Review Article

When it matters to keep promises: Funding of retiree benefit and government borrowing cost

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Abstract

While funding of retiree benefits has become a critical challenge to the fiscal sustainability of U.S. local governments, little is known about the consequences of public expenditures on OPEBs and pensions. This study examines whether and when annual contributions to other post-employment benefits (OPEBs) plans affect government borrowing costs. By reducing unfunded liabilities, OPEB contributions may decrease borrowing costs. As two parts of deferred employee compensation, expenditure tradeoffs may exist between OPEBs and pension contributions. Fiscal capacity can further moderate these expenditure tradeoffs. Results show that, as U.S. city and county governments make more contributions to OPEB plans, they pay lower borrowing costs when the pension contribution is low and when fiscal capacity is low. They pay higher borrowing costs when the pension contribution is high and when fiscal capacity is low. These findings suggest that the savings of borrowing costs from OPEB contributions depend on the tradeoffs between OPEB and pension expenditures and the availability of fiscal resources.

As society is aging and healthcare costs are growing, funding of retiree benefits has been increasingly challenging the fiscal sustainability of U.S. local governments (Chapman, 2008; Hoang & Goodman, 2018; Shui-Yan et al., 2014). Retiree benefits for public employees generally consist of pension and other post-employment benefits (OPEBs). OPEBs consist of retiree health care, life insurance, disability payments, and long-term care. The major part of OPEBs is retiree healthcare benefits, where local governments subsidize health insurance premiums for retirees. Alternatively, the subsidy becomes implicit in that local governments allow retirees to stay in the same health insurance pool with active employees, who are usually younger, healthier, and thus cheaper to insure. While many local governments subsidize health insurance costs for retirees until they qualify for Medicare at age 65, others continue the subsidy beyond 65 (Novy-Marx & Rauh, 2013).

OPEBs differ from pensions in important ways (Government Accountability Office, 2007). First, while pensions are legally protected, OPEBs are not guaranteed under state laws. OPEBs are subject to negotiations between governments and unions. Compared to pensions, local governments have more flexibility to make changes to their

OPEB plans. Second, most pensions are prefunded and managed as trust funds. OPEBs are funded on a pay-as-you-go basis, in which payments are made to retirees from annual operating funds. Since 2008, many local governments have reported OPEB costs on an actuarial accounting basis under GASB 45.

While pension funding has been central to recent policy and scholarly debates (Anzia, 2017; Qiushi & Peng, 2018; Thom, 2013), the funding of OPEBs has received less attention (Coggburn & Kearney, 2010; Marlowe, 2007; Yu, 2021). OPEB funding, however, may represent an equally pressing fiscal issue for state and local governments in the U.S. The unfunded OPEB liabilities are huge for local governments (David & Varshney, 2007; Government Accountability Office, 2008; Munnell & Crawford, 2016). For example, Munnell and Crawford (2016) estimate a total of about \$538 billion of unfunded OPEB liabilities.

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Moreover, OPEB costs can grow fast in the future (Government Accountability Office, 2007; McNichol, 2008). McNichol (2008) estimates that total OPEB liabilities for state and local governments can increase to between $1 and $1.3 trillion in the next 30 years.

Local governments may have "trouble keeping promises" in funding OPEBs (Coggburn & Kearney, 2010). Local governments have no direct control over the rise of healthcare costs, which has been driving the growth of OPEB costs. On the other hand, the funding of OPEBs is constrained by fiscal stress. One may argue that local governments might simply renege on OPEB promises, as OPEBs are not as legally protected as pensions. However, this option may have high costs. In the short term, OPEB cuts to current employees are likely to face opposition from public unions (Anzia & Moe, 2015; DiSalvo & Kucik, 2018). In the long run, this may make it harder for local governments to attract and retain employees of high quality (Coggburn & Kearney, 2010).

No matter whether local governments adopt radical reforms on OPEB funding, making contributions to OPEB plans is a routine policy decision. This study focuses on government contribution to OPEB plans as the key policy parameter. First, government contributions represent what local governments actually spend on OPEB plans as opposed to what they "promise" to pay, as reflected in OPEB liabilities reported under GASB 45. This distinction is critical because many local governments consider OPEB liabilities as "soft" (Novy-Marx & Rauh, 2013) and may not necessarily commit themselves to fully funding OPEBs. Second, government contributions represent expenditures on OPEBs and thus reflect the direct impact of OPEB liabilities on government budgets. While prior studies have focused on the funded status of OPEB plans as indicated by funded ratios or unfunded liabilities (e.g. Marlowe, 2007), little attention is paid to the realized burden of OPEB debt on government budgets.

To meet balanced budget requirements, everything else equal, local governments must make expenditure tradeoffs between OPEB contributions and pension contributions. Expenditure tradeoffs may exist for any government expenditures in the budget-making process. But the tradeoffs between the OPEB contribution and the pension contribution can be particularly salient because they fall into the same expenditure function and target the same group of beneficiaries. In addition, because the literature on OPEBs and pensions develops separately, rare attention has been paid to the interactions between government expenditures on OPEBs and pensions. Furthermore, while most studies treat pension funding as the primary concern and OPEB funding as the secondary, few have examined the impact of contextual factors. This study focuses on fiscal capacity as a critical contextual factor that can moderate the expenditure tradeoffs between OPEB and pension contributions.

This study assesses the effects of OPEB contribution on local government borrowing costs. One of the many consequences of OPEB and pension contributions is the borrowing cost that local governments pay when issuing debt in the municipal bond market. Since OPEB liability is a form of government debt (Bifulco et al., 2012), changes in OPEB contributions are likely to factor into borrowing costs regardless of whether the borrowing is for OPEB financing. The results show that the annual contribution to OPEB plans matters to borrowing costs. County governments pay lower borrowing costs when making a greater contribution to OPEB plans. Moreover, for both city and county governments, the impact of OPEB contribution on borrowing cost is conditional on pension contributions and fiscal capacity.

This study makes three contributions. First, using government-reported OPEB data for a national sample of cities and counties, this study empirically tests the impact of OPEB contribution on borrowing costs. Second, drawing on literature from the budget tradeoff (e.g. Berry & Lowery, 1990) and the capacity-performance link (Hall, 2008; Hou & Moynihan, 2006), this study shows the conditional effects of pension contributions and fiscal capacity on the relationship between OPEB contributions and borrowing costs. Third, this study helps local government decision-makers understand the conditions under which local governments are likely to save borrowing costs by making greater contributions to OPEB plans.

Previous studies

Existing literature has focused on the credit risk consequences of OPEB funding and pension funding. First, scholars have examined the impact of OPEB underfunding on municipal bond market outcomes. Marlowe (2007) finds that OPEB liabilities do not influence municipal borrowing costs, though high OPEB liabilities and low fiscal capacity are associated with lower credit ratings. This indicates that fiscal capacity can be a significant contextual factor for understanding the impact of OPEB liabilities on government borrowing costs. While Marlowe (2007) examines the impact of OPEB liabilities, the present study focuses on the effects of government OPEB contributions on government borrowing costs. In addition, Matkin and Krivosheyev (2013) find preliminary evidence that local governments might earn higher credit ratings by reducing OPEB liabilities. This implies that, as a means of decreasing unfunded OPEB liabilities, government OPEB contributions may improve credit ratings. Given the well-documented negative correlation between credit ratings and borrowing costs, this further suggests that government OPEB contribution may decrease borrowing costs.

Second, scholars have examined the impacts of pension funding on municipal bond market outcomes. Copeland and Ingram (1983) find no association between various pension fund ratios and municipal bond yields in the secondary market. Unfunded pension liabilities are positively associated with bond yields in the secondary bond market

(Raman & Wilson, 1990). Martell et al. (2013) find that as funded ratios of pensions decrease, states are more likely to receive lower credit ratings and negative rating outlooks. While these studies examine the impact of pension funding status on secondary bond market outcomes, none has tested the effects of government expenditures on pensions on government borrowing costs.

Moreover, while previous studies have examined the impact of the investment returns of pension funds, little attention has been paid to the effects of government contributions. Employee contributions, government contributions, and investment returns constitute the key sources of pension funding. Novy-Marx and Rauh (2012) find that state investment losses of pension funds in the Great Recession increased borrowing costs. This indicates that, as an alternative source of pension funding, government contributions may also influence government borrowing costs.

Furthermore, previous studies on OPEB funding and pension funding largely omit connections between the two parts of public employee compensation. Scholars have paid predominant attention to pension funding while marginalizing the OPEB funding issues. However, government contributions to OPEBs and pensions represent two critical parts of government expenditures in the same functional area. Consequently, interdependence may exist in government funding strategies. The present study accounts for the interactions between OPEB and pension expenditures in examining the impact of OPEB contributions on government borrowing costs.

OPEB funding and borrowing cost: When it matters

OPEB contribution and default risk

Under the prevalent practice of pay-as-you-go financing, many local governments do not establish trust funds to pay OPEB liabilities. Instead, local governments incur OPEB expenditures from general funds as they come due. Typically, the OPEB payments are made to insurance providers for current retirees only. Since local governments usually do not maintain assets to cover the promised OPEBs that current employees have earned, OPEB liabilities are accumulated and underfunded.

The underfunding of OPEBs has significant implications for the fiscal performance of local governments (Marlowe, 2007). As more public employees retire, OPEB expenditures increase in the short run. OPEB expenditures can make up a larger proportion of government budgets and crowd out other critical expenditures. This may lead to lower quality or quantity of public service delivery in such critical areas as education and public safety. Moreover, increased OPEB expenditures may make it harder for local governments to balance budgets in economic downturns.

In the long run, OPEB underfunding can reduce government fiscal sustainability. Unfunded OPEB liabilities represent promises of retiree fringe benefits to be met in the future. Given the institutional constraints, the influences of public employee unions, and the potential legal challenges, it is unlikely for local governments to renege on the whole OPEB debt. Indeed, while many state governments choose to cut OPEBs for the new hires, few cut OPEBs for current employees (Coggburn et al., 2012), perhaps due to these various obstacles. This suggests that OPEB liabilities, being "soft liabilities" (Novy-Marx & Rauh, 2013), may still have a negative impact on government budgets.

Therefore, OPEB underfunding can increase the credit risk of local governments by deteriorating their fiscal performance and challenging their fiscal sustainability. This proposition is consistent with empirical evidence. For instance, Marlowe (2007) finds that high OPEB liabilities and the low fiscal capacity of local governments are associated with lower credit ratings. Given that low credit ratings indicate high default risks, OPEB liabilities can increase government borrowing costs.

Local governments have taken steps to reduce unfunded OPEB liabilities. Aside from OPEB cuts for new hires, local governments regularly make annual OPEB contributions. The OPEB contribution "consists of payments directly to or on behalf of a retiree or beneficiary, premium payments to insurers, or irrevocably transferred assets to a trust (or equivalent arrangement)" (GASB, 2004). If local governments adopt pay-as-you-go financing for OPEBs, the OPEB contribution will be the amount of OPEB expenses that come due for current retirees. If they also establish OPEB trust funds, the OPEB contribution can include additional expenses made to the trust funds.

Under GASB 45, local governments had been required to report OPEB contributions as a percentage of the annual required contribution (ARC),[1] the amount required to fully fund OPEB liabilities on an accrual accounting basis. GASB 45 did not require local governments to pay 100% of the ARC or fully fund OPEB liabilities. While local governments can continue paying the amount based on pay-as-you-go financing, they can choose to pre-fund OPEB liabilities by paying gradually higher percentages of ARC each year. To the extent that some local governments establish OPEB trust funds after GASB 45, their percentages of ARC paid would increase.

Local governments may have incentives to pay higher percentages of ARC for OPEBs because this indicates their efforts and capacities of paying down the long-term OPEB liabilities. This is a positive move for rating agencies and bond investors that can reduce the default risks resulting from unfunded OPEB liabilities. As McNichol (2008, p. 4) puts it, if the OPEB "liability is large and the state does not plan to address it, this could affect a state's bond rating and the cost of borrowing money." In the same spirit, if local governments have made considerable contributions to reduce unfunded OPEB liabilities, their default risks may be decreased. There is some empirical support for this conjecture. For example, Matkin and Krivosheyev (2013) find that

local governments reducing OPEB liabilities tend to earn higher credit ratings, an indicator of lower default risks.

Alternatively, local governments may report higher percentages of ARC paid for OPEB plans by changing the ARC only. They can reduce ARC for OPEB plans in two ways. Substantively, local governments may cut OPEBs for current employees and thus reduce the sizes of OPEB liabilities. This would lead to lower levels of estimated ARC for OPEB plans. Symbolically, local governments may adopt optimistic accounting rules that make the ARC appear smaller than the real size. In either case, local governments would report higher percentages of ARC paid even if they make the same level of OPEB contribution as before GASB 45.

Regardless of the causes, an increase in the percentage of ARC paid would indicate that local governments have made more OPEB contributions relative to the level that would be required to fully fund OPEBs. This indicates the realized level of budgetary commitments to reduce long-term unfunded OPEB liabilities. Bond investors may or may not identify whether an increase in the percentage of ARC paid to OPEB plans results from a higher level of employer contribution, smaller size of OPEB liabilities, or simply creative accounting. Given that the municipal bond market is semi-efficient (Denison, 2001), it seems reasonable to assume that bond investors may interpret such an increase as a positive sign that local governments are taking serious steps toward addressing unfunded OPEB liabilities.

As local governments make more OPEB contributions to reduce unfunded OPEB liabilities, borrowing costs may decrease. The OPEB contribution is a key parameter of government fiscal performance, which can directly influence borrowing costs when governments issue bonds. As local governments make more OPEB contributions, they demonstrate better fiscal performance and can pay lower borrowing costs. Indirectly, OPEB contributions can decrease local governments' borrowing costs by enhancing their credit ratings. Indeed, credit rating agencies have clearly considered OEPB underfunding and related policy solutions as crucial risk factors. For example, Standard and Poor's (2013) grades general obligation bonds of local governments negatively for unfunded OPEB liabilities: "if there is a plan to address the obligations, the final score worsens by one point; otherwise, the score worsens by two points". Higher percentages of ARC paid to OPEBs can signify to rating agencies that a local government has a "plan" to address its unfunded OPEB liabilities.

In sum, unfunded OPEB liabilities have short-term and long-term implications for government budgets that may increase the credit risks of local governments. As a solution to reducing unfunded OPEB liabilities, the OPEB contributions can decrease default risks and thus borrowing costs of local governments. Therefore, the first hypothesis follows.

> *H1: OPEB contribution rates decrease borrowing costs.*

Expenditure tradeoff

Expenditure tradeoff is common in the budgeting process. A rich literature has documented and explained budget tradeoffs at various levels of government (Hendrick & Garand, 1991; Nicholson-Crotty et al., 2006; Yu et al., 2019). Budget tradeoffs mean that increases in spending in one functional area can crowd out expenditures in other areas. For example, more spending on education may mean less spending on health or highways (Nicholson-Crotty et al., 2006).

Following the same rationale, there can be tradeoffs between OPEB spending and other expenditures. For instance, Anzia (2017) finds that increased pension costs crowd out public services of cities in spending on construction and equipment. Particularly, holding other government expenditures constant, there can be tradeoffs between OPEB and pension spending. First, this tradeoff is caused by budget constraints as for any other two categories of government expenditures. For example, Thom and Randazzo (2015) argue that there can be a zero-sum game of budgeting between pension funding and OPEB funding. As local governments spend more on pensions, there will be fewer fiscal resources available for OPEB expenditures. Second, this tradeoff may be intensified by the functional similarity between OPEBs and pensions. They are two main parts of deferred compensation for the same beneficiary group, public employees. OPEBs and pensions can be treated as substitutes. If there is some consensus on the appropriate level of total compensation for public employees, increases in OPEBs may crowd out pensions and vice versa.

Budget tradeoffs must be settled by setting budget priorities. In this case, OPEBs are likely to lose to pensions (Government Accountability Office, 2007). OPEB spending has less legal protection and financial insulation from budgeting changes than pension spending. In the tradeoffs between OPEB and pension spending, local governments may treat OPEB spending as secondary. The lower budgetary priority of OPEB expenditures than pension expenditures implies that OPEB funding is contingent on pension funding. If local governments consider OPEB and pension funding as two interchangeable means of compensation for retirees, they may choose the level of OPEB contributions based on pension contributions. If the pension contribution is high, local government decision-makers may feel less obligated to pay as much to OPEBs. At the same time, a higher level of pension contributions means less money available for OPEB contributions, all else equal. Conversely, if the pension contribution is low, local government decision-makers would have more fiscal resources available and feel more obligated to pay down OPEB liabilities.

From the perspective of stakeholders in the municipal bond market, the interdependence between OPEB contributions and pension contributions can mean differential default risks. Everything else equal, stakeholders in the municipal bond market should welcome a greater OPEB

contribution if they believe OPEB debts must be paid some-time. When local governments pay more OPEB liabilities, the default risks should decrease to a larger extent than when they choose a lower OPEB contribution. Since local governments are likely to fund more OPEB debt when the pension contribution is low, the default risks and borrowing costs would be reduced more. Similarly, when local governments fund less of OPEB debt when pension contributions are high, the decreases in borrowing costs would be smaller. Therefore, the second hypothesis follows.

H2: OPEB contribution rates decrease borrowing costs more when pension contribution rates are low.

Fiscal capacity

Fiscal capacity is a key dimension of government capacity (Gargan, 1981; Hall, 2008), which means a government's "ability to do what it wants to do" (Gargan, 1981, p. 652). In one sense, fiscal capacity can be defined as the availability of fiscal resources that allows a government to pursue its goals. In managing OPEB and pension plans, one policy goal of local governments is to maintain annual contributions. Fiscal capacity indicates the degree to which a local government has the necessary fiscal resources to achieve the goals of OPEB and pension management. Scholars have established a link between fiscal capacity and government performance in such areas as managing rainy-day funds (Hou & Moynihan, 2006; Hou et al., 2003) and local governments' application for federal grants (Hall, 2008). In parallel, fiscal capacity can influence local governments' performance in making annual contributions to OPEB and pension plans.

Local governments of varying levels of fiscal capacity can make differential levels of contributions to OPEB plans, which can generate differential default risks and borrowing costs. Marlowe (2007) finds that OPEB liability reduces credit ratings only for local governments with lower fiscal capacity. This implies that the OPEB contribution can have a differential impact on borrowing costs by fiscal capacity. Specifically, with more fiscal resources, local governments of high fiscal capacity can afford higher OPEB contributions. They might afford to pay more than the amounts as determined under the pay-as-you-go financing or establish OPEB trust funds. This can decrease the default risks associated with OPEB debt and lower borrowing costs. In contrast, local governments of low fiscal capacity may face greater fiscal stress to meet OPEB obligations. This can cause higher default risks and borrowing costs when they issue debt. Thus, the third hypothesis follows.

H3: OPEB contribution rates decrease borrowing costs more when fiscal capacity is high.

In addition, fiscal capacity can influence how local governments make tradeoffs between OPEB and pension contributions. Local governments of higher fiscal capacity can

afford higher levels of total compensation to employees. As a result, the tradeoff between OPEBs and pensions may be less demanding. Pension contributions may have a smaller crowding-out effect on OPEB contributions. In this scenario, local governments can contribute more to OPEB plans even if they have spent generously on pensions.

On the other hand, local governments of low fiscal capacity face tighter budget constraints and must make hard trade-offs between OPEB and pension contributions. Pension contributions may crowd out OPEB contributions to a larger extent. For example, Chaney et al. (2002) find that states under fiscal stress choose to underfund pensions to meet balanced budget requirements. This implies that local governments of lower fiscal capacity might underfund OPEBs further if they have struggled with pension contributions.

Fiscal capacity can influence default risks and borrowing costs by shaping the tradeoffs between OPEB and pension contributions. As fiscal capacity increases, the budgetary tradeoff between OPEB and pension contributions becomes less demanding since local governments can afford more of both. Consequently, pension contributions will crowd out OPEB contributions to a lower degree. Since the OPEB contribution is more likely to increase despite the growth in pension contributions, the default risks associated with OPEB underfunding will decrease, leading to lower borrowing costs. By the same logic, as fiscal capacity decreases, an increase in pension contributions is likely to crowd out OPEB contributions, leading to higher default risks associated with OPEB underfunding and higher borrowing costs. Therefore, the fourth hypothesis follows.

H4a: OPEB contribution rates decrease borrowing costs more when pension contribution rates are high and when fiscal capacity is high.
H4b: OPEB contribution rates decrease borrowing costs less when pension contribution rates are high and when fiscal capacity is low.

Data and model
Data

The data on OPEB and pension contributions are taken from the Financial Indicators Database, released by the Government Financial Officers Association (GFOA) as a collection of local governments' comprehensive annual financial reports (CAFR). The Financial Indicators Database provides CAFR data for a national sample of U.S. local governments used widely in previous studies (Evans & James, 1983; Ingram & DeJong, 1987; Reck & Wilson, 2006). The database covers local governments participating voluntarily in the Certificate of Achievement for Excellence in Financial Reporting Program offered by GFOA. This implies that local governments in the database have a higher quality of financial management.
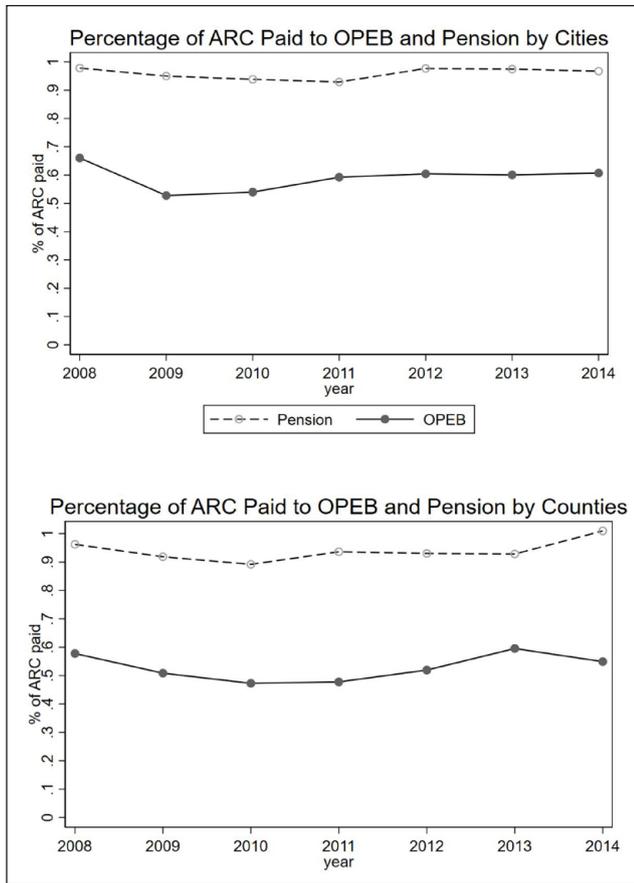
Figure 1. Percentage of ARC paid to OPEB and pension by cities and counties.

The sample construction starts with all cities and counties that repeatedly appear in the Financial Indicators Database between 2008 and 2014. Next, data on bond issues are taken from Bloomberg. These data provide information about bond characteristics such as yield at issue. The sampled cities and counties are matched with all the bonds issued in the same period. The cities and counties must meet two conditions to remain in the final sample. First, they issue at least one bond in the period of study. Second, they must report annual contributions to OPEB and pension plans on CFARs. There are 405 cities matched with 33,630 bonds in the city sample and 105 counties matched with 7,992 bonds in the county sample.

Econometric model

Given the panel structure of the data, a fixed-effect panel model is estimated at the city or county level. The model is specified as follows.

$$
\begin{aligned}
y_{it} = {}& \alpha O_{it} + \beta P_{it} + \theta F_{it} + \chi O_{it} P_{it} + \delta P_{it} F_{it} + \gamma O_{it} F_{it} \\
& + \eta O_{it} P_{it} F_{it} + \varphi X_{it} + \lambda_i + \mu_t + e_{it}
\end{aligned}
$$

In this model, y_{it} is the dependent variable, a measure of borrowing costs. On the right-hand side, O_{it} and P_{it} indicate

annual contributions to OPEB and pension plans, respectively; F_{it} indicates fiscal capacity. To test the conditional effects of pension contribution and fiscal capacity on OPEB contribution, the model controls for three-way interactions among O_{it}, P_{it}, and F_{it}. In addition, X_{it} represents a vector of control variables that vary across cities or counties and over time. The model also controls for government fixed effects, λ_i, and year fixed effects, μ_t. Lastly, e_{it} indicates the error term.

Key variables of interest

Initial offering yield is used as a measure of borrowing costs, as previous studies (Capeci, 1991, 1994; Fairchild & Koch, 1998). Bond yield accounts for the time value of money as an internal rate of return equalizing bond price with the present value of bond proceeds. The key independent variables include two measures of annual employer contribution rates of retiree benefits, and one measure of fiscal capacity. The annual contribution rates to OPEB and pension plans are measured by the percentage of annual required contribution (ARC) paid by local governments. Reported under GASB 45, this variable shows annual contributions as a proportion of annual OPEB costs estimated on an accrual accounting basis. Accordingly, OPEB contribution rate is measured by the variable *percentage of OPEB ARC paid*,[2] while pension contribution rate is measured by the variable *percentage of pension ARC paid*.[3]

To show how the annual contribution rates to OPEB and pension plans change over time, Figure 1 shows the average percentage of ARC paid by cities and counties each year between 2008 and 2014. First, the average percentage of ARC paid to OPEBs is about 60% and to pension is about 95% for the city sample. For the county sample, the average percentage of ARC paid to OPEBs is about 50% and to pension is about 90%. Thus, both city and county governments have paid lower annual costs to OPEBs than to pensions. This suggests that city and county governments have prioritized pension contributions over OPEB contributions. Second, except during the Great Recession, the percentage of ARC paid to OPEB and pension plans remained largely stable during the period. Since the Great Recession, there have been slight increases in the percentage of OPEB ARC paid by cities and counties. Third, despite the slight increases in OPEB contribution, it seems that the gap between the annual contributions between OPEB and pension plans has not been narrowed.

In addition, fiscal capacity is measured by *general revenue per capita*. Fiscal capacity has multiple dimensions and has been measured in various ways. This measure captures the availability of fiscal resources, which is consistent with the revenue-based measurements of fiscal capacity in prior studies (Borge et al., 2008; Hall, 2008; Schneider, 2005). For instance, Hall (2008) measures the fiscal capacity of counties with own source revenue per capita. Contributions made to OPEB plans represent a general fund

expenditure for cities and counties. Cities and counties with more general revenues have more affluent resources to pay OPEB and pension debts. In other words, this measure of fiscal capacity reflects the flexibility of budget constraints of local governments in spending on OPEB and pension plans.

Control variables

Consistent with previous studies (Capeci, 1991; Johnson & Kriz, 2005; Marlowe, 2007; Martell et al., 2013; Palumbo & Zaporowski, 2012), the model includes two groups of control variables. One is to measure economic, fiscal, and demographic features of cities and counties[4] that issue bonds; another is to capture characteristics of bonds. All variables measured in dollars have been adjusted by CPI to account for inflation. Appendix 1 shows the description and data sources for all the control variables.

The fixed effects of cities and counties can control time-invariant, unobservable factors. If the institutional environments in which cities and counties operate remain stable between 2008 and 2014, fixed effects can account for their impact. The model includes year fixed effects to account for the unobserved factors that may affect all the cities or counties in a year.[5] One such factor is the Great Recession that started in 2007. Economic downturns can influence OPEB and pension contributions and borrowing costs of city governments. Because the influences are present in all cities, they can be controlled by fixed effects. Appendix 2 presents descriptive statistics for all the variables in the model.

Results of the estimation

The city sample

Table 1 shows the impact of OPEB contribution on borrowing costs of city governments.[6] Model 1 presents the baseline model where no interaction terms are included. Model 2 controls the three-way interaction among OPEB contribution, pension contribution, and fiscal capacity. Appendix 3 reports the interpretation of the control variables.

As column (1) shows, the coefficient of the key independent variable, *percentage of OPEB ARC paid*, is not statistically significant. This indicates that, under the assumption of unconditional effect, OPEB contribution has no impact on city government borrowing costs. In contrast, when accounting for the conditional effects of pension contribution and fiscal capacity in column (2), all the components of the interaction terms reach statistical significance at the $p < .01$ level. This implies that OPEB contribution has a heterogeneous impact on borrowing costs that would be otherwise masked if omitting the moderating effects of pension contribution and fiscal capacity.

To interpret the coefficients of the key independent variables in column (2), Figure 2 shows the average marginal effects of OPEB contribution by pension contribution and by fiscal capacity. The solid line shows the average marginal effects of OPEB contribution by pension contribution when general revenue per capita is fixed at the 25th percentile of the sample distribution, an indicator of low fiscal capacity. The dashed line shows the average marginal effects of OPEB contribution by pension contribution when general revenue per capita is fixed at the 75th percentile of the sample distribution, an indicator of high fiscal capacity.

As Figure 2 shows, the average marginal effect of OPEB contribution, as measured by *percentage of OPEB ARC paid*, is negative and statistically significant ($p < .05$) when pension contribution is low and fiscal capacity is low. Specifically, holding pension contribution at 77%, or about the 10th percentile of the sample distribution, and fiscal capacity at the 25th percentile of the sample distribution, the average marginal effect of OPEB contribution is about -0.02 and statistically significant at the $p < .05$ level. This indicates that city governments with low fiscal capacity and low pension contribution can save borrowing costs by about 0.2 percentage points when increasing the proportion of OPEB ARC paid by 10 percentage points. These results are consistent with the second hypothesis that OPEB contribution reduces borrowing costs more when pension contribution is relatively low.

In contrast, when pension contribution is high and when fiscal capacity is low, the average marginal effect of *percentage of OPEB ARC paid* turns positive and statistically significant ($p < .05$). Specifically, holding pension contribution at about 103%, or the 90th percentile of the sample distribution, and fiscal capacity at the 25th percentile of the sample distribution, the average marginal effect of OPEB contribution is about 0.035 and statistically significant at the $p < .05$ level. This indicates that the borrowing costs of city governments with relatively high pension contributions and low fiscal capacity increase by 0.35 percentage points when increasing the proportion of OPEB ARC paid by 10 percentage points. This is consistent with the hypothesis of H4b that OPEB contribution decreases borrowing costs less when pension contribution is high and when fiscal capacity is low.

The county sample

Table 2 shows the impact of OPEB contribution on borrowing costs of county governments.[7] Column (1) shows the results of the baseline model controlling for no interaction terms. Column (2) shows the results of the model controlling for the three-way interactions among OPEB contribution, pension contribution, and fiscal capacity. Appendix 4 reports the interpretation of the control variables.

As column (1) shows, the independent variable of interest, *percentage of OPEB ARC paid*, has a coefficient of about -0.048 and is statistically significant ($p < .05$). This indicates that, for county governments, OPEB contribution has an unconditional, negative impact on borrowing costs.

Table 1. Impact of OPEB contribution on city borrowing costs.

Variables	(1)	(2)
	Model 1	Model 2
Key independent variables		
Percentage of OPEB ARC paid	0.001 (0.008)	−0.325*** (0.062)
Percentage of pension ARC paid	−0.080*** (0.027)	−0.430*** (0.066)
Percentage of OPEB ARC paid × Percentage of pension ARC paid		0.377*** (0.065)
General revenue per capita	0.006 (0.004)	−0.082*** (0.017)
Percentage of OPEB ARC paid × General revenue per capita		0.091*** (0.022)
Percentage of pension ARC paid × General revenue per capita		0.097*** (0.017)
Percentage of OPEB ARC paid × Percentage of pension ARC paid × General revenue per capita		−0.107*** (0.022)
Control variables	Yes	Yes
City fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	33,630	33,630
R-squared	0.878	0.878

Note. Robust standard errors in parentheses. OPEB = other postemployment benefit; ARC = annual required contribution.
***$p < .01$.

Figure 2. Average marginal effects of city OPEB contribution by pension contribution and by fiscal capacity.
Note. Low fiscal capacity = general revenue per capita at 25th percentile; high fiscal capacity = general revenue per capita at 75th percentile.

When an average county government increases the payment of ARC to OPEB plans by 10 percentage points, it can save borrowing costs by about 0.5 percentage points.

Column (2) shows the conditional effects of OPEB ARC paid by pension contribution and by fiscal capacity. All the constituent variables of the interaction terms are statistically significant at the $p < .05$ level. Figure 3 shows the average marginal effects of county OPEB contribution by pension contribution and by fiscal capacity. Again, the solid line shows the average marginal effects of OPEB contribution

by pension contribution when general revenue per capita is fixed at the 25th percentile of the sample distribution, representing low fiscal capacity. The dashed line shows the average marginal effects of OPEB contribution by pension contribution when general revenue per capita is fixed at the 75th percentile of the sample distribution, representing high fiscal capacity.

Overall, Figure 3 shows a pattern consistent with Figure 2. When pension contribution is low, and when fiscal capacity is low, OPEB contribution has a negative and statistically

Table 2. Impact of OPEB contribution on county borrowing costs.

Variables	(1)	(2)
	Model 1	Model 2
Key independent variables		
Percentage of OPEB ARC paid	−0.048** (0.023)	−1.486*** (0.201)
Percentage of pension ARC paid	−0.089*** (0.026)	−1.398*** (0.179)
Percentage of OPEB ARC paid × Percentage of pension ARC paid		1.581*** (0.201)
General revenue per capita	−0.001*** (0.000)	−0.324*** (0.055)
Percentage of OPEB ARC paid × General revenue per capita		0.564*** (0.160)
Percentage of pension ARC paid × General revenue per capita		0.361*** (0.056)
Percentage of OPEB ARC paid × Percentage of pension ARC paid × General revenue per capita		−0.633*** (0.162)
Control variables	Yes	Yes
County fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	7,992	7,992
R-squared	0.889	0.890

Note. Robust standard errors in parentheses. OPEB = other postemployment benefit; ARC = annual required contribution.
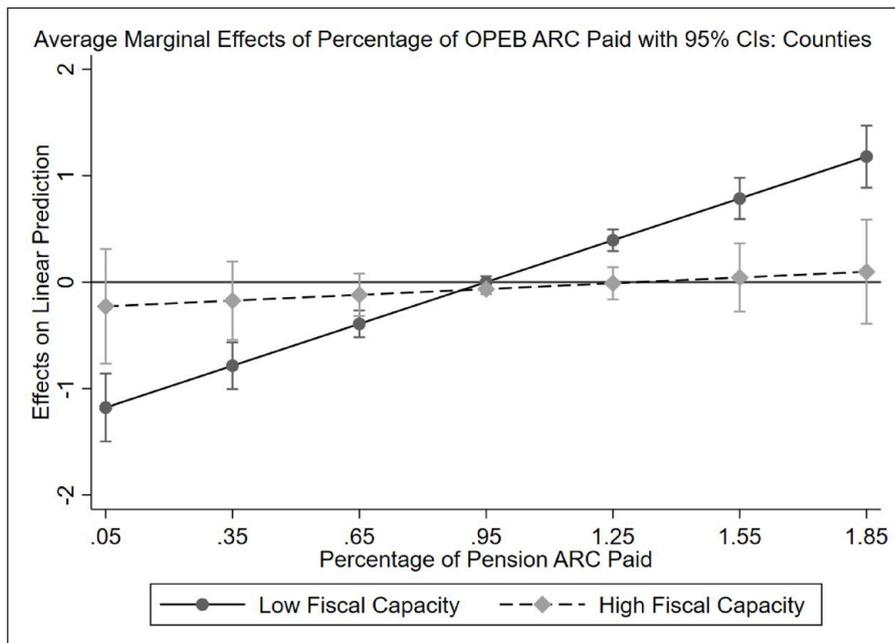**$p < .05$. ***$p < .01$.

Figure 3. Average marginal effects of county OPEB contribution by pension contribution and by fiscal capacity.
Note. Low fiscal capacity = general revenue per capita at 25th percentile; high fiscal capacity = general revenue per capita at 75th percentile.

significant effect ($p < .05$) on county government borrowing costs. Specifically, holding pension contribution at 60%, or about the 10th percentile of the sample distribution, and fiscal capacity at the 25th percentile of the sample distribution, the average marginal effect of OPEB contribution is about −0.459 and statistically significant at the $p < .05$ level. This indicates that city governments with low fiscal capacity and low pension contribution can save borrowing costs by about 4.6 percentage points when increasing the payment of OPEB ARC by 10 percentage points. This is also consistent with the second hypothesis that OPEB contribution reduces borrowing costs more when pension contribution is low.

When pension contribution is high and fiscal capacity is low, OPEB contribution has a positive and statistically significant effect ($p < .05$) on county government borrowing costs. Specifically, holding pension contribution at about 102%, or the 90th percentile of the sample distribution, and fiscal capacity at the 25th percentile of the sample distribution, the average marginal effect of OPEB contribution is about 0.09 and statistically significant at the $p < .05$ level.

Table 3. Summary of impact of OPEB contribution on borrowing costs by pension contribution and by fiscal capacity.

	Low fiscal capacity	High fiscal capacity
Panel A: Cities		
Low pension contribution	−0.023** (0.011)	−0.008 (0.014)
High pension contribution	0.035*** (0.009)	−0.001 (0.011)
Panel B: Counties		
Low pension contribution	−0.459*** (0.072)	−0.129 (0.116)
High pension contribution	0.092*** (0.028)	−0.052** (0.022)

Note. Low pension contribution = % of pension ARC paid at 10th percentile; High pension contribution = % of pension ARC paid at 90th percentile; Low fiscal capacity = general revenue per capita at 25th percentile; High fiscal capacity = general revenue per capita at 75th percentile.
**$p < .05$. ***$p < .01$.

This indicates that county governments with high pension contributions and low fiscal capacity can see borrowing costs increase by about 0.9 percentage points when increasing the payments of OPEB ARC by 10 percentage points. Again, this is consistent with the hypothesis of H4b that OPEB contribution reduces borrowing costs less when pension contribution is high and when fiscal capacity is low.

In contrast, when pension contribution is high and fiscal capacity is high, OPEB contribution has a negative and statistically significant effect ($p < .05$) on county government borrowing costs. Specifically, holding pension contribution at about 102%, or the 90th percentile of the sample distribution, and fiscal capacity at the 75th percentile of the sample distribution, the average marginal effect of OPEB contribution is about −0.05 and statistically significant at the $p < .05$ level. This indicates that county governments with high pension contributions and high fiscal capacity can see borrowing costs decrease by about 0.5 percentage points when increasing the payment of OPEB ARC by 10 percentage points. This is consistent with the hypothesis of H4a that OPEB contribution reduces borrowing costs more when pension contribution is high and when fiscal capacity is high.

Summary of findings

Based on the results from the city sample and the county sample, Table 3 summarizes the impact of OPEB contribution by pension contribution and by fiscal capacity. Increasing the percentage of OPEB ARC paid reduces borrowing costs of city and county governments with low pension contributions and low fiscal capacity. It also reduces the borrowing costs of county governments with high pension contributions and high fiscal capacity. When the level of pension contribution is well-matched with fiscal capacity, fiscal resources are more likely to become available for OPEB contribution. In these cases, the pension contribution is less likely to crowd out the OPEB contribution. Increasing OPEB contribution then reduces default risks and saves borrowing costs because it reduces unfunded OPEB liabilities without deteriorating the government's fiscal performance.

By contrast, increasing OPEB contribution increases borrowing costs of city and county governments when pension contribution is high and when fiscal capacity is low. When pension contribution is out of pace with fiscal capacity, the financial resources for OPEBs suffer. Low fiscal capacity means a tight budget constraint. High pension contribution means a stronger crowding-out effect on OPEB contribution. Under these two conditions, increasing OPEB contribution increases default risks and borrowing costs for city and county governments.

Discussion and conclusion

Because of population aging, healthcare cost growth, and fiscal stress, the U.S. local governments have been under pressure to fund OPEBs while maintaining fiscal sustainability. No matter which funding strategies local governments choose, they must decide the proportion of ARC to pay for OPEB plans, representing the realized level of budget commitment to OPEB funding. The present study has examined whether local government OPEB expenditures influence borrowing costs and the conditions for the impact to materialize by focusing on a regular policy action and a relevant consequence. The results show that OPEB contribution decreases borrowing costs of cities and counties; pension contribution and fiscal capacity are the two key conditions.

In particular, three key findings stand out. First, for county governments, the annual contribution to OPEB plans is associated with lower borrowing costs. Second, OPEB contribution decreases borrowing costs when pension contribution is relatively low. This implies an expenditure trade-off between OPEB contribution and pension contribution. Third, OPEB contribution decreases borrowing costs when the level of pension contribution is matched with fiscal capacity and increases borrowing costs when the level of pension contribution is mismatched with fiscal capacity.

In general, the findings are robust across the city sample and the county sample. Given the many institutional differences across the two forms of local governments, this lends substantial support to the validity of the results. Furthermore, the findings are consistent with existing literature. Since OPEB contribution is the main way to reduce unfunded OPEB liabilities, and low credit ratings usually mean high borrowing costs, the negative impact of the level of OPEB

contribution on borrowing costs resonates with extant findings that unfunded OPEB liabilities are associated with lower credit ratings (Marlowe, 2007; Matkin & Krivosheyev, 2013).

These findings have critical policy implications for local governments on how much to pay the ARC of OPEB plans. The findings indicate that the municipal bond market rewards OPEB contribution. From the perspective of saving borrowing costs, it is generally a positive move to contribute a larger percentage of ARC to OPEB plans. This seems especially true for county governments because OPEB contribution shows an unconditional, negative effect on borrowing costs. Furthermore, local governments with varying levels of fiscal capacity and pension contribution may adopt different funding strategies for OPEB plans. As far as borrowing cost is concerned, local governments with higher fiscal capacity and lower pension contributions can make more aggressive OPEB contributions. Given the present low percentage of annual contribution of OPEB plans, more contribution may be correlated with substantive savings in borrowing costs. This might motivate local governments to move away from pay-as-you-go financing for OPEBs and establish trust funds to reduce long-term unfunded OPEB liabilities.

While previous studies on OPEB funding and pension funding are largely detached, this study demonstrates the interaction between local government expenditures on OPEB and pension plans by drawing on expenditure trade-off and fiscal capacity literature. Given that most local governments treat pension as the primary debt obligation, the tradeoff is likely to be one-way in that OPEB expenditure depends on how much has been spent on pension. Since OPEBs and pensions benefit the same group of public employees, local governments may weigh their expenditures on the two parts of deferred employee compensation under budget constraints. Otherwise, bond investors may worry that excessive expenditures on retiree benefits may crowd out other spending and cause higher default risks. For the tradeoff between OPEB and pension expenditures, fiscal capacity has a role to play because it affects the degree of budget constraints. Local governments of low fiscal capacity are more vulnerable to hard tradeoffs between OPEB and pension spending. Consequently, there are more likely to bear higher borrowing costs when making high contributions to both OPEB and pension plans.

OPEB and pension contributions are measured by the percentage of ARC paid to OPEB and pension plans. This measure has direct policy relevance as a parameter under the direct control of policymakers. Since financial reporting can reflect changes in accounting rules instead of allocation of financial resources, one should use caution when interpreting the results. Like all other financial indicators, this measure does not distinguish the changes in accounting rules versus the changes in allocated money. Previous studies suggest that state governments under fiscal stress can choose more optimistic accounting rules to reduce pension liabilities (Eaton & Nofsinger, 2004). To the extent they manipulate the accounting rules, the findings might be interpreted as changes in contribution policies for OPEB plans, not necessarily changes in the allocation of fiscal resources.

This study has some limits and opens up several avenues for future research. Conceptually, fiscal capacity can have multiple dimensions beyond the availability of fiscal resources as operationalized in this study. Future research may test whether the findings will hold with alternative measures of fiscal capacity. Empirically, the sample is non-random because cities and counties choosing to participate in the GFOA's award program may differ from others in the population. Thus, the external validity of the findings is limited to the U.S. cities and counties dedicated to higher quality financial management. Future studies may focus on a random sample of cities and counties in the U.S. or local governments elsewhere.

Declaration of conflicting interests

Funding

Notes

1. The annual required contribution (ARC) has two parts. One is the normal cost, which is the cost of OPEB or pension benefits earned by employees for the current year of service. Another is the amortized cost, which is "a catch-up payment for past service costs to fund the unfunded actuarial accrued liability over the next 30 years" (GASB, 2018). Thus, while the percentage of ARC paid by cities or counties measures the annual contribution, it also captures changes in long-term OPEB or pension debts.
2. When there are multiple plans, the percentage of ARC paid for a city or county is weighted by the size of the liability for each OPEB plan. A similar procedure is employed for pension plans.
3. To remove outliers, these two variables are winsorized at the 1st and 99th percentiles.
4. Unemployment rate and personal income are controlled for counties because of data availability.
5. The results are robust with the control of month fixed effects.
6. Since general obligation bonds are backed up by the general faith and credit of governments, the change in OPEB contribution is likely to have a stronger impact on their pricing. The results are robust when limiting the sample to cities issuing general obligation bonds only.
7. The results are robust when limiting the sample to counties issuing G.O. bonds only.

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Appendix 1

Table A1. Description of variables.

Variable name	Description	Data source
Yield	Yield at issue	Bloomberg
Key independent variables		
Percentage of OPEB ARC paid	Employer contribution divided by annual required contribution (ARC) of OPEB plans	Financial indicators database
Percentage of pension ARC paid	Employer contribution divided by the annual required contribution of pension plans	Financial indicators database
General Revenue per capita	General fund revenue per capita	Financial indicators database
Government-level control variables		
Operating ratio	General fund revenue minus general fund expenditure divided by general fund revenue	Financial indicators database
Debt ratio	General bonded debt as a percentage of general fund revenue	Financial indicators database
Percentage of intergovernmental revenue	General fund intergovernmental revenue as a percentage of general fund revenue	Financial indicators database
Ln of population	Natural log of population	Financial indicators database
Unemployment rate	Unemployment rate at the county level	U.S. Bureau of Labor Statistics
Ln of personal income	Personal income per capita at the county level	U.S. Bureau of Economic Analysis
Issue characteristics		
Ln of time to maturity	The number of days from issuing date to maturity date in natural log form	Bloomberg
Credit rating	Standard and Poor's underlying ratings, ranging from 1 to 16, from highest to lowest rating	Bloomberg
No rating	A dummy variable indicating whether there is no rating assigned for a bond	Bloomberg
Missing rating	A dummy variable indicating whether credit rating is missing for a bond	Bloomberg
Callable	A dummy variable indicating whether a bond is callable	Bloomberg
Competitive sale	A dummy variable indicating whether a bond is sold using a competitive rather than negotiated method	Bloomberg
Ln of par value	Issue size of a bond in dollars and natural log form	Bloomberg
Insured	A dummy variable indicating whether a bond is insured by a third party	Bloomberg
Missing insured	A dummy variable indicating whether bond insurance information is missing	Bloomberg
Refunding issue	A dummy variable indicating whether a bond is a refunding issue	Bloomberg
General obligation	A dummy variable indicating whether a bond is a general obligation bond	Bloomberg
Tax exemption	A dummy variable indicating whether a bond is qualified for federal and state income tax exemption	Bloomberg
Bond Buyer Index	Bond Buyer 20 G.O. Index in the week of issuing date of a bond	The Bond Buyer

Appendix 2

Table A2. Descriptive statistics (2008–2014).

Variables	(1)	(2)	(3)	(4)
	Mean	SD	Min	max
Panel A: The city sample (N = 33,630)				
Yield	2.601	1.371	0.0250	8.817
Percentage of OPEB ARC paid	0.584	0.467	0	3.968
Percentage of pension ARC paid	0.958	0.193	0	1.505
Population	493,862	1.588e+06	3,533	8.392e+06
Time to maturity	3,335	2,110	17	14,421
Callable	0.407	0.491	0	1
Competitive sale	0.457	0.498	0	1
Insured	0.0513	0.221	0	1
Missing insured	0.0834	0.277	0	1
General obligation	0.860	0.347	0	1
Tax exemption	0.395	0.489	0	1
Refunding issue	0.0748	0.263	0	1
Credit rating	1.904	1.515	0	16
Bond Buyer Index	4.292	0.442	3.270	6.010
No rating	0.0137	0.116	0	1
Missing rating	0.171	0.377	0	1
Par value	5.903e+06	3.203e+07	10,903	3.241e+09
Percentage of intergovernmental revenue	0.112	0.128	0	1.348
Debt ratio	1.195	1.193	0	20.19
Operating ratio	0.0199	0.319	−8.602	0.912
General revenue per capita	3.361	3.787	0.00181	25.04
Panel B: The county sample (N = 7,992)				
Yield	2.633	1.355	0.0880	7.600
Percentage of OPEB ARC paid	0.525	0.411	0	3.004
Percentage of pension ARC paid	0.934	0.411	0.064	5.243
Population	642,072	715,756	10,090	1.056e+07
Unemployment rate	7.577	2.388	2.500	17.10
Time to maturity	3,410	2,163	45	14,244
Callable	0.393	0.488	0	1
Competitive sale	0.465	0.499	0	1
Par value	4.835e+06	2.968e+07	5,000	1.300e+09
General obligation	0.825	0.380	0	1
Tax exemption	0.622	0.485	0	1
Refunding issue	0.118	0.322	0	1
Bond Buyer Index	4.279	0.435	3.290	5.580
Credit rating	1.756	1.351	0	10
Missing rating	0.0962	0.295	0	1
General revenue per capita	0.00266	0.0399	0.000245	3.568
Personal income per capita	97,945	26,808	48,674	196,893
No rating	0.0183	0.134	0	1
Insured	0.0628	0.243	0	1
Percentage of intergovernmental revenue	0.113	0.122	0	0.686
Debt ratio	1.390	1.358	0	6.645
Operating ratio	0.0730	0.123	−0.552	0.905

Appendix 3

As Table A3 shows, control variables at both the government and the bond levels show generally expected results when reaching statistical significance. At the government level, while the percentage of intergovernmental revenue is positively correlated with city borrowing costs ($p < .05$), operating ratio, debt ratio, and population show negative and statistically significant effects ($p < .05$). The negative effect of the debt ratio appears contrary to expectation since more debt outstanding implies high default risks. It may well be plausible, however, that city governments anticipating lower borrowing costs choose to borrow more in the first place.

At the bond level, bonds that are callable, with longer time to maturity, with no or low credit ratings, and with missing information on credit ratings are associated with higher borrowing costs. The Bond Buyer Index is also positively associated with borrowing costs. On the other hand, general obligation bonds, refunding issues, insured bonds, bonds issued through competitive sale, and bonds qualified for federal and state tax exemption are correlated with lower borrowing costs.

Table A3. Impact of OPEB contribution on city borrowing costs: Full results.

Variables	(1) Model 1	(2) Model 2
Key independent variables		
Percentage of OPEB ARC paid	0.001 (0.008)	−0.325*** (0.062)
Percentage of pension ARC paid	−0.080*** (0.027)	−0.430*** (0.066)
Percentage of OPEB ARC paid × Percentage of pension ARC paid		0.377*** (0.065)
General revenue per capita	0.006 (0.004)	−0.082*** (0.017)
Percentage of OPEB ARC paid × General revenue per capita		0.091*** (0.022)
Percentage of pension ARC paid × General revenue per capita		0.097*** (0.017)
Percentage of OPEB ARC paid × Percentage of pension ARC paid × General revenue per capita		−0.107*** (0.022)
City-level control variables		
Operating ratio	−0.106*** (0.015)	−0.111*** (0.015)
Debt ratio	−0.043*** (0.006)	−0.046*** (0.006)
Percentage of intergovernmental revenue	0.225** (0.110)	0.217** (0.110)
Ln of population	−0.077*** (0.025)	−0.080*** (0.025)
Bond-level control variables		
General obligation	−0.486*** (0.018)	−0.487*** (0.018)
Refunding issue	−0.060*** (0.011)	−0.060*** (0.011)
Insured	−0.126*** (0.018)	−0.124*** (0.018)
Missing insured	0.026 (0.018)	0.028 (0.018)
Competitive sale	−0.172*** (0.009)	−0.173*** (0.009)
Callable	0.551*** (0.010)	0.550*** (0.010)
Ln of time to maturity	1.008*** (0.008)	1.008*** (0.008)
Ln of par value	0.001 (0.003)	0.001 (0.003)
Credit rating	0.034*** (0.006)	0.035*** (0.006)
No rating	0.132*** (0.025)	0.134*** (0.025)
Missing rating	0.227*** (0.031)	0.236*** (0.031)
Tax exemption	−0.498*** (0.014)	−0.504*** (0.014)
Bond Buyer Index	0.609*** (0.010)	0.609*** (0.010)
Constant	−5.686*** (0.312)	−5.341*** (0.318)
City fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	33,630	33,630
R-squared	0.878	0.878

Note. Robust standard errors in parentheses. OPEB = other postemployment benefit; ARC = annual required contribution.
**$p < .05$. ***$p < .01$.

Appendix 4

As Table A4 shows, control variables at both the government and the bond levels show results generally consistent with expectations. Operating ratio and population are negatively associated with borrowing costs. The percentage of intergovernmental revenue is positively associated with borrowing costs. While the debt ratio shows a negative effect in the city sample, its sign turns positive in the county sample. This is consistent with the conventional interpretation that costs of borrowing increase with the amount of borrowing. Interestingly, personal income shows a positive effect on borrowing costs. While the debt ratio captures the size of general bonded debt as compared against general revenue, county governments in wealthier jurisdictions may also issue a larger amount of other types of debts. If so, the positive effect of personal income may reflect the possibility that wealthier counties borrow more.

At the bond level, bonds that are callable, with longer time to maturity, larger par value, no or low credit ratings, and missing information on credit ratings are associated with higher borrowing costs. The Bond Buyer Index is also positively associated with borrowing costs. Insured bonds are associated with higher borrowing costs, which may result from the reverse causation that bonds of lower credit quality are insured in the first place. On the other hand, general obligation bonds, refunding issues, bonds issued through competitive sale, and bonds qualified for federal and state tax exemption are correlated with lower borrowing costs.

Table A4. Impact of OPEB contribution on county borrowing costs: Full results.

Variables	(1)	(2)
	Model 1	Model 2
Key independent variables		
Percentage of OPEB ARC paid	−0.048** (0.023)	−1.486*** (0.201)
Percentage of pension ARC paid	−0.089*** (0.026)	−1.398*** (0.179)
Percentage of OPEB ARC paid × Percentage of pension ARC paid		1.581*** (0.201)
General revenue per capita	−0.001*** (0.000)	−0.324*** (0.055)
Percentage of OPEB ARC paid × General revenue per capita		0.564*** (0.160)
Percentage of pension ARC paid × General revenue per capita		0.361*** (0.056)
Percentage of OPEB ARC paid × Percentage of pension ARC paid × General revenue per capita		−0.633*** (0.162)
City-level control variables		
Operating ratio	−0.247*** (0.069)	−0.151** (0.070)
Debt ratio	0.029* (0.015)	0.040*** (0.015)
Percentage of intergovernmental revenue	0.487* (0.276)	0.583** (0.277)
Unemployment rate	0.002 (0.013)	0.007 (0.013)
Ln of personal income	0.933*** (0.239)	1.108*** (0.240)
Ln of population	−0.665*** (0.202)	−0.805*** (0.208)
Bond-level control variables		
General obligation	−0.183*** (0.031)	−0.160*** (0.031)
Refunding issue	−0.074*** (0.019)	−0.071*** (0.018)
Insured	0.109*** (0.037)	0.120*** (0.037)
Competitive sale	−0.230*** (0.021)	−0.241*** (0.021)
Callable	0.560*** (0.019)	0.563*** (0.019)
Ln of time to maturity	1.027*** (0.016)	1.026*** (0.016)
Ln of par value	0.021*** (0.006)	0.020*** (0.005)
Credit rating	0.091*** (0.011)	0.093*** (0.011)
No rating	0.271*** (0.040)	0.282*** (0.039)
Missing rating	0.431*** (0.054)	0.426*** (0.053)
Tax exemption	−0.768*** (0.028)	−0.772*** (0.028)
Bond Buyer Index	0.598*** (0.021)	0.603*** (0.021)
Constant	−9.196*** (3.543)	−8.231** (3.569)
County fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	7,992	7,992
R-squared	0.889	0.890

Note. Robust standard errors in parentheses. OPEB = other postemployment benefit; ARC = annual required contribution.
*$p < .1$. **$p < .05$. ***$p < .01$.