Municipal Bonds and Infrastructure Development – Past, Present, and Future

An International City/County Management Association (ICMA) and Government Finance Officers Association (GFOA)

White Paper

August 2015

ICMA

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A Policy Issue White Paper

Prepared on behalf of the ICMA Governmental Affairs and Policy Committee

August 2015

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About GFOA

The Government Finance Officers Association is a membership and training organization founded in 1906 to educate members and be a resource on government financial and leadership issues. GFOA's 18,000+members are the finance officers of state and local governments nationwide.

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Municipal Bonds and Infrastructure Development – Past, Present, and Future

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Written by:

Justin Marlowe, University of Washington

Executive Summary

The purpose of this paper is to describe how access to tax-exempt financing shapes state and local infrastructure investment. This is a crucial issue given that state and local governments have been widely criticized for under-investing in infrastructure, while President Obama and key members of Congress have proposed policy changes that could constrain access to the capital needed to finance those investments.

In light of these developments this paper seeks to answer three questions:

1. How sensitive is state and local capital spending to fluctuations in the interest rates on tax-exempt state and local government (i.e., "municipal") bonds?
2. How does the tax-exempt nature of municipal bonds affect state and local governments' cost of capital for infrastructure investment?
3. If Congress repealed the tax exemption for municipal bonds, what would happen to state and local borrowing costs?

The answers presented in this paper are based on a comprehensive review of the academic, government, and industry literature on state and local capital spending, and on some original empirical analysis of data from several million observed transactions in municipal bonds.

The main findings are:

- In 2014 state and local governments invested nearly $400 billion in capital projects. Although large, that figure represents a significant slowdown in spending. For roughly 40 years prior to the Great Recession the rate of annual spending grew almost every year. Following a brief spike in spending from the federal stimulus, total state and local capital spending has not yet returned to pre-Great Recession levels.
- Approximately 90 percent of state and local capital spending is financed with debt. At the moment, alternative financing methods such as pay-as-you-go and public-private partnerships are effective for some types of capital projects, but are not a robust alternative to traditional municipal bonds.
- Demographics and politics drive state and local capital spending levels. Bond market conditions have a noteworthy, but secondary effect.
- If the federal tax exemption for municipal bonds were repealed, state and local governments would have paid $714 billion in additional interest expenses from 2000-2014. For a typical bond issue this would mean $80-210 in additional interest expenses per $1,000 of borrowed money.

The author is grateful for helpful comments from Andrew Ang, Joshua Franzel, Bart Hildreth, Roger Kemp, Marty Luby, Dustin McDonald, Jerry Newfarmer, Rob Wassmer, Jeff White, and seminar participants at the Federal Reserve Bank of Cleveland. Thanks also to Mathew Lane for excellent research assistance. The views expressed here are those of the author and do not necessarily reflect the views of the University of Washington. Please direct correspondence to jmarlowe@uw.edu.

1. Development of State and Local Infrastructure Finance

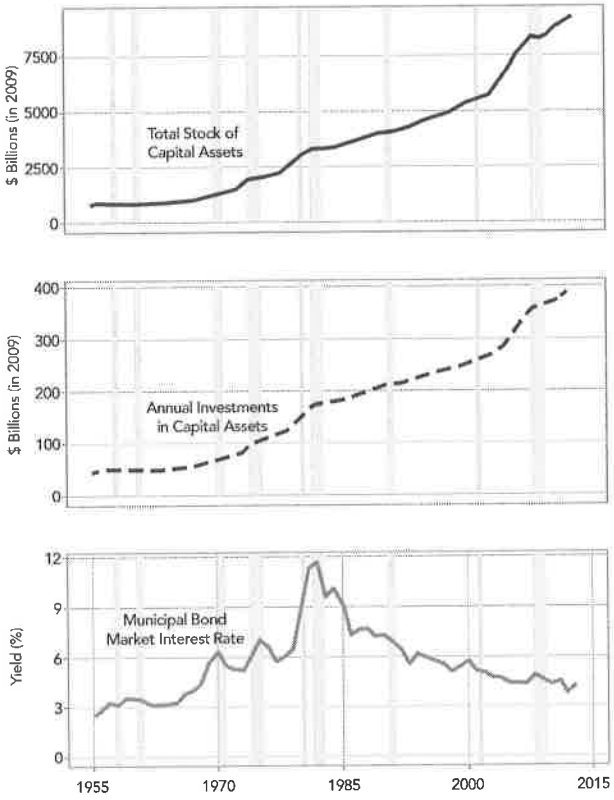
Infrastructure is the linchpin of the US economy. Workers use public sidewalks, roads, highways, bridges, and mass transit systems to travel to work. Manufacturers need electricity to produce their goods and ports to ship those goods. We educate the bulk of our future workforce in public schools, colleges, and universities. For these and many other reasons, one of state and local governments' most critical functions is to invest in public infrastructure.

It is difficult to measure how much states and local governments spend on infrastructure. By some estimates it accounts for two percent of US Gross Domestic Product and 12 percent of all state and local government spending (Fisher and Wassmer 2015). However, this number likely understates the full scope of public infrastructure because it does not include private and non-profit spending that replaces public investment. This substitution effect is especially important for non-profit hospitals and private schools, among other areas. Moreover, large segments of ostensibly public infrastructure are meant to serve quasi-public or even private purposes. For instance, local governments often invest in streets, storm water systems, parking structures, and other infrastructure meant to support mostly commercial development. Aside from potential economic development benefits, the overall "publicness" of these investments is less clear.

That said, the best available data on the scope of state and local investment in infrastructure assets are from the National Income and Product Accounts (NIPA) from the U.S. Bureau of Economic Analysis. The NIPA data include state and local spending on "fixed assets," a broad category composed mostly of infrastructure, but that also includes lesser amounts spent on equipment, intellectual property, and other assets with long useful lives. For consistency, this category is simply called "capital assets."

Figure 1 is based on those data. The top panel shows the cumulative value of all state and local capital assets, and the middle panel shows annual investment in those assets. The bottom panel is the trend over time in the overall interest rate on state and local debt. Those interest rates are from the Bond Buyer, a newspaper that specializes in state and local government finance. As described below, most capital investments are financed with debt. The shaded gray bars identify recessions.

Figure 1: State and Local Capital Spending, 1955-2014



Sources: National Income and Product Accounts, US Bureau of Economic Analysis; the Bond Buyer

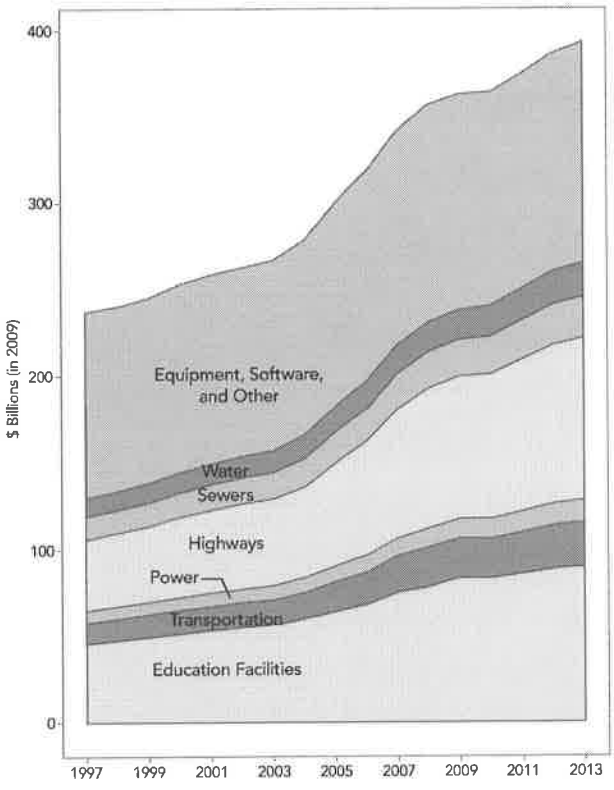
Figure 1 shows the three phases of state and local capital spending since 1955. From 1955 to 1970 state and local governments spent around $50 billion (in real 2009 dollars) on infrastructure each year, and the cumulative value of all state and local infrastructure (net of depreciation) hovered around $1 trillion. Starting in 1970, the rate of that investment accelerated each year so that by 2000, the cumulative value was $5 trillion and annual investment was $250 billion. Much of that growth happened during the economic "boom" of the mid- to late 1990s (Pagano 2002). The most rapid expansion happened from 2004 to 2013. During this decade, the total value of infrastructure grew more than it had the previous 50 years, to nearly $10 trillion. Historically low interest rates since the early 1990s contributed to this expansion, as did new federal support for state and local investments in water quality, environmental remediation, affordable housing, highways, and other infrastructure (Pagano 2002).

Note that the overall US population also grew rapidly

during this time, so the growth in per capita spending is not as strong as the real growth in spending (Fisher and Wassmer 2015; for more on the "optimal" level of state and local capital spending see Wassmer and Fisher 2011). Nevertheless, the central point is clear: Capital spending has emerged as an essential and expensive part of state and local government.

Figure 2 shows more detail on the composition of the recent surge in spending. It shows state and local annual capital spending broken out by six key areas. Spending on educational facilities and highways accounts for much of the recent expansion. Also note the large portion of total spending on equipment, software, and other capital goods. Spending on this type of "soft infrastructure" was virtually zero prior to 1990, but in the last 35 years it has become a key part of state and local capital investment.

Figure 2: Composition of State and Local Annual Capital Spending, 1997-2014



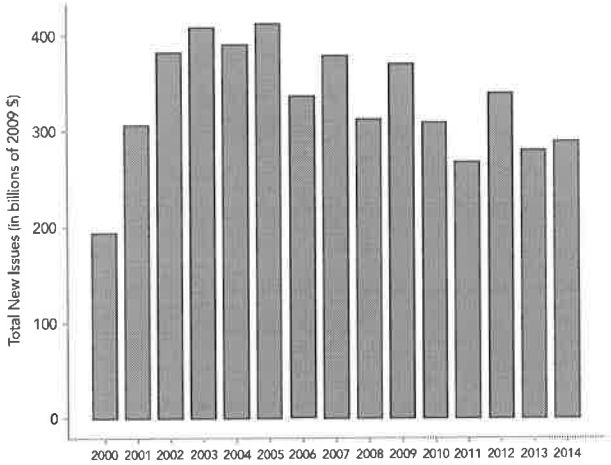
Source: National Income and Product Accounts, US Bureau of Economic Analysis

The vast majority of state and local capital spending is financed through debt. State and local governments issue bonds to pay for projects, then repay those bonds plus interest over time. The term "municipal bonds" or "munis" describes bonds issued by states, counties, cities, school districts, public utilities, ports, and other sub-national governments.

The muni market is complex. Today there are more than one million bonds in the market, and their total par value is just over $3.6 trillion (SIFMA). Those bonds were issued by more than 50,000 individual units of government, and many of those governments sell multiple types of bonds backed by specific revenue streams. Governments also sell bonds to refinance other bonds, and some governments routinely borrow money on behalf of private and non-profit entities. Given the enormous number of issuers and the enormous variety of bonds they issue, it can be difficult to know who sold a bond, why they sold it, and who is responsible for repaying it. Contrast this to the corporate bond market, which is nearly twice as large in terms of dollars outstanding, but there are just over 1,000 publicly traded companies with outstanding debt, and virtually none of that debt is tied to specific revenue streams.

Figure 3 shows the total amount of municipal bonds sold each year from 2000-2014. That total varies from just over $200 billion (in real 2009 dollars) to just under $400 billion. Recall from Figure 1 that total state and local annual capital investment during this time was also between $200 billion and $300 billion. State and local governments finance a small portion of their capital investments through capital reserves or cash on hand – sometimes called "pay-as-you-go" (Marlowe, et. al. 2009, 134-140) – but virtually all of it is financed through municipal bonds.

Figure 3: Total New Issuance of Municipal Bonds, 2000-2014

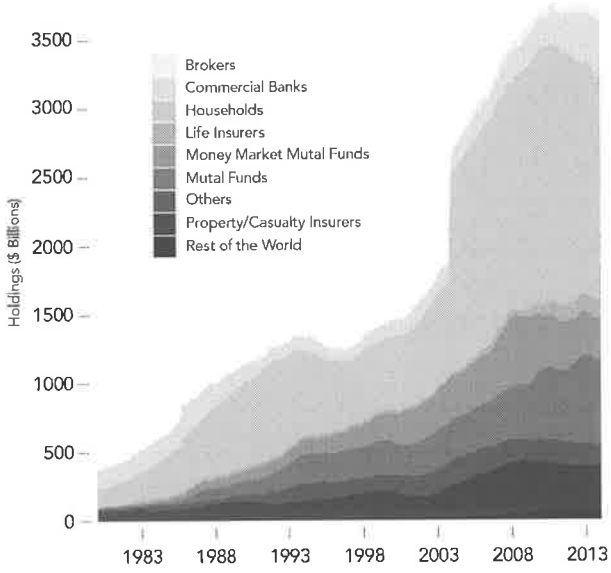


Source: Author calculations

The defining characteristic of the muni market is that investors do not pay federal income taxes on the interest they receive from owning municipal bonds. This niche within federal tax policy is broadly known as the "muni exemption." It has been part of US tax law since before the federal government adopted the progressive income tax in 1913.

Because of the tax exemption, munis appeal to two main types of investors. One is individual investors who want a safe, predictable vehicle for retirement planning, college savings, and other long-term financial goals. The other is institutional investors, like property-casualty insurance companies, who need to hold long-term assets to match their long-term risk exposures. Munis tend to have much longer maturities than corporate bonds and Treasuries, which makes them a suitable vehicle for this sort of asset-liability matching. Figure 4 shows who has owned municipal bonds since 1983. Households and mutual funds (most of which are owned by households) dominate this market. Insurers and a selected few other institutional investors play key roles in certain market segments. For much more detail on the structure of investor demand for munis, see Friedlander (2014).

Figure 4: Holders of Municipal Bonds, 1981-2013



Source: US Federal Reserve Flow of Funds Report

2. The Supply Elasticity of State and Local Capital Investment

Each year the American Society of Civil Engineers (ASCE) releases its "Report Card for America's Infrastructure" (available at http://www.infrastructurereportcard.org/). That report, and many others like it, highlights a perceived widening gap between the actual and needed levels of state and local capital investment. The 2013 Report Card graded US infrastructure a "D+" and enumerated $3.6 trillion of essential, urgent capital investment needs. Ironically, that figure is about the size of the current municipal bond market.

These types of reports raise two important questions. First, what, if anything, drives state and local capital investment? Critics make clear that poor infrastructure condition does not drive it enough. And second, what is the appropriate or optimal level of state and local capital spending? Virtually all economists agree that public capital investment is necessary to promote private sector economic growth (for comprehensive reviews see Gramlich 1994 and Srithongrung 2008). It's less clear if state and local governments' apparent underinvestment in infrastructure stifles economic growth. Oddly enough, there is little academic research on either of these questions, but the analysis that has been done is instructive.

The research that has been done has focused on explaining the variation in spending levels across states and local governments. This is a useful exercise because it helps us understand the relative influence of different types of economic, demographic, and political factors on capital spending decisions.

The most recent comprehensive work in this area is by Fisher and Wassmer (2015) who examined variation in total state and local capital spending across the states from 2000-2010. They found that the main drivers of capital investment during this time were demographic factors like income, population density, and population growth. Governments that serve large, dense, wealthy populations tend to spend more on capital assets than governments that serve smaller, less dense, less wealthy populations. They also found that current infrastructure condition and the availability of federal infrastructure grants mattered to a lesser degree. In their own assessment, their findings suggest these factors have not changed in several decades.

Studies like Fisher and Wassmer (2015) are designed to show how state and local capital spending responds to changes in a variety of demographic and macroeconomic factors. There is a separate stream of literature focused more narrowly on the supply elasticity of capital spending. In other words, how sensitive is capital spending to changes in the price of capital assets? In the state and local context, price means the cost to purchase or produce new assets, but more

important, it means the cost of capital to make those investments. And since most state and local spending is financed with debt, the central question with respect to supply elasticity is: How do state and local capital spending levels respond to changes in the interest rates on tax-exempt bonds?

This relationship seems intuitive but it is difficult to study for two reasons. First, as Fisher and Wassmer (2015; 2014) and others (Holtz-Eakin 1991) point out, demographics are a key driver of capital spending. If a growing population wants new infrastructure, but interest rates are high, state and local policymakers might have no choice but to issue high interest rate bonds. Over time, this sort of persistent mismatch between demand for capital investment and bond market conditions can severely constrain a government's ability to meet future capital spending needs. The opposite is also true. Taxpayer demand for capital investment can and often does wane when debt financing is cheap. In fact, this is precisely the missed opportunity that many state and local governments face today (Marlowe 2015b).

The second challenge is that capital costs affect capital spending as much as capital spending affects capital costs. For example, if tax-exempt interest rates are low, and state and local governments borrow more money to finance capital projects, then interest rates will quickly increase and capital projects will become more expensive. And vice versa.

Despite these challenges, a few researchers have attempted to untangle the relationship between bond market conditions and capital investment. The most recent comprehensive work is from Joulfaian and Matheson (2009), who found that a one percent decrease in market interest rates associates with increased borrowing of about $25 per capita in 2009 dollars. With some assumptions about who buys municipal bonds, this finding suggests the tax exemption increased total state and local borrowing by around $9 billion each year from 1983-2007. In other words, there is substantial elasticity of supply for municipal debt. Fisher and Wassmer (2014) found a similar supply elasticity for 2008-2010.

These findings belie a much broader question: What is the "optimal" level of state and local capital spending? The ASCE and others argue that state and local governments' failure to properly maintain public infrastructure threatens economic growth and, more important, the health and safety of our citizens. Others point to the related problem of "misplaced" capital investment. In their view governments too often invest in capital projects with little connection to public safety, economic growth, or other policy objectives.

This later perspective is critical here because it is the basis for a popular critique of the muni tax exemption. That critique begins with some of the early work in this area (for example, Holtz-Eakin 1991) that showed the availability of tax-exempt financing affects state and local governments' decisions to issue debt, but not necessarily affect capital spending levels. One interpretation of this finding is that governments use debt to finance projects that citizens do not want or cannot afford to buy with taxes or other current resources. Later work (Gordon and Metcalf 1991; Eberts and Fox 1992) shows that at sufficiently high interest rates, governments will shift away from debt and into pay-as-you-go financing of capital investments. A better alternative to the muni exemption, according to this view, is for the federal government to offer categorical grants and other targeted assistance for specific types of state and local infrastructure projects.

3. The Muni Exemption and State and Local Capital Costs

How much does the muni exemption subsidize borrowing costs for state and local governments? Three main streams of research speak to this question. So far, not one has answered this question definitively.

There is rich literature in public financial management that examines the determinants of state and local costs of capital. Analysts in this space employ sophisticated statistical models to examine how the interest rates on bonds are affected by dozens of different factors at once, including the bonds' rating, the amount of money borrowed, bond market conditions at the time of the transaction, and many others.

Those models often include a variable to correct for bonds that do not qualify for the federal exemption, such as private activity bonds for industrial development projects, convention and entertainment centers, and many other special cases. Findings from these analytical models show that, all else being equal, the average interest rate on a taxable muni issued by a city or county is 25 basis points (or .25 percent) higher than a comparable tax-exempt bond (Guzman and Moldogaziev 2012). For bonds issued by states, those rates are up to 136 basis points higher (Johnson and Kriz 2005). Clearly, the muni exemption produces a noticeable borrowing cost savings.

The problem with this approach is that even a complex statistical model cannot account for all the unique characteristics of taxable munis. They appeal to different types of investors and trade in a different

segment of the market. For that reason this approach yields at best a rough estimate of the borrowing cost implications of the muni exemption.

A second style of research is focused on how much revenue the US Treasury foregoes each year as a result of the muni exemption. This "tax expenditure" is a proxy for the additional interest investors would demand from state and local governments to compensate for the loss of the muni exemption. Most of this research is based on statistical analysis of the investment portfolios of actual households. The most recent comprehensive analysis in this style is Poterba and Verdugo (2009), who estimated the cost of the muni exemption at $14 billion annually. That figure is half of the $28 billion subsidy quoted in a recent Congressional Research Service report (Maguire and Stupak 2015) and substantially less than figures reported elsewhere in the academic literature. (Note: For a more complex alternative approach based on "implied" marginal tax rates see Ang, et. al. 2010 and Longstaff, et. al. 2011).

However, note that many analysts who employ these methods caution against interpreting these tax expenditures as an indicator of the value of the muni exemption. They argue that comparison is misleading because investors would almost certainly recalibrate their portfolios if the muni exemption were reduced or eliminated. High net worth investors who realize most of the tax benefit in the municipal market today (Feenberg and Poterba 1991; Poterba and Verdugo 2009; Galper, et. al. 2014; Bergstresser and Cohen 2015) would likely shift into corporate bonds or equities that produce higher after-tax yields. At the same time, taxable munis could appeal to new investors who do not currently benefit from the exemption, such as pension funds, hedge funds, and international investors. If the net demand for taxable munis was greater than the current demand for tax exempt munis, muni yields might actually decrease and borrowers would pay less to finance projects. This also implies that Treasury would actually recover far less revenue from ending the exemption than suggested elsewhere (Joint Committee on Taxation 2012).

As part of the American Recovery and Reinvestment Act of 2009 (the "stimulus" bill), Congress authorized a temporary new borrowing instrument known as "Build America Bonds" (BABs). With BABs, the federal government paid a subsidy directly to the state or local government that sold the bonds. This is in contrast to traditional munis, where that subsidy flows to the investors who buy those bonds through the muni exemption. Absent that subsidy to investors, BABs sold at yields closer to taxable yields. This was by design; those higher yields were intended to entice investors who do not benefit from the muni exemption to buy munis. BABs were designed to lower state and local borrowing costs, relative to traditional munis, through this combination of higher investor demand plus the direct federal subsidy. The BABs program expired at the end of 2010 and was not renewed. Although short-lived, BABs were also a rare opportunity to observe investor interest in munis with characteristics of taxable bonds.

Analysis of the market interest rates on BABs suggests the program lowered borrowing costs for state and local governments by 30 to 80 basis points compared with traditional tax-exempt bonds (Ang, et. al. 2010; Liu and Denison 2014). Some of that reduction is due to the federal government's aggressive subsidy (around 35% for most BABs), but these results suggest that even with a smaller subsidy, BABs would still have produced lower issuer borrowing costs for many issuers. An analysis of a few selected BABs transactions (Luby 2012) found that issuers paid slightly higher transaction costs on BABs, but the borrowing cost savings were still between six and 60 basis points compared with tax-exempt bonds. In all, the "BABs Experiment" suggests there is strong latent demand for municipal bonds with features similar to taxable bonds. Keep in mind, however, that many BABs issuers saw their direct subsidies reduced as part of the Congressional "sequestration" process in 2013-2014. Moreover, BABs contained several features that made them more like corporate bonds, such as "term" or "bullet" structures and "make whole" call provisions. Those unique features make it difficult to directly compare BABs to traditional munis.

4. State and Local Cost of Capital Without the Muni Exemption

As mentioned, municipal bonds have been tax-exempt for as long as the US has had an income tax. And with a few exceptions, such as the Build America Bonds program, there is no way to observe directly how a major change to the federal exemption would affect muni yields and state and local governments' eventual cost of capital.

However, there is some analysis that documents and infers those effects from indirect evidence. This research tends to follow one of two methods.

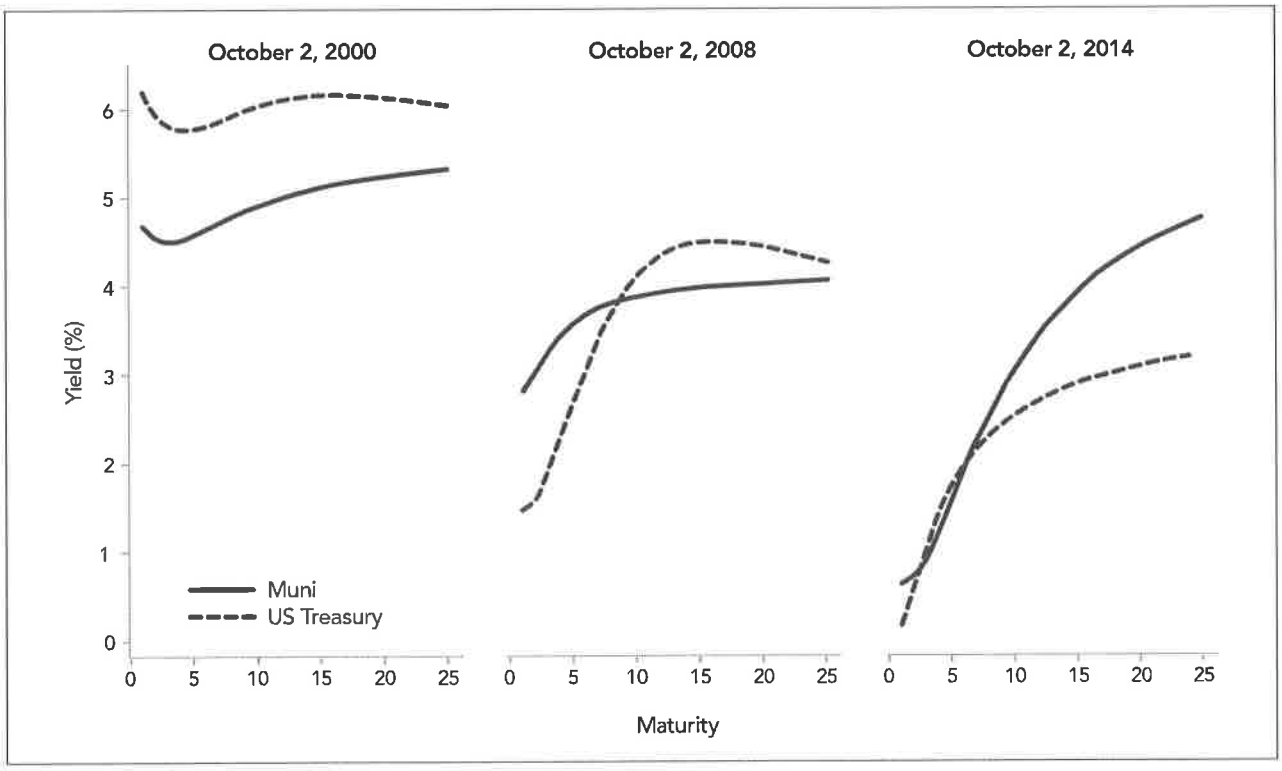
One is to assume that ending the exemption would uniformly increase the interest rates on all municipal bonds. That assumption allows us to compute hypothetical taxable municipal bond interest rates and the

subsequent higher interest expenses for state and local governments. A recent study from the National Association of Counties (NACo 2013; study affiliates included the National League of Cities and the Government Finance Officers Association) employed this method. That study was based on the assumption that if Congress repealed the muni exemption, all municipal bond interest rates would increase by 200 basis points. That increase was then applied to the current debt portfolios of a sample of large city and county governments from 2003-2012, and from that sample the authors estimated the likely additional interest expenses for cities and counties as a whole. The main finding was that without the muni exemption, state and local governments would have incurred $495 billion in additional interest expenses on the $1.65 trillion of municipal bonds issued during that period. Similar analysis by the Securities Industry and Financial Advisory Association (SIFMA) and Friedlander (2014) also concluded that state and local debt service costs would increase 20 to 30 percent if the exemption were repealed.

This approach is straightforward, but it has two main drawbacks. First, there is no evidence that ending the exemption would affect all munis uniformly. In fact, a recent Bank of America/Merrill Lynch study (2013) showed that large issuers like state governments, big cities, and major public utilities would pay little if any additional debt service in a taxable market. These issuers are able to attract institutional investors to their bonds, which drives down liquidity and transaction costs. As mentioned, the Build America Bonds program was also instructive on this point. And yet, many small issuers are not able to attract this sort of attention and would likely pay much more interest in a taxable market. Second, any approach that assumes a uniform effect on yields washes out important day-to-day market movements that affect the interest rates on both tax-exempt and taxable bonds.

As an alternative, the approach used here is to extract information about the value of the tax exemption from the market prices of individual tax-exempt bonds. Specifically, the goal is to determine why interest rates on munis deviate from interest rates on comparable Treasury bonds. This difference – also known as the "muni spread" – is essential because Treasury interest rates are the basis for interest rates across the market, and because the interest investors earn for holding Treasuries is taxable. If we can understand

Figure 5: Term Structure of Municipal Bond Yields and US Treasury Yields on Selected Dates



Sources: Author calculations and Gurkaynak, et. al. (2007)

variation in the muni spread we can understand in a more nuanced way how muni yields would change if the exemption were repealed.

Figure 5 (see previous page) highlights the motivation for this approach. It shows the muni spread on three different dates. The left panel shows October 2, 2000, a day typical of the market for the roughly ten years that preceded the financial crisis of 2008. Muni rates were well above 4.5 percent overall, and the difference in rates between short-term and long-term maturities – also known as the "slope" of the yield curve – was only around 1 percent (or 100 "basis points" or bps; a basis point is .01 percent). Treasury yields were also 90-120 bps above munis, due mostly to munis' tax advantage. The middle panel is October 2, 2008, the height of the financial crisis. At that time investor demand for safe, liquid investments was exceedingly high, and that demand drove interest rates on short-term Treasury bonds well below short-term muni rates. This was one of the first moments when the muni spread became "inverted." The right panel is October 2, 2014, a day typical of more recent market conditions. Here we see steep slopes and a wide muni spread.

The key point from Figure 5 is that the muni spread is dynamic. Muni interest rates move closer or further from Treasuries at different points in time. The value of the tax exemption will fluctuate in economically meaningful ways not captured by a simple blanket assumption applied to all munis at all times.

One of the central questions in the municipal market today is what explains the widening muni spread. There are plenty of potential reasons, including lower overall liquidity for munis, persistent concerns about state and local governments' financial health, and ultra-low Treasury yields due to uncertainty throughout the financial world. Some of that widening spread might be due to changes in the value to investors of the muni exemption.

To address that question, some new estimates of the credit, liquidity, and tax components of the muni spread were computed. These estimates were based on the market prices for more than ten million transactions in municipal bonds between 2000 and 2014. This method allows for a granular look at how the value of the tax exemption varies in space and time. For more information on this methodology, see Section A of the technical appendix.

The main finding was that from 2000 to 2014, the tax component of the muni spread was normally between -225 basis points and -150 basis points. In other words, the muni exemption reduced the interest rate on a typical municipal bond by1.50 to 2.25 percent, all else being equal. This is a slightly smaller savings than the flat 2.00 percent decrease assumed in the NACo/NLC methodology. A related finding is that the non-tax components of the muni spread do not generally respond to changes in federal tax policy. This affirms a key assumption implicit in previous work: repealing the muni exemption would affect only the tax component of the muni spread.

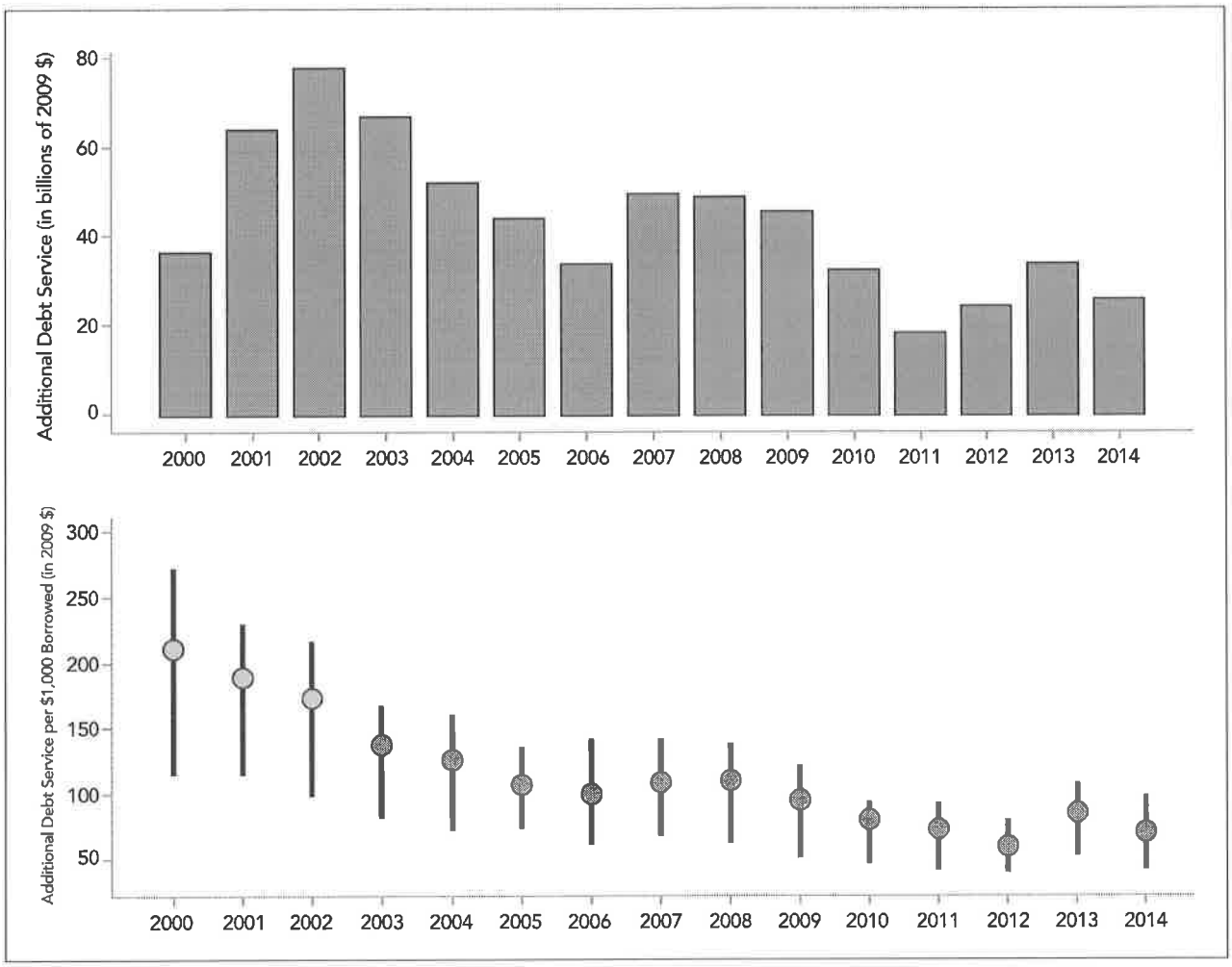
With an estimate of the tax component of the muni spread we can also measure how the interest expenses on state and local borrowing would increase if the muni exemption was repealed. This is done by increasing each muni bond's interest rate by the average tax component for all munis of the same maturity on the day the bond was sold. In other words, we can derive a hypothetical "taxable equivalent" interest expense for every municipal bond in the market and compare it to its actual interest expense based on its actual tax-exempt interest rate.

For example, if a state or local government issued a $500,000 bond with an initial interest rate of 3.5 percent that matures in five years, that government will pay $120,242 each year to pay off that borrowed money with interest. This assumes the government structures the bond to pay it off in equal installments over time. This is generally known as "level debt service." Say the analysis above suggests the taxable equivalent interest rate on this bond is 5.25 percent. In that case its annual debt service payment would be $131,082, an increase of nearly $11,000, or more than 9 percent. Consider also that state and local governments typically sell bundles of 10 to 30 individual bonds packed as a larger "bond issue." Applying these same calculations across multiple bonds, it's possible to see how debt service expenses could increase by millions of dollars on even a modestly sized bond issue.

The top panel of Figure 6 shows these additional debt service expenses aggregated across all bonds for each year from 2000-2014. These results show that in total, the muni tax exemption saved state and local borrowers $650 billion dollars from 2000-2014 (Note: $650 billion in 2009 dollars is roughly $715 billion in 2014 dollars). Total annual savings ranged from $18 billion in 2011 to $49 billion in 2007. These figures are roughly consistent with the estimates presented in the NACO/NLC studies and other prior work.

The bottom panel of Figure 6 presents the average additional debt service expense incurred by a state or local government and expressed in terms of the

Figure 6: Estimated Additional Municipal Bond Debt Service without the Federal Exemption, 2000-2014



Source: Author calculations

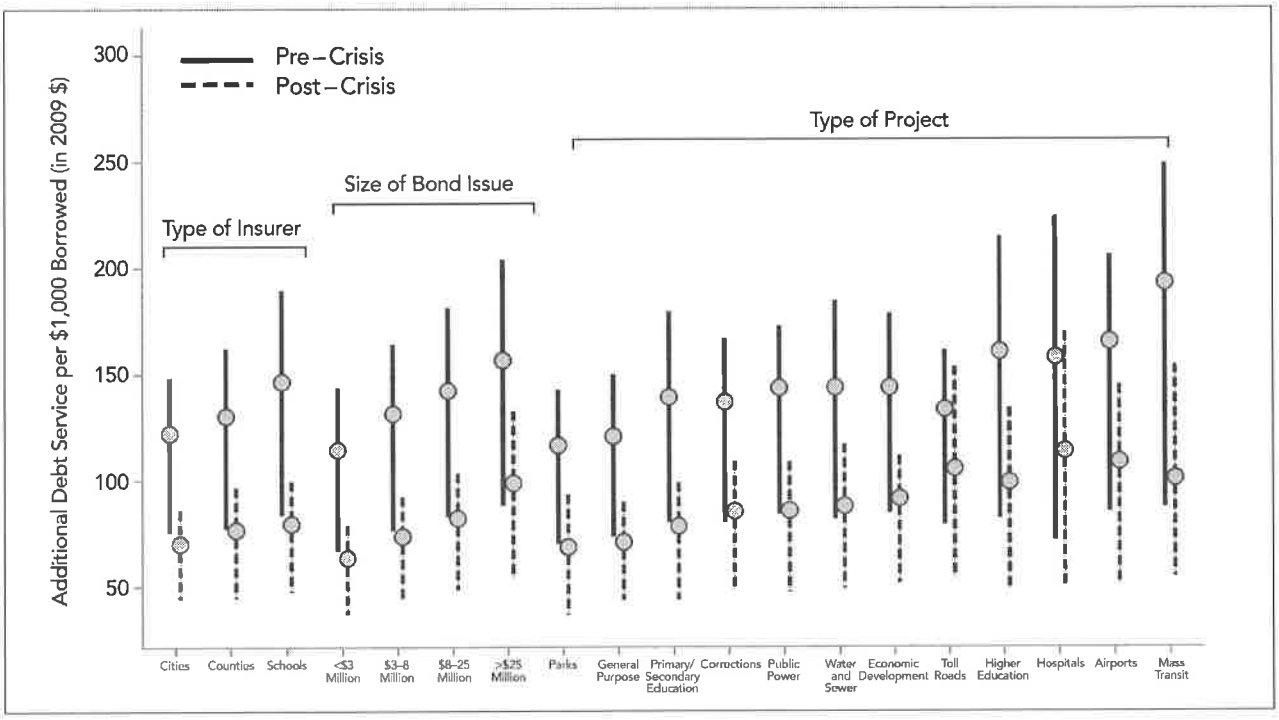
amount of money borrowed. The hollow dots identify the average additional borrowing costs on $1,000 of borrowed money, and the lines identify the 25th and 75th percentiles. For instance, for a typical municipal bond in 2000 the additional debt service associated with the loss of the muni exemption is $210 per $1,000 of borrowed money. In this case, a city borrowing $5 million would have paid an additional $1,050,000 in debt service. For later years this impact is much smaller.

Figure 7 (see next page) shows these same figures for sub-samples of bonds identified by the type of issuer, the size of the bond issue, and the project financed by the bond issue. It also presents separate estimates for average additional debt service expenses before and after the financial crisis of 2008. This comparison is important because different types of borrowers tend to borrow different amounts of money and often at different maturities.

These results show that additional borrowing costs are much lower since the financial crisis. This is not surprising given that interest rates on US Treasury bonds have been at record low levels for most of the post-crisis period. These results also show that additional debt service expenses do not vary much across types of borrowers. Since the financial crisis, this has meant savings of around $70 per $1,000 of borrowed money for cities. For counties it is $76; for schools, $79. Savings vary a bit more by the size of the transaction and vary widely by type of project.

Table 1 (see page 14) reports these same basic effects, this time for a group of representative bond issues. These examples were chosen to show how taxable interest rates would affect some of the most

Figure 7: Additional Debt Service on a Typical Municipal Bond without the Federal Exemption, Sub-Sample Estimates, 2000-2014



Source: Author calculations

common types of municipal bonds. Total debt service is the total principal and interest payments over the life of the bonds. True interest costs (TIC) is, in effect, the average interest rate on an entire bond issue. Proceeds are the amount of money the issuer receives at the time of the transaction. For more details on the methodology to produce these examples, see Section B of the technical appendix.

These figures show that a repeal of the exemption would mean many issuers would receive substantially less money from a typical bond transaction. This is especially true for larger transactions.

5. Alternatives to Debt Financing

At the moment there are two main alternatives to traditional tax-exempt debt financing: pay-as-you-go and public-private partnerships. These financing tools are not nearly as well developed or standardized as the tax-exempt bond market, so know at the outset that terms and concepts used to describe them vary. At this point the limited empirical evidence suggests these alternatives are good complements to tax-exempt financing, but not good alternatives.

To "pay-as-you-go" is to finance a capital investment with current resources rather than borrowed resources (for a longer exposition see Marlowe, et. al. 2009, 134-140; also note that PAYGO in this context is quite different from PAYGO in the context of federal budgeting, where it refers to the rule that new federal appropriations must be "paid for" with expenditure cuts or realized savings). Put differently, PAYGO is to "save up" for capital projects.

Virtually all state and local governments use PAYGO for some of their capital investments. Leasing programs in areas like information technology and fleet management are a form of PAYGO. Many local governments use capital reserve programs, where a portion of annual budget surplus or fund balance is set aside for future maintenance needs in areas like streets and utilities. Others finance heavy equipment and other shared items through internal service funds. Under this plan, departments and agencies that use the equipment pay an occasional tax or fee that accumulates in an internal service capital needs fund. Strictly speaking, intergovernmental grants for capital spending are also a form of PAYGO. In that case another unit of government expedites the capital accumulation process.

PAYGO has several advantages. It is flexible. Once the government has accumulated the requisite capital

reserves it can procure a capital asset at the best available timing and pricing. With debt financing, borrowers' choices about how and when to borrow money are usually limited by state law, internal policies, bond market conditions, and the political climate. PAYGO is also more transparent. The cost to procure the asset is its purchase price. Debt financing requires interest payments, fees to underwriters and other parties, and other transaction costs often paid off over many years. With so many additional costs it's rarely clear what it will cost to purchase an asset. Some policymakers also find PAYGO an attractive way to "pay it forward" for future generations.

PAYGO's main disadvantage is scalability. It is extraordinarily difficult for state and local governments to build the capital reserves needed for large projects like new water treatment facilities, port infrastructure, or major bridge replacements. It can take decades to save up the requisite capital, and on a present value basis, debt becomes cheaper at some point in the intermediate to long-term future.

There is virtually no evidence on how much states and local governments use PAYGO. The only known study of the states showed that from 1988-2003 a typical state financed around 7.5 percent of its annual capital spending through PAYGO (Wang, Hou, and Duncome 2007). Again, PAYGO works as a complement, but not an alternative, to debt.

There are no data on local governments, but there are a few compelling anecdotes. For instance, Maricopa County, AZ used to finance much of its five-year capital improvement plan through a PAYGO strategy (Marlowe 2013). One of the key and unique features of that strategy was that funds unspent at the end of the fiscal year were swept into a strategic capital projects fund. Departments could access that fund by submitting a business plan for a new capital project through a competitive internal selection process. This incentivized saving rather than spending end-of-year surplus, and it animated a large-scale PAYGO process. The City of Akron, OH, follows a similar strategy by dedicating a portion of its local income tax to capital projects.

The second alternative to debt financing is public-private partnerships (PPPs). There is no textbook definition of public-private partnership, but most public finance experts agree that an infrastructure PPP is any arrangement in which partners from both sectors share the risks and rewards of delivering and/or operating the asset over an extended time period.

PPPs offer state and local governments two main advantages. First and foremost is access to a new source of capital. Instead of issuing bonds, a government can enlist a private partner to build, repair, upgrade, or maintain the capital asset in question. In a typical PPP, the private partner will make that investment in exchange for some portion of the long-term revenues that asset will generate. For private partners, access to the revenue stream from an essential piece of public infrastructure is superior to many other potential investments.

PPPs also offer governments the opportunity to preserve or expand infrastructure capacity in unique ways that only the private partner can offer. In many cases that capacity is related to new technology, equipment, or business processes unique to that private partner. If properly implemented, that new capacity can drive down costs and improve that infrastructure's overall efficiency and effectiveness. "Potential legislation, including the "Move America Act of 2015 proposed by Senators John Hoeven and Ron Wyden, seeks to build that new capacity by broadening the types of investors who can realize the tax benefits of investing in public infrastructure through public-private partnerships.

Consider the following example. In 2005, the City of Seattle decided to build a new water filtration plant at its main watershed on the Cedar River. Instead of financing and building the facility itself, the City chose to pursue a PPP. It eventually partnered with CH2M Hill, an international environmental engineering firm, for a "design-build-operate" PPP. Under this agreement CH2M Hill designed the new facility, financed, and built it, and agreed to operate it for 25 years in exchange for a portion of Seattle residents' water utility payments over that same period.

This partnership was unique because it was organized around outcomes rather than inputs. Instead of dictating the water treatment technology the facility would use, as would be the case in a traditional "design-build" process, the partnership agreement only identified the levels of water quality the facility would need to achieve. How it achieved those levels was up to CH2M Hill. With this latitude CH2M Hill was been able to develop, test, and refine a variety of cutting-edge ultraviolet water treatment technologies. Those technologies worked well and allowed the facility to deliver cleaner water at lower overall cost for virtually no up-front public investment. Not only was the facility profitable for CH2M Hill, but the technology it developed is now in use at similar facilities around the world (National Council on Public Private Partnerships 2006). This is a good example of a successful PPP.

PPPs also carry a variety of risks. Most important

for the public partner is that private sector failure can have significant financial, legal, and political consequences. It is difficult for governments to effectively measure and "price" this risk when negotiating a PPP, and if necessary, transfer some or all of that risk to the private partner. The main risk to private partners is that political support for the PPP can change if the political climate changes. For those reasons all successful PPPs are predicated on trust and a fair sharing of the relevant risks. For more on the tactics and strategies of successful PPPs for state and local governments see the Brookings Institution's recent overview (2014), or the longer treatments by Yescombe (2012) or Weber (2010).

The main question surrounding PPPs is whether they are a robust alternative to traditional municipal bonds. At the moment the tentative answer is no. There is no definitive estimate of the portion of infrastructure spending needs that could be met through PPPs. Clearly, the best candidates are infrastructure projects that can generate a stand-alone revenue stream, like water utilities, toll roads, airports, and stadiums. We also know that many of the most widely publicized successful PPPs, such as the Seattle Public Utilities example, are for large projects that demand hundreds of millions of dollars of investment. It's less clear if the model can work as well for the enormous spending of needs non-revenue generating infrastructure like highways and school buildings, and for much smaller projects that constitute the bulk of state and local capital spending.

Ironically, there is a more or less direct trade-off between PPPs and municipal bonds. PPPs are the mainstay of public capital investment everywhere in the world except the US, precisely because the tax-exempt bond market is a uniquely US institution. For most public infrastructure projects it is cheaper to sell long-term, tax-exempt municipal bonds than to secure up-front private sector investment at a much higher expected rate of return. For that reason governments usually turn to PPPs when they are at or near the limit of their borrowing capacity, or when they cannot generate the new tax or other revenues needed to pay off long-term bonds. That said, it is not clear if this trade-off would hold if the muni exemption were repealed or reduced.

It's also important to note that the term PPP is routinely misused. A partnership is different from privatization, in which a private partner assumes most or all the risks of operating an existing service or piece of infrastructure in exchange for a fixed payment from a state or local government. By that definition many of the recent high profile infrastructure "partnerships" are actually privatizations. One of the most noteworthy was the 2005 Chicago Skyway lease transaction, in which the City of Chicago transferred the maintenance, operations, and right to future tolls to a private operator for 99 years in exchange for a $1.83 billion up-front payment. Transactions involving Chicago's parking meters, Midway airport, and the Indiana Tollway among many others followed similar leasing arrangements.

Technical Appendix

A. The Tax Component of Municipal Yield Spreads

Prior research shows that muni spread happens for three reasons. One is credit risk. Munis rarely default, but they are not risk-free like US Treasury bonds. Investors will demand additional compensation to hold them over holding Treasury bonds. The second component is liquidity risk. Munis are, for the most part, a "buy and hold" investment (Downing and Zhang 2004; Harris and Piwowar 2006). When investors do buy and sell munis they must trade in a complex "over-the-counter" market where transaction costs can be quite high relative to other types of bonds (Green, et. al. 2006). These credit and liquidity risks increase the muni spread. The third component is taxes. Interest on US Treasury bonds and corporate bonds is taxable, but muni interest is tax-exempt. This tax advantage lowers the muni spread.

We can estimate those components several ways. Here I employ a method described by Ang, Bhansali, and Xing (2014) that is based on concepts advanced by Duffie and Singleton (1997), Chalmers (1998), and Kalotay and Dorigan (2009). The tax component and borrowing cost estimates throughout this paper, and the methodology to produce those estimates, are both explained in much greater detail in Marlowe (2015a).

The basic empirical strategy is to identify discount rates that include one of the three spread components but not the other two, and then discount the cash flows on municipal bonds using those discount rates. Those discounted cash flows imply hypothetical bond prices and yields that show us how investors might evaluate munis that have no credit risk, no liquidity risk, or, of particular interest here, no tax advantage.

I derive a credit "risk free" municipal bond discount rate by observing the yields on municipal bonds that are escrowed with US Treasury bonds. This happens when an issuer defeases a callable bond before its call date, also known as an "advanced refunding" (for more see Ang and Green 2013; Chalmers 1998). To do this, I observe all inter-dealer trades reported to the Municipal Securities Rulemaking Board (MSRB) in pre-refunded bonds from 2000-2014. For each day in the sample period I apply the Nelson-Siegel method (Nelson and Siegel 1987) to derive from those transactions a zero coupon pre-refunded yield curve. I then re-price all municipal bonds, both pre-refunded and not, to that hypothetical "risk free" yield curve. The credit component of the muni spread is the difference between a bond's actual yield and its hypothetical risk-free yield.

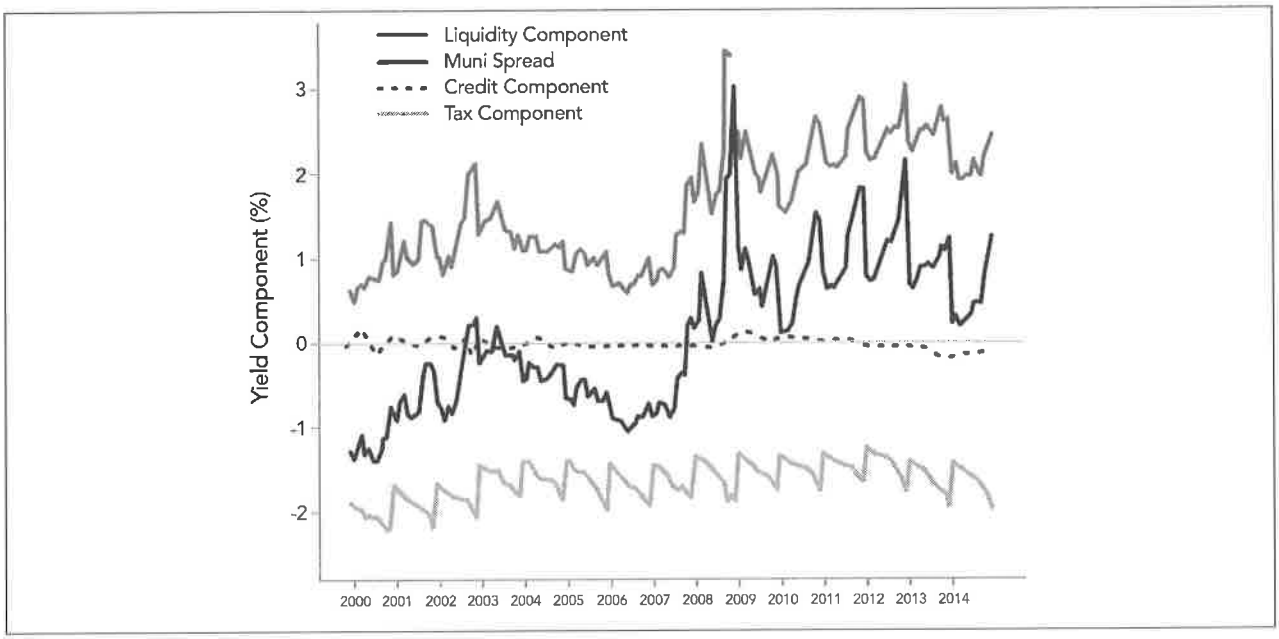
For the liquidity component I compute a hypothetical "after tax" yield on every municipal bond that traded during this period. To do this, I increase the coupon for each muni bond that traded during this time by the contemporaneous top marginal federal income tax rate. In effect, this sets the bond's coupon to a taxable equivalent and removes the unique effect of the muni exemption. For instance, a 5 percent tax-exempt coupon in 2000, when the top federal marginal rate was 39.6 percent, would be 5 percent X (1-.396) or 3.02 percent. I then discount these after-tax cash flows by US Treasury zero coupon rates (from Gurkaynak, et. al. 2007) to remove the effect of credit risk. For each municipal bond that traded during this time, the difference between the "after tax" yield and the previously described "risk free" yield is the liquidity component of the muni spread. Put differently, a muni with no credit risk and no tax advantage is identical to a US Treasury except for its relative lack of liquidity.

A muni's tax component is the difference between its "after tax" yield and the yield implied by discounting its cash flows by US Treasury zero coupon rates. The after tax yield and the US Treasury yields are identical except that the latter is taxable while the former is not.

From 2000-2014 more than two million munis traded through more than10.5 million individual inter-dealer transactions. I compute the muni spread components implied by each of these trades. Figure A1 (see next page) shows the average of these components over time.

The tax component can be interpreted as what would happen to muni yields if Congress were to repeal the muni exemption. That repeal would increase muni yields by between 1.5 and 2.2 percent on average. Also note that the liquidity component and the credit component do not seem to respond to changes in federal tax policy. This suggests that repealing the exemption would increase yields by only the tax component.

Figure A1: Figure A1: Components of the Municipal Yield Spread, 2000-2014



Source: Marlowe (2015)

Table 1 New Bond Issue Scenarios With and Without the Federal Tax Exemption

Issuer	Pima County (AZ)	Edmonds School District (WA)	Cleveland County Ed. Facilities Authority (OK)	New York City Municipal Water Finance Authority
Reference CUSIP	721882EF1	833153TF6	18604TBE7	64972GDK7
Description	Street & Highway Revenue Bonds	Unlimited Tax General Obligation Bond	Educational Facilities Lease Revenue Bonds (Norman Public Schools Project)	Water and Sewer System Second General Resolution Revenue Bonds
Sale Date	1/30/2014	6/12/2014	6/1/2014	4/3/2014
Total Debt Service	$30,684,084.38	$305,613,000.00	$108,942,000.00	$935,199,275.00
Average Interest Rate (TIC) - Tax Exempt	2.2938%	3.3843%	1.2757%	3.9784%
Average Interest Rate (TIC) – Taxable	4.1599%	3.0728%	3.1144%	6.2416%
Total Proceeds at Sale - Tax Exempt	$27,232,332.71	$210,365,765.66	$104,216,017.17	$541,218,791.99
Total Proceeds at Sale – Taxable	$24,632,058.47	$217,345,343.24	$97,858,465.01	$431,869,576.08

B. Effects of the Repeal on Example New Bond Issues

Table 1 (on previous page) reports how a repeal of the exemption would likely affect some specific new bond issues. To compute those estimated effects I examine how the yields, true interest costs (TIC), and proceeds at the time of the sale would change if that same bond issue had priced to a taxable municipal yield curve at the time of its sale. The taxable yield curve was simply the average tax component (computed as discussed above) for all munis across the full-term structure on the bond's sale date.

The example below illustrates this process for a typical local government revenue bond: Pima County, AZ, Street and Highway Revenue Bonds, Series 2014. This issue sold on January 14, 2014 and, presumably, priced to a benchmark tax-exempt yield curve such as the Municipal Market Data (MMD) high-grade municipal bond index. The total par amount was $24,805,000, but most of the shorter maturities priced at substantial premiums. In turn, Pima County received more than a $2.7 million premium on this transaction. The TIC on this transaction – the discount rate that sets the total proceeds equal to the present value of the future debt service – was 2.2938 percent.

Pima County, AZ, Street and Highway Revenue Bonds, Series 2014
Par Amou nt: $24,805,000; Dated Date: 1/30/2014
Reference CUSIP No.: 721882

1. Maturity Schedule
Original from Official Statement

Maturity Date	Principal Amount	Coupon	Yield	Price	CUSIP (a) (721882)	Proceeds
7/1/2015	$775,000.00	5.00%	0.250%	106.7260057	EF1	$827,126.54
7/1/2016	$820,000.00	5.00%	0.450%	110.93615	EG9	$909,676.43
7/1/2017	$5,215,000.00	5.00%	0.650%	114.6863599	EH7	$5,980,893.67
7/1/2018	$5,495,000.00	5.00%	1.030%	117.1079637	EJ3	$6,435,082.60
7/1/2019	$1,025,000.00	5.00%	1.400%	118.7240475	EK0	$1,216,921.49
7/1/2020	$1,075,000.00	5.00%	1.850%	118.9825511	EL8	$1,279,062.42
7/1/2021	$1,130,000.00	5.00%	2.200%	119.0693317	EM6	$1,345,483.45
7/1/2022	$1,190,000.00	5.00%	2.500%	118.8731008	En4	$1,414,589.90
7/1/2023	$1,245,000.00	3.00%	2.700%	102.479085	EP9	$1,275,864.61
7/1/2024	$1,285,000.00	3.00%	2.880%	100.9823889	EQ7	$1,297,623.70
7/1/2025	$1,325,000.00	3.00%	3.100%	99.18696302	ER5	$1,314,227.26
7/1/2026	$1,365,000.00	3.25%	3.160%	100.7265757	ES3	$1,374,917.76
7/1/2027	$1,405,000.00	3.25%	3.343%	99.25198481	ET1	$1,394,490.39
7/1/2028	$1,455,000.00	3.38%	3.343%	99.28793347	EU8	$1,444,639.43

True Interest Cost (TIC): 2.2938%
Proceeds: $27,510,599.65

Had this same issue priced to the taxable muni curve implied by the average tax component of the muni spread on January 14, 2014, these same bonds would have priced as follows:

2. Maturity Schedule
Including tax component to simulate elimination of tax exemption

Maturity Date	Principal Amount	Coupon	Yield	Price	CUSIP (a) (721882)	Proceeds
7/1/2015	$775,000.00	5.00%	3.237%	102.4245412	EF1	$793,790.19
7/1/2016	$820,000.00	5.00%	2.659%	105.4477537	EG9	$864,671.58
7/1/2017	$5,215,000.00	5.00%	2.765%	107.2419588	EH7	$5,592,668.15
7/1/2018	$5,495,000.00	5.00%	3.077%	107.888788	EJ3	$5,928,488.90
7/1/2019	$1,025,000.00	5.00%	3.436%	107.6719802	EK0	$1,103,637.80
7/1/2020	$1,075,000.00	5.00%	3.855%	106.4554482	EL8	$1,144,396.07
7/1/2021	$1,130,000.00	5.00%	4.133%	105.4898256	EM6	$1,192,035.03
7/1/2022	$1,190,000.00	5.00%	4.441%	103.8854512	En4	$1,236,236.87
7/1/2023	$1,245,000.00	3.00%	4.806%	86.44270605	EP9	$1,076,211.69
7/1/2024	$1,285,000.00	3.00%	5.000%	85.12119622	EQ7	$1,093,807.37
7/1/2025	$1,325,000.00	3.00%	5.170%	83.97882266	ER5	$1,112,719.40
7/1/2026	$1,365,000.00	3.25%	5.429%	84.09152048	ES3	$1,147,849.25
7/1/2027	$1,405,000.00	3.25%	5.689%	82.39930647	ET1	$1,157,710.26
7/1/2028	$1,455,000.00	3.38%	5.949%	81.63820656	EU8	$1,187,835.91

True Interest Cost (TIC): 4.1599%
Proceeds: $24,632,058.47

In a taxable market Pima County's premium on these bonds would likely disappear, and the TIC would increase to an estimated 4.1599 percent. This assumes the County would not adjust its coupons, sizing, or other characteristics of the bonds to price more efficiently in a taxable market. This is not a practical assumption, but it does help to illustrate how the shift to a taxable market would affect typical state and local debt management practices. It is also intuitive, given that the vast majority of munis since 2000 have priced at re-offering premiums. I replicate this basic analysis for each of the four bond issues outlined in Table 1 on page 14.

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