Bonding vs. Pay-Go

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16. Abstract
This research examines the value of financing infrastructure improvements through bonding versus a program of pay-go improvements. Postponed construction becomes more costly in nominal terms because inflation raises the cost of construction over a longer period before construction begins. However, postponements can also create a variety of other situations. For example, postponements add to the level of damage that must be repaired when projects are subsequently let to contract. Both methods of finance encounter factors such as availability of funds and fiscal stability, inflation, population growth, as well as congestion growth rates, to name a few. While there is no one-size fits all answer, understanding how these factors influence the outcomes and when they may be applicable, allows policy makers to make more informed decisions for the future.

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EXECUTIVE SUMMARY

This research report provides an overview of the advantages and disadvantages associated with both bonding and pay-go methods of funding. Additionally, a review of Michigan and 10 peer states was conducted to gain a better understanding of their current debt practices. The review found that Michigan is fairly similar in its debt usage and ranks in the middle of the group in regards to outstanding debt, debt per capita, and debt per lane mile. This research project provides a comparison tool to evaluate the impacts varying economic factors such as coverage ratios, inflation, and interest rates have on both methods of finance.

Additionally, the report delves into the costs and benefits attributed to both funding mechanisms. To assess the costs and benefits of both pay-go and bonding mechanisms, the research team selected three reconstruction projects that were funded using bond proceeds ranging from $41.5 million to $143.1 million. Inflationary and congestion factors were applied to these three projects to illustrate the estimated change in costs, had the project been constructed under a pay-go scenario. Both a 5-year and 10-year delay were examined.

Inflationary Impacts and Congestion Costs

An 8.2 percent inflation rate would increase the construction cost of the three example project scenarios by a range of $20 million to nearly $70 million over the 5-year delay period and by $50 million to more than $170 million over the 10-year delay period. The research team next examined the estimated congestion impacts associated with delay. A 5-year delay would result in nearly $2 million to $26 million in additional congestion costs. Likewise, a 10-year delay is estimated to produce nearly $4 million to $59 million.

Deferred Maintenance

Another important factor contributing to the cost and benefits of each funding method is the impact to deferred maintenance. If funding is delayed for some time, more projects will reach the point where they are classified as in need of rehabilitation, as opposed to routine maintenance. With the option to fund projects through bonds, more opportunities are available to reduce the number of maintenance projects delayed. While annual debt service is a factor that reduces available funds, the repayment schedule is typically distributed over many years, resulting in a lower annual payment. Bonding larger projects frees up funding that can now go towards smaller projects like routine road maintenance.

Qualitative Impacts

Outside of the costs associated with construction and debt, the decision to fund or finance transportation projects has impacts on planning and programming that are more difficult to quantify. At the program level, the availability of funding affects decisions around whether to focus on maintaining existing infrastructure or adding capacity to address existing or future needs.

INTRODUCTION

There are two general methods of paying for large transportation projects. The first, pay-as-you-go, or pay-go, means that the entire cost of the project must be paid for in existing cash on hand. The alternative to this method is to finance projects through debt with the use of bonds. Both methods have unique advantages and disadvantages and may be appropriate in different situations. Several different types of bonds can be utilized by states, again with their own requirements, advantages, and disadvantages.

This review will first define both the pay-go and bonding approach to paying for highway construction followed by a more in-depth review of topics such as:

- The true cost of bonding,
- The impacts of inflation on transportation projects,
- Costs related to construction delay, and
- Costs related to increasing user delay.

PAY-GO VS BONDING

Both pay-go and bonding offer distinct advantages and disadvantages. Benefits of pay-go include reduced interest expense, enhanced debt capacity, and increased fiscal responsibility, while disadvantages include insufficient funds for projects, sensitivity to inflation, and inter-generational inequity. Advantages of bonding include the ability to build projects when needed, more equitable costs across generations, and increased fiscal stability. Disadvantages include increased interest costs, limited future revenues, and the increased risk of fiscal irresponsibility.

Pay-Go

An earlier study conducted by the Arizona Department of Transportation provided a great deal of background information. While this study is dated, the basic principles remain relevant today. This section highlights the critical pros and cons outlined in that study.

Because pay-go does not incur debt and thus does not incur interest payments or transaction fees; the lack of these additional costs can be a significant advantage. Government issued tax exempt bonds currently have interest rates varying from about two to five percent of the principal. Additionally, loan origination fees can be up to one percent of the principal of the loan. For example, to borrow $100 million for a project at four percent interest with a one percent fee over twenty years would result in a total project cost of about $147 million over the twenty-year period. In addition to these higher costs, the money spent on interest incurs an opportunity cost, as that money could be spent on other projects in the future (*1*).

Because interest payments must be made regularly for an extended period of time, these payments impose inflexibility on the issuing agency. Pay-go gives increased budgetary flexibility in the event of an economic downturn or incorrectly forecasted future tax revenues. In these

situations, interest payments could force agencies to forgo important projects or services in order to meet the required debt payments. Pay-go avoids this risk (*1*).

Pay-go can be used to limit outstanding debt allowing for greater debt capacity and lower interest rates on that debt in scenarios where debt is required. If the agency is already carrying high levels of debt, then it may not be able to issue further debt or may pay higher interest rates in the event of an emergency or if a critical project needs funding. Additionally, this provides the agency with increased fiscal responsibility. Paying for projects up front removes the possibility of overspending on projects now and passing costs off to future generations. Likewise, the ability to fund fewer projects could mean that only the most effective projects would be funded, reducing wasteful spending on less efficient projects (*1*).

Pay-go also carries distinct disadvantages relative to bonding. One of the biggest drawbacks to pay-go is the amount of funds required to fully pay for a project up front. If the entire cost of the project cannot be covered by existing funds, then the project must either be delayed or funded by debt. This means critical projects may be delayed even though they are needed, and fewer projects may be completed overall. This may result in projects being initiated when funding is available rather than when the project is most needed. Additionally, it is more difficult to plan future expenditures, compared to bonding in which debt payments can be easily forecast. Under pay-go, funding needs may greatly vary year to year making forecasting difficult (*1*).

Pay-go can also result in intergenerational equity concerns between the current taxpayers who are paying for the project and future users who are gaining the benefits of the project. There is no way to quantify this concern, however taxpayers may find it unfair that they are paying for a project that they will not reap the full benefits of, while future users will gain the benefits, but have never paid into the project. Likewise, taxpayers may move into or out of an area, meaning new arrivals to the area may experience the full benefit without paying, while people who move away may pay for the project without ever using the facility (*1*).

Another potential issue is the “raiding” of reserve funds for future projects. As money is being accumulated for use in future projects, state governments with limited funding may divert the reserve fund to other projects or agencies the state government deems more important. This is less likely to be an issue with debt financing (*1*). Figure 1 shows the pros and cons of a pay-go approach.

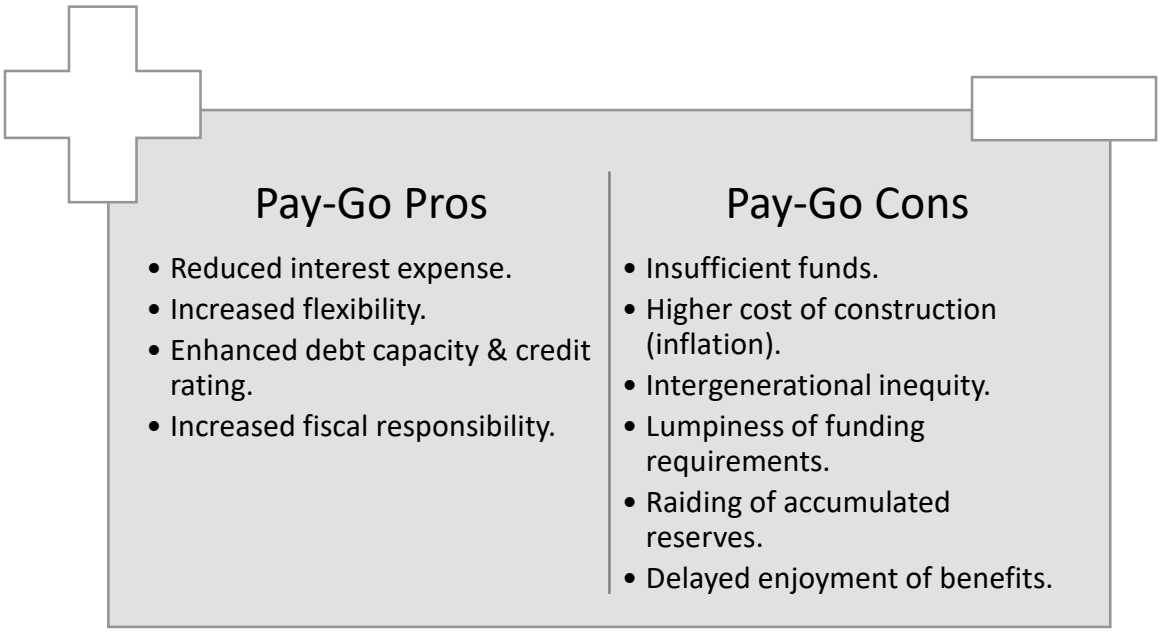

Figure 1. Pros and Cons of Pay-Go (*1*)

Bonding

Debt financing projects has its own set of advantages and disadvantages relative to pay-go. A major advantage is that bonding can significantly accelerate the transportation project construction process. With pay-go, projects cannot start until the agency can pay for the entire project. This can lead to important projects being delayed, interrupted, or potentially never completed at all. By debt financing the project, it can begin and can continue uninterrupted before all the necessary funds could be collected in a pay-go scenario. This also allows benefits to begin accruing to the facility users earlier than what would occur in the pay-go scenario (*1*).

Bonding also reduces the intergenerational equity concerns mentioned earlier. Debt financing allows the project costs to be evenly distributed over the life of the project, which could be anywhere from 10 to 30 years. This means that the taxpayers benefiting from the project over its lifespan are the ones bearing the cost, rather than the taxpayers in the past who may not have gained any benefit from the project (*1*).

Bonding can also allow for the repayment of project costs in cheaper future dollars if inflation increases faster than the interest rate of the bond. A high enough inflation rate could reduce or completely eliminate interest costs in real terms. Predicting this when budgeting for a project is likely impossible, and the market's expectations of future inflation will be priced into the interest rate paid (*1*).

Finally, bonding allows for increased fiscal stability. Debt financing a project means that the agency knows its future payment obligations with certainty. This makes planning for future projects easier and allows the state to smooth its expenditures over time, removing the lumpiness associated with pay-go funding (*1*).

A major drawback to debt financing projects is the interest cost associated with debt. As previously discussed, interest and loan fees can substantially add to the total cost of a project. Over time, as many projects are debt financed, the combined interest costs can result in fewer projects overtime being funded, as less total funding is available. However, many of the projects will be completed sooner. Excessive amounts of debt can also damage the credit rating of agencies, making additional debt more expensive or impossible to obtain. In the worst case this could result in a default or a bailout by the taxpayers (*1*). Figure 2 shows the pros and cons of debt financing.

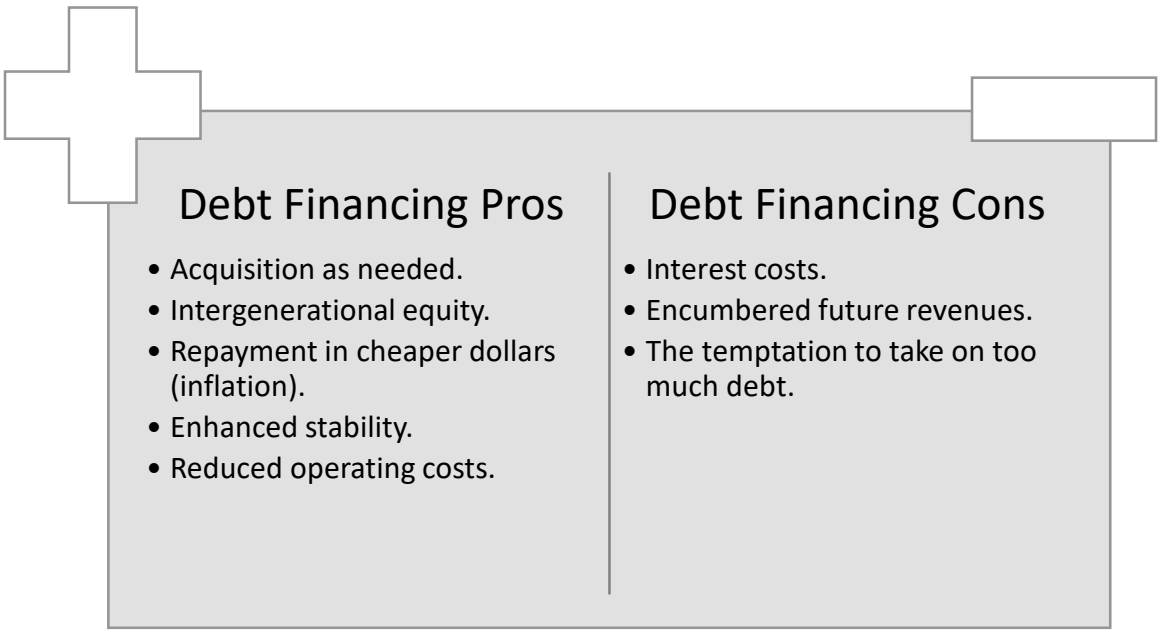

Figure 2. Pros and Cons of Debt Financing (*1*)

Types of Bonds

General obligation bonds are one of the most common ways for states and municipalities to pay for transportation projects. These bonds are used for projects that do not generate revenue and are backed by the ability of the issuing government to pay back the debt with tax revenues. Taxes can be raised to ensure that the bond obligations can be met, but the ability to do this and the size of the bond itself may require voter approval depending on state law (*2*).

Revenue bonds are similar to general obligation bonds except that they are backed by the revenue generated by the transportation project. These are commonly used on toll or transit related projects, where a toll or transit agency can collect revenues resulting from the project. For toll projects, toll agencies can issue bonds against future expected toll revenues. Transit revenue bonds operate similarly; however, transit fares are often not high enough to cover the full bond repayment, thus the total amount bonded may be limited based on system revenues. Advantages of revenue bonds are that they are typically tax exempt and may also be used as part of a public-private partnership, in which a private partner finances the project through a private activity bond and repays the debt from toll revenue (*2*).

Private activity bonds were extended to transportation projects in 2005 allowing private project sponsors to benefit from the lower costs of tax-exempt public bonds as part of a public-private partnership. Originally $15 billion in bonds were authorized to be issued, but this was increased to $30 billion with the 2021 Infrastructure Investment and Jobs Act. $24.7 billion in private activity bonds have been issued or allocated by the United States Department of Transportation (USDOT) to date. Qualified projects include any surface transportation project or international bridge or tunnel that receives Federal assistance under Title 23, United States Code (*3*).

Tax credit bonds are a bond where instead of receiving interest payments, bondholders receive federal tax credits that they can apply to their federal tax liability. This federal tax credit acts as a subsidy to the bond issuer from the federal government, lowering the borrowing cost for the borrower. However, these bonds were only available for transportation projects from 2009 to 2010 as part of the American Recovery and Reinvestment Act (*2*).

Grant Anticipation Revenue Vehicles, or GARVEEs, allow agencies to issue debt backed by future federal aid funding (*2*). Qualifying projects are typically those that are large enough to justify debt financing rather than pay-go with costs of delay sufficient to override the costs of financing. These projects typically do not have access to revenue streams, and the state Department of Transportation (DOT) is typically willing to reserve future federal highway funds to cover debt service requirements (*4*).

In addition to these types of bonds, states can operate state infrastructure banks to assist in financing projects. These banks are funded by federal formula grants states receive for highways and transit. This money can then be used to provide loans for state transportation projects or to act as leverage for the issuance of tax-exempt bonds. These banks were established by law in 1995, and as of 2016 had been created in 33 states, however, were only active in about 12. From 2006 to 2016, no state had used federal money to increase its state infrastructure bank capitalization (*5*).

OTHER COST CONSIDERATIONS

There are several factors that should be considered when estimating the costs of a project. These factors include equipment and machinery, labor, weather conditions, and level of productivity. Once the project is underway, other factors can lead to changes in costs. Delays are cited as one of the major cost overruns which can be triggered by funding issues, inflation or other price changes, design changes, exchange rate, and material or labor shortages (*6*). There will be instances where these cost factors will significantly affect the ability to fund a project causing decisionmakers to seek alternative financing options.

Construction project components can be grouped into internal or external sources, where internal sources are those that are controllable while external are not directly related to the agency's management of the project (*7*). Internal factors that cause an increase in costs are attributed to poor management, poor execution, and/or ambiguous contracts. External factors that affect costs are regulations, market conditions, inflation, and any other unpredictable

events. The identification of these factors can better help properly budget construction projects. This section will focus more closely on the impacts of inflation and the impacts on the economy in relation to bonds and pay-go financing.

Impacts of Inflation

Inflation is a major component that affects the economy and is defined as a general increase in the price of goods and services across the economy. It is a factor often considered when making investment decisions or conducting cost estimates as inflation can affect wages, material costs, and equipment. The Consumer Price Index (CPI) is often referenced to view the historic price changes across a basket of common household goods, while the Producer Price Index (PPI) tracks changes in the price of goods and services produced in the US. Costs specific to highway construction in the US are tracked with the National Highway Construction Cost Index (NHCCI), while many states maintain their own state specific highway construction cost index. These price changes can be caused by fluctuations in demand, supply, changes in fiscal or monetary policy, changes in inflation expectations, and other world economic events. Although some of these events are unpredictable, construction estimates take into account inflation rates in their calculations. The following section will discuss the causes of inflation, historic and current inflation trends in the US, and its overall impact on the economy.

The causes of inflation have been researched extensively in the literature, where changes in demand and supply and other factors have been cited as some of the primary causes of changes in prices. When demand for goods exceeds the available supply, leading to an increase in prices due to competition, this is known as demand-pull inflation (*8*). Inflation can also occur when wage increases significantly outpace productivity contributing to higher costs, known as cost-push inflation (*8*). These terms have also been referenced in other literature sources. In a 2021 study, demand-pull inflation is defined as a strain in supply when income and credit grow (*9*). Cost-push inflation occurs when companies increase their prices as a response to increasing material or wage costs. Another identified factor causing inflation is government involvement. These administered prices are triggered when bill expenses or taxes are raised, or when new taxes are adopted. Figure 3 provides some examples of how these factors manifest, leading to a change in inflation rate (9):

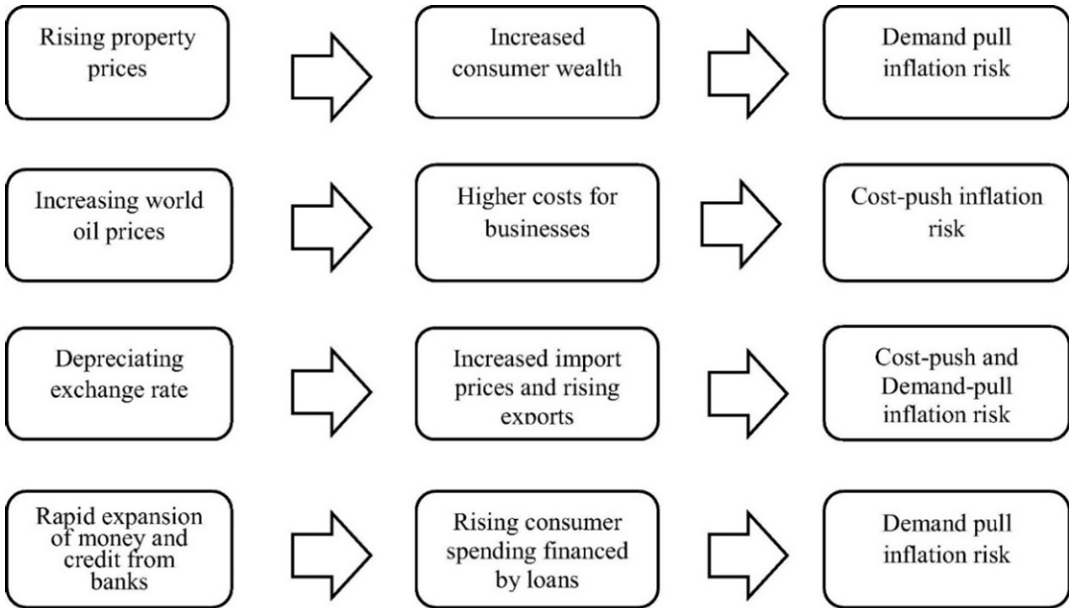

Figure 3. Example Factors affecting Inflation.

In the US, the inflation rate has increased over the years, as recorded by the Bureau of Labor of Statistics (BLS). Figure 4 shows the year-over-year percent change in CPI from 2005 to 2025 (*10*).

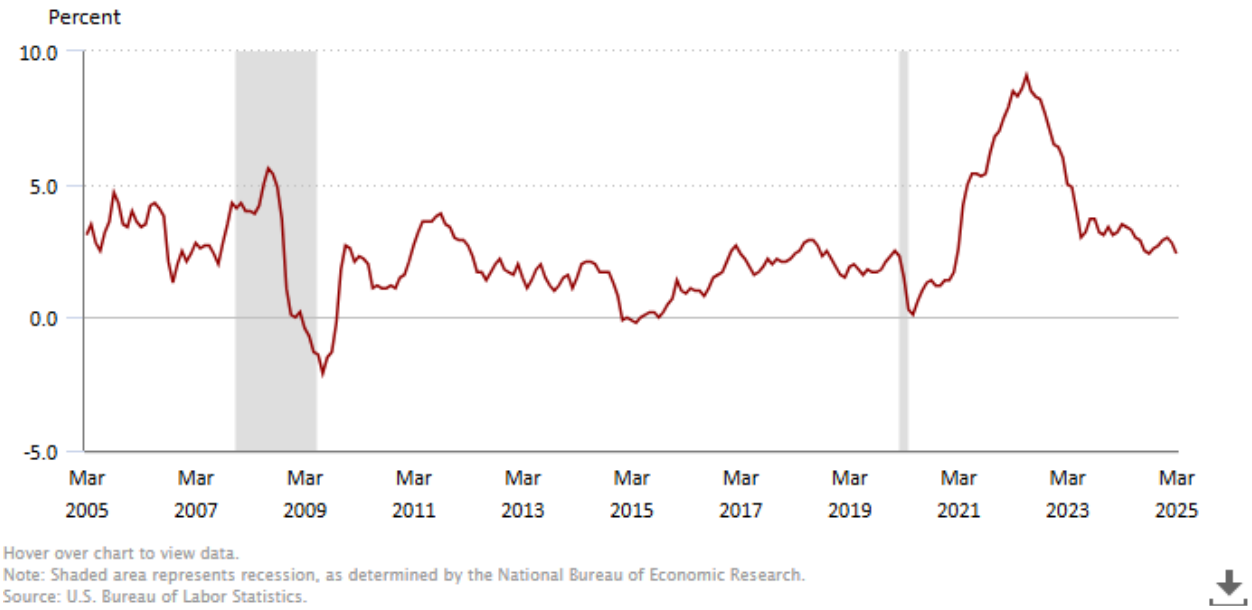

Figure 4. 12-Month Percentage Change, Consumer Price Index, All Items, 2005-2025

Impact on the Economy

A relationship exists between inflation and the federal funds rate that is used by the Federal Reserve Bank to manage interest rates across the economy. The Federal Reserve has a "dual mandate" of achieving maximum employment while maintaining stable prices, typically with a target inflation rate of around 2 percent. If inflation is above this rate, they may raise the federal funds rate to raise the cost of borrowing money and therefore reduce spending. This allows the

economy to slow down and subsequently bring inflation down (*11*). In practice, this increase in borrowing costs should reduce consumption and slow down the increase in prices. The opposite also holds true. If the economy is moving too slowly, such as during a recession, and inflation is under control, interest rates can be lowered to decrease borrowing costs, incentivize spending, and help stimulate the economy. Situations can occur, such as the "stagflation" of the 1970s, where inflation is high during times of high unemployment and low economic growth. In that scenario the Federal Reserve must balance their priorities between maintaining low inflation and full employment, since increasing rates to control inflation may further increase unemployment and further slow economic growth.

There are instances when high inflation rates can be a benefit while low rates can become a hindrance. In the case of borrowing, fixed rates are not ideal when receiving funds, such as a pension, during high inflation periods; the real value of those funds will depreciate. In contrast, borrowers benefit during these periods as the real interest rate can be zero, or negative, reducing the real value of interest payments and therefore making it less burdensome to pay off debt (*12*). Low inflation rates typically enable consumers to purchase more, but a constant decrease in prices (deflation) can impact purchasing behavior. Consumers may hold off on making purchases, expecting to take advantage of further decreasing prices (*12*). Ultimately, inflation and interest rates heavily impact whether bonding or pay-go is the best option to finance transportation projects.

Impact on Transportation Projects

Inflation adds a layer of complexity to the project budgeting process often causing budget deficits or deadline extensions. Historically, project managers have accounted for these changes in their projects; however, there are recorded instances where estimated project costs differ significantly from actual costs. Because construction projects span several years, the price of material and services can change as a result of inflation. However, there are some alternatives that can be undertaken to enable starting on the project instead of deferring construction. Weighing the impacts on transportation projects can help decisionmakers understand whether to defer construction or seek to start the project on a pay-go basis.

The change in material and machinery prices along with services and their impact on construction projects has been researched in the literature. In general, materials account for approximately 30 to 60 percent of a project's total cost, which places greater importance in accurately accounting for inflation (*9*). Factors that affect material pricing include market conditions, direct costs related to transport and energy, and inflation (*13*). Materials are not the only cost inputs affected by inflation, labor wages also experience fluctuation for similar reasons, including inflation. The BLS, in addition to tracking the change of prices in everyday items, records the change in wages for a variety of occupations. Nominal hourly wages have increased steadily over the years, with some disturbances encountered since the pandemic. Since 2010, wages have increased by roughly two to four percent per year in nominal terms, as shown in Figure 5 (*14*).

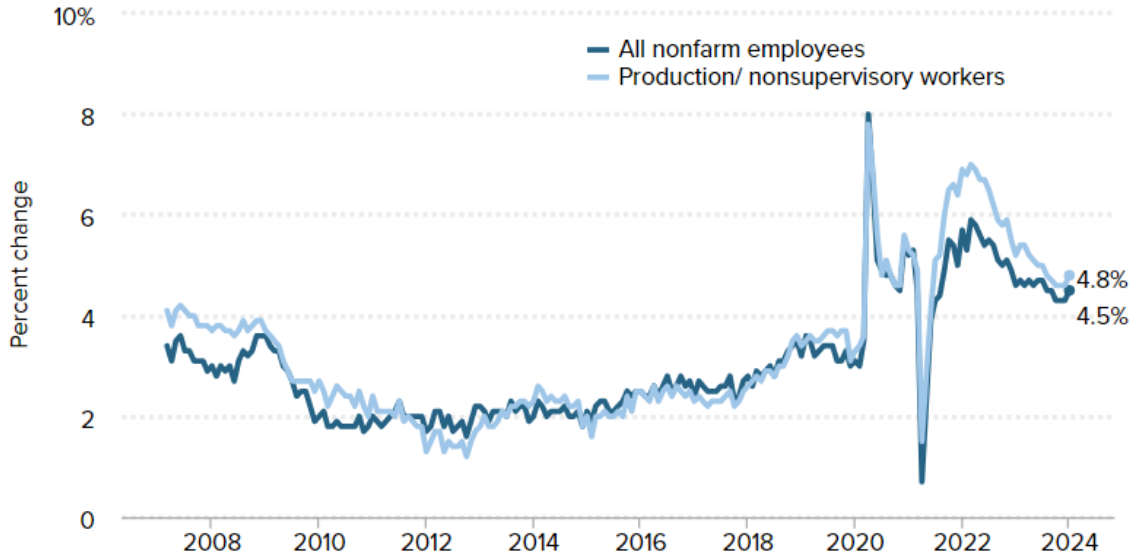

Figure 5. Nominal Hourly Wage Percent Change

Inflation also impacts transportation project materials causing prices to fluctuate. A study on the effect on inflation on construction projects highlighted all the economic factors that impact the prices of materials (*9*). As shown in Figure 6, materials such as steel, cement, sand, and electrical components are affected by inflation. Those who purchase these materials are not only paying for the material and services but are also covering the costs of fluctuating prices caused by changing market conditions. This impact on transportation projects is a determining factor for deciding how to fund transportation projects.

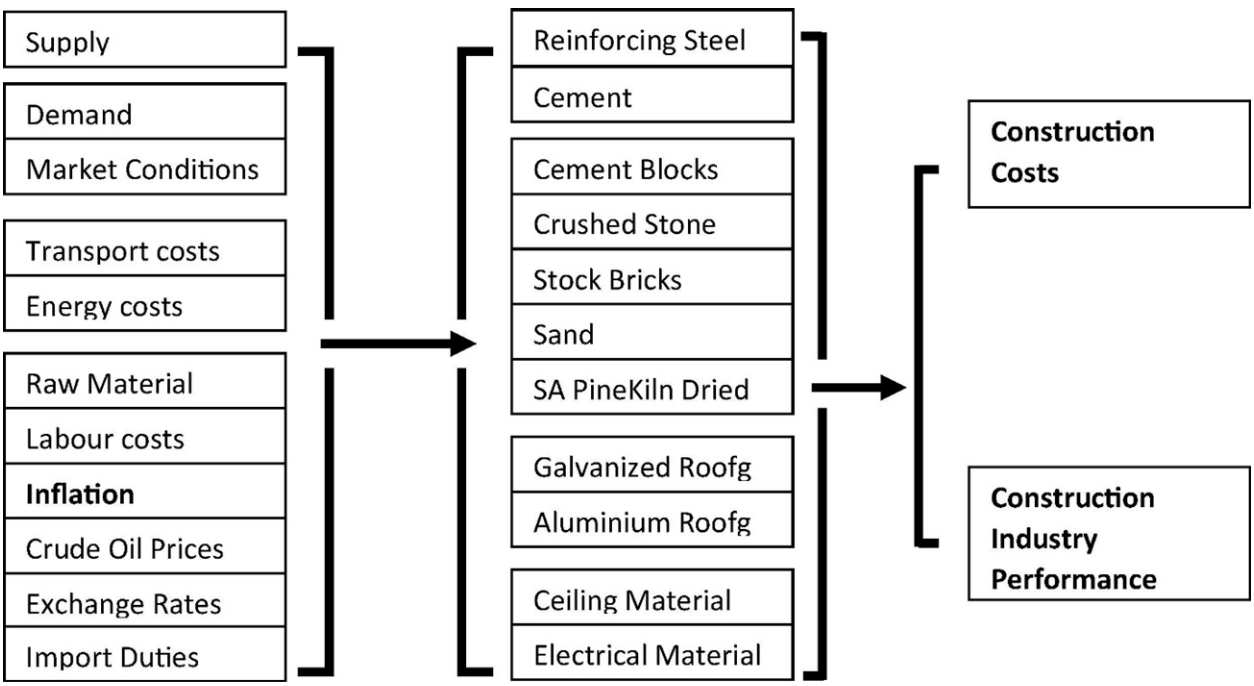

Figure 6. Flow of how building material prices are affected.

Similar to the CPI, highway construction costs are tracked at the national level with the National Highway Construction Cost Index (NHCCI) (see Figure 7) (*15*). This index tracks price changes associated with a basket of components or goods and services specific to highway construction. The NHCCI consists of 29 major components that range from grading and excavation to asphalt and concrete pavement materials to utilities.

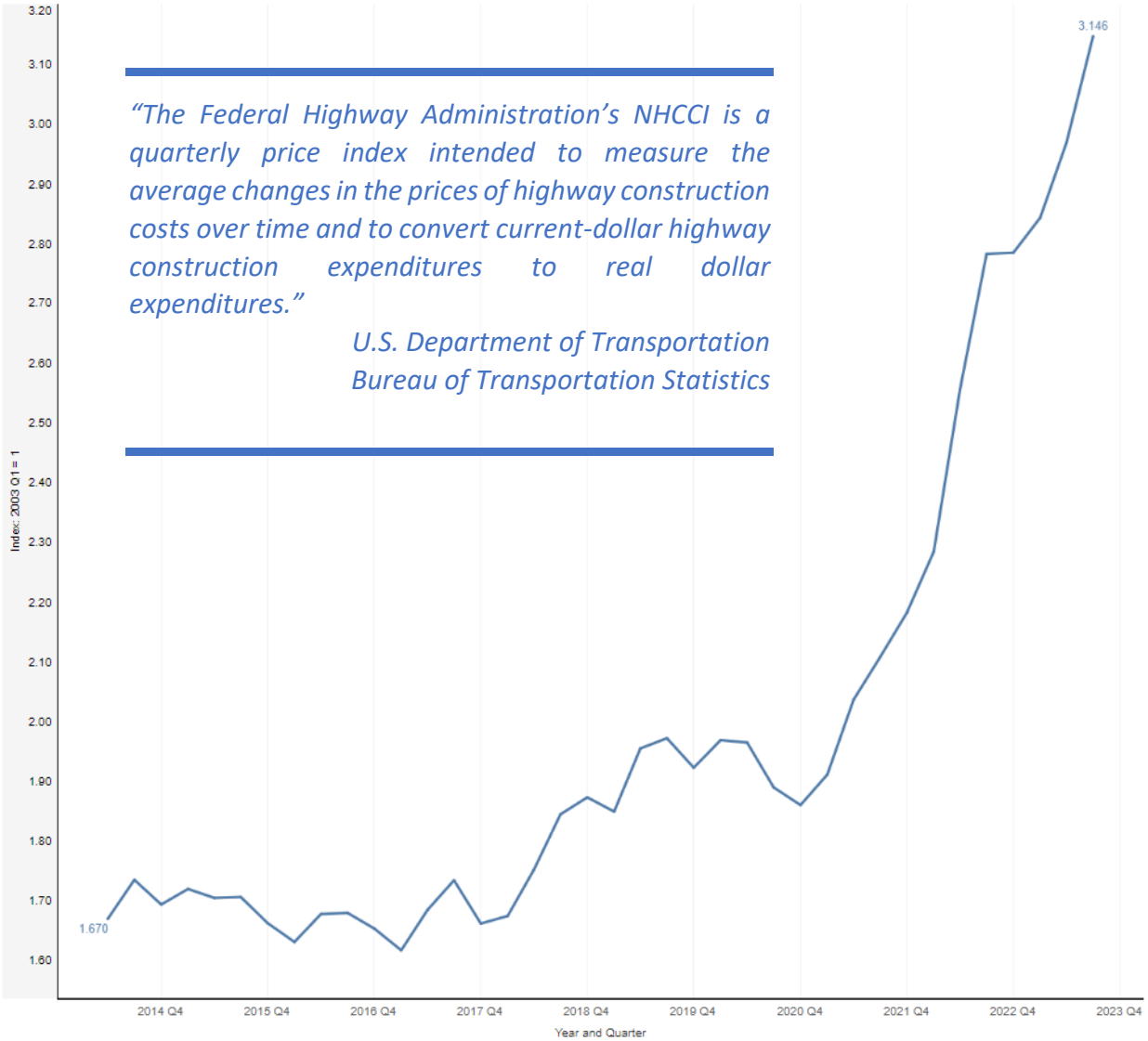

Figure 7. FHWA's National Highway Construction Cost Index (NHCCI)

The NHCCI measures the average change in price from the buyer's perspective while the PPI for Streets and Highways measures changes to price from the seller's perspective (see Figure 8) (*16*). A few states, including Michigan, have created and track their own highway construction cost indices.

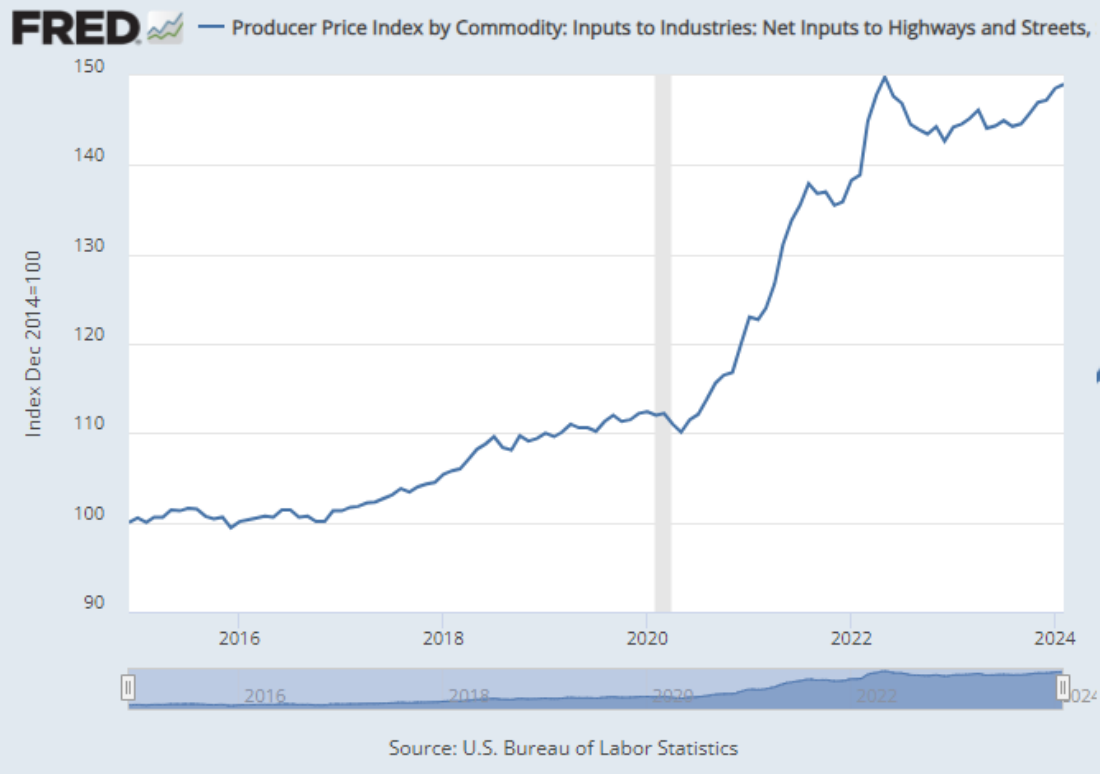

Figure 8. Federal Reserve Bank of St. Louis- Producer Price Index- Streets and Highways (16)

Having an idea of how the prices of construction and maintenance bid items are trending can help the agency plan and estimate future expenditure needs. If the cost of item X typically fluctuates seasonally, or if the price of item Y has been trending upward, the agency can use this information to make a more informed decision regarding the need to construct more near-term projects (possibly with the use of bonds) or to pay-as-they-go with traditional agency funds.

Costs Associated with Construction Delays

Some state DOTs struggle with limited budgetary resources and need to prioritize projects which can lead to postponing construction projects. There are two types of delays related to project development: construction delay (deferred construction) and user delay (increased congestion). The cause of construction delays can include several factors, but lack of funds can cause construction projects to be put on hold. These departments are also concerned with preserving already existing infrastructure which could lead to allocating a greater share of funds for maintenance. To strike a balance between deferring project construction that can create additional user delay and costs and accelerating construction projects that can increase the final cost due to interest, state agencies must prioritize their needs and strategic goals (*17*). Acceleration techniques tend to be utilized when a project disrupts highway traffic, increases user cost, and interferes with local businesses and neighborhoods. Bonding can provide the necessary funds to complete the job at a timely rate and thus decrease the negative effects that result from construction projects taking longer (*18*).

There are three stakeholders in delay costs: the agency, contractors, and the public. The cost of the construction project may increase due to a delay and can be a significant factor when dealing with a finite supply of transportation funds. Increasing costs for one project can mean postponing other projects, thus causing their benefits to be delayed.

The Texas A&M Transportation Institute (TTI) previously conducted a study on the impact of delaying a project that demonstrated how costs can change. To conduct the analysis, the study considered several variables associated with direct and indirect costs, including project length, travel time before and after a project, value of time, and cost of fuel. Three scenarios, based on a range of project costs, were also developed to model the severity of delay on costs. The scenarios include a small ($7 million to $20 million), medium ($20 million to $80 million), and large (more than $80 million) project. The result of the analysis of a Texas Department of Transportation (TxDOT) medium project ($28.5 million) showed how the public experienced various costs. The average speed before the improvement of the example site was 57mph, increasing to 60mph after the project was finished. The expansion of roadways caused induced demand which only allowed a small rise in speed, but the project improved travel time, reduced wasted fuel, and created a positive economic effect along the roadway. The economic effect was the result of the construction dollars being spent in the state as well as their indirect benefits stemming from construction workers spending a portion of their wages in the local economy. This impact, however, took longer to be implemented due to a 2-month delay which cost $870,000, or almost $420,000 per month, in increased construction costs and delayed economic impact. This number includes a 3 percent ($356,000 monthly) increase in construction price during the delay and $47,000 monthly due to the delayed economic impact of the expanded roadway (*19*). Bonding allows the community to see the economic benefits faster and any delay is a further cost the surrounding area will have to incur. Pay-go would cause a longer-term project since it is based on available funds and makes the opportunity for growth further out of reach.

Costs Associated with User Delay

Another aspect of delay is user delay costs where costs are affected by whether or not to proceed with construction. The Federal Highway Administration (FHWA) provides a more thorough overview of user delay costs as part of the impact of work zone road user costs. Costs associated with these types of road conditions include vehicle operation costs, travel delay costs, crash costs, emissions costs, and the impacts on nearby facilities (*20*). These cost factors require calculating unit costs respectively. While there are costs in relation to construction delay, user delay costs are costs incurred by the driver as a result of construction interrupting use of the roads (*21*). These costs are typically measured as travel time delays experienced when a driver is required to take a detour, when lanes are closed causing a reduction in roadway capacity, or when a driver cannot benefit from said project as a result of it being delayed. In other words, there is value associated with time, therefore when a project is not completed in time, drivers' commutes will take longer to complete and fuel costs will accumulate as the vehicle continues to spend more time on the road (*3*).

User delay costs are derived from several components ranging from travel time classification to the type of commodities being transported. For the purposes of this project, with regard to delay, travel time is given a monetary value based on the dollar amount related to personal and business travel time as well as the value of truck travel time. Travel time costs are therefore calculated as dollars per hour. Additionally, vehicle depreciation and cost of delayed freight delivery are included in the valuation of travel time. User delay costs are present in different forms, and it is vital to weigh these costs when determining how the project will continue or if there are other alternatives to consider.

REVIEW OF PEER STATES

Ten states similar to Michigan were selected based on their population and debt characteristics. Population of the selected states ranged from a low of 4.5 million in Kentucky to 11.8 million in Ohio, with Michigan at 10.0 million. Outstanding debt ranged from a low of $0.55 billion for Indiana to a high of $4.53 billion in Virginia, while Michigan had $3.31 billion. Debt per capita ranged from a low of $80 per person in Indiana to a high of $566 per person in Wisconsin, with Michigan at $330 per person. Of the eleven-state sample, Michigan is the fourth largest state by population and falls in the middle of the sample with the fifth most outstanding debt. Likewise, Michigan has the fifth highest debt per capita in the sample. See Table 1 for a peer state comparison. Additional discussion of state-by-state debt for the eleven sample states can be found in Appendix A. State Debt Comparison.

Table 1. Peer State Comparison

State	Population	Population Growth 2010-2020	2024 Outstanding Debt Obligations ($ Thousands)	Debt per capita	Lane Miles*	Debt per Lane Mile
Arizona	7,431,344	11.88%	$1,353,110	$182	163,373	$8,282
Georgia	11,029,227	10.57%	$2,126,212	$193	270,734	$7,854
Indiana	6,862,199	4.65%	$546,235	$80	202,750	$2,694
Kentucky	4,526,154	3.84%	$1,124,615	$248	166,575	$6,751
Michigan	**10,037,261**	**1.96%**	**$3,311,370**	**$330**	**256,171**	**$12,926**
Minnesota	5,737,915	7.59%	$2,602,277	$454	294,335	$8,841
Missouri	6,196,156	2.77%	$1,483,270	$239	279,052	$5,315
North Carolina	10,835,461	9.48%	$4,332,154	$400	231,528	$18,711
Ohio	11,785,935	2.28%	$3,760,255	$319	262,279	$14,337
Virginia	8,715,698	7.88%	$4,525,921	$519	165,051	$27,421
Wisconsin	5,910,955	3.64%	$3,348,291	$566	239,873	$13,958

*Lane Miles from FHWA 2023 Highway Statistics Series HM-60.

Discussion

Michigan is fairly similar in its debt usage to other states in this sample. Most states, including Michigan, rely primarily on highway-user tax revenue to service their debt. Exceptions to this include Virginia and Ohio which have both historically used toll revenue to supplement highway-user tax revenue. Georgia also began to use toll revenue in 2022. Several states such as Arizona, Georgia, Kentucky, Minnesota, Missouri, and Wisconsin have used one-time general revenue

fund transfers to service their debt. Michigan has not used toll revenue or general revenue fund transfers to service their debt during the eleven-year study period.

Interest payments as a percentage of total outstanding obligations for Michigan ranged from 4.05 percent to 5.97 percent depending on the year. This was generally in line with other states in the sample. Finally, Michigan has a similar amount of debt per capita compared to most states in the sample, at $330 per capita, although substantially lower than the highest states. Minnesota carried almost 40 percent more debt per capita at $454, while Wisconsin had 70 percent more per capita at $566.

DEBT COVERAGE RATIO COMPARISON

A debt coverage ratio is calculated by dividing the revenues available to repay the debt by the actual debt service payment required (principal plus interest). Table 2 shows the debt coverage ratio comparison of the selected peer states.

Table 2. Debt Coverage Ratio Comparison of Peer States

Year	Michigan Comprehensive Transportation Fund	Michigan State Trunkline Bonds	Indiana Transportation Bonds	Ohio Highway Capital Improvement Bonds	Wisconsin DOT Revenue Bonds
2014	12.0	4.7	8.1	21.4	3.68
2015	11.4	5.0	8.2	20.4	2.95
2016	11.8	5.0	8.3	23.9	2.97
2017	13.9	6.3	7.9	22.8	3.03
2018	15.2	6.9	2.7	25.6	3.16
2019	15.6	7.5	16.4	22.3	3.65
2020	23.4	10.2	13.9	23.3	4.18
2021	24.2	9.1	16.1	23.5	4.4
2022	29.3	7.6	6.6	25.4	4.68
2023	115.3	8.9	16.1	24.9	4.28

Bonds by State

Michigan

Michigan has three series of bonds, the Comprehensive Transportation Fund (CTF), the State Trunkline Bonds, and GARVEE bonds (which are not covered in this report). The State Trunkline Bonds make up most of the outstanding debt. The Comprehensive Transportation Fund bonds had about $22 million outstanding each year until they began to decrease in 2020. During this time debt coverage ratios shown for the CTF in Table 3, remained around 11.8 to 29.3, before increasing to 115.3 as payments declined.

Table 3. Michigan Comprehensive Transportation Fund

Year	Comprehensive Transportation Fund Annual Payments	Available Revenue	Debt Coverage Ratio
2014	$22,400,000	$268,800,000	12.0
2015	$23,200,000	$264,480,000	11.4
2016	$22,700,000	$267,860,000	11.8
2017	$22,900,000	$318,310,000	13.9
2018	$22,900,000	$348,080,000	15.2
2019	$22,800,000	$355,680,000	15.6
2020	$14,300,000	$334,620,000	23.4
2021	$14,300,000	$346,060,000	24.2
2022	$14,300,000	$418,990,000	29.3
2023	$3,700,000	$426,610,000	115.3

The Michigan State Trunkline Bonds make up the bulk of transportation debt in Michigan. Outstanding debt has ranged from $118 million to $178 million between 2014 to 2023. Debt coverage ratios range from 4.7 to 10.2:1 with a policy requirement to maintain at least 4:1 as shown in Table 4.

Table 4. Michigan State Trunkline Bonds

Year	State Trunkline Bonds Annual Payments	Available Revenue	Debt Coverage Ratio
2014	$165,700,000	$778,790,000	4.7
2015	$160,100,000	$800,500,000	5.0
2016	$162,200,000	$811,000,000	5.0
2017	$161,800,000	$1,019,340,000	6.3
2018	$160,800,000	$1,109,520,000	6.9
2019	$160,700,000	$1,205,250,000	7.5
2020	$118,400,000	$1,207,680,000	10.2
2021	$144,000,000	$1,310,400,000	9.1
2022	$178,300,000	$1,355,080,000	7.6
2023	$157,900,000	$1,405,310,000	8.9

Indiana

Debt coverage ratios for Indiana were estimated based on available higher-user tax revenues compared to outstanding obligations. This ranged from a low 2.7 in 2018 to a high of 16.4 in 2019. As shown in Table 5, coverage ratios have generally increased over time as Indiana has not issued new debt.

Table 5. Indiana Bonds

Year	Annual Payments	Available Revenue	Debt Coverage Ratio
2014	$100,259,000	$809,572,000	8.1
2015	$101,325,000	$828,108,000	8.2
2016	$100,419,000	$837,279,000	8.2
2017	$696,979,000	$848,243,000	7.9
2018	$305,205,000	$825,647,000	2.7
2019	$111,653,000	$1,834,471,000	16.4
2020	$109,712,000	$1,527,191,000	13.9
2021	$221,629,000	$1,568,910,000	16.1
2022	$269,650,000	$1,785,042,000	6.6
2023	$97,700,000	$1,569,696,000	16.1

Ohio

Ohio funds its transportation debt through General Obligation Highway Capital Improvement bonds. Outstanding obligations ranged from a low $120 million in 2016 to a high $158 million in 2023. Available revenue has steadily increased from $2.835 billion in 2014 to $3.935 billion in 2023. As shown in Table 6, debt coverage ratios have remained relatively constant between 20.4 and 25.6.

Table 6. Ohio General Obligation Bonds

Year	General Obligation Highway Capital Improvement Bonds Annual Payments	Available Revenue	Debt Coverage Ratio
2014	$132,542,000	$2,835,092,000	21.4
2015	$140,205,000	$2,860,186,000	20.4
2016	$119,839,000	$2,858,167,000	23.9
2017	$127,399,000	$2,904,689,000	22.8
2018	$144,603,000	$3,703,292,000	25.6
2019	$137,224,000	$3,054,611,000	22.3
2020	$152,696,000	$3,562,397,000	23.3
2021	$156,448,000	$3,670,273,000	23.5
2022	$153,638,000	$3,897,806,000	25.4
2023	$158,078,000	$3,934,550,000	24.9

Wisconsin

Wisconsin debt funds its transportation projects through DOT revenue bonds as well as General Obligation bonds, which are not depicted in the table. DOT revenue bonds outstanding have remained relatively stable over time between $180 million to $231 million, decreasing to $201

million in 2023 from a high in 2016. Debt coverage ratios have ranged from 2.95 to 4.68 as shown in Table 7.

Table 7. Wisconsin Revenue Bonds

Year	DOT Revenue Bonds Annual Payments	Available Revenue	Debt Coverage Ratio
2014	$179,785,000	$661,609,000	3.68
2015	$225,739,000	$665,930,000	2.95
2016	$231,770,000	$688,357,000	2.97
2017	$231,023,000	$700,000,000	3.03
2018	$225,146,000	$711,461,000	3.16
2019	$193,439,000	$706,052,000	3.65
2020	$204,368,000	$854,258,000	4.18
2021	$209,649,000	$922,456,000	4.40
2022	$195,595,000	$915,385,000	4.68
2023	$201,138,000	$860,871,000	4.28

Interest Rates

Interest rates were identified when possible. These rates are the coupon rates; the true interest cost for various bonds could be lower in reality. The Michigan State Trunkline Bond series ranged between 4 to 5 percent in recent years. Michigan's true interest cost (TIC) for these bonds ranged from 2.3 percent to 4.4 percent. Ohio rates typically ranged from 4 to 5 percent, with the interest on one bond issue from 2012 initially beginning at 1.5 percent before increasing to 5 percent. The Wisconsin general obligation bonds typically ranged from 4 percent to 5 percent, however one refunding issue was as low as 2 percent. Wisconsin revenue bonds ranged from 3 percent to 5 percent over the same period. All of these bonds were issued in the low-interest rate environment of the previous decade, and most of the bonds issued across these states during this timeframe have a similar 4 to 5 percent coupon rate. It is likely that 2023 and 2024 issues will show somewhat higher interest rates, as the federal reserve rate has increased several points in the previous two years. Table 8 shows the interest rates for different bond types.

Table 8. Interest Rates

State	Bond Type	Interest Rate
Michigan	State Trunkline Bonds	4-5%
Ohio	GO Highway Capital Bonds	1.5-5%
Wisconsin	GO Bonds	2-5%
Wisconsin	Revenue Bonds	3-5%

COSTS AND BENEFITS OF THE APPLICABLE FUNDING MECHANISM

To assess the costs and benefits of both pay-go and bonding mechanisms, the research team selected three projects that were funded using bond proceeds. Inflationary and congestion

factors were applied to these three projects to illustrate the estimated change in costs, had the project been constructed under a pay-go scenario. Both a 5-year and 10-year delay were examined.

The projects utilized include:

- I-275 from Northline Road (south of I-94) to M-153 in Canton Township and City of Romulus Townships in Wayne County. Bond proceeds in the amount of $143.1 million were utilized.
- I-496 from Lansing Road to the Grand River. The project cost $90.7 million and incorporated $70 million in bond proceeds.
- I-69 from N. Drive North (Exit 42) to the Eaton County line. Bond proceeds in the amount of $41.5 million were utilized.

These projects represent reconstruction projects that included concrete pavement rebuilding and repairs.

Inflationary Impacts

The first factor examined was the inflationary impact associated with a 5-year and 10-year delay. The delay periods selected represent the estimated time frame needed to accumulate enough transportation funds to pay for the projects under a pay-go funding scenario. The timing would depend on many factors such as planning and programming priorities, population growth, and market conditions.

The research team applied two separate rates of inflation. Since these projects were constructed in 2020 and 2021, Table 9 uses 12.0 percent for future inflation. This rate was determined by averaging the annual increase in the NHCCI from 2020 to 2024. A 12.0 percent inflation factor would increase the construction cost of each project over the 5-year and 10-year delay period.

Table 9. Impacts of 12.0 Percent Inflation

	12.0% Future Inflation		
$ Millions	I-275 (2021)	I-496 (2021)	I-69 (2020)
Project Cost	$143.1	$90.7	$41.5
Est. 5-Year Delay Cost	$253.0	$160.4	$73.4
Est. 5-Year Additional Cost	**$109.9**	**$69.7**	**$31.9**
Est. 10-Year Delay Cost	$447.2	$283.6	$129.8
Est. 10-Year Additional Cost	**$304.1**	**$192.9**	**$88.3**

**2020-2024 NHCCI average annual increase is 12%*

Table 10 applies 8.2 percent for future inflation. The Michigan Highway Construction Cost Index (MHCCI) provides a 4.4 percent average annual rate of increase for years 2015 through 2019. This average annual increase was combined with the NHCCI average annual rate of increase for years 2020 through 2024 (12%). The resulting 8.2 percent inflation factor was applied to determine the increase in construction costs for each project over the 5-year and 10-year delay period.

Table 10. Impacts of 8.2 Percent Inflation

	8.2% Future Inflation		
$ Millions	I-275 (2021)	I-496 (2021)	I-69 (2020)
Project Cost	$143.1	$90.7	$41.5
Est. 5-Year Delay Cost	$212.6	$134.8	$61.7
Est. 5-Year Additional Cost	**$69.5**	**$44.1**	**$20.2**
Est. 10-Year Delay Cost	$315.7	$200.2	$91.7
Est. 10-Year Additional Cost	**$172.6**	**$109.5**	**$50.2**

**Average of 2015-2019 MHCCI average annual increase (4.4%) and 2020-2024 NHCCI (12%) is 8.2%*

In addition to the three projects listed above, the research team examined the Michigan 2020-2024 Five-Year Transportation Program (5YTP). Table 11 shows the actual dollar amount programmed for each year from 2020 to 2024 and the increased amount that would be needed each year to complete the same program of projects in 2024. The dollars were adjusted using the NHCCI. This exercise illustrates the inflationary impacts that result from a prolonged period of savings.

Table 11. Five-Year Transportation Program Delay Scenario

Highway Program (Preservation)			
FY	Actual $M	Needed in 2024 to Complete the Same Work ($M)	NHCCI Q1
2020	$1,286	$2,083	1.969
2021	$1,520	$2,537	1.911
2022	$1,399	$1,955	2.283
2023	$1,484	$1,665	2.843
2024	$1,487	$1,487	3.190

Congestion Costs

Using the three projects selected above, the research team next examined the estimated congestion impacts associated with delaying a project for a 5-year and 10-year period using a pay-go scenario. Congestion costs were estimated by applying a 1 percent growth in vehicle miles traveled (VMT) each year over the 5-year and 10-year time period. Additionally, a 5 percent reduction in capacity was applied to account for poor pavement conditions and older roadway geometry that would continue to worsen as the project reconstruction was delayed. The resulting total hours of delay were used to determine the congestion cost savings explained below. Table 12 shows the congestion costs associated with delay.

- Vehicle operating costs ($30.80/hour) - these costs were calculated for light-duty vehicles and include operating costs such as fuel, maintenance, tires, and depreciation (*22*).
- Value of time ($19.40/hour) - assumes a mix of business and personal travel for passenger vehicles (***Error! Bookmark not defined.***).

- Environmental costs ($7.60/hour)[1]- calculation assumes passenger vehicles traveling an average of 55 miles per hour.

Table 12. Congestion Costs Associated with Delay

$ Millions	I-275	I-496	I-69
5-Year Vehicle Operating Cost	$15.6	$3.6	$1.0
5-Year Value of Time Cost	$7.8	$1.8	$0.5
5-Year Environmental Cost	$3.0	$0.7	$0.2
5-Year Total Costs	**$26.4**	**$6.1**	**$1.7**
10-Year Vehicle Operating Cost	$34.6	$7.9	$2.1
10-Year Value of Time Cost	$17.3	$3.9	$1.1
10-Year Environmental Cost	$6.8	$1.5	$0.4
10-Year Total Costs	**$58.7**	**$13.3**	**$3.6**

Note: Assumes passenger/light-duty vehicle costs.

Deferred Maintenance

The asset's lifespan is a component that informs project prioritization and ultimately whether to defer maintenance of others. As discussed in the pavement selection manual and Michigan's 2022 Transportation Asset Management Plan, ideally at least 95 percent of all assets should be rated as in a state of good or fair repair, however, the state's funding gap limits the actual number of projects that can be funded. In this instance prioritization takes place to select which projects will be either maintained (preservation) or rehabilitated while deferring maintenance of others. To determine which projects are selected for funding, DOTs use a life-cycle cost analysis (LCCA) to estimate the total cost of the asset's entire lifetime. LCCAs take into account pavement conditions and rate of deterioration, costs, and effects of alternative investment approaches such as maintenance and rehabilitation to inform states how much a pavement project will cost. The final result provides state agencies with total project costs which can inform decisions on pavement design, maintenance and rehabilitation. Although this is the standard methodology to preserve as many assets as possible above fair conditions, there are other factors that can affect the final project selection. This summary of LCCAs will help explain the impact of deferred maintenance on life-cycle costs.

LCCA is comprised of several factors that capture the costs at different stages of the asset's life. The first factor considered is the expected service life of the asset. Service life refers to the number of years that the asset is available for use and informs states when maintenance cycles will occur. Within that time frame, initial and future costs are calculated for the asset. Costs considered in the analysis include initial construction costs, initial user costs, future maintenance costs, future user costs, and remaining life value. Initial construction costs can include projects ranging from constructing lanes, ramps, underdrains, and sand subbases as well as paving of

[1] Environmental cost per hour default value estimated using NOx, SOx, and PM rates sourced to MOVES3. CO2 rates were estimated using the EPA Greenhouse Gases Equivalencies Calculator.

roads. In circumstances where rehabilitation is required, there is an additional set of initial construction costs that are included to account for the greater number of resources needed. Initial user costs are costs that accrue in a driver's daily commute and are also included in an LCCA due to the impact it has on life-cycle costs. For example, when a construction zone is present, the use of roads becomes restricted causing traffic conditions to change. Drivers now experience delays due to changes in reduced road capacity, congestion, detours, or complete stops, all of which contribute to user costs.

In the case of deferred maintenance, however, LCCAs need to be revised to show the true cost of delaying preservation projects. When a maintenance project is deferred, the asset is subject to more wear and degradation until funds become available to repair it. If no funding is available for some time, more projects will reach the point where they are classified as in need of rehabilitation, as opposed to routine maintenance. Not only will pavement conditions worsen, but construction costs will also be exposed to pressures from inflation as described above. In the context of LCCA, the service life may need to be changed to reflect continuing wear on pavement. Additional costs will also need to be integrated in the calculation if the asset needs to be rehabilitated or completely replaced. User costs may also experience increases as project parameters (e.g., duration, work zones, etc.) will be impacted. Therefore, it is ideal to preserve assets in a good-to-fair rating and prevent them from reaching poor conditions. Maintenance curves illustrate this case by comparing the cost of preservation (maintenance) versus rehabilitation for an asset's service life. In Figure 9 below, if projects are kept above a fair rating where they only require maintenance measures, the total lifetime costs are lower than deferring until it needs rehabilitation (*23*).

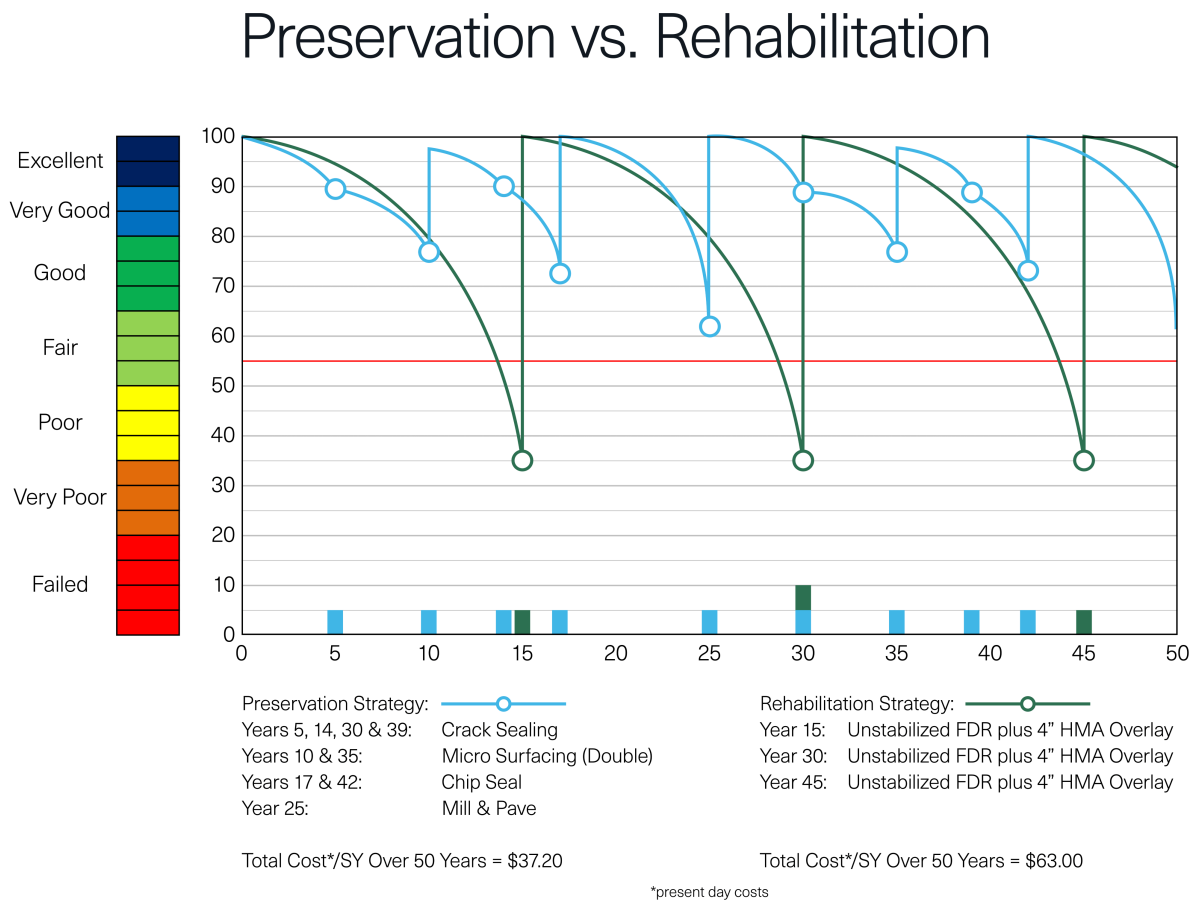

Figure 9. Cost difference between preservation versus rehabilitation

With the option to fund projects through bonds, more opportunities are available to reduce the number of maintenance projects deferred. Bonding larger projects frees up funding that can now go towards smaller projects like capital preventive maintenance. As demonstrated by the bond vs pay-go calculator in the sections below, the state's available funds may have greater purchasing power when bonds are introduced. The first few years of the larger project are covered by the bond while the remaining funds can be used for other purposes. By being able to prioritize more preventive maintenance projects, the state can minimize the costs of road preservation.

Qualitative Impacts

Outside of the costs associated with construction and debt, the decision to fund or finance transportation projects has impacts on planning and programming that are more difficult to quantify. At the program level, the availability of funding affects decisions around whether to focus on maintaining existing infrastructure or adding capacity to address existing or future needs. In transportation, planning takes place across various time horizons, for state DOTs that is typically the State Transportation Improvement Program (STIP) and the State Long-Range Transportation Plan (SLRP) representing the short and long-term planning documents. Funding

versus financing can ultimately change programmatic decision-making. Finally, project-level impacts include the cost of delays associated with planning, design, and engineering.

Program Level Decision-Making and Prioritization

At a high level, availability of funds - either through traditional revenue sources or financing - can impact the overall program of projects that is advanced by a state DOT. Relying on a pay-go approach can reduce the ability to both add capacity and maintain infrastructure. The Deferred Maintenance section above discussed the potential costs associated with delaying maintenance activities including the need for more intensive rehabilitation efforts.

A key component in developing planning documents is project prioritization. Each plan will typically include a list of projects for completion in the established timeframe. The STIP often provides the closest approximation of projects that will be funded over the next four years, especially since STIPs are often updated every two years, while long range plans rely on projected revenues or the availability of a financing tool or mechanism to establish projects that meet their priorities into the future (20+ years).

Funding versus financing projects impacts those planning efforts by providing fiscal constraints for a state DOT to develop their program. A shift in the way transportation projects are paid for ultimately changes the timeline on various programs and can either shift spending forward or further into the future or delay them entirely. In addition, the type of projects that are prioritized may need to change if spending must be reduced. This high-level decision-making requires time and effort, which can ultimately add to the cost of a project should it lead to a delay. In addition, while uncertainty will always be a factor in the planning process, reducing uncertainty and creating stability is a benefit associated with stable funding and financing options.

As transportation revenues are reduced through fuel efficiency and alternative fuel vehicles, bonding is one mechanism that allows a state DOT to maintain a consistent program of projects that meets their infrastructure needs. Uncertainty cannot be easily quantified, but it does impact both program- and project-level costs.

Impacts to “Soft” Costs - Planning, Design, and Engineering

The selected funding or financing mechanism can have impacts across the project lifecycle. The analysis in this report has largely focused on construction costs as well as high-level program prioritization decisions. While it can be difficult to quantify the exact impact to other stages of the project lifecycle, there is an impact to planning when considering whether to bond or use a wholly pay-go approach. The impacts to planning, design, and other parts of the project lifecycle will be discussed to understand the potential benefits associated with the two funding approaches as well as costs that may occur through delays.

Bonding versus a pay-go approach with transportation projects will typically focus on programmatic decisions; how to fund entire programs of projects, as well as the specific impact to projects once they are ready for construction. However, the impact of these high-level

programmatic decisions is displayed throughout the project lifecycle. The project lifecycle contains five major stages: (1) planning, (2) preliminary design and environmental review, (3) final design and right-of-way acquisition, (4) construction, and (5) operation.

The qualitative impacts discussed here will focus on planning and preliminary design and environmental review as well as final design and right-of-way acquisition to a certain extent. The first two stages in the project lifecycle can be lengthy, especially with larger projects that often involve more complex environmental review requirements. This inherently adds uncertainty to the overall project costs. With a pay-go approach, the initial phases of a project may be completed, but then no funds are available after final design. A key part of final design is plans, specifications, and estimates (PS&E). PS&E are critical for the construction phase as they provide the information needed for letting. When a project's planning and design phases are completed without funding available, certain elements of those phases may need to be repeated once funding becomes available again. For example, if a project is slated to be let in 2025, but there is no funding available, PS&E may need to be revised when the project is re-visited. Extended delays may require additional environmental reviews, further extending the time and cost associated with the project. Bonding can be a useful tool, especially for large projects. Large, or mega, projects often have a more intensive planning and design phase, which would face higher costs if the project was delayed and designs had to be revised.

Bonding packages provide an additional layer of certainty, when successful, and allow for a program of projects to be completed immediately reducing the likelihood that the project is indefinitely delayed. Michigan utilizes bond funds, in part, for major rehabilitation projects. Switching to a pay-go approach may alter the scope of those projects as major rehabilitation work is pushed further into the future or delayed entirely and a short-term fix is utilized, as highlighted under the previous section on deferred maintenance. The completion of projects earlier provides greater benefits over time due to the expected rate of return from highway projects, which incorporates travel time, safety, and environmental cost savings. The time-value of benefits is discussed under Comparison Study/ Findings and shown in the Debt Calculator Tool.

As bonding can allow more projects to be let at one time, the DOT may be able to bundle projects and obtain cost savings. The cost of construction is impacted by a range of economic factors, and initial plans, designs, and estimates cannot take all economic factors into account. A pay-go approach limits the ability of the DOT to let multiple large projects, but it can reduce the need to have additional “shovel-ready” projects for the bonding package. Conversely, removing the option to bond moving forward can disrupt projects that were otherwise ready to be let.

Societal Benefits

As bonding brings spending forward in time, other benefits typically associated with transportation projects are received sooner by the community. These benefits can include reduced noise, state of good repair, resilience, more efficient land use, and improved health from

reduced emissions or bicycle and pedestrian projects. Transportation projects that also improve other infrastructure, such as stormwater infrastructure, can reduce costs due to extreme weather events and improve quality of life for the surrounding residents. Reducing delay is typically associated with travel time savings, but it can also expand market areas, result in agglomeration economies (benefits from the spatial concentration of economic activity), and improve emergency service response time.

Other Economic Benefits

Investments in infrastructure support employment, primarily through construction, and provide an economic benefit to the local economy. Leveraging bonds for infrastructure projects may allow for a greater number of projects to be completed, ultimately supporting more jobs throughout the local economy. Spending on infrastructure supports local business through the purchase of goods and services, and the employees at those businesses as well as the construction employees will spend money at restaurants and on other leisure activities, further supporting the local economy. Employment and its ripple effects throughout the local economy can be quantified using an economic impact analysis, but this requires access to modeling software or detailed data on the supply chains related to transportation infrastructure projects.

Completing maintenance projects earlier can also reduce wear and tear to vehicles on the road. Weather and climate conditions are a key factor in the life and health of roadways; cold and wet conditions may lead to greater maintenance needs as roads deteriorate faster. A pay-go approach may shift routine maintenance further into the future to address critical needs; bonding can help cover major projects to allow traditional sources of revenue to fund routine maintenance items. Aging and poor road conditions represent a cost to the traveling public; alongside congestion, it is estimated to cost the average driver $1,400 in vehicle operating costs and lost time (*24)*.

COMPARISON STUDY AND FINDINGS FOR POTENTIAL IMPLEMENTATION

Pay-go vs Bonding Calculator

Inputs

In order to evaluate the potential net benefits or costs of pay-go versus bonding, the team developed a pay-go vs bonding calculator tool. The tool allows the user to input several variables including total budget, debt coverage ratio, expected rate of inflation, expected return on investment, and the discount rate. The tool outputs include the absolute net benefit or cost resulting from bonding, the relative additional benefit accrued, and the relative amount of additional projects that can be funded. This tool enables users to evaluate if debt funding is appropriate and what the impact of it will be, across different user-defined scenarios.

The tool works by assuming a pay-go scenario and a debt funding scenario and comparing the two over a 20-year period. First, the annual budget, coverage ratio, and interest rate are set by the user. The pay-go scenario assumes that 100 percent of the budget will go towards funding projects each year for the next 20 years. Therefore, if a budget of $1 billion is chosen, the pay-go

scenario assumes that $1 billion, in nominal terms, will be spent every year, for a total of $20 billion spent on projects. Figure 10 below shows the user inputs available in the calculator tool.

Budget	$ 1,000,000,000
Coverage Ratio	4.00
Inflation	8.2%
Return	10.0%
Interest	5.0%
Discount	3.1%

Figure 10. Debt Calculator Inputs

The debt funding scenario assumes that the maximum amount possible is bonded in year 1, based on the budget and coverage ratio. Therefore, with an estimated budget of $1 billion and an assumed coverage ratio of 4:1, $250 million could be allocated towards annual debt payments, with $750 million in reserve each year. At 5 percent interest, this allows for a bond face value of $3.115 billion in year 1. The debt scenario assumes that this amount plus the previous year's reserve is spent towards projects in year 1. Then all following years the reserve is spent towards projects with the remainder going towards debt payments. In this example, year 1 would allow for $3.865 billion in project spending (bond face value + reserve), while every following year would have $750 million in spending (budget – annual debt payment).

Next, the user selects the rate of inflation expected. The inflation rate should be the expected increase in the cost of highway construction projects. This rate reduces the future buying power each year afforded by the budget previously selected. In this example, 8.2 percent was selected in line with the previous analysis, meaning that each year it becomes 8.2 percent more expensive to build the same project, or alternatively, that each year buying power is reduced by 8.2 percent. An 8.2 percent inflation rate results in the $1 billion budget in the final year (year 20 in this example) having a real spending power of only $224 million. In this example, over the 20-year analysis period, inflation results in $10.5 billion in real spending in the pay-go scenario and $11.0 billion in real spending in the bond scenario. At this inflation rate, it means that $500 million real dollars more are spent on projects and that they are delivered earlier in time. A higher inflation rate makes the debt funding scenario more attractive, as it shifts spending into the first year, where buying power is higher.

Next the user selects the rate of return on the project. This is set to a default conservative value of 10 percent, which is in line with major highway construction projects, but can be adjusted if a different return is expected. The analysis assumes that projects accumulate benefits over a 20-year period. The rate of return is the expected annual benefit of the project. Benefits in this sense are the benefits society and project roadway users gain from the project once it is completed. This would include the benefits previously discussed such as reduced emissions, increased safety, and reduced travel times. In this example, if $1 billion of projects are built in year 1 then the annual benefit based on the rate of return is $100 million for 20 years, for a total benefit of $2

billion undiscounted. This is calculated for each year of the analysis based on the real spending each year. Real spending is reduced by inflation each year, so over the analysis period benefits decrease each year.

Finally, a discount rate is chosen, set to the default rate of 3.1 percent recommended by USDOT (***Error! Bookmark not defined.***). The discount rate represents the time-value of the benefits being generated by the projects. While inflation reduces the total amount of projects that can be funded, and thus reduces benefits over time, it does not account for the benefit of roadway users and the state accruing these benefits earlier in time. The discount rate accounts for this by reducing the value of future benefits. A higher discount rate will make the bonding scenario more attractive as that scenario accrues benefits earlier in time compared to pay-go.

Outputs

The final result of the analysis is three outputs: Net Benefit, Additional Benefit, and Additional Projects. Net Benefit is the difference in dollars between the discounted net benefit in the pay-go and bonding scenarios. In this example the Net Benefit is $1.48 billion. This shows the absolute value in dollars of the benefit accrued by the bonding scenario. A negative value would mean that the pay-go scenario generates a larger benefit. Additional Benefit is the Net Benefit divided by discounted pay-go benefits. This shows the additional benefit in relative terms of the bonding scenario. In this example, it is 11.4 percent showing that the bonding scenario generates 11.4 percent more benefits than the pay-go scenario. Additional Projects is the difference in real spending on projects in the two scenarios, divided by the real spending in the pay-go scenario. In this example it was 4.8 percent, showing that 4.8 percent more real dollars were spent on projects in the bond scenario than in the pay-go-scenario, ultimately delivering 4.8 percent more projects. Figure 11 shows the outputs view in the debt calculator tool.

Annual Payment	$	250,000,000
Reserve (Debt Coverage)	$	750,000,000
Face Value	$	3,115,552,586
Repayment Period		20
Net Benefit	$	1,478,498,678
Additional Benefits		11.4%
Additional Projects Built/Value		4.8%

Figure 11. Debt Calculator Outputs

In this example the results show that with the inputs chosen, the bonding scenario generated 11.4 percent more benefits over the analysis period, while delivering 4.8 percent more projects. If inflation is adjusted to the higher 12 percent number used previously the results increase to 19.2 percent more benefits and 12.2 percent more projects delivered in the bonding scenario. These numbers are only an example to show how the tool functions; actual results may vary substantially based on the inputs chosen and are especially dependent on current inflation and interest rates.

The bonding scenario allocates funding earlier in time, while decreasing future spending because funds must be allocated to bond payments. Decreasing the coverage ratio allows for more debt to be taken out initially, which can improve the bonding scenario if the other inputs favor earlier spending. Increasing the inflation rate reduces buying power in future years, improving the bond scenario. Likewise, increasing the discount rate improves the bonding scenario because future benefits will be more heavily discounted. Increasing the interest rate reduces the bond scenario benefits, since less money can be borrowed initially with the same annual budget.

CONCLUSION

There are advantages and disadvantages associated with both pay-go and bonding methods of finance. Both methods include factors such as availability of funds and fiscal stability, inflation, population growth, as well as congestion growth rates, to name a few. While there is no one-size fits all answer, understanding how these factors influence the outcomes and when they may be applicable allows policy makers to make more informed decisions for the future.

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APPENDIX A. STATE DEBT COMPARISON

The following section details data retrieved from FHWA's Highway Statistic Series. Data was available for 2012 through the end of 2023. The outstanding obligations reflect the balance at the beginning of that year. Thus, the 2024 balance reflects the ending balance of 2023; no additional data is available yet for 2024.

Michigan

Total outstanding obligations in Michigan decreased from 2012 to 2021, when new debt was issued, then again following a new debt issue during 2023 (see Table 13). From 2012 to 2024 the total debt level increased by $1.04 billion, mostly due to the most recent debt issue. Michigan receipts towards debt payments were made up of highway user tax revenues and refunding of previous debt. Unlike some other states in the sample, Michigan did not use any toll revenue, investment revenue, or money allocated from general revenue to pay towards debt obligations. Interest payments as a percentage of outstanding obligations ranged from 4.05 percent to 5.97 percent depending on the year.

Table 13. Michigan Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
Michigan	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$2,267	$0	$308	$0	$0	$0	$308	$121	$0	$185	$2	$308
2013	$2,240	-$26	$258	$0	$0	$0	$258	$119	$0	$140	$0	$258
2014	$2,106	-$135	$234	$0	$0	$280	$514	$104	$0	$410	$0	$514
2015	$1,960	-$145	$262	$0	$0	$0	$262	$93	$0	$189	-$20	$262
2016	$1,801	-$159	$274	$0	$0	$762	$1,036	$79	$53	$904	$0	$1,036
2017	$1,578	-$223	$230	$0	$0	$0	$230	$82	$0	$149	$0	$230
2018	$1,430	-$149	$224	$0	$0	$0	$224	$73	$0	$151	$0	$224
2019	$1,278	-$151	$215	$0	$0	$0	$215	$57	$0	$159	$0	$215
2020	$1,120	-$159	$325	$0	$0	$0	$325	$53	$0	$272	$0	$325
2021	$1,751	$631	$283	$0	$0	$0	$283	$104	$35	$143	$0	$283
2022	$2,394	$643	$248	$0	$0	$0	$248	$97	$0	$151	$0	$248
2023	$2,243	-$151	$225	$0	$0	$0	$225	$100	$0	$125	$0	$225
2024	$3,311	$1,068										

Arizona

Total outstanding obligations in Arizona begin at $2.87 billion in 2012, increasing to $2.97 billion in 2014, then decreasing to $1.35 billion in 2024, with a slight rise in 2020 (see Table 14). These obligations are covered partially by highway-user tax revenues, but mostly through general revenue fund transfers. Interest payments as a percentage of outstanding obligations ranged from 4.19 percent to 8.32 percent depending on the year.

Table 14. Arizona Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
Arizona	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$2,871	$0	$1	$0	$367	$513	$881	$184	$3	$693	$0	$881
2013	$2,937	$66	$55	$0	$242	$614	$912	$212	$2	$697	$0	$912
2014	$2,956	$18	$295	$0	$11	$0	$306	$140	$0	$166	$0	$305
2015	$2,790	-$166	$0	$0	$420	$791	$1,211	$232	$2	$977	$0	$1,211
2016	$2,567	-$222	$5	$0	$300	$0	$305	$122	$0	$183	$0	$305
2017	$2,384	-$183	$18	$0	$320	$425	$763	$184	$0	$579	$0	$763
2018	$1,814	-$570	$108	$0	$159	$0	$267	$108	$0	$159	$0	$267
2019	$1,718	-$96	$313	$0	$0	$0	$313	$114	$0	$199	$0	$313
2020	$2,237	$519	$3	$0	$350	$473	$826	$138	$0	$688	$0	$826
2021	$2,060	-$177	$104	$0	$210	$0	$314	$88	$0	$226	$0	$314
2022	$1,834	-$226	$16	$0	$300	$81	$397	$77	$0	$320	$0	$397
2023	$1,599	-$235	$11	$0	$300	$0	$311	$65	$0	$246	$0	$311
2024	$1,353	-$246										

Georgia

Georgia's outstanding obligations begin at $3.23 billion in 2012, slowly decreasing until new debt is issued in 2016 putting the total at $4.66 billion (see Table 15). This declines to $2.13 billion by 2024. Georgia debt is paid for mostly by highway-user tax revenues with occasional transfers from the general revenue fund. Interest payments as a percentage of outstanding obligations ranged from 1.83 percent to 4.55 percent depending on the year.

Table 15. Georgia Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
Georgia	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$3,233	$0	$507	$7	$0	$285	$799	$147	$39	$613	$0	$799
2013	$3,029	-$203	$149	$7	$285	$61	$502	$137	$9	$347	$9	$502
2014	$2,730	-$300	$389	$2	$30	$0	$422	$123	$0	$319	$0	$443
2015	$2,469	-$261	$404	$0	$0	$0	$404	$112	$0	$292	$0	$404
2016	$4,658	$2,189	$445	$0	$0	$0	$445	$97	$0	$750	-$402	$445
2017	$4,009	-$649	$898	$24	$280	$0	$1,202	$130	$0	$1,134	-$207	$1,057
2018	$2,647	-$1,362	$417	$0	$0	$377	$794	$89	$0	$1,225	-$522	$793
2019	$2,509	-$139	$345	$0	$0	$0	$345	$46	$0	$820	-$522	$344
2020	$2,320	-$188	$143	$0	$0	$0	$143	$0	$41	$277	-$176	$142
2021	$1,686	-$635	$298	$0	$0	$0	$298	$41	$0	$431	-$174	$298
2022	$2,471	$785	$533	$347	$0	$0	$880	$48	$10	$570	$252	$880
2023	$2,364	-$107	$226	$16	$0	$0	$242	$51	$3	$258	-$78	$234
2024	$2,126	-$237										

Indiana

Indiana obligations stand at $4.07 billion in 2012, increasing to $7.74 billion in 2013 (see Table 16). Obligations then decline to $1.13 billion in 2014 before slowly declining to $0.55 billion in 2024. Indiana primarily pays their debt with highway-user tax revenues, however in 2013 $129 million was allocated from tolling revenue. Interest payments as a percentage of outstanding obligations ranged from 1.37 percent to 5.32 percent depending on the year.

Table 16. Indiana Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
Indiana	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$4,071	$0	$101	$0	$3	$0	$104	$56	$1	$208	-$161	$104
2013	$7,736	$3,666	$100	$129	$8	$0	$237	$188	$1	$456	-$408	$237
2014	$1,134	-$6,602	$100	$0	$0	$0	$100	$50	$1	$49	$0	$100
2015	$1,081	-$53	$101	$0	$0	$0	$101	$48	$1	$53	$0	$101
2016	$1,028	-$53	$100	$0	$0	$0	$100	$45	$1	$55	$0	$100
2017	$973	-$55	$107	$0	$0	$590	$697	$45	$1	$651	$0	$697
2018	$949	-$24	$305	$0	$0	$0	$305	$36	$1	$268	$0	$305
2019	$1,063	$114	$112	$0	$0	$0	$112	$36	$1	$75	$0	$112
2020	$988	-$75	$110	$0	$0	$0	$110	$36	$1	$73	$0	$110
2021	$915	-$73	$97	$0	$0	$124	$222	$45	$1	$197	-$21	$222
2022	$844	-$72	$270	$0	$0	$0	$270	$45	$0	$225	$0	$270
2023	$619	-$225	$98	$0	$0	$0	$98	$24	$1	$73	$0	$98
2024	$546	-$73										

Kentucky

Outstanding debt obligations in Kentucky begin at $1.71 billion in 2012, increasing to a high of $2.19 billion in 2015, then declining to $1.13 billion by 2024 (see Table 17). This is paid for out of highway-user tax revenues, however, in 2014 and 2015 general revenue funds were transferred to cover the debt. Interest payments as a percentage of outstanding obligations ranged from 5.85 percent to 9.29 percent depending on the year.

Table 17. Kentucky Obligations, Receipts, and Disbursements ($ Millions)

	Debt Obligations		Receipts Applicable to Debt Service					Disbursements				
Kentucky	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin/ Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$1,705	$0	$171	$0	$0	$0	$171	$100	$0	$71	$0	$171
2013	$1,852	$148	$218	$0	$0	$0	$218	$135	$0	$83	$0	$218
2014	$1,770	-$83	$228	$0	$21	$174	$423	$142	$4	$276	$0	$423
2015	$2,187	$417	$157	$0	$100	$0	$257	$150	$0	$107	$0	$257
2016	$2,080	-$107	$640	$0	$0	$0	$640	$150	$3	$487	$0	$640
2017	$2,113	$34	$288	$0	$0	$0	$288	$153	$3	$132	$0	$288
2018	$2,024	-$90	$463	$0	$0	$0	$463	$155	$1	$307	$0	$463
2019	$1,891	-$133	$319	$0	$0	$0	$319	$154	$0	$164	$0	$319
2020	$1,726	-$165	$314	$0	$0	$0	$314	$142	$0	$171	$0	$314
2021	$1,555	-$171	$355	$0	$0	$0	$355	$142	$0	$151	$61	$355
2022	$1,402	-$153	$279	$0	$0	$177	$456	$130	$1	$325	$0	$456
2023	$1,233	-$168	$344	$0	$0	$0	$344	$132	$1	$211	$0	$344
2024	$1,125	-$109										

Minnesota

Minnesota outstanding debt obligations begin at $1.06 billion in 2012 and gradually increase to a high of $2.602 billion in 2024 (see Table 18). Minnesota uses a mix of highway-user tax revenues, investments, and general fund transfers to cover their debt. Highway-user tax revenues vary from $40 million to $209 million of receipts depending on the year, while general fund transfers range from $60 million to $274 million in the years where they are used. Investment income makes up a few million dollars of receipts each year as well. Interest payments as a percentage of outstanding obligations ranged from 3.14 percent to 5.07 percent depending on the year.

Table 18. Minnesota Obligations, Receipts, and Disbursements ($ Millions)

	Debt Obligations		Receipts Applicable to Debt Service					Disbursements				
Minnesota	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin/ Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$1,058	$0	$209	$0	$1	$0	$209	$44	$0	$93	$0	$136
2013	$1,313	$256	$124	$0	$1	$0	$125	$54	$0	$71	$0	$125
2014	$1,508	$195	$180	$0	$1	$0	$182	$62	$0	$120	$0	$182
2015	$1,716	$208	$114	$0	$61	$118	$294	$62	$0	$232	$0	$294
2016	$1,945	$228	$67	$0	$142	$51	$259	$77	$0	$182	$0	$259
2017	$2,133	$188	$106	$0	$169	$0	$275	$108	$0	$167	$0	$275
2018	$2,196	$63	$40	$0	$202	$103	$345	$86	$0	$199	$60	$345
2019	$2,141	-$55	$76	$0	$4	$170	$251	$82	$0	$169	$0	$251
2020	$2,230	$89	$158	$0	$98	$0	$256	$86	$0	$171	-$1	$256
2021	$2,306	$76	$133	$0	$294	$358	$785	$86	$0	$542	$0	$629
2022	$2,300	-$6	$83	$0	$215	$130	$429	$72	$0	$157	$0	$229
2023	$2,583	$283	$56	$0	$2	$235	$293	$76	$0	$216	$0	$293
2024	$2,602	$20										

Missouri

Outstanding debt obligations for Missouri have generally declined from a high of $3.21 billion in 2012 to a low of $1.27 billion in 2023, before increasing slightly to $1.48 billion in 2024 (see Table 19). Debt has generally been paid for by highway-user tax revenues with general revenue fund transfers being used in 2013 and 2017. Interest payments as a percentage of outstanding obligations ranged from 4.37 percent to 4.90 percent depending on the year.

Table 19. Missouri Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
Missouri	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$3,205	$0	$274	$0	$0	$0	$274	$140	$0	$133	$0	$274
2013	$3,072	-$133	$129	$0	$160	$0	$289	$136	$0	$154	$0	$289
2014	$2,918	-$154	$297	$0	$0	$978	$1,275	$131	$5	$1,140	$0	$1,275
2015	$2,679	-$239	$291	$0	$0	$0	$291	$121	$0	$170	$0	$291
2016	$2,510	-$170	$280	$0	$0	$0	$280	$112	$0	$168	$0	$280
2017	$2,341	-$168	$104	$0	$309	$0	$413	$104	$0	$309	$0	$413
2018	$2,033	-$309	$290	$0	$0	$0	$290	$89	$0	$200	$0	$290
2019	$1,832	-$200	$402	$0	$0	$0	$402	$80	$1	$321	$0	$402
2020	$1,614	-$218	$244	$0	$0	$0	$244	$76	$0	$169	$0	$244
2021	$1,624	$10	$295	$0	$0	$0	$295	$80	$0	$215	$0	$295
2022	$1,409	-$215	$299	$0	$0	$0	$299	$67	$0	$233	$0	$299
2023	$1,265	-$144	$289	$0	$0	$0	$289	$54	$1	$235	$0	$289
2024	$1,483	$218										

North Carolina

Outstanding debt obligations in North Carolina begin at $1.71 billion and remain fairly stable around this number until increasing to $2.86 billion in 2020, then up to $4.54 billion by 2023, before declining slightly to $4.33 billion in 2024 (see Table 20). Debt payments have been entirely funded by highway-user tax revenues and refunding of old debt. Interest payments as a percentage of outstanding obligations ranged from 4.35 percent to 9.19 percent depending on the year.

Table 20. North Carolina Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
North Carolina	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$1,709	$0	$187	$0	$0	$0	$187	$90	$0	$97	$0	$187
2013	$2,430	$721	$248	$0	$0	$0	$248	$106	$0	$142	$0	$248
2014	$1,998	-$432	$255	$0	$0	$0	$255	$100	$0	$155	$0	$255
2015	$1,862	-$136	$230	$0	$0	$0	$230	$102	$0	$128	$0	$230
2016	$1,999	$137	$230	$0	$0	$0	$230	$115	$0	$114	$0	$230
2017	$1,885	-$114	$508	$0	$0	$0	$508	$116	$21	$372	$0	$508
2018	$1,851	-$34	$650	$0	$0	$0	$650	$118	$2	$530	$0	$650
2019	$1,695	-$155	$301	$0	$0	$162	$462	$156	$8	$299	$0	$462
2020	$2,860	$1,164	$323	$0	$0	$0	$323	$132	$5	$185	$0	$323
2021	$3,162	$302	$419	$0	$0	$0	$419	$165	$5	$249	$0	$419
2022	$4,186	$1,024	$399	$0	$0	$0	$399	$200	$2	$197	$0	$399
2023	$4,541	$355	$924	$0	$0	$0	$924	$216	$0	$708	$0	$924
2024	$4,332	-$208										

Ohio

Outstanding debt obligations in Ohio gradually increased from $2.33 billion in 2012 to $4.05 billion in 2022, before declining to $3.76 billion in 2024 (see Table 21). This debt has been funded mostly by highway-user tax revenues ranging from $232 to $370 per year, however Ohio has also heavily utilized toll revenue. Toll revenue allocated towards debt service has increased from $53 million in 2012 to $123 million in 2023, reaching as high as $147 million in 2019. Interest payments as a percentage of outstanding obligations ranged from 2.86 percent to 4.07 percent depending on the year.

Table 21. Ohio Obligations, Receipts, and Disbursements ($ Millions)

	Debt Obligations		Receipts Applicable to Debt Service					Disbursements				
Ohio	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin/ Fees	PAR Value	Premium or Discount	Total Disbursements
2012	$2,326	$0	$264	$53	$0	$0	$317	$66	$0	$250	$0	$317
2013	$2,076	-$250	$259	$59	$0	$0	$318	$58	$4	$257	$0	$318
2014	$3,278	$1,202	$269	$95	$0	$0	$365	$102	$0	$265	-$3	$365
2015	$3,280	$2	$277	$95	$0	$0	$373	$103	$0	$272	-$3	$373
2016	$3,245	-$35	$264	$95	$0	$0	$360	$99	$0	$264	-$3	$360
2017	$3,229	-$16	$251	$96	$0	$137	$485	$105	$1	$379	$0	$485
2018	$3,225	-$3	$232	$108	$1	$143	$483	$112	$2	$374	-$6	$483
2019	$4,088	$863	$276	$147	$1	$0	$423	$129	$0	$302	-$9	$423
2020	$4,161	$73	$332	$109	$1	$456	$899	$161	$3	$756	-$21	$899
2021	$4,023	-$139	$370	$111	$0	$0	$481	$157	$1	$410	-$87	$481
2022	$4,048	$25	$286	$133	$0	$356	$775	$165	$2	$623	-$14	$775
2023	$3,904	-$144	$289	$123	$1	$0	$414	$149	$0	$275	-$10	$414
2024	$3,760	-$144										

Virginia

Outstanding debt obligations in Virginia have steadily increased from $2.47 billion in 2012 to $4.53 billion in 2024 (see Table 22). This debt has been mostly funded by highway-user tax revenues, ranging from $367 million to $572 million per year. Virginia uses toll revenues to a lesser extent ranging from $14 million to $49 million per year, with this method being relied on more in recent years. Interest payments as a percentage of outstanding obligations ranged from 4.40 percent to 5.21 percent depending on the year.

Table 22. Virginia Obligations, Receipts, and Disbursements ($ Millions)

			Debt Obligations			Receipts Applicable to Debt Service			Disbursements			
Virginia	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Investments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$2,474	$0	$572	$14	$0	$0	$586	$109	$8	$390	$0	$507
2013	$3,135	$661	$385	$14	$0	$0	$400	$144	$0	$218	$2	$365
2014	$3,075	-$60	$622	$22	$0	$0	$645	$140	$13	$484	$8	$645
2015	$3,118	$43	$369	$15	$0	$0	$385	$150	$0	$191	$0	$340
2016	$3,186	$68	$367	$25	$0	$91	$483	$166	$2	$291	$2	$461
2017	$3,245	$59	$386	$29	$0	$80	$496	$158	$19	$318	$0	$496
2018	$3,657	$413	$479	$20	$0	$975	$1,475	$174	$116	$1,184	$1	$1,475
2019	$3,992	$335	$437	$20	$1	$0	$458	$185	$0	$272	$1	$458
2020	$4,091	$99	$381	$28	$1	$0	$410	$193	$1	$229	-$13	$410
2021	$4,296	$205	$424	$39	$0	$0	$463	$196	$0	$239	-$15	$420
2022	$4,158	-$138	$373	$49	$0	$211	$633	$188	$7	$450	-$12	$633
2023	$4,178	$19	$440	$36	$1	$0	$477	$190	$1	$256	-$15	$432
2024	$4,526	$348										

Wisconsin

Outstanding debt obligations in Wisconsin increased from $3.16 billion in 2012 to a high of $4.18 billion in 2018, before decreasing to $3.35 billion in 2024 (see Table 23). Wisconsin funds its debt primarily through highway-user tax revenues although general revenue fund transfers of $100 million and $98 million were used in 2015 and 2016, respectively. Interest payments as a percentage of outstanding obligations ranged from 0.16 percent to 8.08 percent depending on the year.

Table 23. Wisconsin Obligations, Receipts, and Disbursements ($ Millions)

	Debt Obligations		Receipts Applicable to Debt Service					Disbursements				
Wisconsin	Outstanding Obligations	Change in Obligations	Highway-User Tax Revenues	Tolls	Invest-ments/ Misc	Sale of Bond Proceeds	Total Receipts	Interest	Admin / Fees	PAR Value	Premium or Discount	Total Disburse-ments
2012	$3,160	$0	$268	$0	$0	$470	$738	$133	$3	$592	$0	$728
2013	$3,345	$185	$557	$0	$1	$0	$558	$158	$2	$397	$0	$558
2014	$3,405	$60	$671	$0	$0	$0	$671	$158	$3	$462	$49	$671
2015	$3,789	$384	$766	$0	$100	$188	$1,054	$177	$3	$686	$188	$1,054
2016	$3,766	-$23	$581	$0	$98	$0	$679	$304	$2	$373	$0	$679
2017	$4,109	$343	$647	$0	$0	$0	$647	$183	$2	$462	$0	$647
2018	$4,176	$67	$329	$0	$1	$696	$1,026	$45	$4	$977	$0	$1,026
2019	$3,993	-$183	$552	$0	$2	$0	$554	$192	$1	$280	$81	$554
2020	$3,874	-$119	$467	$0	$3	$0	$470	$173	$1	$297	$0	$470
2021	$3,787	-$87	$763	$0	$0	$0	$763	$6	$4	$753	$0	$763
2022	$3,759	-$28	$360	$0	$0	$375	$735	$90	$2	$644	$0	$735
2023	$3,525	-$234	$472	$0	$4	$417	$893	$135	$51	$707	$0	$893
2024	$3,348	-$176										

APPENDIX B: ACRONYMS AND ABBREVIATIONS

5YTP - Michigan 2020-2024 Five-Year Transportation Program

ADA – Americans with Disabilities Act

BLS - Bureau of Labor Statistics

CPI - Consumer Price Index

DOT – Department of Transportation

FHWA – Federal Highway Administration

GARVEE - Grant Anticipation Revenue Vehicles

LCCA - Life-Cycle Cost Analysis

MDOT – Michigan Department of Transportation

MHCCI - Michigan Highway Construction Cost Index

NHCCI - National Highway Construction Cost Index

PPI - Producer Price Index

PS&E - Plans, Specifications, and Estimates

SLRP - State Long-Range Transportation Plan

STIP - State Transportation Improvement Program

TTI - Texas A&M Transportation Institute

TxDOT – Texas Department of Transportation

USDOT – United States Department of Transportation

VMT - Vehicle Miles Traveled