Tax Revenue Risk, Municipal Bond Yield, and Public Investments *

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Abstract

Tax revenue fluctuations can threaten municipalities' fiscal stability, especially when shortfalls coincide with economic downturns. We study how exposure to tax revenue risk—the covariance between tax revenues and macroeconomic conditions—affects municipal borrowing costs and public investment. Municipalities with higher tax risk pay more to borrow: a one-standard-deviation increase in tax risk raises offering yields by 3 basis points and secondary-market yields by 7 basis points. These effects are robust to a border-discontinuity design and are strongest where alternative repayment capacity is limited. Greater tax risk, in turn, leads to sustained reductions in public investment.

Keywords: Tax Risk, Municipal Bond Yield, Volatility, Public Goods
JEL Classification: D40, G20, H71

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1 Introduction

The cost of capital shapes how and when governments invest in schools, infrastructure, and public services. For state and local governments, this cost is governed by municipal bond yields, which reflect investors' pricing of state-contingent repayment risk. A large literature studies how institutional features, credit quality, and liquidity affect municipal borrowing costs (Butler, 2008; Adelino et al., 2017, 2023; Gao et al., 2019). Less is known about whether investors price the fundamental risk embedded in tax revenues, which fund the repayment of government debt. Existing work often emphasizes revenue volatility, but volatility alone is an incomplete measure of fiscal risk. Revenue shortfalls during economic downturns are more costly than equally sized revenue gains are beneficial during booms. We introduce a new measure of *tax risk* that captures this timing asymmetry and show that it is a key determinant of municipal borrowing costs and public investment.

Despite the central role of tax revenues in municipal debt repayment, existing research on municipal bond pricing has emphasized fiscal rules, credit ratings (Adelino et al., 2017), state distress policies (Gao et al., 2019), and liquidity (Butler, 2008; Adelino et al., 2023) as determinants of borrowing costs. Less attention has been paid to the risk properties of tax revenues as state-contingent cash flows. Whether investors price the state-contingent risk embedded in tax revenues, separate from realized default, remains an open question. We show that they do. States with higher tax risk have higher municipal bond yields and, through that channel, lower public investment. These results point to municipal bonds as a transmission mechanism linking governments' cost of capital to real public spending decisions, particularly for tax-backed investment.

Tax risk builds on a simple insight: a dollar is more valuable in recessions than in booms. For governments, a revenue shortfall during a recession is therefore far more costly than an equally sized windfall during a boom. Tax risk captures this asymmetry by measuring the covariance between tax revenues and the government's marginal utility of revenue. Formally, tax risk measures the covariance between tax revenues and Arrow–Debreu state prices, which place greater value on revenues realized in recessions. Procyclical tax revenues, those that fall in recessions and rise in booms, generate positive tax risk and, in turn, higher borrowing costs.

We construct tax risk at the state-year level using revenues from personal income, corporate income, and sales taxes, and measure Arrow-Debreu prices based on state GDP growth.[1] Conceptually, tax risk is the covariance between tax revenues and state prices, scaled by expected total tax revenue. Tax risk varies across states and over time: its mean is 0.04 with a standard deviation of 0.02. States such as Michigan and New Mexico rank among the highest in tax risk, while Washington and Texas rank among the lowest. Importantly, tax risk is different from volatility. Tax risk is only weakly correlated with commonly used tax volatility measures because volatility measures the magnitude of fluctuations in tax revenues, whereas tax risk captures the cyclicality of tax revenues.

Tax risk strongly predicts municipal bond yields. A one–standard–deviation increase in tax risk raises offering yields by 3 basis points in the primary market and by 7 basis points in the secondary market. These effects are economically meaningful, amounting to roughly 1.5 to 3 times the yield spread between the highest- and second-highest-rated municipal bonds.

[1]Property taxes are often earmarked towards school district spending and, therefore, tend not to affect the government's repayment capacity. Modern state budgets rely primarily on income and sales taxes (Seegert, 2016; Boyd, 2022). We also conduct the analyses while including property taxes in the tax revenue calculation. The results are qualitatively similar.

We also find that tax risk explains yield variation beyond that explained by conventional measures of credit quality or liquidity.

For identification, we exploit state border discontinuities and compare counties across state borders that share local economies but face different state tax systems. This design helps isolate the causal effect by holding local conditions constant while tax risk varies across state lines. The results reinforce our main finding. A one-standard-deviation increase in tax risk raises offering yields by 3.5 basis points and secondary-market yields by 5.7 basis points.

We find evidence for a straightforward mechanism. Tax risk affects municipal bond yields by weakening governments' capacity to service debt when economic conditions deteriorate. Specifically, the effect is substantially larger for states with smaller rainy-day funds and for bonds backed directly by tax revenues without the pledges of project cash flows. These results are hard to reconcile with explanations based on credit quality or liquidity concerns more generally. Instead, the evidence points toward a specific channel: investors price tax risk because it erodes repayment capacity precisely when it is most valuable.

Our analysis separates the timing of revenue risk from the magnitude of revenue fluctuations. Volatility measures, often emphasized in policy-making and prior literature, capture the magnitude of fluctuations but ignore their timing. Canonical finance theory, however, implies that timing, specifically, the covariance of revenues with downturns, is what matters for fiscal stability. We find no evidence that volatility is priced into municipal bond yields, whether measured as a rolling standard deviation, year-over-year changes, or residual "surprises" from trend. Instead, bond yields respond to the covariance between tax revenues and economic downturns (i.e., tax risk) rather than to volatility alone. This distinction has great implications for tax policy design. Governments are not penalized for noisy tax revenues,

but for revenues that fail when they are most valuable.

State tax portfolios directly determine the tax risk states face. A state's mix of personal income, corporate income, and sales taxes determines how revenues respond to economic cycles. We find that states leaning more on income-based taxation face considerably higher tax risk. Sales taxes, by contrast, offer something of a partial hedge. These results align with evidence on the cyclicality of different revenue sources (Seegert, 2016; Dean et al., 2023). By linking tax policy to borrowing costs, we show that the design of tax portfolios shapes not only the equity and efficiency of taxation but also governments' fiscal stability and cost of capital.

Finally, we show that tax risk has real effects on government spending through municipal bond yields (Rodden and Wibbels, 2010; Novy-Marx and Rauh, 2012; Adelino et al., 2017; Yi, 2021). Using a two-step approach, we isolate the component of borrowing costs attributable to tax risk and trace these predicted costs into subsequent expenditure patterns. A one-percentage-point increase in borrowing costs attributable to tax risk reduces taxing-power-backed expenditures by 2.2 percentage points relative to the total municipal budget. We find the effect is more pronounced for general obligation and school district bonds, where repayment is tied directly to tax revenues. By contrast, project-revenue-backed spending shows much smaller effects. Taken together, these results show that tax risk raises financing costs and directly curtails governments' tax-backed investments in schools, infrastructure, and essential services.

This paper makes several contributions. First, we introduce tax risk—a state-contingent measure of fiscal risk grounded in asset-pricing theory—and show that it is distinct from, and economically more relevant than, traditional measures of revenue volatility. Our results

demonstrate that investors price the covariance between tax revenues and economic downturns rather than the magnitude of revenue fluctuations. Second, we show that the structure of state tax systems plays a central role in shaping tax risk and, through it, governments' cost of capital. By linking tax portfolios to borrowing costs, we identify a risk-based channel through which tax policy affects financial markets, independent of realized default, credit ratings, or liquidity conditions. Lastly, we show that this pricing has real effects. Higher tax risk raises borrowing costs and, in turn, reduces tax-backed public investment, particularly in areas such as general obligation and school district spending. Taken together, our findings establish tax risk as a previously unrecognized determinant of municipal borrowing costs and identify a risk channel through which tax policy shapes governments' financing conditions and public investment. Our results provide an economic interpretation of why municipal bond yields are among the most important predictors of household asset demand Gabaix et al. (2023).

The remainder of the paper is organized as follows. Section 2 situates our contribution within the municipal bond literature. Section 3 outlines our tax risk and volatility measures. Section 4 describes our data, and section 5 presents our main results. Section 6 explores mechanisms behind our findings, and section 7 contrasts risk with volatility. Section 8 examines the determinants of tax risk in state tax portfolios, and section 9 evaluates the consequences for government expenditures. Section 10 concludes.

2 Related Literature

This paper contributes to a large literature on the determinants of municipal bond yields. Early studies identify default risk, liquidity, and investor clientele as core drivers of municipal yields. Hastie (1972) shows that yield spreads reflect default risk and marketability, proxied by debt levels, economic diversification, block size, and net debt, with effects that vary across investor clienteles. More recent work decomposes municipal spreads into credit, liquidity, and tax components. Ang et al. (2014) find that liquidity accounts for a large share of municipal spreads, particularly after the financial crisis, while Schwert (2017) shows that default risk, rather than liquidity, is the primary driver of spreads, with a premium that exceeds that observed in corporate bond markets. Wang et al. (2008) reconcile these views within a unified framework in which liquidity, default risk, and taxes jointly affect yields, with effects that are stronger for lower-rated and longer-maturity bonds.

A growing literature examines how exposure to long-run risks and localized shocks is priced in municipal bond markets. Goldsmith-Pinkham et al. (2023) and Painter (2020) show that exposure to sea-level rise raises borrowing costs and underwriting fees. Related work links municipal yields to demographic change, regulatory regimes, and spatial re-sorting. Population aging increases spreads by eroding the tax base and increasing pension and health obligations (Butler and Yi, 2022). States with more permissive fiscal distress frameworks exhibit higher and more cyclical yields, consistent with evidence from municipal bankruptcy episodes (Gao et al., 2019; Deal, 2007). Pandemic-era migration and work-from-home exposure are also capitalized into yields and subsequent revenues (Gustafson et al., 2023). Intermediation and market structure matter as well: restricting advisor–underwriter

conflicts lowers auction costs by increasing competition and standardizing issuance terms (Garrett, 2024). Investor behavior further shapes pricing, as attention and insurance coverage affect yield incidence (Cornaggia et al., 2022, 2024).

Institutional and political environments also influence municipal borrowing costs. Credit ratings play a central role in pricing (Cornaggia et al., 2018), while political cycles affect issuance costs, with yields rising ahead of gubernatorial elections (Gao et al., 2019). Political connections are associated with lower borrowing costs, consistent with preferential access to capital markets (Butler et al., 2009).

This paper extends the municipal bond literature by identifying a new priced dimension of fiscal risk: tax risk—the covariance between tax revenues and economic downturns. We show that tax risk is systematically priced in both primary and secondary markets, is amplified when repayment capacity is limited, and has real effects on government spending. By distinguishing tax risk from revenue volatility and linking it to the structure of state tax systems, our analysis connects asset pricing in municipal bond markets to the design of tax policy and fiscal capacity.

3 Tax Revenue Risk and Tax Revenue Volatility

Maintaining a stable tax system has long been a central challenge in public finance. In The Wealth of Nations, Adam Smith emphasized the importance of public revenues that are "certain and not arbitrary," recognizing that fiscal predictability underpins effective governance. That concern remains relevant today. In modern state and local finance, revenue instability has increased as governments have shifted away from historically stable sources, such as prop-

erty taxes, toward more cyclical tax bases, including personal and corporate income taxes. This shift has heightened fiscal exposure to economic downturns and contributed to larger budget shortfalls and disruptions in public service provision (Seegert, 2016). Understanding the nature of this fiscal risk is therefore central to the study of government finance.

The terms tax revenue volatility and tax revenue risk are often used interchangeably, but they capture distinct concepts. Volatility measures the magnitude of revenue fluctuations over time and is typically summarized using standard deviations, year-over-year changes, or detrended residuals (Boyd, 2022). Risk, by contrast, concerns the timing of those fluctuations. A tax system may generate large revenue swings yet pose little fiscal risk if windfalls occur in expansions and shortfalls occur when fiscal demands are low. Tax revenue risk arises when revenue shortfalls coincide with economic downturns—periods in which fiscal capacity is most strained and borrowing needs are greatest. In this sense, tax revenue risk reflects the covariance between government revenues and macroeconomic conditions.

3.1 Tax Revenue Risk

We measure states' exposure of tax revenues to economic downturns using a measure we refer to as *tax risk*. The central idea is that a dollar of tax revenue is more valuable when economic conditions are weak and fiscal constraints are binding. Tax systems whose revenues fall in downturns and rise in expansions are therefore riskier than systems that deliver revenues when fiscal needs are greatest. Said differently, *tax risk* captures the *procyclicality* or covariance of tax revenues with economic conditions.

Formally, let R_t denote tax revenue in year t and let m_t denote a state-contingent valua-

tion that assigns greater weight to revenues realized in downturns and a lower weight during booms. The value of the revenue stream is

$$\begin{aligned}\mathbb{E}[m_t R_t] &= \mathbb{E}[m_t]\mathbb{E}[R_t] + \mathrm{Cov}(m_t, R_t) \\ &= \underbrace{\mathbb{E}[m_t]\mathbb{E}[R_t]}_{\substack{\text{Certainty} \\ \text{Equivalent}}} - \underbrace{\left(-\mathrm{Cov}(m_t, R_t)\right)}_{\substack{\text{Tax} \\ \text{Risk}}}. \end{aligned} \tag{1}$$

The first term represents the expected value of a revenue stream (up to a scaler) that corresponds to the *certainty equivalent* each year. The second term captures *tax risk*: the valuation discount associated with revenue declines when revenues are most valuable.

Said differently, the tax risk term captures the value of the co-movement between tax revenue and economic conditions. We express it with a negative sign so that a higher tax risk corresponds to a higher disutility and a lower value of the revenue stream. When revenues are procyclical, R_t is low in downturns when m_t is high, generating a negative covariance and positive *tax risk*. When revenues are countercyclical, the covariance is positive, *tax risk* is negative, and revenues provide insurance by stabilizing fiscal resources during downturns.

We construct *tax risk* at the state-year level using data from the U.S. Census Bureau's *Annual Survey of State Government Tax Collections (STC)*. For each state s and year t, total tax revenue $R_{s,t}$ equals the sum of personal income, corporate income, and sales tax, which are the main sources of revenue for state budgets (Seegert, 2016; Boyd, 2022). Property taxes are excluded because they are largely earmarked for local school districts; including them yields qualitatively similar results.

To operationalize the state-contingent valuation m_t, we use state-level GDP growth as an

inverse proxy for the marginal value of public funds. When GDP growth is high, resources are abundant, and a tax dollar is less valuable; when growth is low, revenues are more valuable. That is, we use the reciprocal of GDP growth as our empirical proxy for m_t.[2]

We compute tax risk using a four-year rolling window ($t-3$ to t) following Equation 1. The results are robust to alternative window lengths. Let $\pi_{s,t}$ denote the reciprocal of state-level GDP growth. To remove size effects, we scale the covariance term by the expected value of revenues and define tax risk as

$$\text{Tax Risk}_{s,t} = \frac{-\operatorname{Cov}\left(\pi_{s,t},\, R_{s,t}\right)}{\mathbb{E}\left[\pi_{s,t} R_{s,t}\right]}. \tag{2}$$

A higher value of tax risk indicates that revenues fall when $\pi_{s,t}$ is high—that is, when GDP growth is low and the state needs funds the most—implying a more procyclical and riskier tax system. Conversely, a lower (or negative) tax risk implies countercyclicality and greater fiscal stabilization.

Insert **Table 1** About Here

Table 1 reports summary statistics for tax risk across states and years. Tax risk is positive for most states, indicating that state tax revenues are generally procyclical and therefore less valuable than a constant revenue stream from the perspective of fiscal smoothing. At the same time, tax risk exhibits substantial cross-state variation.

[2]Formally, our empirical proxy for m_t can be derived from a model with a representative agent with CRRA utility consuming state-level GDP. Setting relative risk aversion to one, consistent with estimates in the literature (Chetty, 2006; Layard et al., 2008), implies that the intertemporal marginal rate of substitution is proportional to the inverse of GDP growth.

Figure 1 illustrates the geographic distribution of tax risk, averaged across sample years. States in the Northeast and Midwest exhibit higher tax risk, while states in the West and parts of the South tend to have lower tax risk. Section 5 examines how this variation translates into differences in municipal bond yields.

Insert **Figure 1** About Here

3.2 Tax Revenue Volatility

Tax revenue volatility captures the magnitude of fluctuations in tax revenues, independent of their timing relative to economic conditions. To benchmark our measure of tax risk, we construct three standard measures of tax revenue volatility commonly used in the literature.

1. **Standard deviation of year-over-year change:** First, we measure volatility as the rolling standard deviation of year-over-year growth in tax revenue. Let $g_{s,t}$ denote the year-over-year growth rate of tax revenue in state s and year t, and let $\bar{g}_{s,t}$, denote its mean over a rolling window of length $T = 4$. The results are qualitatively similar with alternative lengths of the rolling window. The volatility measure is defined as

$$\text{Tax Volatility}_{s,t}^{sd} = \sqrt{\frac{1}{T-1}\sum_{j=t-T+1}^{t}(g_{s,j} - \bar{g}_{s,t})^2}. \tag{3}$$

   The rolling-window standard deviation of the rate of change is one of the most widely used methods for measuring volatility (Campbell et al., 2001).

2. **Absolute value of year-over-year change:** Second, we measure volatility as the mean absolute value of year-over-year revenue growth, averaged over the same rolling window,

$$\text{Tax Volatility}^{g}_{s,t} = \frac{1}{T} \sum_{j=t-T+1}^{t} |g_{s,j}|. \tag{4}$$

This measure is frequently employed in policy settings and state budget analysis (Boyd, 2022).

3. **Residual against time trend:** Third, we construct a detrended volatility measure based on deviations from a smooth revenue trend. We estimate a fifth-order polynomial in time for tax revenue and compute the absolute deviation of realized revenue from this trend $\hat{R}_{s,t}$, scaled by revenue and averaged over four years,

$$\text{Volatility}^{res}_{s,t} = \frac{1}{T} \frac{|R_{s,t} - \hat{R}_{s,t}|}{R_{s,t}}, \tag{5}$$

This measure captures revenue fluctuations unexplained by long-run growth (Seegert, 2016).

We find that tax risk is distinct from tax volatility. We report the summary statistics for the above three measures of tax volatility in **Table 1** and the correlation matrix of tax risk and measures of tax volatility in **Table 2**. As expected, the volatility measures are strongly correlated with one another.

However, tax risk is negatively correlated with tax volatility^{sd} and tax volatility^{g} and slightly positively correlated with tax volatility^{res}. The low or negative correlation between

tax risk and tax volatility measures suggests that they capture fundamentally different dynamics.

Insert **Table 2** About Here

Figures 1b–1d illustrate the geographic distribution of tax risk and tax volatility. The spatial patterns differ markedly: states with high tax risk often exhibit relatively low volatility. Section 7 compares the ability of tax risk and tax volatility to predict municipal bond yields.

4 Data for Municipal Bonds

Our analysis combines bond-level issuance data with transaction-level secondary-market data, drawing on standard sources used in municipal bond research. We study pricing at issuance using data from Mergent's Municipal Bond Securities Database, which provides comprehensive coverage of new municipal debt issues. The database reports offering yields along with standard bond characteristics, including maturity, taxable status, seniority, and whether the bond is issued at a premium. As reported in Table 1, the average offering yield is 2.85%, ranging from roughly 1 to 4.5% between the 10^{th} and 90^{th} percentiles. Maturities average about ten years, with most issues below twenty years. The sample is dominated by tax-exempt securities (92%), and a large fraction of bonds are issued at a premium (60%) or are senior in claim (38%).

To analyze post-issuance pricing and yields, we use transaction-level data from the Municipal Securities Rulemaking Board (MSRB), which records all reported secondary market

trades of municipal bonds. For each transaction, the data reports the trade price and the yield-to-worst implied by the transaction price. Yield-to-worst is the lowest return an investor can expect from a bond, assuming no default but allowing for the issuer to exercise any call options. In essence, yield-to-worst is similar to yield-to-maturity, but it explicitly accounts for the bond's callability. We refer to yield-to-worst as the secondary-market yield throughout the rest of the paper for simplicity. We aggregate secondary-market yields from the transaction level to the bond-year level. Table 1 shows that the average secondary-market yield is comparable to the primary market offering yield. The average secondary-market yield is 2.71%, with the 10^{th} and 90^{th} percentiles of 0.89% and 4.47%, respectively.

5 Empirical Results

We next examine whether tax risk is priced into municipal bond markets. We find that higher tax risk is associated with higher municipal bond yields in both primary and secondary markets. The effects are robust to controlling for a wide set of bond- and state-level characteristics, alternative estimation windows for tax risk, and sample restrictions that exclude recession years. For identification, we exploit a spatial discontinuity design that isolates the variation in tax risk from potential confounding unobservable characteristics. We separately discuss and control for credit ratings and liquidity of the bond, which are important determinants of bond yields documented in the literature. The results remain qualitatively similar. Together, we find tax risk raises municipal bond yields in both primary and secondary markets.

5.1 Tax Risk and Municipal Bond Yields

Investors should demand higher yields from issuers with high tax risk whose fiscal capacity is most exposed to downturns. If investors price this exposure, primary-market offering yields should increase with tax risk. We test this prediction using the following specification with offering yield as the dependent variable and tax risk as the independent variable of interest.

$$\text{Offering Yield}_{i,t} = \beta_0 + \beta_1 \text{Tax Risk}^{j}_{s,t-1} + \sum_{k} \gamma^k X^k_{i,t} + \delta_c + \delta_t + \varepsilon_{i,t}. \tag{6}$$

Tax risk is calculated following Equation 2 using tax revenue and GDP growth data from year $t-j$ to year $t-1$ (a total of j years). The baseline uses a 4-year window ($j = 4$), and the results are robust to alternative windows. This specification includes a vector of control variables at both the bond and state levels, X^k. Bond-level controls include the bond maturity and indicator variables for whether the bond is taxable, senior, and issued at a premium. State-level controls include GDP growth and per capita personal consumption expenditure growth. This specification also includes county fixed effects, δ_c, which capture slow-moving local conditions that might simultaneously affect tax risk and municipal bond yields. It also includes year-fixed effects δ_t, which control for broad market conditions.

We report the results in **Table 3**, where tax risk $\text{Tax Risk}^{j}_{s,t-1}$ is lagged a year and standardized to have a unit standard deviation, so that β_1 is the change in offering yield (in percentage points) associated with a one standard deviation increase in tax risk. **Table 3** reports the results.

Insert **Table 3** About Here

Table 3 shows that greater tax risk predicts higher borrowing costs in the primary market, highlighting that tax risk is priced by investors. In our baseline specification in column 1, a one-standard-deviation increase in tax risk corresponds to a 2.8 bps increase in offering yields. The coefficient remains positive, precisely estimated, and slightly larger at 3.2 bps when we include the full set of bond- and state-level controls. The coefficient remains similar at 3.6 and 3.4 bps when we exclude recession years from 2008 to 2010 (the Global Financial Crisis, column 3) and the COVID-19 period from 2020 to 2022 (column 4), respectively. We also find similar coefficients (3.3 bps and 3.6 bps) when using 3- and 5-year estimation windows to calculate tax risk, respectively.

The point estimates are also economically significant. During the sample period, the yield spread between the highest-rated and second-highest-rated bonds is 2.3 bps. Therefore, the preferred specification in column 2 suggests that a one-standard-deviation increase in tax risk raises bond yields by approximately 1.5 times the yield spread between the top two ratings.

To test the robustness and stability of the estimates, we repeat the main specification in column 2 while leaving out one state from the sample at a time. Figure 2 reports the point estimates with 95% confidence intervals. We see that, in Figure 2a, the vast majority of the estimates are stable around the full-sample estimate, indicated by the horizontal red line. All estimates are statistically significant at the 5% level (with 1 estimate just above 5%). These results suggest that the effect of tax risk on municipal bond offering yield is robust to state-level sample selections.

Insert **Figure 2** About Here

Next, we examine whether investors price tax risk in the secondary market. We focus on the trade-by-trade yield-to-worst (i.e., yield-to-maturity adjusted for the callability of the bond) averaged to the bond-year level. Therefore, the secondary-market analysis is based on panel regression at the bond and year levels (as opposed to the primary-market analysis, which is based on a cross-sectional regression). **Table** 4 reports the results and shows that investors also price tax risk in the secondary market. In the baseline specification in column 1, a one-standard-deviation increase in tax risk is associated with a 7.3 bps increase in yields. With bond-level and state-level controls in column 2, the point estimate is 6.6 bps. Excluding the GFC and COVID periods and constructing the risk measure with 3- and 5-year lookback windows (columns 3 to 6) produces coefficients between 6.4 and 6.8 bps. The coefficients are statistically significant at the 1% level across all specifications, and the magnitudes are approximately twice those in the primary market. Overall, we find that tax risk is priced in municipal bond yields. The pattern holds in both primary and secondary markets and is robust to controls, sample restrictions, and alternative windows for tax risk calculation.

Insert **Table** 4 About Here

Similarly, we also conduct the leave-one-state-out exercise. Figure 2b shows that the point estimates are stable around the estimate in the main specification. All estimates remain statistically significant on the 5% level. These results show that the effect of tax risk on municipal bond yields in the secondary market is also robust across different state-level samples.

5.2 Spatial Discontinuity in Tax Risk

A key challenge in interpreting the pricing of tax risk is separating state-level fiscal exposure from local economic fundamentals that may also affect municipal bond yields. We address this challenge using a border-discontinuity design that compares bonds issued in adjacent counties across state borders (Cornaggia et al., 2022; Cornaggia and Iliev, 2023; Gárate and Pennington-Cross, 2023; Aiello et al., 2025). Because neighboring counties share local economic conditions but face different state tax systems, this design isolates cross-state differences in tax risk while holding local fundamentals constant.

We construct border county pairs by matching each county located at a state border with all adjacent counties in neighboring states. Bonds issued in these counties are compared within county-pair fixed effects, so that identification comes from yield differences across state borders within otherwise similar local economies. Some counties border multiple states and therefore appear in more than one county pair. To avoid over-representation, observations are weighted by the inverse number of pairings. In Internet Appendix A, we provide a detailed example using the Oklahoma Panhandle in **Figure IA.A1**.

We estimate the border-discontinuity specification using the primary-market offering yield and the secondary-market yield-to-worst as the dependent variable. The key explanatory variable is the issuing state's lagged tax risk, Tax Risk$_{s,t-1}$. The specification includes bond- and state-level controls, $X^k_{i,t}$, and year fixed effects δ_t, along with county-pair fixed effects, δ_{cp}, that absorb all time-invariant local characteristics common to each border pair.

Together, this gives our border-discontinuity design,

$$\text{Yield}_{i,t} = \beta_0 + \beta_1 \text{Tax Risk}_{s,t-1} + \sum_k \gamma^k X^k_{i,t} + \delta_{cp} + \delta_t + \varepsilon_{i,t}. \tag{7}$$

Higher tax risk is associated with higher municipal bond yields in both the primary and secondary markets, even when local economic conditions are held constant across state borders. **Table 5** shows that a one–standard–deviation increase in tax risk leads to a 3.5 basis point increase in offering yields in the primary market and a 5.7 basis point increase in secondary-market yields. Crucially, the magnitudes in the border design closely mirror those in the baseline specifications: 3.2 basis points for the primary markets in **Table 3** column 2 and 6.6 basis points for the secondary market in **Table 4** column 2. These results indicate that the pricing of tax risk is not driven by unobserved local conditions or regional shocks.

Insert **Table 5** About Here

We find broadly consistent estimates across counties of different sizes. To account for the drastically different sizes of counties, we separately estimate the effect using large and small county pairs, defined as those above or below the median geographic area. The estimates remain stable relative to those from the full sample and are statistically significant (the secondary market estimates are barely below 5% level).

Taken together, the border-discontinuity results reinforce the interpretation that municipal bond investors price tax risk as a state-level fiscal exposure, rather than as a reflection of localized economic conditions.

5.3 Credit Ratings and Liquidity

Prior literature documents that credit quality and liquidity are important determinants of municipal bond yields and account for a substantial share of the cross-sectional variation in secondary-market pricing. Table 6 examines whether tax risk contains incremental pricing information relative to these standard components by directly controlling for these bond-level time-varying characteristics.

Column 1 includes a full set of credit rating indicators. As expected, the yields decline monotonically with higher ratings. However, conditional on credit ratings, tax risk continues to enter positively and remains precisely estimated, with a magnitude similar to that in the baseline specification. This indicates that tax risk is not subsumed by ratings-based measures of credit quality.

Columns 2 and 3 further control for secondary-market liquidity using transaction-based measures—the log number of days traded and the log dollar trading volume throughout the year. These variables enter with the expected signs, but their inclusion has little effect on the estimated coefficient on tax risk. Across specifications, tax risk continues to predict higher yields with magnitudes comparable to those reported earlier.

Overall, the estimates in Table 6 indicate that tax risk captures variation in municipal bond yields that is not subsumed by conventional measures of credit quality or liquidity. Even after conditioning on these standard pricing factors, the state-contingent risk of tax revenues remains systematically priced in secondary markets. These results show that tax risk reflects a distinct dimension of repayment risk, orthogonal to trading frictions and to default risk captured by credit ratings.

6 Economic Mechanism

We propose that tax risk operates through a channel of state-contingent repayment capacity. Tax risk affects municipal bond pricing because it determines the resources available for debt service during economic downturns. When tax revenues fall during downturns, governments face tighter budget constraints precisely when borrowing costs rise and refinancing options contract. As a result, revenue shortfalls in recessions impair repayment capacity more than equally-sized revenue gains during expansions improve it.

This mechanism differs from realized default risk. Most municipal bonds do not default, but investors price the likelihood that fiscal stress constrains governments' ability to service debt without resorting to costly adjustments. Tax risk captures this state-contingent exposure by measuring how revenues covary with economic downturns rather than their unconditional volatility.

6.1 Fiscal Buffers and the Pricing of Tax Risk

If tax risk operates through repayment capacity, its pricing should depend on the availability of fiscal buffers. Governments with larger rainy-day funds can smooth revenues during downturns and mitigate the impact of adverse shocks on debt service. By contrast, governments with limited reserves are more exposed to downturn-related revenue losses.

To test this implication, we examine whether the pricing of tax risk varies with fiscal slack. We measure fiscal buffers using state rainy-day fund balances at the state-year level from Theal and Forrest (2025). We divide states into high- and low-rainy-day fund groups based on the median number of days the government can operate on the rainy-day funds.

We then re-estimate Equation 6 separately for states with high and low fiscal slack, using both primary-market offering yields and secondary-market yields as dependent variables. The results are reported in **Table 7**.

Insert **Table 7** About Here

The estimates show that the association between tax risk and municipal bond yields is substantially stronger for states with smaller rainy-day funds. A one-standard-deviation increase in tax risk raises offering yields by about 6 bps in low-fund states but has no discernible effect in high-fund states. In the secondary market, a one-standard-deviation increase in tax risk raises yield-to-worst by 7.1 bps in low-fund states and 3.4 bps in high-fund states.[3] We also perform F-tests for the point estimates and find that they are statistically significantly different between low-fund and high-fund states for both primary and secondary markets. Overall, fiscal buffers mitigate the effect of tax risk on municipal bond yields. These results support the interpretation that tax risk affects municipal bond yields through the government's capacity to repay its debt obligations. These results are inconsistent with explanations based on liquidity or general credit quality, which do not systematically co-move with the level of fiscal buffers.

[3]The secondary market yield-to-worst is still predicted by tax risk, albeit with a smaller magnitude. One possible explanation is that tax risk and tax revenue dynamics in general may be correlated with recall and refinancing risks, which are priced into yield-to-worst in the secondary market. In contrast, such optionality is absent in the primary market offering yields; therefore, the estimate in column 2 is economically and statistically insignificant.

6.2 Project Revenue Pledge and Exposure to Tax Risk

Tax risk should be priced more strongly for bonds whose repayment depends directly on governments' taxing authority. General obligation bonds are backed by taxing power, whereas revenue bonds are serviced by project-specific cash flows. The pledge of project revenue to the repayment of revenue bonds mitigates tax revenue risk. If tax revenue risk affects yields through governments' capacity to raise tax revenue during downturns, its effect should be larger for general obligation bonds and attenuated for revenue bonds.

To test this implication, we examine whether tax risk pricing varies by bond category. **Table 8a** reports estimates from re-estimating Equation 6 separately by bond category. For bonds backed by taxing power, we consider general purposes, school district, and police, fire, and jail bonds in Columns 1 through 3. For bonds backed by project revenue, we consider housing, recreation, and transportation in Columns 4 through 6. We describe how we categorize bonds based on their use of proceeds in Internet Appendix B. **Table 8b** reports analogous results for secondary-market yields.

Insert **Table 8** About Here

Across bond categories, the effect of tax risk on yields is substantially larger for bonds backed by taxing power than for bonds backed by project revenue. A one-standard-deviation increase in tax risk is associated with 3.2, 5.0, and 4.6 bps higher offering yields for bonds backed by taxing power, as shown in Columns 1 to 3. In contrast, a one-standard-deviation increase in tax risk is associated with 0.9, 0.3, and 2.1 bps higher offering yields for bonds backed by project revenue. These coefficients are small and not statistically significant.

In the secondary market, tax risk continues to raise yields for general obligation bonds. The response for revenue bonds is more mixed: while some categories exhibit positive sensitivity to tax risk, the estimates are smaller and less uniform than for general obligation bonds. This weaker but present effect of tax risk on revenue bond yield-to-worst is again consistent with the estimate for states with high fiscal buffers in the secondary market (**Table 7** column 4), likely due to tax revenue dynamics being correlated with recall and refinancing risk. Overall, the pricing of tax risk remains strongest for bonds backed by a taxing authority, consistent with a repayment-capacity channel.

7 Tax Risk versus Tax Volatility

Municipal bond yields may reflect the magnitude of fluctuations in tax revenues or the timing of those fluctuations relative to economic conditions. Tax revenue volatility captures the size of year-to-year revenue movements but treats all fluctuations symmetrically. By contrast, tax risk measures whether revenues decline during economic downturns, when fiscal stress is most costly. If markets price the timing of revenue shortfalls rather than their unconditional variability, tax risk should predict yields, while volatility should not.

We evaluate this distinction by estimating specifications that include tax risk alongside alternative measures of tax revenue volatility. Tax volatility is measured using three standard approaches: the standard deviation of year-over-year revenue growth, the mean absolute year-over-year growth rate, and a detrended residual measure. All measures are computed using rolling windows of past revenues. The estimating equation follows Equation 6, augmented to include tax volatility alongside tax risk.

Across all specifications, the volatility measures exhibit no economically meaningful or statistically significant association with municipal bond yields. Table 9 reports results for both primary- and secondary-market yields. In specifications that include volatility alone, in head-to-head comparisons with tax risk, and in a full specification that includes tax risk and all three volatility measures simultaneously, tax risk remains precisely estimated while volatility has no predictive power.

These results indicate that municipal bond markets price the covariance of tax revenues with economic downturns rather than the unconditional variability of revenues. Revenue instability is not penalized per se; what matters for borrowing costs is whether revenues fall when economic conditions are weak.

8 The Determinants of Tax Risk

States differ markedly in how they finance public expenditures, relying to varying degrees on income, corporate, and sales taxes. These differences raise the question of whether some tax bases systematically generate more tax risk than others. Prior research emphasizes differences in the volatility of tax revenues across tax types (Groves and Kahn, 1952; Dye and McGuire, 1991; Seegert, 2015, 2016), but does not examine how tax structure affects the timing of revenue shortfalls.

We examine how a state's tax risk varies with its tax mix and statutory rates using the specification,

$$\text{Tax Risk}_{s,t} = \beta_0 + \beta_1 \tau_{s,t} + \delta_t + \varepsilon_{s,t}, \tag{8}$$

where $\tau_{s,t}$ is either (i) the fraction of tax revenue from personal income taxes, corporate

income taxes, or sales taxes for state s in year t, or (ii) the statutory tax rate for these tax types. δ_t represents year fixed effects. We report the results in **Table 10**.

Insert **Table 10** About Here

Two patterns emerge. Greater reliance on income-based revenues, both personal and corporate, is associated with higher tax risk. This finding is consistent with using tax revenue shares (columns 1 and 2) and tax rates (columns 4 and 5). States that rely more heavily on income taxes therefore exhibit more procyclical fiscal capacity and greater exposure to downturn-related revenue shortfalls.

Sales taxes display the opposite pattern. A larger sales-tax revenue share is associated with lower tax risk, while the statutory sales-tax rate itself is not systematically related to tax risk (columns 3 and 6). Taken together, these results imply that tax systems tilted toward income-based revenues tend to generate higher tax risk than those relying more heavily on consumption taxes. Our results are consistent with existing evidence on the cyclicality of different tax bases and recent changes in consumption behavior and income-tax progressivity documented in the literature (Seegert, 2016; Dauchy et al., 2021; Dean et al., 2023).

9 The Effect of Tax Risk on Expenditures

We examine whether the pricing of tax risk has real effects on public investment and spending. If tax risk raises municipal borrowing costs, higher financing costs may constrain governments' ability to fund public expenditures, particularly those backed by taxing authority.

To assess whether tax-risk–driven variation in borrowing costs is associated with subsequent spending, we proceed in two steps (Pierson et al., 2015). First, we predict offering yields using tax risk, estimating Equation 6 separately by bond type. We isolate the component of municipal borrowing costs attributable to tax risk, rather than to contemporaneous spending conditions. These estimates are reported in **Table 8a**.

Second, we examine whether higher predicted yields, those attributable solely to tax risk, lead to lower government expenditures. The key explanatory variable is the predicted offering yield from the first stage, aggregated to the county level, $\widehat{\text{Offering Yield}}_{c,p,t}$. The outcome is the share of county expenditures devoted to a given category in year $t+f$, $\text{Expenditure}_{c,p,t+f}$. The specification includes state and year fixed effects, δ_s and δ_t,

$$\text{Expenditure}_{c,p,t+f} = \beta_0 + \beta_1 \widehat{\text{Offering Yield}}_{c,p,t} + \delta_s + \delta_t + \varepsilon_{c,p,t+f}. \tag{9}$$

We estimate this relationship separately for expenditure categories backed by taxing authority and for those backed by project revenues. The results are reported in Table 11. The coefficient on the predicted offering yield, β_1, captures the real effect of tax risk on government spending through financing costs.

Insert **Table 11** About Here

Higher tax-risk–driven borrowing costs are associated with lower government spending in categories backed by taxing power. A one-percentage-point increase in predicted offering yields reduces the share of expenditures backed by taxing authority by approximately 2.2

percentage points in the issuance year, reported in **Table 11a**. This pattern indicates that higher financing costs attributable to tax risk are associated with meaningful reductions in tax-backed public spending.

By contrast, predicted borrowing costs have little effect on expenditures funded by project revenues. For these categories, the estimated coefficients are substantially smaller and generally statistically indistinguishable from zero, reported in **Table 11b**. This difference is consistent with the financing-cost channel: when expenditures are not directly tied to tax revenues, higher tax risk has limited implications for spending decisions.

Taken together, these results indicate that tax risk affects government expenditures, with effects concentrated in categories that rely on taxing authority for repayment.

10 Conclusion

This paper shows that tax risk, rather than tax revenue volatility, is priced into municipal bond yields and has real effects on government expenditures. Municipalities exposed to more procyclical tax revenue streams face systematically higher borrowing costs. We document this relationship using multiple sources of variation, including cross-state differences, within-state comparisons, and state border discontinuities. Tax risk is priced in both primary and secondary municipal bond markets, and higher tax risk is associated with higher borrowing costs and lower public investment and spending.

We document heterogeneous responses of bond yields to tax risk given different levels of fiscal buffers and project revenue pledges. States with smaller rainy-day funds and bonds not backed by revenue pledges from projects (i.e., general obligation bonds) exhibit substantially

greater sensitivity to tax risk than fiscally buffered states or project-revenue-backed bonds. These results support a repayment-capacity channel, through which investors view tax risk as a measure of weakened repayment capacity during periods of fiscal stress.

By contrast, conventional measures of tax revenue volatility do not predict municipal bond yields. Volatility captures the unconditional variability of tax revenues, but does not distinguish between expansions and downturns. Our results show that markets price the systematic co-movement of tax revenues with economic downturns rather than revenue variability per se. This distinction clarifies why existing approaches that focus on volatility miss the dimension of fiscal risk most relevant for credit markets.

The results highlight an additional channel through which tax policy affects fiscal outcomes. Tax structure shapes not only the equity and efficiency of revenue systems, but also governments' cost of capital. Revenue systems with lower tax risk are associated with lower borrowing costs and greater capacity to finance public investment. By linking tax policy design to municipal borrowing costs and government spending, this paper identifies tax risk as a central component of fiscal sustainability.

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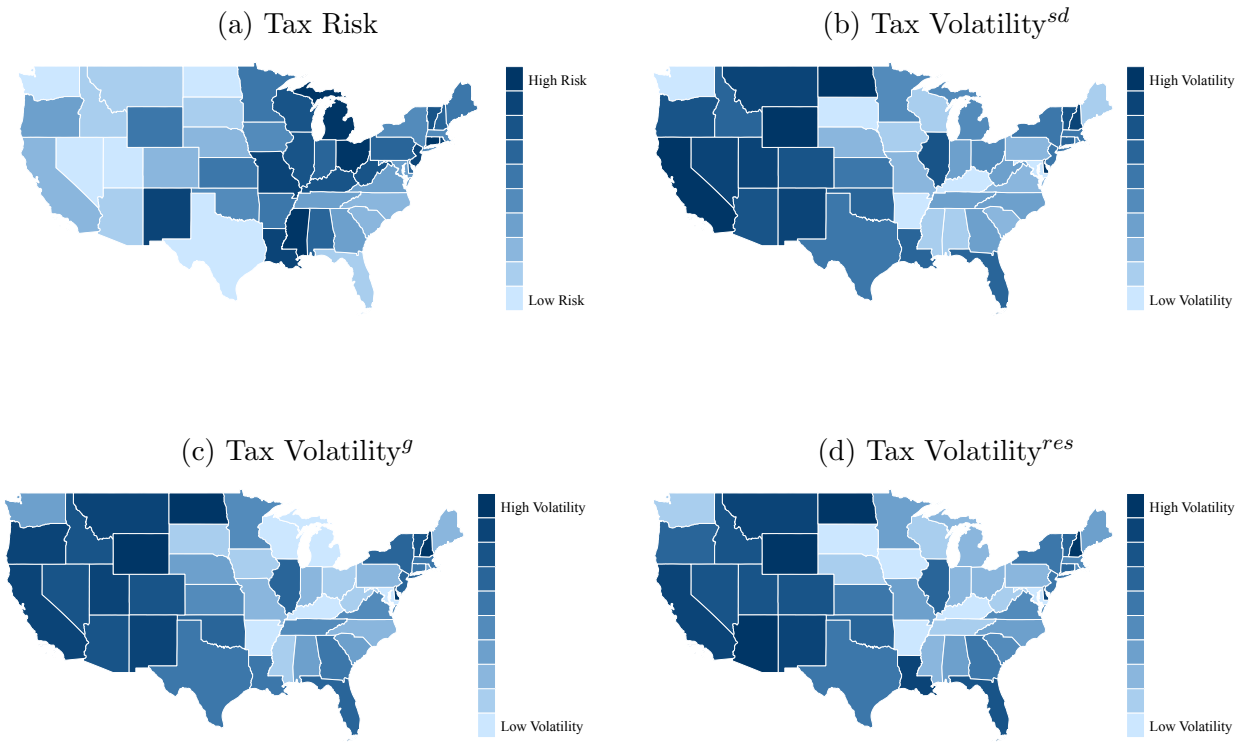
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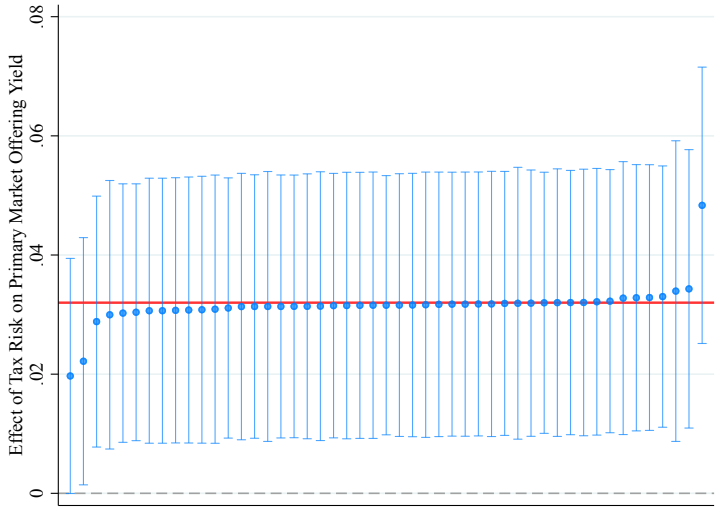
Figure 1. Risk and Volatility Measures by State



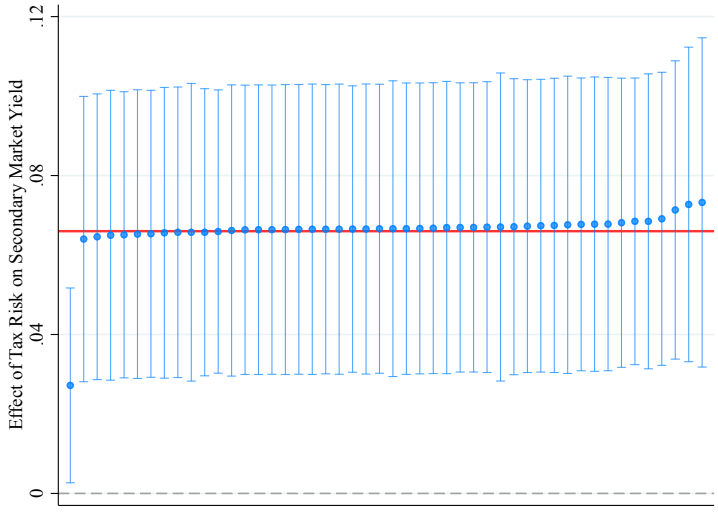
This figure plots the measures of tax revenue risk and volatility across U.S. states over time. Panel (a) shows the tax risk calculated over a four-year rolling window. Panel (b) reports the standard deviation of the year-over-year growth rate of tax revenue. Panel (c) presents the mean of the absolute value of the year-over-year growth rate of tax revenue. Panel (d) shows the mean of the absolute value of the residualized tax revenue detrended up to a fifth-degree polynomial.

Figure 2. Leave-One-State-Out Jackknife

(a) Primary Market



(b) Secondary Market



This figure reports jackknife (leave-one-state-out) estimates of the effect of tax risk on municipal yields. In panel (a), the dots plot the coefficient of tax risk on municipal bond offering yield in primary markets from re-estimating the baseline regression in Table 3 column 2 after excluding one state at a time. In panel (b), the dots plot the coefficient of tax risk on municipal bond yield-to-worst (i.e., the worst yield considering the bond being callable) in secondary markets from re-estimating the baseline regression in Table 4 column 2 after excluding one state at a time. Vertical bars represent 95% confidence intervals. The solid red line represents the coefficient of the full-sample estimate.

Table 1
Summary Statistics

This table reports summary statistics for variables used in the analysis. Tax Risk is our state-level measure of tax revenue uncertainty, computed for each state over a rolling four-year window that ends in the year before the bond is issued. Tax Volatility^{sd} is the standard deviation of the year-over-year growth rate of tax revenue. Tax Volatility^{g} is the mean of the absolute value of the year-over-year growth rate of tax revenue. Tax Volatility^{res} is the mean of the absolute value of the residualized tax revenue detrended up to a fifth-degree polynomial. GDP Growth is the annual GDP growth rate across all states. Personal Consumption Growth is the annual per capita personal consumption growth rate across all states. Offering Yield is the primary-market yield at issuance (in percent). Secondary Yield is the yield to maturity computed from secondary-market trades in the post-issuance window (in percent). Price is the secondary-market transaction price over the post-issuance window (dollars per $100 of par). Maturity is years to stated maturity at issuance. Taxable is an indicator variable equal to 1 for taxable issues and 0 otherwise. Senior is an indicator variable equal to 1 for senior lien bonds and 0 for junior/subordinate liens. Premium is an indicator variable equal to 1 if the the bond is issued at a premium, and 0 otherwise.

	Mean	StDev	p10	p50	p90	N
State Level Variables:						
Tax Risk	0.04	0.02	0.02	0.04	0.06	1,104
Tax Volatility^{sd}	0.07	0.05	0.02	0.06	0.13	1,104
Tax Volatility^{g}	0.07	0.04	0.04	0.07	0.12	1,104
Tax Volatility^{res}	0.14	0.09	0.05	0.12	0.25	1,104
GDP Growth (%)	4.39	3.49	0.10	4.30	8.50	2,887,087
Personal Consumption Growth (%)	3.68	3.04	1.30	3.40	6.10	2,887,087
Bond Level Primary Market Variables:						
Offering Yield (%)	2.85	1.31	1.05	2.90	4.50	2,887,087
Maturity (Years)	9.62	6.47	2.00	9.00	19.00	2,887,087
$\mathbb{1}$[Bond Is Taxable]	0.08	0.27	0.00	0.00	0.00	2,887,087
$\mathbb{1}$[Bond Is Senior]	0.38	0.48	0.00	0.00	1.00	2,887,087
$\mathbb{1}$[Bond Is Issued at Premium]	0.60	0.49	0.00	1.00	1.00	2,887,087
Bond-Year Level Secondary Market Variables:						
Secondary Market Yield (%)	2.71	2.26	0.89	2.80	4.47	10,001,963
Bond Price ($)	103.12	10.36	97.85	102.40	113.51	10,212,210

Table 2
Correlation Matrix

This table reports pairwise correlations among the risk measures used in the analysis. Tax Risk is our state-level measure of tax revenue uncertainty, computed for each state over a rolling four-year window that ends in the year before the bond is issued. Tax Volatility^{sd} is the standard deviation of the year-over-year growth rate of tax revenue. Tax Volatility^{g} is the mean of the absolute value of the year-over-year growth rate of tax revenue. Tax Volatility^{res} is the mean of the absolute value of the residualized tax revenue detrended up to a fifth-degree polynomial.

	Tax Risk	Tax Volatility^{sd}	Tax Volatility^{g}	Tax Volatility^{res}
Tax Risk	1.00			
Tax Volatility^{sd}	-0.13	1.00		
Tax Volatility^{g}	-0.35	0.83	1.00	
Tax Volatility^{res}	0.20	0.54	0.46	1.00

Table 3
Tax Risk and Municipal Bond Yields in Primary Markets

This table reports estimates from the following regression:

$$\text{Offering Yield}_{i,t} = \beta_0 + \beta_1 \text{Tax Risk}^{j}_{s,t-1} + \sum_k \gamma^k X^k_{i,t} + \delta_c + \delta_t + \varepsilon_{i,t},$$

where Offering Yield$_{i,t}$ is the offering yield of bond i issued in year t. Tax Risk$^{j}_{s,t-1}$ is the tax risk in year $t-1$ for state s, calculated over a rolling window from year $t-j$ to year $t-1$ (i.e., a total of j years). $X^k_{i,t}$ is a vector of bond-level control variables, including the taxable status, maturity, seniority of the bond, and whether the bond is issued at a premium, and state-level control variables, including the lagged GDP growth and lagged per-capita personal consumption growth. δ_c and δ_t are county and offering year fixed effects, respectively. The sample includes all municipal bonds in the U.S. from 2002 to 2023. Column 3 excludes the Global Financial Crisis (i.e., No GFC) by removing years from 2008 to 2010, and column 4 excludes the COVID-19 period (i.e., No COVID) by removing years from 2020 to 2022. Robust standard errors, clustered by county and offering year, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

			No Recession Years		Alternative Risk Windows	
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Risk$^{4}_{s,t-1}$	0.028**	0.032***	0.036***	0.034***		
	(0.013)	(0.011)	(0.011)	(0.011)		
Tax Risk$^{3}_{s,t-1}$					0.033**	
					(0.012)	
Tax Risk$^{5}_{s,t-1}$						0.036***
						(0.010)
Bond-Level Controls:						
Taxable Status		0.584***	0.495***	0.660***	0.584***	0.584***
		(0.073)	(0.048)	(0.070)	(0.073)	(0.073)
Maturity		0.104***	0.097***	0.107***	0.104***	0.104***
		(0.009)	(0.009)	(0.011)	(0.009)	(0.009)
Bond is Senior		0.350***	0.405***	0.333***	0.351***	0.350***
		(0.088)	(0.091)	(0.096)	(0.088)	(0.088)
Bond Issued at Premium		-0.319***	-0.306***	-0.321***	-0.319***	-0.319***
		(0.022)	(0.024)	(0.022)	(0.022)	(0.022)
State-Level Controls:						
GDP Growth		-0.005	-0.001	-0.005	-0.005	-0.005
		(0.004)	(0.002)	(0.004)	(0.004)	(0.004)
Personal Consumption Growth		-0.024***	-0.017**	-0.029**	-0.023***	-0.024***
		(0.008)	(0.008)	(0.010)	(0.008)	(0.008)
Sample Period	Full	Full	No GFC	No COVID	Full	Full
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Offering Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.444	0.795	0.807	0.780	0.795	0.795
Observations	2,887,074	2,887,074	2,499,471	2,532,434	2,887,074	2,887,074

Table 4
Tax Risk and Municipal Bond Yields in Secondary Markets

This table reports estimates from the following regression:

$$\text{Yield}_{i,t} = \beta_0 + \beta_1 \text{Tax Risk}^j_{s,t-1} + \sum_k \gamma^k X^k_{i,t} + \delta_c + \delta_t + \varepsilon_{i,t},$$

where $\text{Yield}_{i,t}$ is the average yield-to-worst (i.e., the worst yield considering the bond being callable) of bond i in year t. $\text{Tax Risk}^j_{s,t-1}$ is the tax risk in year $t-1$ for state s, calculated over a rolling window from year $t-j$ to year $t-1$ (i.e., a total of j years). $X^k_{i,t}$ is a vector of bond-level control variables, including the taxable status, maturity, seniority of the bond, and whether the bond is issued at a premium, and state-level control variables, including the lagged GDP growth and lagged per-capita personal consumption growth. δ_c and δ_t are county and year fixed effects, respectively. The sample includes all municipal bonds in the U.S. from 2002 to 2023. Column 3 excludes the Global Financial Crisis (i.e., No GFC) by removing years from 2008 to 2010, and column 4 excludes the COVID-19 period (i.e., No COVID) by removing years from 2020 to 2022. Robust standard errors, clustered by county and year, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

			No Recession Years		Alternative Risk Windows	
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Tax Risk}^4_{s,t-1}$	0.073***	0.066***	0.065***	0.068***		
	(0.020)	(0.017)	(0.017)	(0.018)		
$\text{Tax Risk}^3_{s,t-1}$					0.067***	
					(0.018)	
$\text{Tax Risk}^5_{s,t-1}$						0.064***
						(0.017)
Bond-Level Controls:						
Taxable Status		0.763***	0.720***	0.768***	0.763***	0.763***
		(0.073)	(0.077)	(0.067)	(0.073)	(0.073)
Maturity		0.066***	0.061***	0.066***	0.066***	0.066***
		(0.008)	(0.006)	(0.009)	(0.008)	(0.008)
Bond is Senior		0.745***	0.716***	0.750***	0.745***	0.745***
		(0.114)	(0.131)	(0.110)	(0.114)	(0.114)
Bond Issued at Premium		-0.322***	-0.328***	-0.322***	-0.322***	-0.322***
		(0.032)	(0.032)	(0.029)	(0.032)	(0.032)
State-Level Controls:						
GDP Growth		-0.004	-0.003	-0.004	-0.004	-0.005
		(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Personal Consumption Growth		-0.058**	-0.053**	-0.061**	-0.055**	-0.057**
		(0.021)	(0.020)	(0.023)	(0.022)	(0.021)
Sample Period	Full	Full	No GFC	No COVID	Full	Full
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.245	0.361	0.382	0.346	0.361	0.361
Observations	8,195,204	8,195,204	6,923,822	7,556,042	8,195,204	8,195,204

Table 5
Tax Risk and Municipal Bond Yield: Spatial Discontinuity

This table presents the results of the following regression:

$$\text{Yield}_{i,t} = \beta_0 + \beta_1 \text{Tax Risk}_{s,t-1} + \sum_k \gamma^k X^k_{i,t} + \delta_{cp} + \delta_t + \varepsilon_{i,t},$$

where $\text{Yield}_{i,t}$ is the offering yield in the primary market in columns 1 to 3 and yield-to-worst (i.e., the worst yield considering the bond being callable) in the secondary market in columns 4 to 6, for bond i in year t. $\text{Tax Risk}_{s,t-1}$ is the tax risk in year $t-1$ for state s, calculated over a rolling window from year $t-4$ to year $t-1$ (i.e., a total of 4 years). $X^k_{i,t}$ is a vector of bond-level control variables, including the taxable status, maturity, seniority of the bond, and whether the bond is issued at a premium, and state-level control variables, including the lagged GDP growth and lagged per-capita personal consumption growth. $\delta_c p$ is county-pair fixed effects, defined in section 5.2 with more details in Internet Appendix A. δ_t is offering-year fixed effects in columns 1 to 3 and year fixed effect in columns 4 to 6. The sample includes municipal bonds issued by municipalities in counties bordering a different state from 2002 to 2023. Robust standard errors, clustered at the county and offering year level in columns 1 to 3 and clustered at the county and year level in columns 4 to 6, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

	Primary Market			Secondary Market		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Risk	0.035***	0.031**	0.040**	0.057**	0.059*	0.039*
	(0.010)	(0.011)	(0.014)	(0.025)	(0.029)	(0.020)
Sample	All Counties	Large Counties	Small Counties	All Counties	Large Counties	Small Counties
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Offering Year FE	Yes	Yes	Yes			
Year FE				Yes	Yes	Yes
Adjusted R-squared	0.798	0.797	0.798	0.339	0.328	0.353
Observations	1,874,041	937,026	937,014	5,066,475	2,530,694	2,535,780

Table 6
Tax Risk and Municipal Bond Yield: Control for Credit Rating and Liquidity

This table presents the results of the main specification for yield-to-worst in the secondary market (**Table 4** column 2) with controls of credit ratings and liquidity. Column 1 controls for credit rating (averaged across credit rating agencies) categories, including AAA/Aaa, AA+/Aa1, AA/Aa2, AA-/Aa1, and A+/A1 (with A/A2 or lower being the omitted group). Columns 2 and 3 control for bond liquidity in the secondary market, measured as the log of the total number of days on which it is traded or the log of the total dollar value traded during the year. The sample includes municipal bonds issued by municipalities in counties bordering a different state from 2002 to 2023. Robust standard errors, clustered at the county and offering year level in columns 1 to 3 and clustered at the county and year level in columns 4 to 6, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Tax Risk	0.043**	0.048**	0.047**
	(0.017)	(0.018)	(0.018)
Credit Ratings:			
AAA/Aaa	-0.510***		
	(0.065)		
AA+/Aa1	-0.478***		
	(0.059)		
AA/Aa2	-0.432***		
	(0.057)		
AA-/Aa1	-0.354***		
	(0.048)		
A+/A1	-0.249***		
	(0.036)		
Liquidity:			
log(Number of Days Traded)		-0.004	
		(0.009)	
log(Dollar Trading Volume)			-0.004
			(0.007)
Controls	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adjusted R-squared	0.499	0.489	0.489
Observations	3,871,768	3,871,768	3,871,767

Table 7
Fiscal Buffers and the Pricing of Tax Risk

This table presents the results of the main specification in column 2 in **Tables 3** and **4**, estimated separately for subsamples of states with tight or loose financial slack. Financial slack is defined on the state level as the number of days that the state government can operate using its rainy-day funds. In each year, states with a below-median number are defined as having low financial slack, and those with an above-median number are defined as having high financial slack. The sample includes all municipal bonds in the U.S. from 2002 to 2023. Robust standard errors, clustered by county and offering year in columns 1 and 2 and clustered by county and year in columns 3 and 4, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

	Primary Market Offering Yield		Secondary Market Yield	
	(1)	(2)	(3)	(4)
Tax Risk	0.059***	0.000	0.071***	0.034**
	(0.019)	(0.009)	(0.023)	(0.012)
Fiscal Buffers	Low	High	Low	High
Controls	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Offering Year FE	Yes	Yes	No	No
Year FE	No	No	Yes	Yes
Adjusted R-squared	0.786	0.784	0.388	0.315
Observations	1,551,568	1,335,476	4,443,716	3,751,382

Table 8
Repayment Sources and the Pricing of Tax Risk

This table presents the results of the main specification in column 2 in **Tables 3** and **4**, estimated separately for subsamples of bonds whose future repayments rely on different sources. Panels 8a and 8b report the results for the primary market and secondary market, respectively. Columns 1 to 3 use bonds whose obligations are covered by municipalities' future taxing power, including bonds that raise money for general-purpose, school district, and police, fire, and jail. Columns 4 to 6 use bonds whose obligations are covered by the future revenue stream generated by the projects, such as housing, recreational facilities, and transportation infrastructures, for which the bonds are issued. See the detailed description of what bonds each category includes in Internet Appendix B. Robust standard errors, clustered by county and offering year, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

(a) Primary Market Yields

	Backed by Taxing Power			Backed by Project Revenue		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Risk	0.032***	0.050**	0.046**	0.009	0.003	0.021
	(0.009)	(0.019)	(0.018)	(0.012)	(0.009)	(0.014)
Bond Type	General Purpose	School District	Police, Fire, Jail	Housing	Recreation	Transport
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Offering Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.823	0.827	0.858	0.716	0.823	0.811
Observations	953,680	870,342	50,759	107,528	67,466	84,846

(b) Secondary Market Yields

	Backed by Taxing Power			Backed by Project Revenue		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Risk	0.081***	0.069***	0.079*	0.063**	0.063**	0.010
	(0.021)	(0.022)	(0.038)	(0.023)	(0.027)	(0.022)
Bond Type	General Purpose	School District	Police, Fire, Jail	Housing	Recreation	Transport
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	2,511,475	2,314,452	118,132	289,038	179,753	358,616
Observations	0.397	0.415	0.399	0.236	0.313	0.417

Table 9
Tax Volatility and Municipal Bond Yields

This table presents the results of the following regression:

$$\text{Yield}_{i,t} = \beta_0 + \beta_1 \text{Tax Risk}_{s,t-1} + \beta_2 \text{Tax Volatility}_{s,t-1} + \sum_k \gamma^k X^k_{i,t} + \delta_c + \delta_t + \varepsilon_{i,t},$$

where $\text{Yield}_{i,t}$ is the offering yield in the primary market in panel **??** or yield-to-worst (i.e., the worst yield considering the bond being callable) in the secondary market in panel **??** for bond i in year t. $\text{Tax Risk}_{s,t-1}$ and $\text{Tax Volatility}_{s,t-1}$ are the tax risk and tax volatility in year $t-1$ for state s, calculated over a rolling window from year $t-4$ to year $t-1$ (i.e., a total of 4 years). Tax volatility is calculated in three different ways. $\text{Tax Volatility}^{sd}$ is the standard deviation of the year-over-year growth rate of tax revenue. $\text{Tax Volatility}^{g}$ is the mean of the absolute value of the year-over-year growth rate of tax revenue. $\text{Tax Volatility}^{res}$ is the mean of the absolute value of the residualized tax revenue detrended up to a fifth-degree polynomial. $X^k_{i,t}$ is a vector of bond-level control variables, including the taxable status, maturity, seniority of the bond, and whether the bond is issued at a premium, and state-level control variables, including the lagged GDP growth and lagged per-capita personal consumption growth. δ_c is county fixed effects. δ_t is offering year fixed effects in panel (a) and year fixed effects in panel (b). The sample includes all municipal bonds in the U.S. from 2002 to 2023. Robust standard errors, clustered by county and offering year in panel 9a and clustered by county and year in panel 9b, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

(a) Primary Market Yields

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tax Risk		0.032***		0.031***		0.030***	0.029***
		(0.011)		(0.011)		(0.010)	(0.010)
$\text{Tax Volatility}^{sd}$	0.004	0.004					0.011
	(0.008)	(0.007)					(0.012)
$\text{Tax Volatility}^{g}$			-0.005	-0.001			-0.010
			(0.007)	(0.007)			(0.012)
$\text{Tax Volatility}^{res}$					0.017	0.010	0.007
					(0.024)	(0.023)	(0.023)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offering Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.795	0.795	0.795	0.795	0.795	0.795	0.795
Observations	2,887,074	2,887,074	2,887,074	2,887,074	2,887,074	2,887,074	2,887,074

(b) Secondary Market Yields

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tax Risk		0.066***		0.064***		0.066***	0.063***
		(0.017)		(0.017)		(0.019)	(0.018)
Tax Volatility^{sd}	-0.010	-0.011					-0.004
	(0.017)	(0.016)					(0.022)
Tax Volatility^{g}			-0.022	-0.013			-0.013
			(0.015)	(0.015)			(0.018)
Tax Volatility^{res}					0.015	-0.001	0.009
					(0.054)	(0.050)	(0.055)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offering Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.361	0.361	0.361	0.361	0.361	0.361	0.361
Observations	8,195,204	8,195,204	8,195,204	8,195,204	8,195,204	8,195,204	8,195,204

Table 10
Determinants of Tax Risk

This table presents the results of the following regression:

$$\text{Tax Risk}_{s,t} = \beta_0 + \beta_1 \tau_{s,t} + \delta_t + \varepsilon_{s,t},$$

where $\tau_{s,t}$ is either the share of the tax revenue (columns 1 to 3) or the statutory tax rate (columns 4 to 6) of state s in year t coming from personal income tax, corporate income tax, and sales tax. δ_t is year fixed effects. Robust standard errors are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

	Share of Tax Revenue from			Statutory Tax Rate of		
	(1)	(2)	(3)	(4)	(5)	(6)
Personal Income Taxes	0.369***			0.027***		
	(0.122)			(0.010)		
Corporate Income Taxes		0.318***			0.046***	
		(0.112)			(0.011)	
Sales Taxes			-0.379***			0.011
			(0.114)			(0.010)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.420	0.414	0.422	0.419	0.430	0.413
Observations	1,056	1,056	1,056	1,056	1,056	1,056

Table 11
Tax Risk, Municipality Financing Cost, and Government Expenditure

This table presents the results of the second stage regression in the following two-stage procedure:

$$\text{Offering Yield}^{p}_{i,t} = \phi_0 + \phi_1 \text{Tax Risk}_{s,t-1} + \sum_k \gamma^k X^k_{i,t} + \delta_c + \delta_t + \varepsilon_{i,t},$$

$$\text{Expenditure}_{c,p,t+f} = \beta_0 + \beta_1 \widehat{\text{Offering Yield}}_{c,p,t} + \delta_s + \delta_t + \varepsilon_{c,p,t+f}.$$

The first-stage regression is also performed and reported in Table **??**, i.e., the main specification in Table 3 column 2, separately estimated for bonds that raise money for spending category p, including general purpose, school district, public safety, housing, recreational facilities, and transportation. The independent variable in the second stage, $\widehat{\text{Offering Yield}}_{c,p,t}$, is the fitted value from the first stage, $\widehat{\text{Offering Yield}}^{p}_{i,t}$, aggregated (by taking the average) to the county level. The dependent variable in the second stage, $\text{Expenditure}_{c,p,t+f}$, is county c's government expenditure in category p divided by its total expenditure in year $t+f$. The second stage regression is estimated separately for spending categories backed by taxing power (general purpose, school district, and public safety) and spending categories backed by project revenue (housing, recreational facility, and transportation). δ_s and δ_t are state and year fixed effects. Robust standard errors, clustered at the state and year level, are reported in parentheses. Significance levels are indicated by ***, **, and * for the 1%, 5%, and 10% levels, respectively.

(a) Expenditure and Offering Yield Backed by Taxing Power

	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Offering Yield	-2.179**	-2.097**	-2.225**	-2.462***	-2.479***	-2.477**
	(0.978)	(0.912)	(0.875)	(0.847)	(0.848)	(0.857)
Expenditure Year Relative to Bond Offering Year	Current Year	One Year after	Two Years after	Current Year	One Year after	Two Years after
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes
Adjusted R-squared	0.106	0.103	0.103	0.115	0.110	0.109
Observations	45,054	42,773	40,730	45,054	42,773	40,730

(b) Expenditure and Offering Yield Backed by Project Revenue

	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Offering Yield	-0.180	-0.299*	-0.273	-0.219	-0.301*	-0.277
	(0.153)	(0.160)	(0.165)	(0.161)	(0.162)	(0.162)
Expenditure Year Relative to Bond Offering Year	Current Year	One Year after	Two Years after	Current Year	One Year after	Two Years after
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes
Adjusted R-squared	0.054	0.058	0.066	0.060	0.063	0.074
Observations	9,203	8,714	8,220	9,203	8,714	8,220

INTERNET APPENDIX

Internet Appendix

Internet Appendix A County Border Pair Example

This appendix describes the implementation details of the border-discontinuity design based on adjacent counties along state borders.

We implement the border-discontinuity design by forming border county pairs so that each county at a state border is paired with all adjacent counties in a different state. **Figure IA.A1** illustrates the construction in the Oklahoma Panhandle. **Figure IA.A1a** maps the region. **Figure IA.A1b** highlights Sherman County, TX, which borders Cimarron County, OK, and Texas County, OK. We create two county pairs: {Sherman, TX; Cimarron, OK} and {Sherman, TX; Texas, OK}. Therefore, the estimation sample includes

1. All municipal bonds issued in Sherman, TX, and Cimarron, OK, with the county pair ID = {Sherman, TX; Cimarron, OK},

2. And all municipal bonds issued in Sherman, TX, and Texas, OK, with the county pair ID = {Sherman, TX; Texas, OK}

Because some counties border multiple states, bonds from those counties appear in multiple pairs. To avoid over-weighting, each observation is weighted by the inverse of the number of pairings $1/N$.

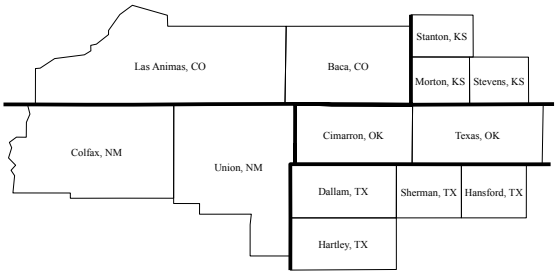
Insert **Figure IA.A1** About Here

Figure IA.A1c shows Cimarron County, OK, which borders five counties outside of Oklahoma: Morton, KS; Baca, CO; Union, NM; Dallam, TX; and Sherman, TX. We cre-

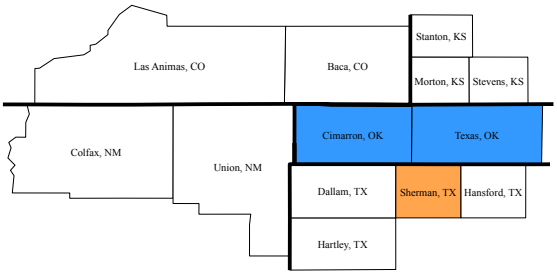
ate four new county pairs: {Cimarron, OK; Morton, KS}, {Cimarron, OK; Baca, CO}, {Cimarron, OK; Union, NM}, and {Cimarron, OK; Dallam, TX}. Along with {Sherman, TX; Cimarron, OK}, which is created above using Sherman, TX as the focal county, these five county pairs capture the cross-border tax risk comparisons for Cimarron, OK. All bonds in Cimarron County, OK appear five times in this sample. We iterate this process for all border counties in the continental U.S. (e.g., **Figure IA.A1d** for Union County, NM), so that the county pairs capture all possible combinations of adjacent counties straddling the state border. Note, we drop interior counties, so county-pair fixed effects ensure comparisons are within county pairs where local economic conditions are similar but tax risk differs.

Figure IA.A1. Border County Pairs for Spatial Discontinuity

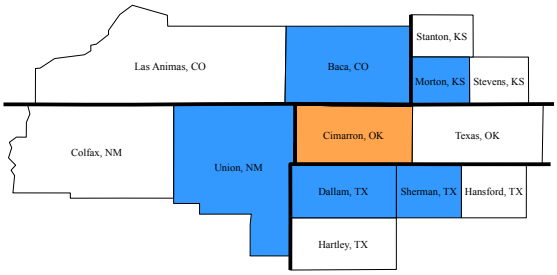
(a) Oklahoma Panhandle



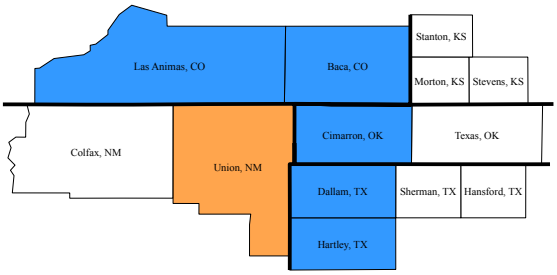
(b) Two County Pairs for Sherman, TX



(c) Five County Pairs for Cimarron, OK



(d) Five County Pairs for Union, NM



This figure depicts the border county pairs used for the spatial discontinuity design. Panel (a) plots counties in the Oklahoma panhandle and its surrounding region, where the thick black line represents the state border. Panel (b) shows that Sherman County, TX has two adjacent counties in other states (both in OK) which form two county pairs: {Sherman, TX; Texas, OK} and {Sherman, TX; Cimarron, OK}. Panel (c) shows the five county pairs corresponding to Cimarron County, OK, across four states (CO, NM, TX, and KS). Panel (d) shows the five county pairs corresponding to Union County, NM, across three states (CO, OK, and TX).

Internet Appendix B Bond Category Mapping

This appendix describes the mapping between the bond categories used in **Tables 8** and **11** and the bond uses in the Mergent Municipal Bond Database.

Table IA.B1
Bond Use Categories and Descriptions

Category	Included Bond Uses
General Purpose	General Purpose/Public Improvement; Government/Public Buildings; Other Public Service
School District	Other Education; Primary/Secondary Education
Police, Fire, Jail	Correctional Facilities/Jails; Courts; Fire Station/Equipment; Police Stations
Housing	CMO-Backed Housing; Multi-Family Housing; New Public Housing; Nursing Homes; Other Housing; Retirement Centers; Single Family Housing; Single/Multi-Family Housing
Recreation	Civic/Convention Centers; Libraries or Museums; Malls/Shopping Centers; Other Recreation; Parks/Zoos/Beaches; Stadiums/Sports Complex; Theaters
Transport	Airlines; Airports; Bridges; Mass/Rapid Transit; Other Transportation; Parking Facilities; Seaports/Marine Terminals; Toll Road and Highway; Tunnels