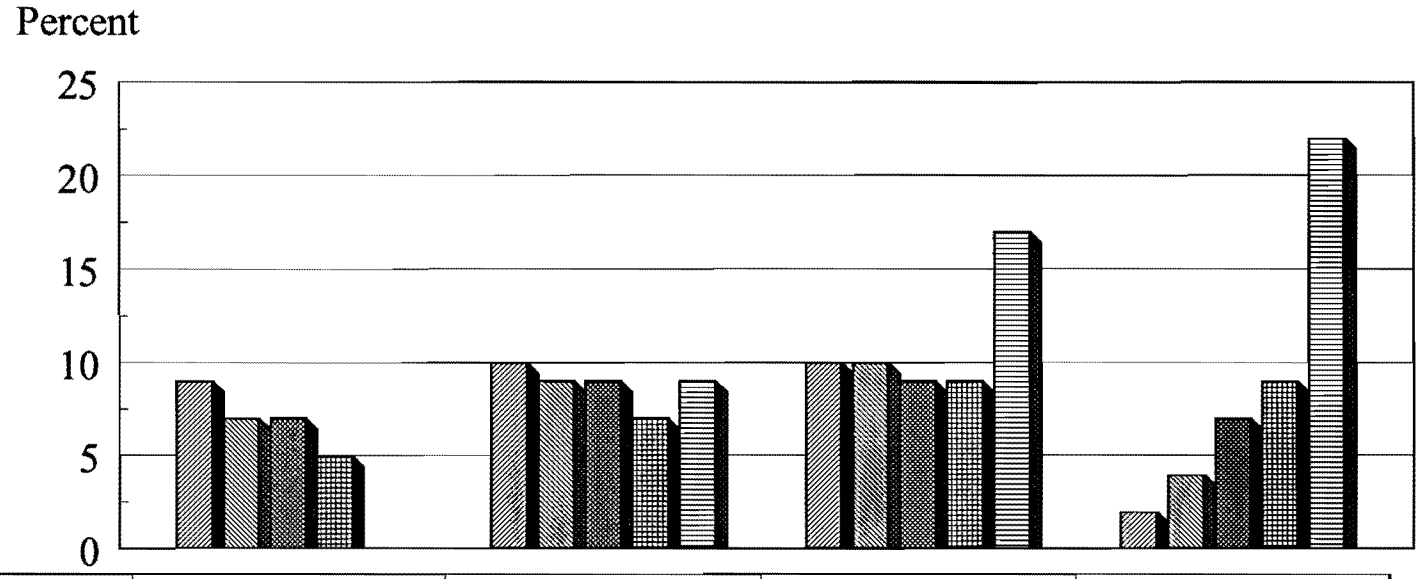
Table 36. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, at End of Fourth Period in Year 2026

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	2%	4%	6%	12%	26%
Oth Prin Art	2	4	7	9	22
Min Art	18	19	20	21	31
Maj Art	30	30	31	33	39
Min Col	30	30	32	32	39
Urban					
Interstate	4%	6%	8%	9%	35%
Oth Exp/Fwy	10	11	12	14	38
Oth Prin Art	33	34	36	40	50
Collect	29	31	35	41	50
Min Art	15	17	19	23	48



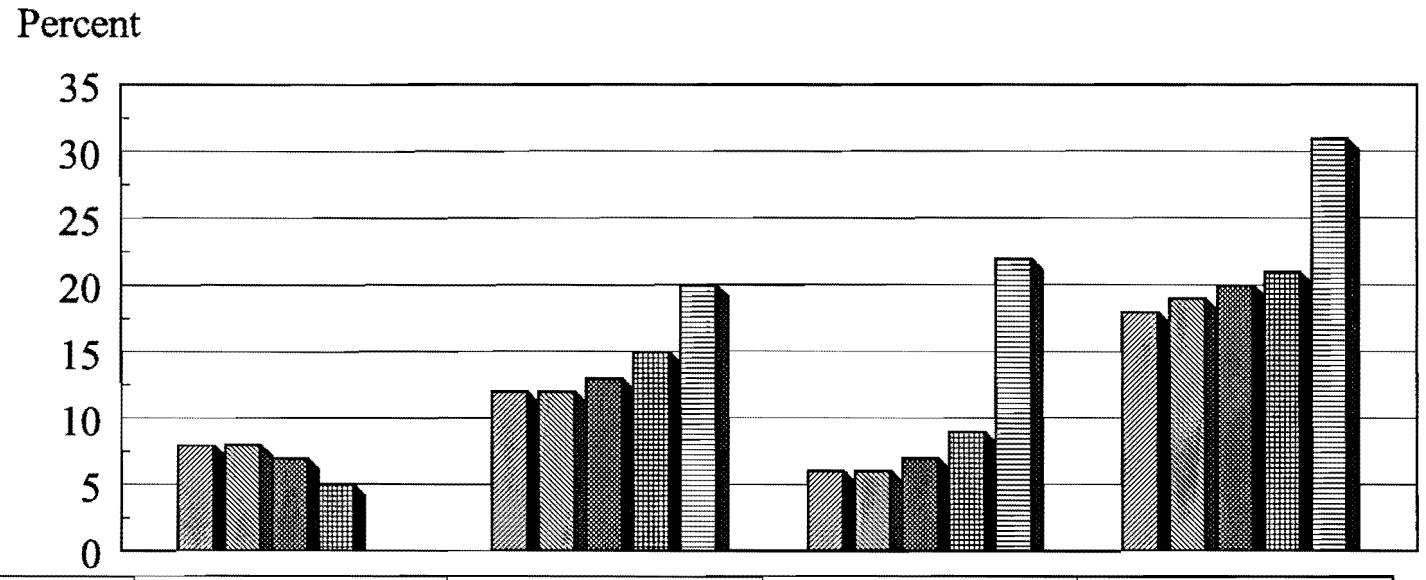
Bond Strategy	1996	2003	2010	2026
No Bonds	1	8	18	2
.75 Billion	1	8	18	4
1.5 Billion	1	8	19	6
3.0 Billion	1	8	20	12
6.0 Billion	1	9	25	26

Figure 3. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Rural Interstate



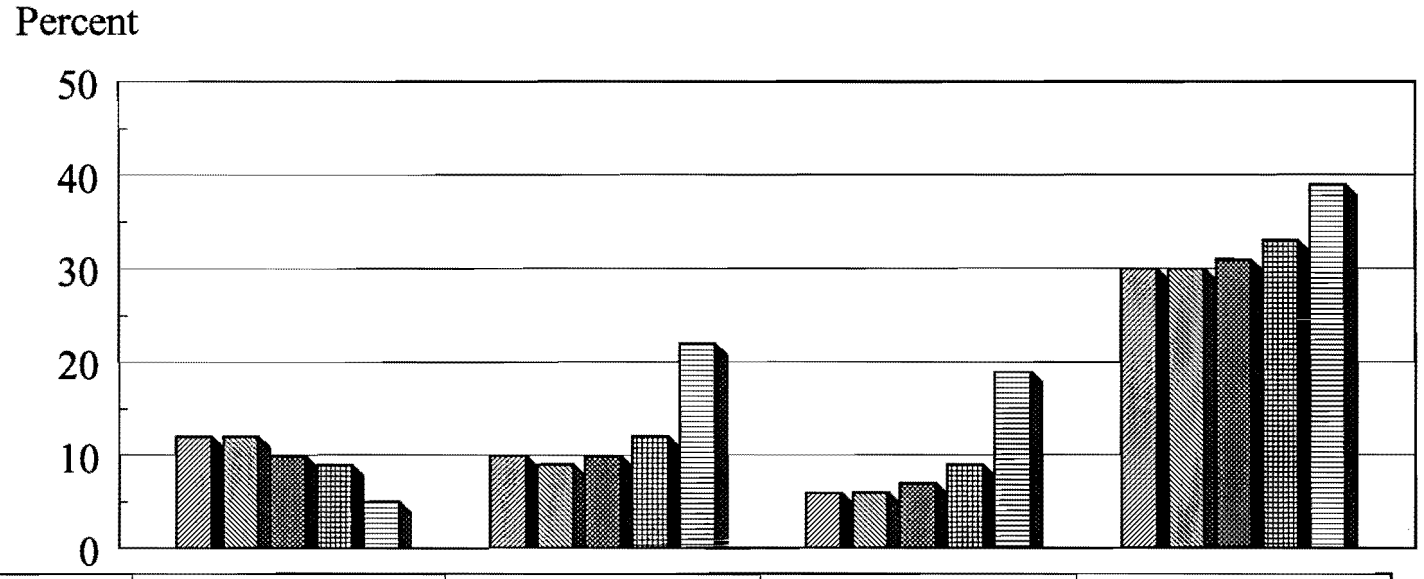
Bond Strategy	1996	2003	2010	2026
No Bonds	9	10	10	2
.75 Billion	7	9	10	4
1.5 Billion	7	9	9	7
3.0 Billion	5	7	9	9
6.0 Billion	0	9	17	22

Figure 4. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Rural Other Principal Arterial



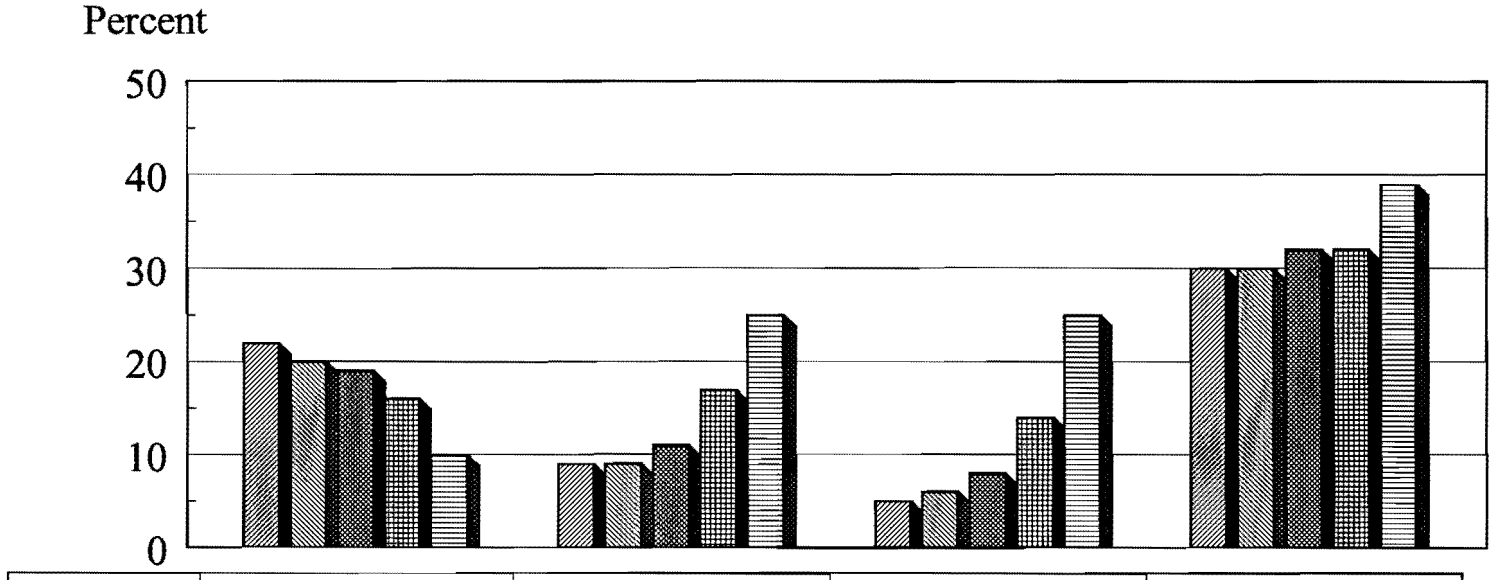
Bond Strategy	1996	2003	2010	2026
No Bonds	8	12	6	18
.75 Billion	8	12	6	19
1.5 Billion	7	13	7	20
3.0 Billion	5	15	9	21
6.0 Billion	0	20	22	31

Figure 5. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Rural Minor Arterial



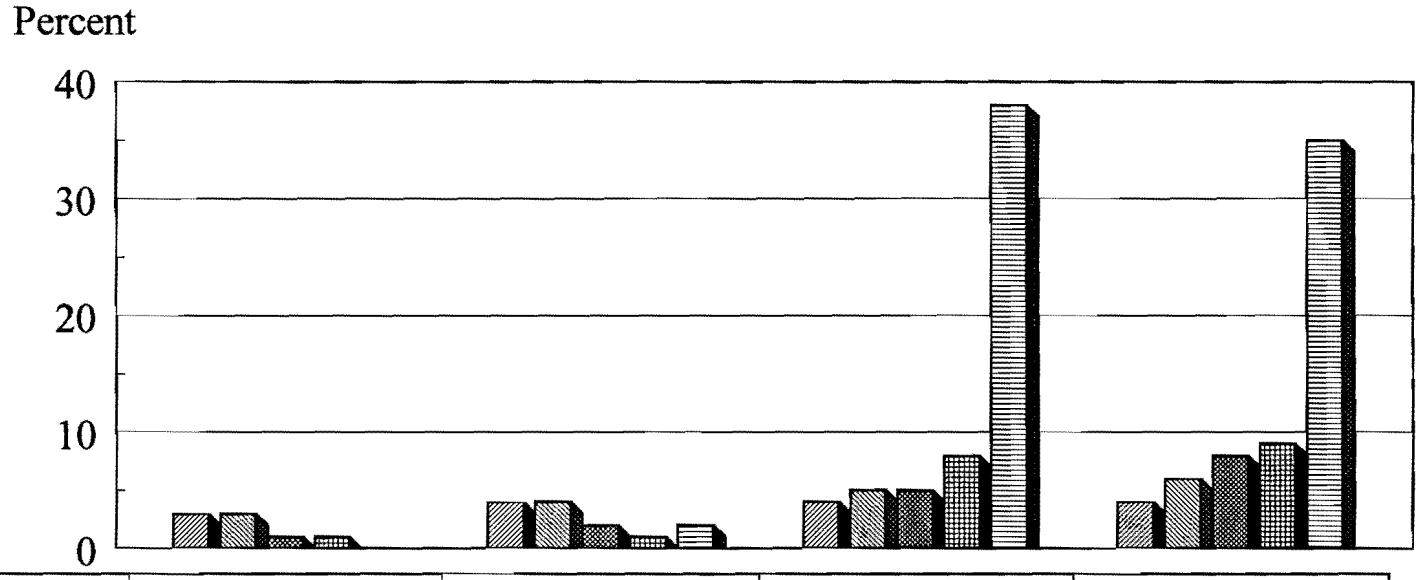
Bond Strategy	1996	2003	2010	2026
No Bonds	12	10	6	30
.75 Billion	12	9	6	30
1.5 Billion	10	10	7	31
3.0 Billion	9	12	9	33
6.0 Billion	5	22	19	39

Figure 6. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Rural Major Collector



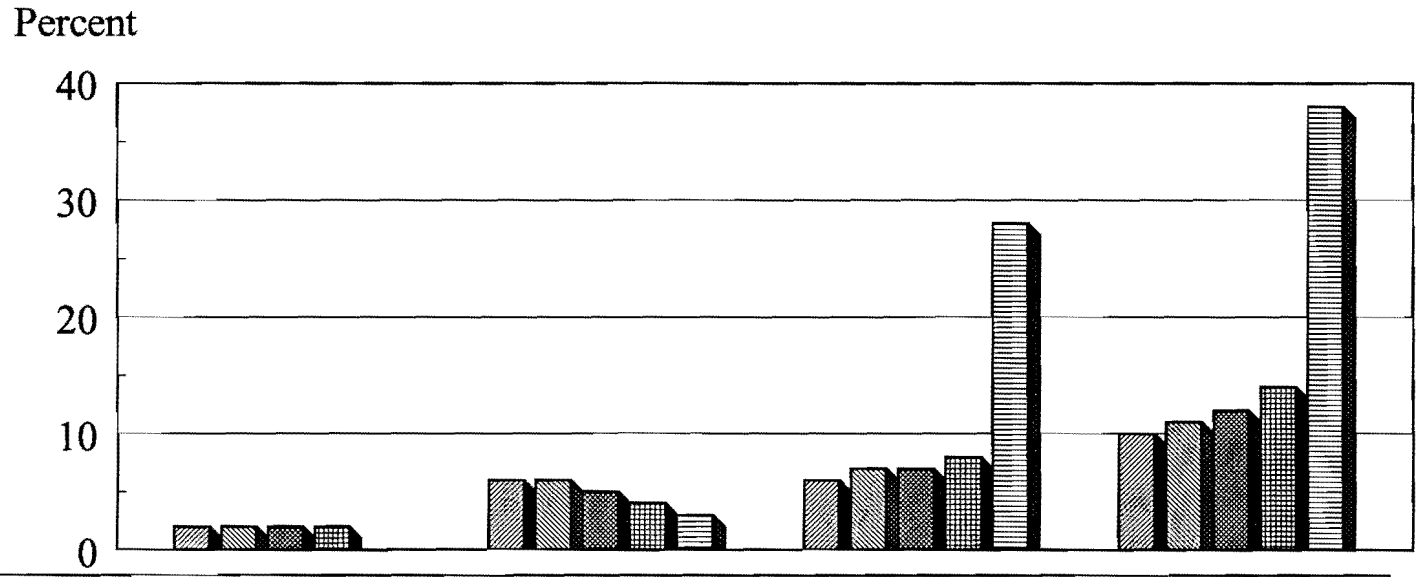
Bond Strategy	1996	2003	2010	2026
No Bonds	22	9	5	30
.75 Billion	20	9	6	30
1.5 Billion	19	11	8	32
3.0 Billion	16	17	14	32
6.0 Billion	10	25	25	39

Figure 7. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Rural Minor Collector



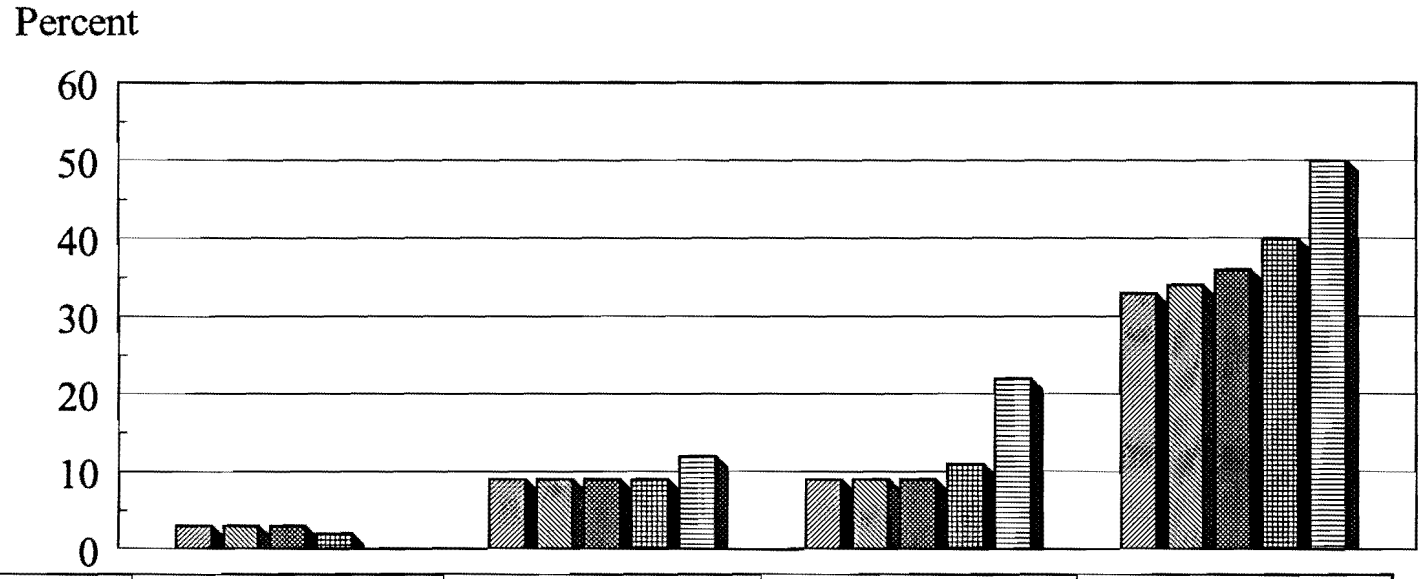
Bond Strategy	1996	2003	2010	2026
No Bonds	3	4	4	4
.75 Billion	3	4	5	6
1.5 Billion	1	2	5	8
3.0 Billion	1	1	8	9
6.0 Billion	0	2	38	35

Figure 8. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Urban Interstate



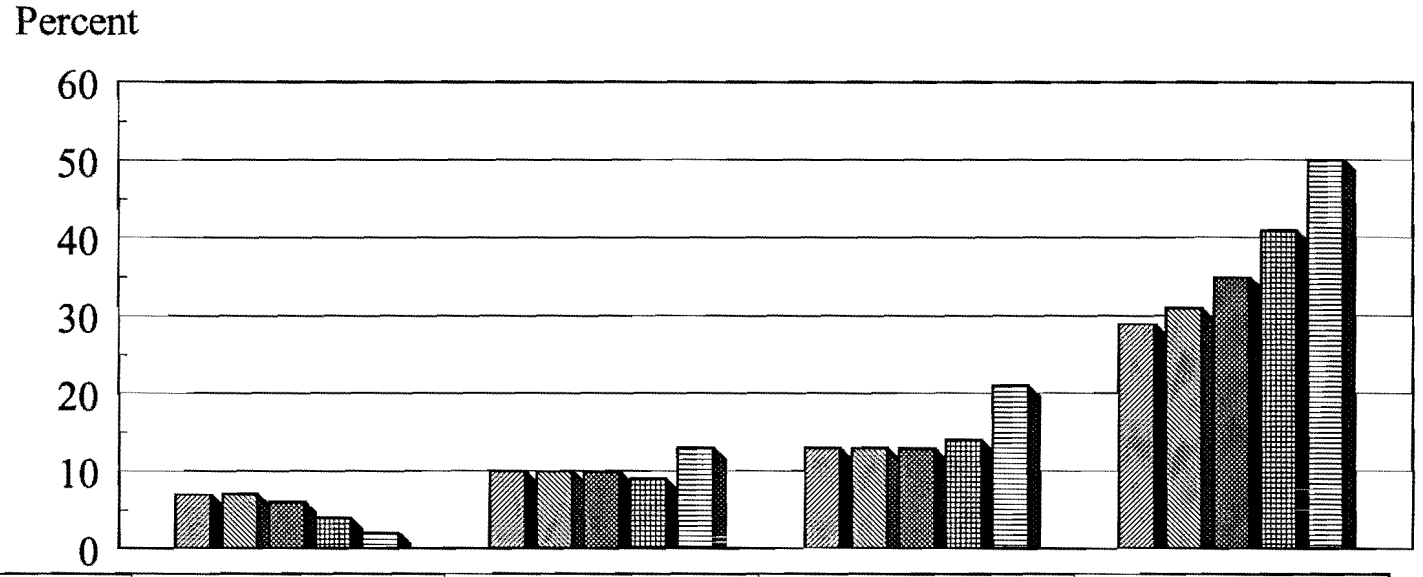
Bond Strategy	1996	2003	2010	2026
No Bonds	2	6	6	10
.75 Billion	2	6	7	11
1.5 Billion	2	5	7	12
3.0 Billion	2	4	8	14
6.0 Billion	0	3	28	38

Figure 9. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Urban Other Freeway and Expressway



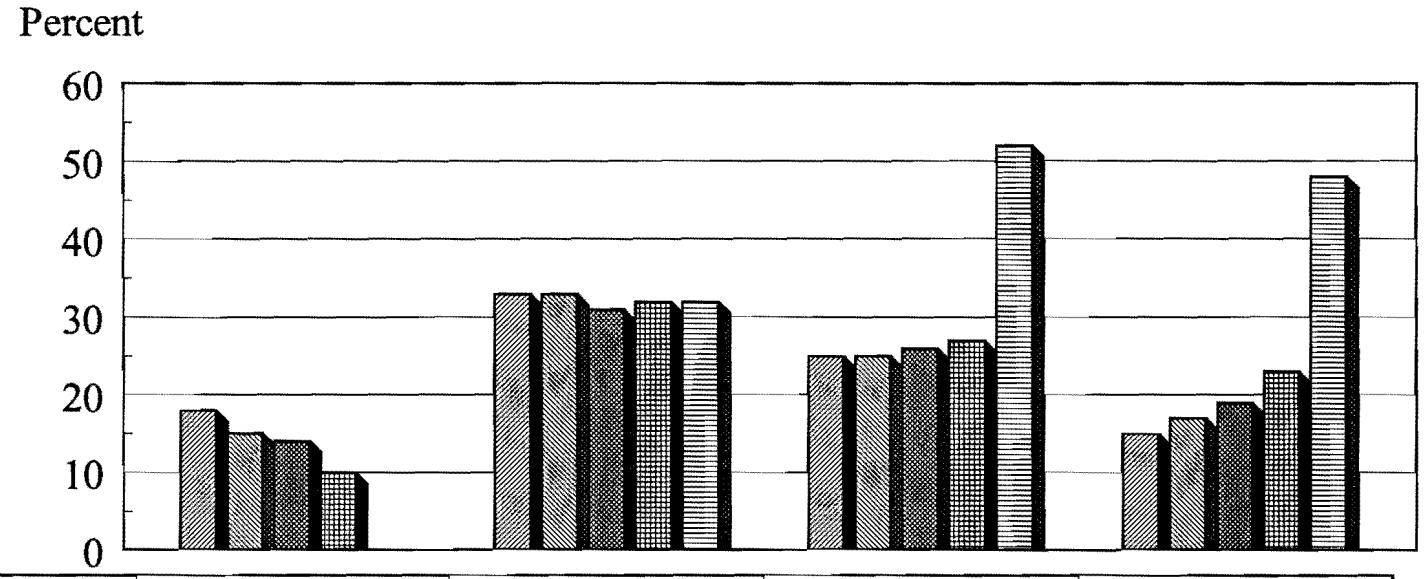
Bond Strategy	1996	2003	2010	2026
No Bonds	3	9	9	33
.75 Billion	3	9	9	34
1.5 Billion	3	9	9	36
3.0 Billion	2	9	11	40
6.0 Billion	0	12	22	50

Figure 10. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Urban Other Principal Arterial



Bond Strategy	1996	2003	2010	2026
No Bonds	7	10	13	29
.75 Billion	7	10	13	31
1.5 Billion	6	10	13	35
3.0 Billion	4	9	14	41
6.0 Billion	2	13	21	50

Figure 11. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Urban Minor Arterial



Bond Strategy	1996	2003	2010	2026
No Bonds	18	33	25	15
.75 Billion	15	33	25	17
1.5 Billion	14	31	26	19
3.0 Billion	10	32	27	23
6.0 Billion	0	32	52	48

Figure 12. Percent of Highway Kilometers with Pavement Serviceability Index below 2.0, Urban Collector

Effects on Average Overall Travel Speed

To show the effects of the different bond funding strategies on highway congestion and delay, researchers developed a set of tables and figures showing the average overall travel speed on the State System. Several tables and figures are used to show the effects of different bond strategies on average speeds in the years at the end of each of the four analysis periods, as forecasted by the HPMS analytical models. The four years represented are 1996, 2003, 2010, and 2026.

Tables 37 through 40 show the average overall travel speed for each bond strategy, by functional highway class, in the years 1996, 2003, 2010, and 2026, respectively. The average overall travel speed also is shown for total rural and total urban in each table. The rural and urban results are depicted in Figures 13 and 14. Each figure shows the results for each bond strategy for each of the four end-of-period years.

In almost all of the functional classes, the average travel speeds are slightly improved (that is, are higher) in 1996, the final year of the first time period. However, with increased use of bonds, the average travel speeds tend to be increasingly lower over time. In the final years of the next three periods, the average speeds almost always are progressively worse over time and are much worse with the strategies using higher levels of bond financing.

Table 37. Average Overall Travel Speed Weighted by Vehicle Kilometers Traveled, at End of First Period in Year 1996

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural	Kilometers per Hour				
Interstate	83.5	83.5	83.8	84.2	85.0
Oth Prin Art	75.5	75.6	76.0	76.3	76.8
Min Art	73.9	74.2	74.5	74.7	75.0
Maj Art	67.4	67.4	67.6	67.6	67.8
Min Col	63.7	63.9	64.1	64.2	64.4
Total	73.7	73.9	74.0	74.4	74.7
Urban					
Interstate	80.6	81.3	81.8	82.4	83.0
Oth Exp/Fwy	68.2	68.6	69.0	69.4	70.5
Oth Prin Art	30.1	30.1	30.1	30.1	30.1
Min Art	32.5	32.5	32.5	32.5	32.3
Collect	34.0	34.0	34.0	34.1	34.1
Total	49.9	50.0	50.2	50.4	50.5

Table 38. Average Overall Travel Speed Weighted by Vehicle Kilometers Traveled, at End of Second Period in Year 2003

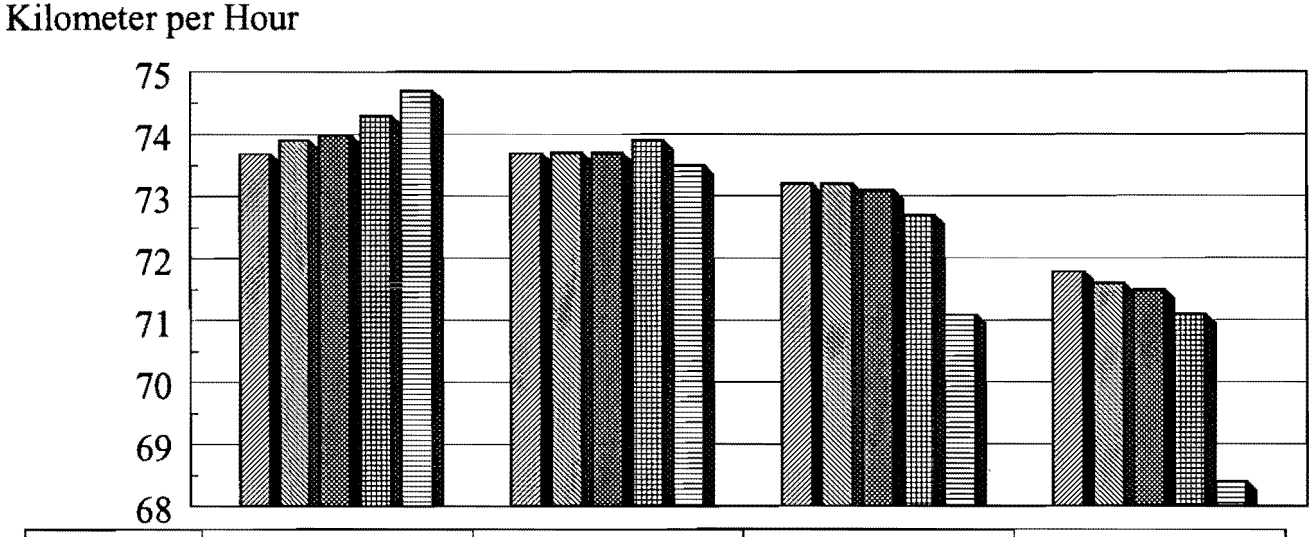
Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural	Kilometers per Hour				
Interstate	82.9	83.0	83.0	83.2	83.2
Oth Prin Art	75.8	75.8	76.0	76.1	76.0
Min Art	74.2	74.2	74.2	74.2	73.9
Maj Art	67.3	67.3	67.3	67.3	66.8
Min Col	64.2	64.2	64.2	64.2	63.2
Total	73.7	73.7	73.7	73.9	73.5
Urban					
Interstate	77.9	78.1	78.2	78.4	78.5
Oth Exp/Fwy	66.9	67.1	67.1	67.4	67.3
Oth Prin Art	29.9	29.9	29.9	29.9	29.8
Min Art	31.9	31.9	31.9	32.0	31.7
Collect	33.2	33.2	33.2	33.2	33.0
Total	48.9	48.9	49.1	49.1	48.9

Table 39. Average Overall Travel Speed Weighted by Vehicle Kilometers Traveled, at End of Third Period in Year 2010

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural	Kilometers per Hour				
Interstate	81.3	80.9	80.8	80.5	78.9
Oth Prin Art	76.3	76.1	76.0	75.5	73.4
Min Art	73.5	73.4	73.2	72.9	71.0
Maj Art	66.9	66.9	66.9	66.8	65.7
Min Col	65.0	64.9	64.7	64.1	62.0
Total	73.2	73.2	73.1	72.7	71.1
Urban					
Interstate	76.6	76.4	76.1	76.1	72.1
Oth Exp/Fwy	66.1	66.1	66.0	65.3	62.3
Oth Prin Art	29.9	29.8	29.8	29.6	29.0
Min Art	31.1	31.1	31.1	30.9	30.6
Collect	32.5	32.5	32.5	32.5	31.9
Total	48.4	48.3	48.3	48.0	46.5

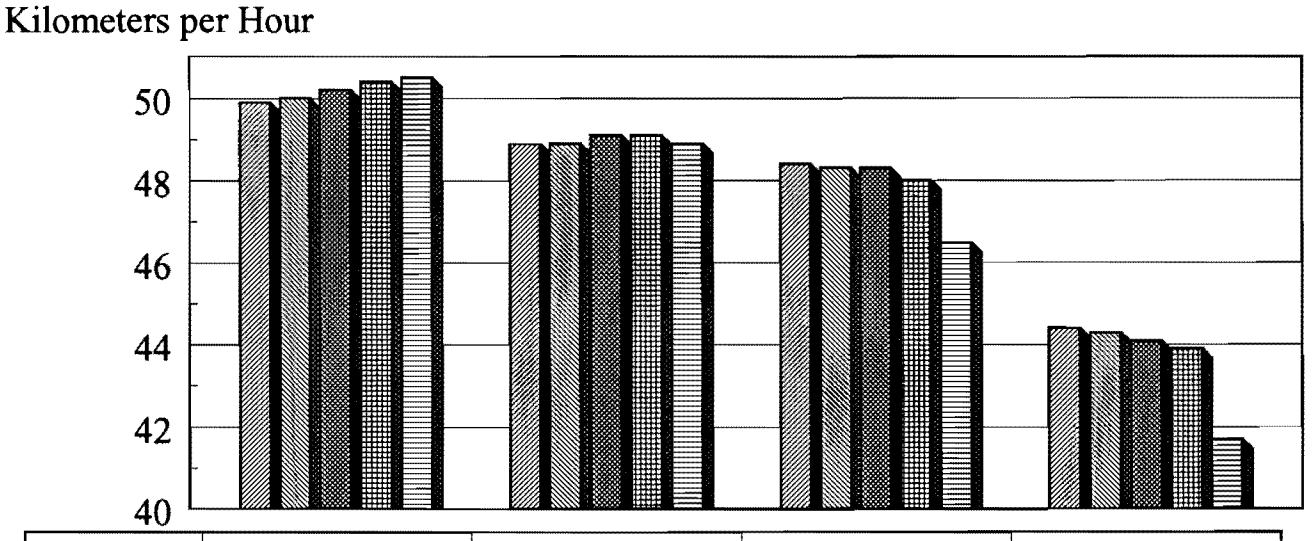
Table 40. Average Overall Travel Speed Weighted by Vehicle Kilometers Traveled, at End of Fourth Period in Year 2026

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural	Kilometers per Hour				
Interstate	82.1	81.8	81.4	80.8	74.8
Oth Prin Art	78.4	78.2	77.9	76.9	72.1
Min Art	71.9	71.9	71.8	71.5	70.2
Maj Art	62.8	62.8	62.8	62.8	62.4
Min Col	62.3	62.3	62.1	62.1	61.5
Total	71.8	71.6	71.5	71.1	68.4
Urban					
Interstate	66.6	66.6	66.5	66.1	60.0
Oth Exp/Fwy	60.5	60.5	60.3	60.0	56.6
Oth Prin Art	28.5	28.3	28.2	28.0	27.2
Min Art	28.5	28.5	28.5	28.3	27.5
Collect	30.4	30.4	30.4	30.4	30.1
Total	44.4	44.3	44.1	43.9	41.7



Bond Strategy	1996	2003	2010	2026
No Bonds	73.7	73.7	73.2	71.8
.75 Billion	73.9	73.7	73.2	71.6
1.5 Billion	74.0	73.7	73.1	71.5
3.0 Billion	74.3	73.9	72.7	71.1
6.0 Billion	74.7	73.5	71.1	68.4

Figure 13. Average Overall Travel Speed, Rural



Bond Strategy	1996	2003	2010	2026
No Bonds	49.9	48.9	48.4	44.4
.75 Billion	50.0	48.9	48.3	44.3
1.5 Billion	50.2	49.1	48.3	44.1
3.0 Billion	50.4	49.1	48.0	43.9
6.0 Billion	50.5	48.9	46.5	41.7

Figure14. Average Overall Travel Speed, Urban

Effects on Vehicle Operating Costs

Researchers developed a set of tables and figures similar to those used for average vehicle speeds to show the effects of bond funding on vehicle operating costs per 1000 kilometers of travel. Tables 41 through 44 show vehicle operating costs and are analogous to Tables 37 through 40 which show average overall travel speed. Likewise, Figures 15 and 16 summarize the vehicle operating cost findings for rural and urban areas for the bond strategies, showing the results at the end of the four time periods.

In rural areas, increased use of bonds tends to decrease vehicle operating costs at the end of the first two periods, but to increase such costs in the final two periods. In urban areas, there is also a slight decrease in vehicle operating costs with increased use of bonds in the first two periods and an increase in the last two periods. For both rural and urban areas, the increase in vehicle operating costs at the end of both the third and the fourth periods is pronounced.

Table 41. Vehicle Operating Costs per 1000 Kilometers Traveled, at End of First Period in Year 1996

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	$177.0	$177.0	$176.6	$175.9	$175.0
Oth Prin Art	156.3	155.7	154.7	153.5	151.9
Min Art	148.6	148.5	148.0	146.7	145.2
Maj Art	157.0	156.5	156.2	155.7	155.3
Min Col	159.0	158.5	158.0	157.1	156.3
Total	160.5	160.1	159.6	158.8	157.7
Urban					
Interstate	$126.1	$126.0	$125.6	$125.3	$125.0
Oth Exp/Fwy	122.8	122.7	122.7	122.5	121.7
Oth Prin Art	150.6	150.2	149.9	149.5	148.9
Min Art	155.9	155.6	155.3	154.5	154.0
Collect	145.8	145.6	145.4	145.0	144.3
Total	134.2	133.9	133.7	133.4	132.9

Table 42. Vehicle Operating Costs per 1000 Kilometers Traveled, at End of Second Period in Year 2003

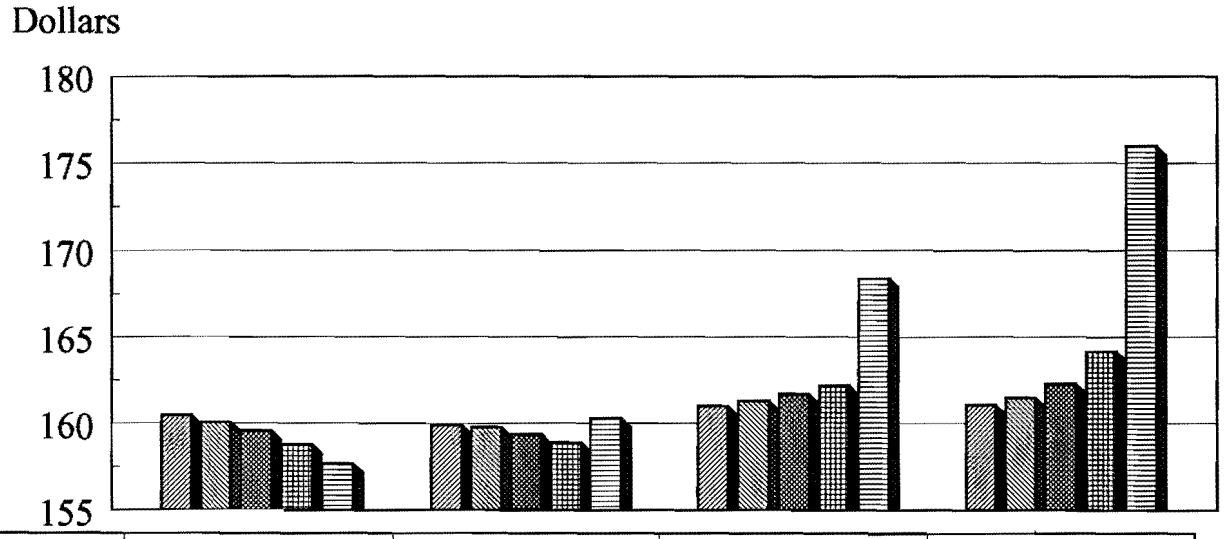
Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	$179.1	$178.8	$178.6	$178.2	$179.3
Oth Prin Art	155.8	155.2	154.2	152.7	152.4
Min Art	147.0	147.0	146.9	147.3	149.6
Maj Art	155.0	155.0	155.0	155.0	157.3
Min Col	156.0	156.0	156.3	157.6	162.5
Total	159.9	159.8	159.4	158.9	160.3
Urban					
Interstate	$129.8	$129.5	$129.1	$128.6	$129.2
Oth Exp/Fwy	126.8	126.4	126.3	125.7	126.1
Oth Prin Art	154.5	154.4	154.3	154.0	156.1
Min Art	158.7	158.5	158.2	157.9	159.6
Collect	150.4	150.3	150.3	149.8	151.7
Total	137.9	137.7	137.5	137.0	138.1

Table 43. Vehicle Operating Costs per 1000 Kilometers Traveled, at End of Third Period in Year 2010

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	$185.9	$186.9	$188.0	$189.5	$198.2
Oth Prin Art	155.9	156.1	155.5	154.7	159.1
Min Art	146.6	147.0	147.6	149.4	157.5
Maj Art	153.9	153.9	154.3	154.8	159.6
Min Col	152.3	152.6	153.6	156.4	166.6
Total	161.0	161.3	161.7	162.2	168.4
Urban					
Interstate	$126.2	$126.4	$126.8	$126.8	$144.7
Oth Exp/Fwy	127.0	126.9	126.9	127.6	137.0
Oth Prin Art	155.2	155.8	156.7	157.7	165.8
Min Art	161.2	161.4	161.7	163.5	170.3
Collect	146.0	146.2	146.3	146.9	160.1
Total	136.8	137.0	137.4	138.0	150.3

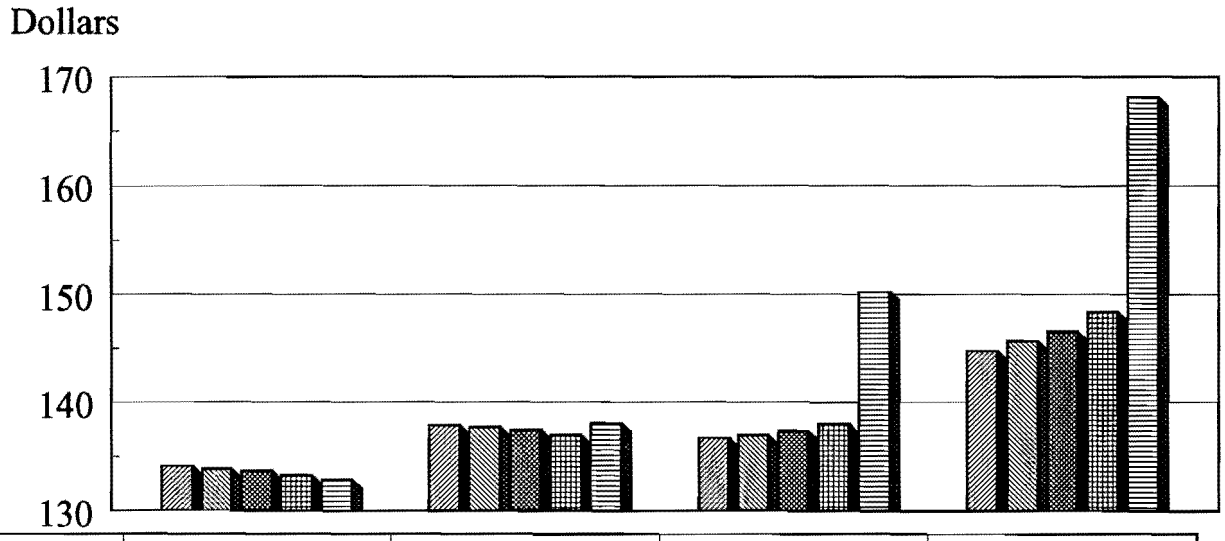
Table 44. Vehicle Operating Costs per 1000 Kilometers Traveled, at End of Fourth Period in Year 2026

Functional class	Bond Strategy				
	No Bonds	$0.75 Bill.	$1.50 Bill.	$3.00 Bill.	$6.00 Bill.
Rural					
Interstate	$177.4	$178.8	$180.4	$184.8	$214.0
Oth Prin Art	150.7	151.2	152.4	154.5	168.1
Min Art	150.1	150.4	150.9	152.0	157.7
Maj Art	162.2	162.1	162.2	162.4	163.9
Min Col	163.2	163.2	163.5	163.5	167.0
Total	161.1	161.5	162.3	164.2	176.0
Urban					
Interstate	$128.1	$128.3	$128.9	$129.6	$159.4
Oth Exp/Fwy	125.5	125.8	125.8	126.4	140.7
Oth Prin Art	183.6	186.4	188.5	193.3	206.8
Min Art	170.1	170.8	171.8	174.8	193.9
Collect	149.0	149.0	149.2	149.6	153.9
Total	144.8	145.7	146.6	148.4	168.2



Bond Strategy	1996	2003	2010	2026
No Bonds	160.5	159.9	161.0	161.1
.75 Billion	160.1	159.8	161.3	161.5
1.5 Billion	159.6	159.4	161.7	162.3
3.0 Billion	158.8	158.9	162.2	164.2
6.0 Billion	157.7	160.3	168.4	176.0

Figure 15. Vehicle Operating Costs per 1,000 Kilometers Traveled, Rural



Bond Strategy	1996	2003	2010	2026
No Bonds	134.2	137.9	136.8	144.8
.75 Billion	133.9	137.7	137.0	145.7
1.5 Billion	133.7	137.5	137.4	146.6
3.0 Billion	133.3	137.0	138.0	148.4
6.0 Billion	132.9	138.1	150.3	168.2

Figure 16. Vehicle Operating Costs per 1,000 Kilometers Traveled, Urban

IV. RESULTS OF PUBLIC OPINION SURVEY

SURVEY PROCEDURES

Researchers conducted a statewide, random survey of Texans to determine their opinions about bond financing and other finance alternatives. The survey included persons 18 years of age or older at the time of the survey in early 1995. The Public Policy Institute at Texas A&M University completed telephone interviews employing trained, multilingual interviewers using a Computer-Assisted-Calling Interview (CACI) approach. The goal was to obtain at least 500 completed interviews; this was exceeded with over 600 interviews completed.

In the survey, a total of 629 completed interviews were produced. However, seven respondents were omitted due to missing data items. This resulted in a usable sample of 622, of which 394 were female and 228 were male. Due to the disparity in the percentages of female and male, the answers were weighted. The most recent distribution (by age by gender) of licensed drivers for the State of Texas was obtained from the Texas Department of Public Safety. These counts were used to determine the percent of total licensed drivers in each age category by gender.

The data from the survey were converted to percentages in each of the categories. Weighting factors were derived by dividing the proportions in each category from the driving population by the proportion represented in the survey sample. As a result of the correction, the cross tabulations derived from the adjusted survey data better represent the responses that could have been expected if the survey sample had included the same proportion of males and females as the state proportions for licensed drivers.

The weighting procedure results in a weighted sample that is 51.1 percent males and 48.9 percent females, as compared to 36.7 percent males and 63.3 percent females in the unweighted survey data. Using these weighting factors creates an artificial sample with 317.87 males and 304.13 females. All of the survey results are shown with this weighted sample.

In conducting this survey, interviewers indicated that they were conducting interviews for research at Texas A&M University and did not mention that the survey was being conducted in connection with research for the Texas Department of Transportation.

SURVEY RESULTS

There were basically two sets of questions about finance. The first question asked was: "How do you feel about the State issuing bonds to build highways?" Respondents were given the following possible choices:

Strongly support
Support
Oppose
Strongly oppose
Neutral or no opinion
Don't know

Figure 17 summarizes the results for this question. These results indicate that 56.52 percent of respondents support use of bonds as compared to only 7.25 percent who oppose use of bonds, with 36.24 percent being neutral, having no opinion, or not knowing.

Interviewees next were asked the following question: "If issuing bonds to build a two million dollar highway project now meant that four million dollars worth of highways could not be built over the next 20 years, then how would you feel about issuing the bonds?" Respondents were given the following choices, which are the same as for the preceding question except for the addition of a "maybe" answer which was explained as "conditional answer such as it depends on the project, etc.":

Strongly support
Support
Maybe
Oppose
Strongly oppose
Neutral or no opinion
Don't know
Refused to choose any of above

Figure 18 summarizes the results for this question. The results indicate that 26.98 percent of respondents either support or strongly support bonds in this situation as compared to 56.52 percent of respondents who support use of bonds in the preceding question. However, respondents were allowed the additional category of "maybe," and inclusion of the percent giving this response gives a total of 51.04 percent either supporting or maybe supporting bonds, depending on the situation.

However, the oppose or strongly oppose percent increased from 7.25 percent opposing use of bonds in the first question to 29.08 percent opposing use of bonds in this form of the question. Thus, in this form of the question where people are told that they must give up $4 million of future projects for $2 million now, they are more opposed. (This giving up of $4 million in the future for $2 million now roughly represents what happens with use of 20-year bonds at current interest rates.) Nevertheless, when presented with this hypothetical situation, over 50 percent of respondents were willing to support use of bonds for highway improvements in at least some cases.

To obtain these same respondents opinions on different finance alternatives, they were

given the following instruction: "I'm going to read a list of ways to generate money to pay for highways. Please tell me if you strongly favor, favor, oppose, strongly oppose, or feel neutral about each financing option." They were then given the following alternatives: gasoline and diesel taxes; automobile license and registration fees; sales tax on automobiles and automobile parts; general revenues (such as that which comes from the state sales tax); and toll road fees. Figures 19 through 23 summarize the answers for these alternatives. Figure 24 is included to allow comparison of answers for alternative funding sources.

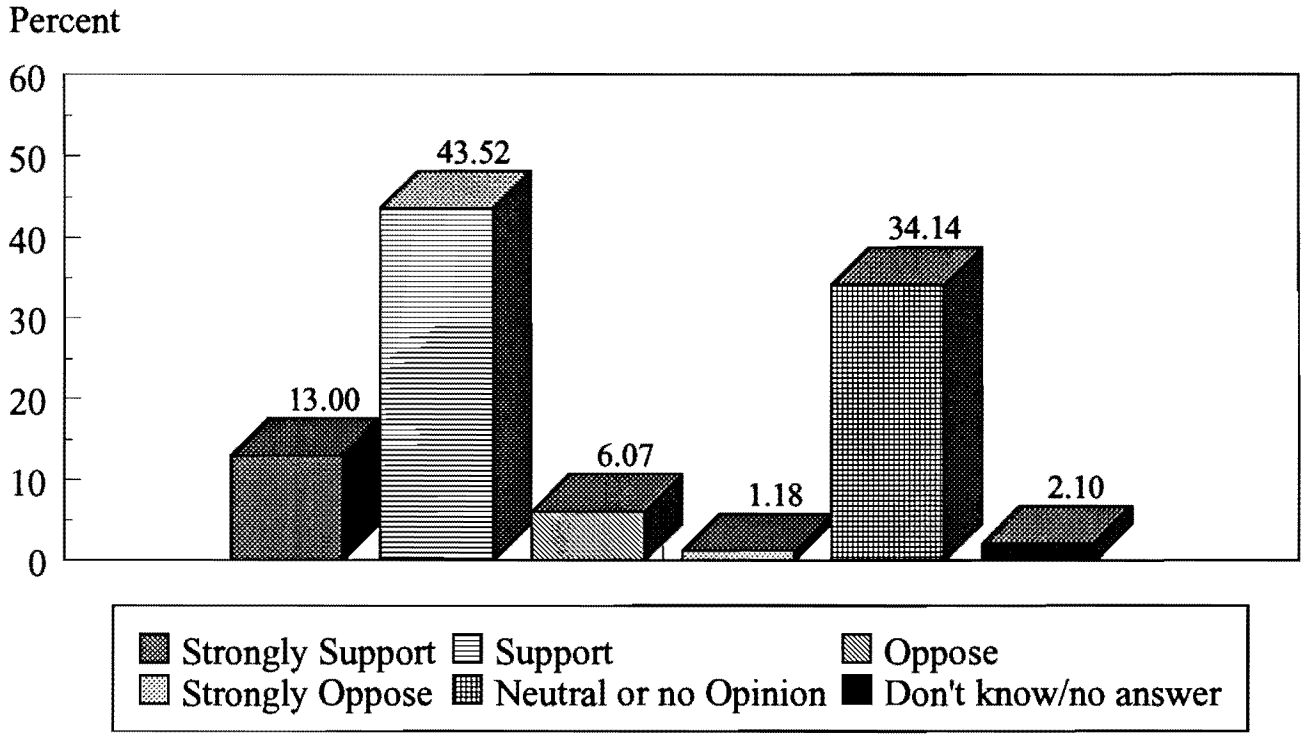


Figure 17. Answers to First Question on Bonds
"How do you feel about the State issuing bonds to build highways?"

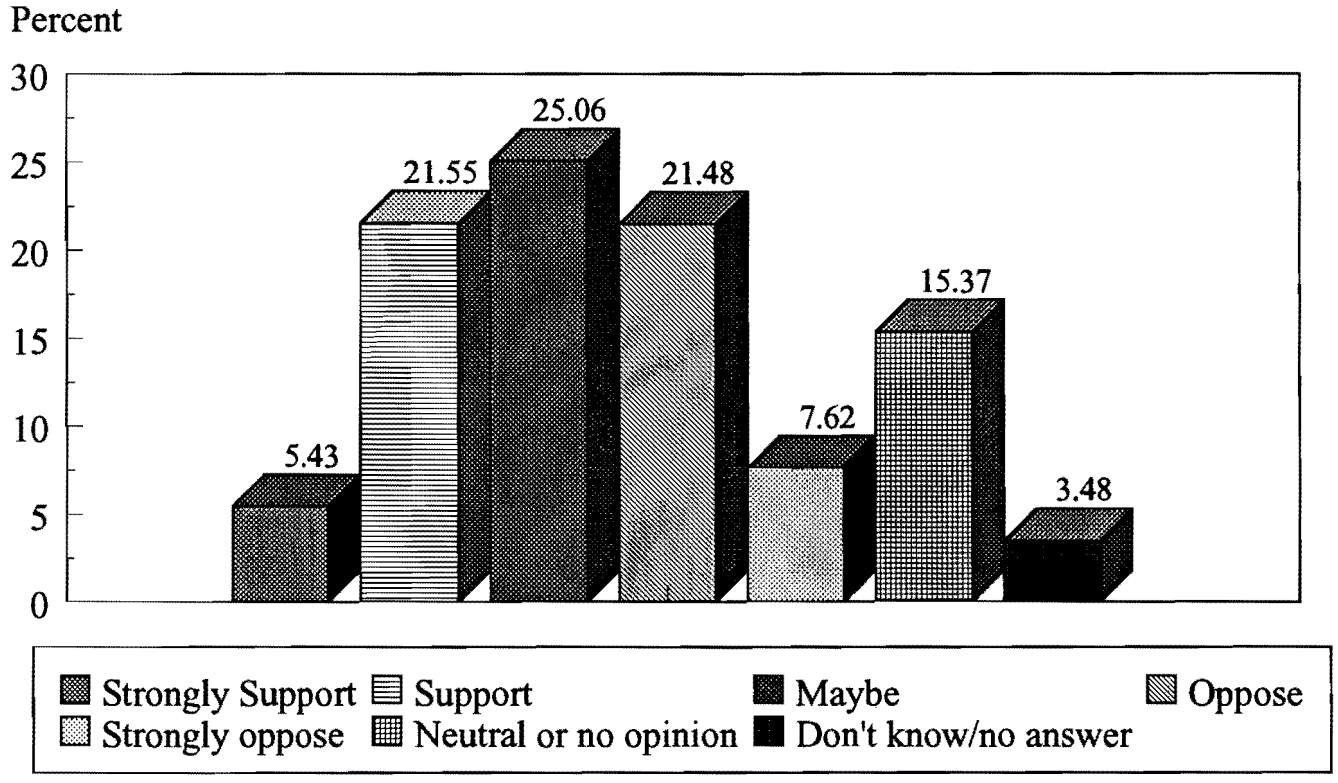


Figure 18. Answers to Second Question on Bonds
"If issuing bonds to build a two million dollar highway project now meant that four million dollars worth of highways could not be built over the next 20 years, then how would you feel about issuing bonds?"

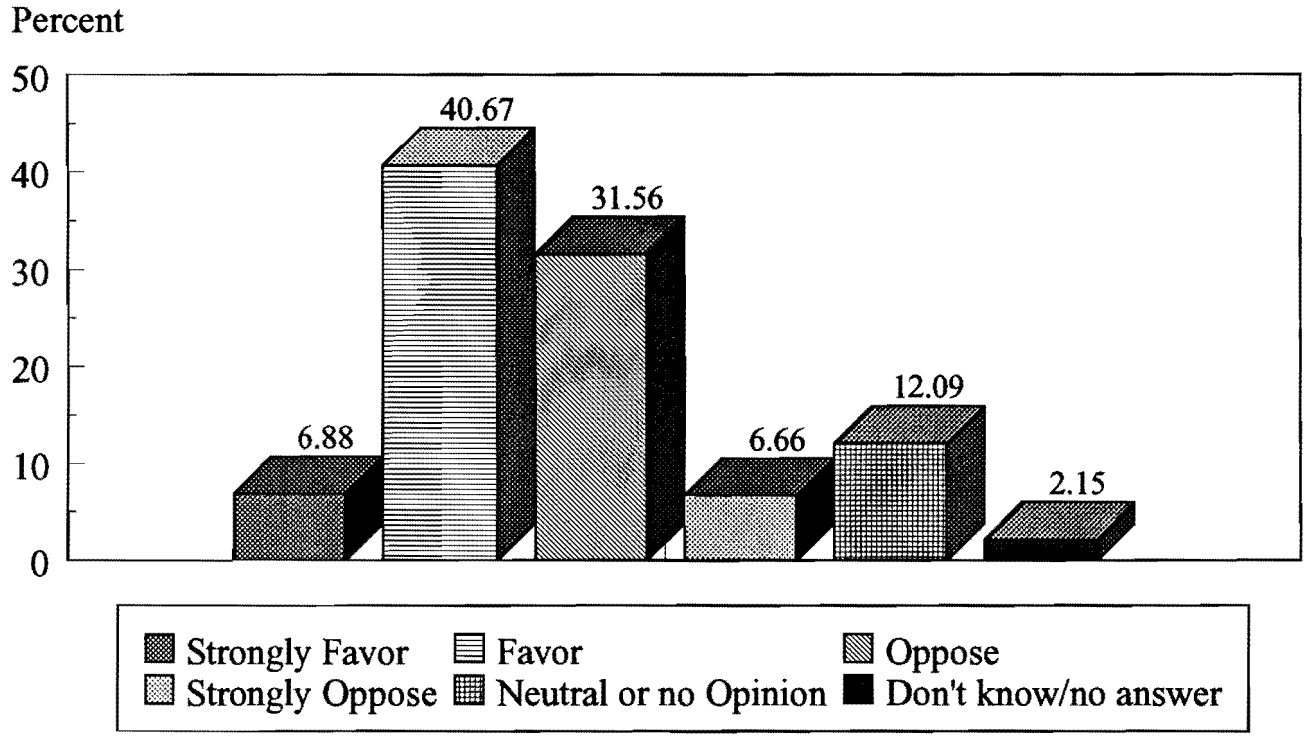


Figure 19. Opinions on Gasoline and Diesel Taxes for Financing Highways

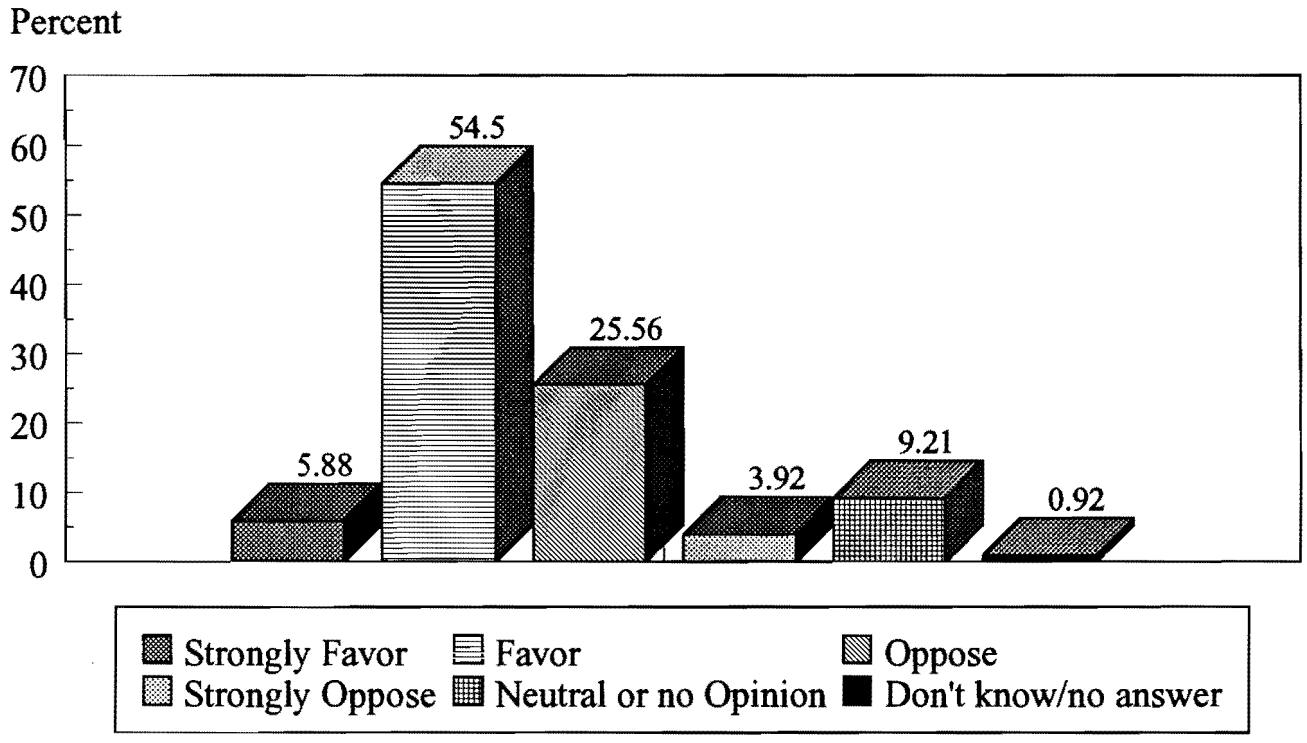


Figure 20. Opinions on Automobile License and Registration Fees for Financing Highways

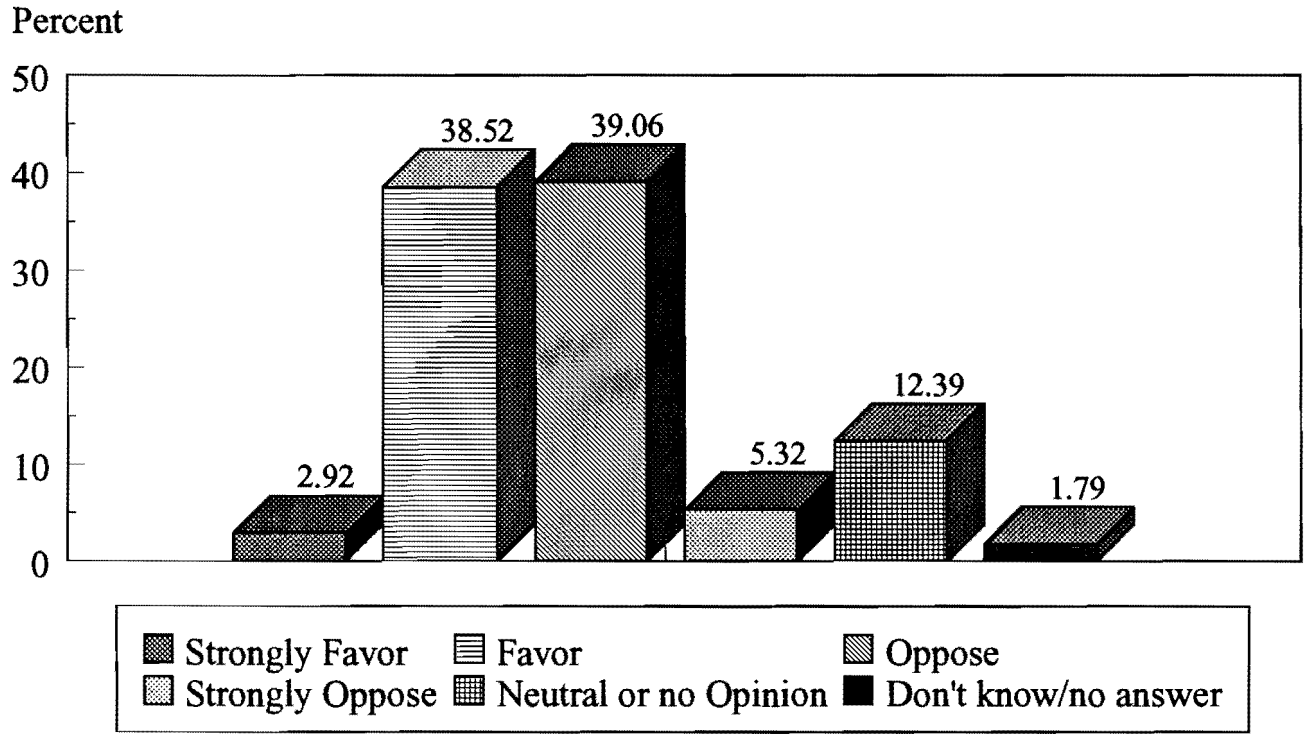


Figure 21. Opinions on Sales Tax on Automobiles and Automobile Parts for Financing Highways

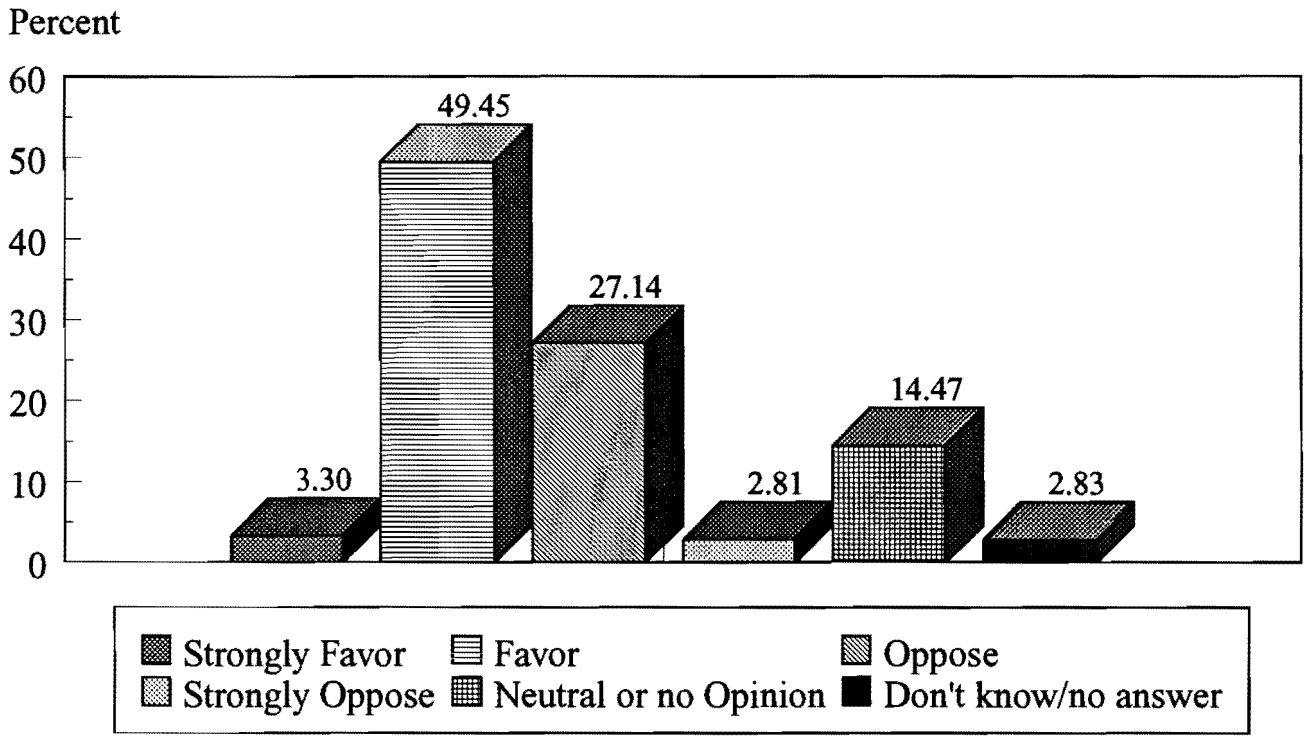


Figure 22. Opinions on General Revenue for Financing Highways

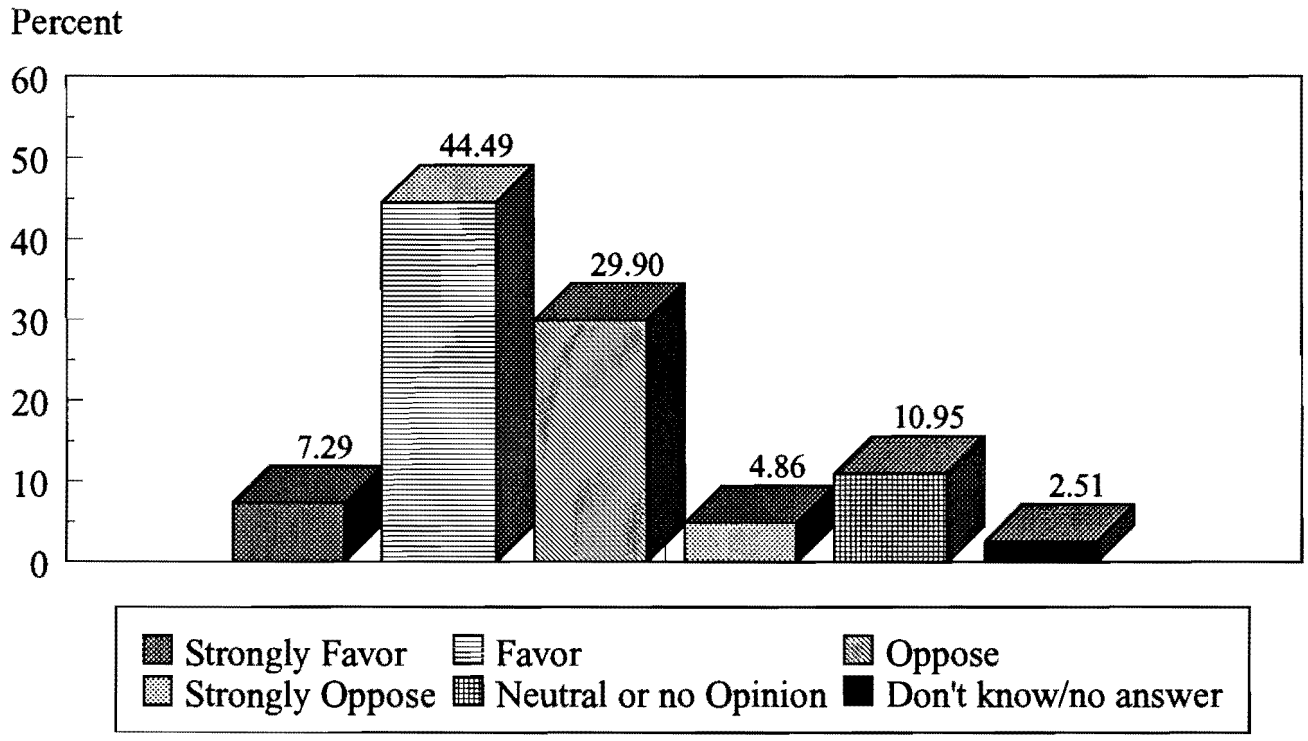


Figure 23. Opinions on Toll Road Fees for Financing Highways

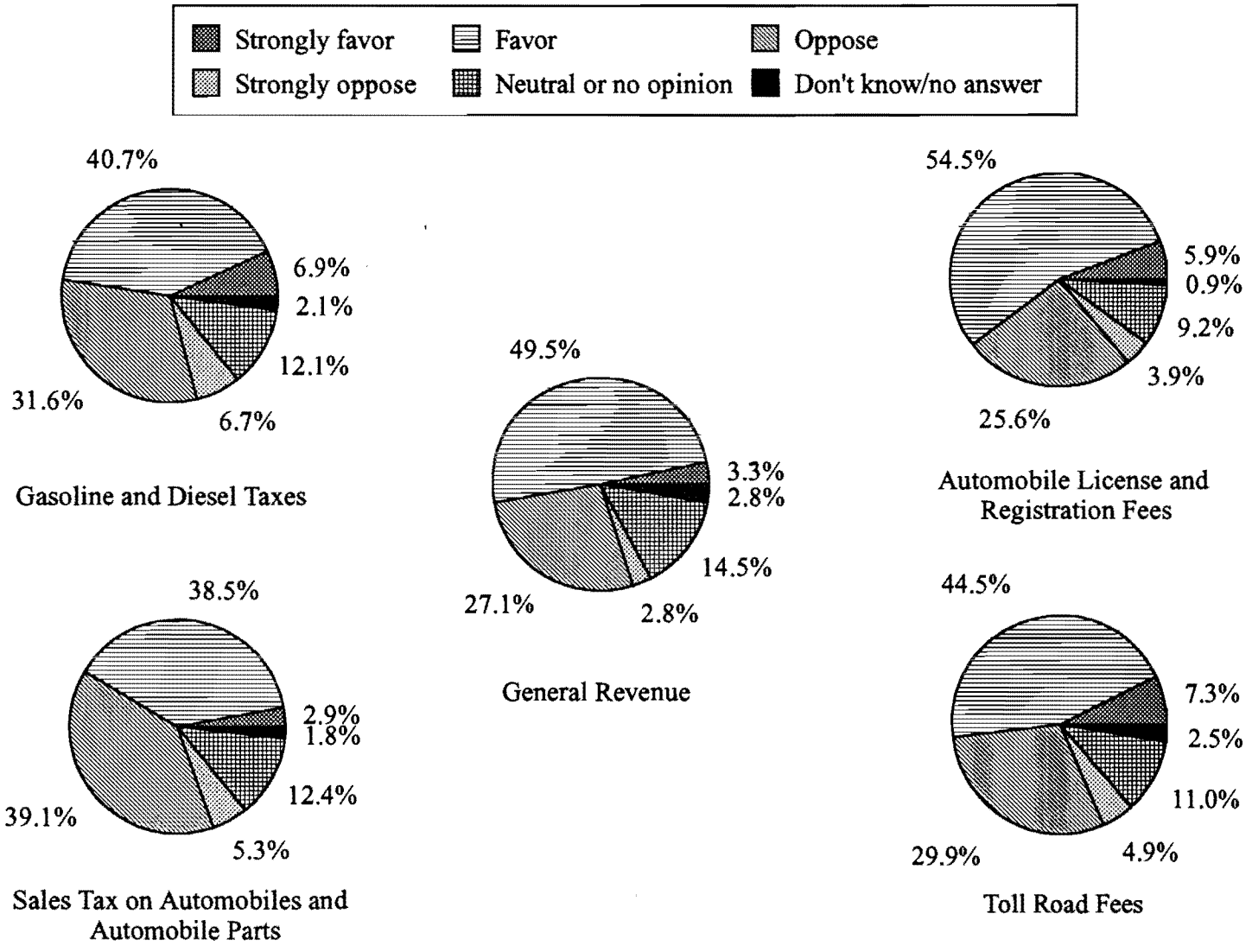


Figure 24. Comparison of Opinions on Alternative Revenue Sources

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