TRAFFIC CONGESTION AND THE MUNICIPAL BOND MARKET

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Abstract

In this paper, we study how traffic congestion affects bond yields in urban areas of the United States (U.S.). While the adverse effects of congestion — such as increased stress and reduced economic activity — have been well documented, this is the first study that investigates its impact on the municipal bond market. Collecting the annual traffic data from the Urban Mobility Reports that were published by the Texas A&M Transportation Institute, we examine municipal bonds and find that areas with high traffic congestion exhibit significantly higher bond yields. A one standard deviation increase in traffic congestion corresponds to a 12.8 basis-point increase in overall bond yields. Furthermore, we treat the COVID-19 pandemic as a shock that reduced traffic congestion due to public safety precautions. We find that areas experiencing greater reductions in congestion see a greater decrease in bond yields. These findings have implications for infrastructure governance. In particular, our findings imply that the management of infrastructure and implementation of policies which are aimed at reducing traffic congestion may also offer capital market benefits.

Keywords: Traffic Congestion, Infrastructure Governance, Municipal Bonds, COVID-19

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1. INTRODUCTION

Traffic flow is often indicative of a region's success in providing employment opportunities and amenities that attract new residents and increase economic activity. However, traffic congestion can hinder value-creating economic transactions (Sweet, 2011; Weisbrod et al., 2003). Time spent in traffic reduces productivity and constrains economic activity. At the individual level, congestion has been shown to negatively impact health, increasing stress and fatigue (Hennessy & Wiesenthal, 1999; Requia et al., 2018). While the adverse economic and health effects from congestion have been well established, its effect on municipal finance is relatively unexplored.

Our study addresses this gap by examining the relationship between traffic congestion and municipal bond yields. We investigate whether traffic congestion in 494 urban areas influences investors' perceptions of municipal credit risk. Congestion increases credit risk through several channels. First, persistent and severe congestion diminishes the attractiveness of a region for business and new investments. This will weaken a municipality's financial foundation and signal weaker economic prospects. Second, congestion makes a region less attractive and discourages inward migration. This will negatively affect property values and tax assessments. Lastly, congestion implies that a region's infrastructure will need maintenance or upgrading. This suggests higher capital spending, more bond issuances, and higher default risk. Traffic congestion highlights the challenges of municipal infrastructure governance and may cause investors to demand higher yields to compensate for higher risks.

Our empirical analysis focuses on municipal bonds traded between 2018 and 2022. We employ three different measures of traffic congestion —

traffic congestion cost, delay hours, and traffic condition indices — to capture an array of regional traffic burdens. The findings reveal a significantly positive relationship between all three congestion measures and municipal bond yields, suggesting that the borrowing cost is higher for municipalities in highly congested regions. Specifically, the results indicate that a one-standard-deviation increase in the traffic congestion measurement corresponds to a 12.8 basis-point increase in overall bond yields.

Further, we use the COVID-19 pandemic as a shock that led to a dramatic reduction in traffic congestion due to public health precautions. We examine how bond yields will be affected by this reduction in traffic. Comparing bond yields one year prior to the pandemic to those during the pandemic, we hypothesize and find that bond yields declined more in regions that had higher traffic congestion before the pandemic relative to regions with lower pre-pandemic congestion.

This study makes a timely contribution by demonstrating a positive relationship between traffic congestion and municipal bond yields. While the adverse effects of congestion have been extensively studied, to our knowledge, this is the first study that investigates its impact on the municipal bond market. Our findings highlight the importance of the governance framework for infrastructure. First, our findings suggest the importance of proper management, maintenance, and upgrading of infrastructure in order to reduce congestion. This implies higher capital spending and highlights the need for greater accountability. We contribute to the discussion of public-private partnerships (PPPs) as a potential avenue for the management and funding of infrastructure projects (Moro Visconti, 2017). Second, our findings indicate that policies such as congestion pricing may have capital market benefits. Recently, New York City became the first region in the United States (U.S.) to implement a congestion pricing plan. While the economic and health effects of congestion are well-documented, our study implies that reduced traffic may benefit municipalities in terms of lower bond yields.

The remainder of this paper is organized as follows. Section 2 provides background and develops the hypothesis. Section 3 describes the data and sample. Section 4 outlines the methodology and presents the results. Section 5 concludes the paper.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1. Municipal bond market

The municipal bond market is a large component of U.S. capital markets, with $4.2 trillion in municipal bonds outstanding as of the third quarter of 2024 (Securities Industry and Financial Markets Association [SIFMA], 2025). States, counties, cities, and local public entities issue municipal bonds to finance infrastructure projects such as schools, parks, roads, highways, water and sewer systems, and utility networks, including electric and gas. Municipal bonds typically offer tax-exempt interest to investors, enabling them to support public infrastructure. These bonds consist of general obligation bonds, revenue bonds, and public improvement bonds. General obligation bonds are backed by the creditworthiness of the issuing entity, which has the authority to raise taxes to create enough funds to pay the principal and interest back to bondholders to fulfill debt obligations. In contrast, revenue bonds are secured by revenue generated by specific projects. Examples include airport revenue bonds, toll revenue bonds, hospital revenue bonds, utility revenue bonds, and mortgage revenue bonds.

Municipal bonds tend to be attractive to investors, especially retail investors who may be less sophisticated (Tang & Li, 2021). First, investors can benefit from investing in municipal bonds, as the interest on the bonds is often exempt from federal income tax and, in some instances, state income tax if the investor resides in the same state as the issuing municipality. This tax advantage is especially appealing to residents of states with high income tax rates (Babina et al., 2021). Second, municipal bonds have historically exhibited very low default rates. A comprehensive study by Moody's found that from 1970 to 2009, the average five-year cumulative default rate for investment-grade municipal bonds was just 0.03% (Pylypczak, 2011). Third, some municipal bonds come with bond insurance as a form of credit enhancement, which guarantees principal and interest payments in the event of issuer default. Bond issuers pay a premium for this insurance, which can reduce their cost of borrowing (Nanda & Singh, 2004).

A growing body of literature explores the determinants of borrowing costs in the municipal bond market. Previous studies examine the effects of tax policy (Ayers et al., 2005; Babina et al., 2021). Gao et al. (2019) find that state policies influence the borrowing costs of financially distressed municipalities. Other research explores the impact of financial reporting on the municipal bond market. For instance, Baber and Gore (2008) show that adherence to Generally Accepted Accounting Principles (GAAP) reduces municipal borrowing costs and contracting costs between borrowers and lenders. Baber et al. (2013) find that financial restatements increase the cost of municipal debt. Further, social capital has been shown to have an impact on the municipal bond market (Li et al., 2018). A recent study by Li et al. (2024) demonstrates that political polarization leads to higher borrowing costs: the more polarized the state, the higher the borrowing cost.

2.2. Traffic congestion

Transportation infrastructure plays a key role in urban growth. Berechman et al. (2006) find a strong correlation between local economic development and investment in transportation infrastructure, including the long-term spillover effects of such investments. Efficient transportation infrastructure is crucial for economic development as it directly impacts a region's productivity and overall quality of life. Efficient transportation systems are essential for regional productivity and overall quality of life. Moreover, efficient transportation enables businesses to access a broader labor market and deliver goods and services quickly and reliably, thereby promoting sustained economic growth.

On the other hand, traffic congestion imposes significant time and economic costs on commuters and society. Graham (2007) demonstrates that congestion reduces firm productivity in the United Kingdom. Sweet (2011) finds that longer commutes delay task completion, reducing the volume of value-creating transactions. McKinnon et al. (2009) also note that congestion interferes with logistics operations, causing delays and operational inefficiencies. According to the 2023 Urban Mobility Report from the Texas A&M Transportation Institute, traffic congestion leads U.S. commuters to spend roughly 54 hours per year stuck in traffic and imposes an annual economic cost of $179 billion. In response, policymakers have adopted a variety of strategies to mitigate congestion, including improving infrastructure, promoting alternative transportation options, and implementing intelligent transportation systems (Barth & Boriboonsomsin, 2008; Cheng et al., 2020). To address severe congestion, cities such as New York, London, Stockholm, and Singapore have implemented congestion pricing programs. In New York City, passenger cars and small commercial vehicles are charged a toll of $9 to access the most heavily trafficked areas of Manhattan during peak hours. The Metropolitan Transportation Authority (MTA) expects the program to generate approximately $500 million annually in its first three years, and then $700 million per year following toll increases. New York City is the first city in the U.S. to adopt a congestion pricing plan, highlighting the issue's importance from a policy perspective. The toll revenue has enabled the MTA to issue $500 million in short-term notes to finance capital projects. The agency plans to leverage future toll revenues to issue additional municipal bonds for further infrastructure development.

Traffic congestion also has detrimental environmental impacts, contributing to increased fuel consumption and elevated air pollutant emissions, which pose significant health risks. According to the U.S. Environmental Protection Agency (US EPA), the average passenger vehicle emits roughly 4.6 metric tons of carbon dioxide (CO_2) each year. Congestion increases these emissions, prompting researchers to develop strategies aimed at reducing CO_2 output (Barth & Boriboonsomsin, 2008). Crüts et al. (2008) find that exposure to diesel exhaust triggers a stress response in the human brain. Additional studies indicate that congestion negatively affects health by increasing commuter stress and fatigue (Hennessy & Wiesenthal, 1999; Requia et al., 2018). Hennessy (2008) further shows that traffic congestion results in heightened driver aggression and workplace hostility. Currie and Walker (2011) examine the effects of traffic congestion on birth outcomes, finding that reduced congestion is linked to lower rates of premature birth and low birth weight. Hao and Pham (2024) find that auditors incorporate traffic congestion into their risk assessments and adjust audit fees accordingly.

2.3. Hypothesis development

Efficient traffic flow is a measure of a region's success in providing transportation infrastructure and amenities that attract new residents and stimulate economic activity. Traffic congestion, however, wastes commuters' time, reduces fuel efficiency, and increases costs for businesses. Business faces higher transportation costs due to longer travel times and increased operating expenses, which may impact competitiveness (Graham, 2007; McKinnon et al., 2009). Literature indicates that traffic congestion disrupts regional productivity and lowers economic output (Graham, 2007; McKinnon et al., 2009; Sweet, 2011). Constant and severe congestion reduces the attractiveness of a region for business, particularly those dependent on efficient logistics or a mobile workforce. The cumulative effect of congestion on business can significantly inhibit regional economic output. Weisbrod et al. (2003) show that traffic congestion limits the markets that businesses can serve and undermines the agglomeration benefits for firms operating in urban areas, with particularly severe impacts on industries that are more sensitive to travel delays. We propose that municipal bond investors may view traffic congestion as a risk factor, as it can suppress economic activity within a municipality.

Sustained and severe traffic congestion can negatively impact a municipality's tax base. Reduced regional productivity and slower economic growth due to congestion may lead to lower revenue sources and weaken the municipal tax base, such as income taxes, sales taxes, and business taxes. A weakened tax base negatively impacts a municipality's capability to set up enough funds to serve existing debt and fund essential public services.

Traffic congestion can also make a region less attractive for investment and talent. If congestion leads to a perception of declining quality of life or economic opportunity, it could undesirably influence regional property values or their rate of growth. As a result, it affects property tax revenues, which are an important income source for municipalities. This may become a primary concern for bond investors and result in them demanding high-risk compensation.

Traffic congestion indicates an overloaded transportation infrastructure, creating pressure for municipalities to increase public expenditure. Because state and local governments have the responsibility for the majority of public spending on roads, bridges, and transit systems, municipalities may experience high maintenance costs for existing infrastructure due to wear and tear from heavy traffic. Meanwhile, they may also face greater demands for investment in new transportation infrastructure to alleviate congestion. The increased infrastructure spending increases budgets and may lead to more municipal bond issuance. The increased supply of municipal bonds with higher perceived risk due to reduced regional productivity may lead to higher municipal bond yields. This will lead to higher borrowing costs, since investors would demand a higher premium to compensate for the risk.

Overall, traffic congestion signals the challenges of a municipality's infrastructure governance, which weakens a municipality's financial foundation, thereby potentially impacting its creditworthiness and bond yields. Investors may perceive traffic congestion as weaker economic prospects or less effective governance. Such perception may lead investors to demand a higher yield to compensate for these risks.

H1: Ceteris paribus, the bond yields are higher for regions with high traffic congestion than for regions with low traffic congestion.

3. RESEARCH METHODOLOGY

3.1. Measuring traffic congestion

This study collects the annual traffic data from the Urban Mobility Reports, published by the Texas A&M Transportation Institute each year since 1987. These reports provide detailed traffic condition data for 494 urban areas in the U.S. and have been widely cited by major publications, broadcast outlets, and academic research.

To assess the relationship between traffic congestion and municipal bond yields, this study uses three measures of traffic congestion, each capturing congestion-related costs from a different perspective:

1) total annual congestion cost;
2) total annual delay hours;
3) travel time index.

First, total annual congestion cost estimates the combined economic cost of wasted time and increased fuel consumption. This measure reflects both recurring and non-recurring sources of delay, capturing the total annual cost of congestion in a given area (denoted as *CongestionCost*). Recurring congestion occurs predictably at specific times and locations due to high traffic volumes. Whereas non-recurrent congestion results from unexpected events such as accidents, weather conditions, or roadwork. Second, to quantify the time lost, we use total annual hours of delay, measured in person-hours. This metric estimates the cumulative number of hours commuters lose due to congestion throughout the year (denoted as *DelayHour*). Third, the travel time index (denoted as *TravelTime*) is the ratio of the average travel time during peak congestion periods to travel time under free-flow conditions for the same period. This index captures both recurring and non-recurring congestion and specifies the additional time needed for any commute during peak periods. For example, a travel time index of 1.50 implies that a 30-minute free-flow trip would take 45 minutes during peak congestion periods. Table 1 presents the average values of these three traffic congestion measurements for the period from 2018 to 2022.

Table 1. Average traffic congestion measurements

Year	*Total annual congestion Cost(CongestionCost, $ million)*	*Total annual hours of delay (DelayHour, person-hours)*	*Travel time index (TravelTime)*
2018	435	17,787,000	1.12
2019	440	18,073,000	1.02
2020	228	9,011,000	1.06
2021	391	14,601,000	1.11
2022	453	17,115,000	1.12

3.2. Sample construction

To construct the sample, we use secondary market data from 2018 to 2022, obtained from the Municipal Securities Rulemaking Board (MSRB). The dataset provides detailed trading information for municipal bonds, including trade date, price, trade volume, bond identifier, and other key variables. Following Downing and Zhang (2004), we restrict the sample to customer buy orders. For each bond, we calculate a volume-weighted yield per week as the dependent variable (*WeightedYields*). In addition, we obtain the yields of U.S. Treasury securities from the Federal Reserve and compute yield spreads by using Treasury yields as a benchmark to control for market-wide risk. Specifically, the spread is calculated as the difference between a weighted municipal bond yield and a benchmark Treasury yield matched by time to maturity and trade date. The Treasury yield curve is estimated using the methodology of Gürkaynak et al. (2007) and Svensson (1994), which allows for a flexible yet parsimonious fit to observed yield spreads; in turn, this avoids overfitting the yields of individual securities. For bonds with maturities exceeding 30 years, we use the U.S. 30-year Treasury yield as the benchmark. The final sample comprises 791,815 observations over the five-year period from 2018 to 2022.

We supplement this dataset with bond characteristics from the Mergent Municipal Bond Securities Database (Mergent). We control for several factors, including: 1) maturity, 2) bond size, 3) credit rating, 4) insurance, 5) issuance method, 6) zero coupon, and 7) bank qualified indicator (Hastie, 1972).

First, maturity is measured in years by calculating the number of days between the trade date and the bond's maturity date, divided by 365 (*Maturity*).

Second, we measure bond size as the natural logarithm of the bond's principal amount plus one (*BondSize*).

Third, to control for credit risk, we apply S&P credit ratings and convert them into a numerical scale (Kao & Wu, 1994). Table A.1 (see Appendix) provides details on the transformation of S&P rating levels into numerical codes.

Fourth, we include an indicator variable, Insurance, to capture whether the bond is protected by bond insurance (Nanda & Singh, 2004).

Fifth, we control for bond type, recognizing that general obligation bonds are generally less risky because they are backed by the full faith and credit of the issuer, whereas revenue bonds may be riskier because they rely on project-specific revenue streams, and investors demand higher bond yields as compensation for higher risk.

Sixth, Blackwell and Kidwell (1988) indicate that bond issuing cost differentiates between public sales and private placement. To control for the impact of the sale method on bond issuing cost, we create a dummy variable named *Competitive* to represent the sale methods.

Seventh, puttable bonds offer bondholders the right to require early repayment from issuers, and the yields of bonds with a puttable option are normally lower. We create an indicator variable named *Puttable* to control for the impact of the puttable feature on bond yields.

Eighth, some bonds are issued with the feature allowing banks to deduct the interest expense for purchasing or carrying them. We include an indicator variable named *BankQualified* to capture this feature.

Ninth, some bonds are issued without paying any interest during the life of the bonds. We include a control variable named *ZeroCoupon* to capture the feature. Table A.2 (see Appendix) provides the details for these variables. All continuous variables are winsorized at 1%. The bond characteristics are matched with the secondary market data by the Committee on Uniform Securities Identification Procedures (CUSIP).

To control for county-level demographic factors that may affect municipal bond yields, we include variables such as *Population*, per capita *Income*, state tax rates (*StateTax*), *Unemployment* rate, and gross domestic product (*GDP*).

First, county-level population data is collected from the Urban Mobility Reports (*Population*). We take the natural logarithm of this variable before including it in the analysis. Second, per capita income at the county level is obtained from the U.S. Census Bureau and is adjusted for inflation using the consumer price index (*Income*). Third, because tax exemption can benefit bondholders who live in the same state as the bond issuer — particularly in states with high income tax rates — we include the maximum state income tax rate as a control variable (*StateTax*). This data is collected from the National Bureau of Economic Research. To control for the broader economic conditions of each county, we include the unemployment rate and GDP. Annual county-level unemployment data is sourced from the U.S. Bureau of Labor Statistics (*Unemployment*), and county-level *GDP* data is collected from the Bureau of Economic Analysis. We use the natural logarithm of *GDP* in the analysis.

To control for macroeconomic factors, we include the Bond Buyer index, a widely used daily index of highly rated, long-term municipal bonds. The index consists of 20 general obligation bonds with maturities of 20 years, and its average rating is roughly equivalent to AA (has very strong capacity to meet its financial commitments) on the S&P scale.

Table 2 presents descriptive statistics for the sample. The average volume-weighted yield is 1.82%, with an average maturity of 13.82 years. The average natural logarithm of bond size is 15.48. For traffic variables, the average natural logarithm of total annual congestion cost is 21.24, the average natural logarithm of total annual delay hours is 18.10, and the average travel time index is 1.25.

Table A.3 (see Appendix) presents a Pearson correlation matrix. Correlation coefficients that are statistically significant at the 1% level or lower are marked with an asterisk. We observe that the Pearson correlations between bond yields and traffic congestion measurements are positive and statistically significant at the 1% level. Additionally, there is a strong positive and significant correlation between traffic congestion and county-level GDP. We also find that the Pearson correlations between traffic congestion and income per capita are positive and significant at the 1% level.

Table 2. Summary statistics

Variable	***Full sample***							
	N	***Mean***	***Std. dev.***	***Min***	***Max***	***1st quartile***	***2nd quartile***	***3rd quartile***
WeightedYields	791,815	1.82	1.40	-10.12	5.87	1.09	1.80	2.57
YieldSpreads	791,815	-0.23	1.22	-12.18	3.50	-0.68	-0.28	0.23
CongestionCost	791,815	21.24	1.57	0.00	23.87	20.25	21.49	22.42
DelayHour	791,815	18.10	1.52	8.99	20.69	17.10	18.36	19.28
TravelTime	791,815	1.25	0.10	1.01	1.51	1.17	1.25	1.33
Covid	791,815	0.19	0.39	0.00	1.00	0.00	0.00	0.00
Maturity	791,815	13.82	6.89	2.76	35.41	8.81	12.23	17.68
BondSize	791,815	15.48	1.34	11.85	19.02	14.60	15.48	16.38
Rating	791,815	0.04	2.19	-1.00	6.00	-1.00	-1.00	-1.00
Insurance	791,815	0.13	0.33	0.00	1.00	0.00	0.00	0.00
General	791,815	0.46	0.50	0.00	1.00	0.00	0.00	1.00
Revenue	791,815	0.22	0.41	0.00	1.00	0.00	0.00	0.00
Puttable	791,815	0.00	0.02	0.00	1.00	0.00	0.00	0.00
BankQualified	791,815	0.04	0.20	0.00	1.00	0.00	0.00	0.00
Competitive	791,815	0.45	0.50	0.00	1.00	0.00	0.00	1.00
ZeroCoupon	791,815	0.01	0.11	0.00	1.00	0.00	0.00	0.00
Population	791,815	14.57	1.25	10.97	16.76	13.82	14.76	15.45
Unemployment	791,815	5.80	2.13	2.10	24.20	4.30	5.30	6.90
StateTax	791,815	4.81	4.28	0.00	14.10	0.00	5.00	6.89
GDP	791,815	31.51	1.26	27.40	34.09	30.79	31.64	32.34
Income	791,815	9.50	0.23	8.93	10.10	9.35	9.45	9.63
BondBuyer	791,815	2.47	0.79	1.06	4.28	1.91	2.51	2.98
TreasuryYield	791,815	2.04	1.08	0.08	4.83	1.25	2.21	2.86

4. RESEARCH RESULTS

4.1. Bond yields and traffic congestion

To examine the effect of traffic congestion on bond yields, we estimate Eq. (1) using ordinary least squares (OLS) regression analysis. The dependent variable in the equation is the volume-weighted weekly yield for each bond. The key independent variables of interest are the traffic congestion measures: total annual delay hours, total annual congestion costs, and travel time index, as previously defined. We control for various bond characteristics, including bond size, time to maturity, credit rating, bond type, presence of a puttable option, bank-qualified status, competitive sale method, and zero-coupon structure. In addition, we include county-level demographic controls such as population, unemployment rate, state income tax rate, and county-level GDP. Last, we account for macroeconomic conditions using the Bond Buyer index.

$$\begin{aligned} WeightedYields = \beta_0 + \beta_1 TrafficMeasurement + \beta_2 Maturity + \beta_3 BondSize + \beta_4 Rating + \beta_5 Insurance \\ + \beta_6 General + \beta_7 Revenue + \beta_8 Puttable + \beta_9 BankQualified + \beta_{10} Competitive + \beta_{11} ZeroCoupon \\ + \beta_{12} Population + \beta_{13} Unemployment + \beta_{14} StateTax + \beta_{15} GDP + \beta_{16} Income + \beta_{17} BondBuyer + \varepsilon \end{aligned} \quad (1)$$

We include year fixed effects and state fixed effects in Eq. (1). The standard errors are clustered at the urban area level. Table 3 presents the regression results from estimating Eq. (1). The coefficients on control variables are consistent with our prediction. For example, bonds with longer maturities, smaller sizes, or lower credit ratings are associated with higher yields. Model 1 in Table 3 reports that the coefficient on total annual congestion cost is 0.744, which is positive and statistically significant at the 1% level. Specifically, the results show that 1% increase in total annual congestion cost accompanies an increase of 0.0074 in bond yields. Model 2 shows that the coefficient on total annual delay hours is 0.517, also positive and statistically significant at the 1% level. Model 3 reports that the coefficient on the travel time index is positive and statistically significant at the 1% level. A one-standard-deviation increase in the travel time index (0.10) corresponds to a 12.8 basis-point increase in overall bond yields (1.278 × 0.10). This is consistent with traffic congestion increasing the borrowing cost of a municipality. These results support hypothesis *H1*: namely, that bond yields are higher in regions with greater traffic congestion compared to those with lower traffic congestion. This is consistent with the observation that traffic congestion increases the borrowing costs incurred by municipalities.

Table 3. Impact of traffic congestion on bond yields

Variable	*Model 1*		*Model 2*		*Model 3*	
	Coefficient	*T-stat*	*Coefficient*	*T-stat*	*Coefficient*	*T-stat*
CongestionCost	**0.744*** **	**5.37**				
DelayHour			**0.517*** **	**4.20**		
TravelTime					**1.278*** **	**2.74**
Maturity	0.049***	22.04	0.048***	21.62	0.048***	21.62
BondSize	-0.033**	-2.49	-0.035**	-2.55	-0.037***	-2.64
Rating	-0.026***	-3.25	-0.028***	-3.34	-0.028***	-3.35
Insurance	-0.042	-0.78	-0.053	-0.92	-0.057	-0.97
General	-0.106***	-3.79	-0.102***	-3.63	-0.097***	-3.45
Revenue	-0.101***	-3.52	-0.091***	-3.10	-0.083***	-2.80
Puttable	2.453***	8.38	2.431***	8.36	2.360***	8.09
BankQualified	-0.054	-1.53	-0.049	-1.37	-0.047	-1.30
Competitive	-0.028	-0.83	-0.021	-0.63	-0.018	-0.54
ZeroCoupon	0.540***	4.73	0.488***	4.15	0.466***	3.85
Population	-0.914***	-5.58	-0.647***	-4.43	-0.104***	-3.59
Unemployment	-0.090***	-8.59	-0.101***	-9.95	-0.107***	-10.53
StateTax	-0.036	-1.25	-0.032	-1.05	-0.040	-1.26
GDP	0.011	0.70	0.013	0.85	0.016	1.11
Income	-0.680***	-8.58	-0.666***	-8.09	-0.652***	-7.47
BondBuyer	0.852***	126.99	0.852***	126.91	0.852***	126.54
Intercept	4.534	5.46	6.867	8.17	6.335	7.61
Year fixed effect	Included		Included		Included	
State fixed effect	Included		Included		Included	
N	791,815		791,815		791,815	
R-squared	36.70%		36.36%		36.17%	

*Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-sided), respectively.*

To capture the risk component in the bond yields, we use Treasury bonds as a risk-free benchmark to adjust bond yields, providing an alternative method to examine the impact of traffic congestion on bond risk. Specifically, we compute the yield spreads as the difference between the bond yields and the benchmark Treasury yields, matched by time to maturity and trade date. In this specification, bond yields in Eq. (1) are replaced by yield spreads as the dependent variable. We re-estimate Eq. (1) using the dependent variable and report the results in Table 4. The coefficients on the control variables remain generally consistent with our expectations. The coefficients on all three traffic congestion measures are positive and statistically significantly positive at the 1% level, respectively. These results further support hypothesis *H1*, suggesting that traffic congestion contributes to higher perceived risk in municipal bonds.

Table 4. Impact of traffic congestion on yield spreads

Variable	*Model 1*		*Model 2*		*Model 3*	
	Coefficient	*T-stat*	*Coefficient*	*T-stat*	*Coefficient*	*T-stat*
CongestionCost	**0.634*** **	**5.21**				
DelayHour			**0.458*** **	**4.19**		
TravelTime					**1.215*** **	**2.95**
Maturity	0.011***	5.09	0.011***	4.87	0.011***	4.81
BondSize	-0.022*	-1.70	-0.024*	-1.77	-0.025*	-1.87
Rating	-0.021***	-2.75	-0.022***	-2.86	-0.022***	-2.87
Insurance	-0.027	-0.58	-0.036	-0.74	-0.040	-0.80
General	-0.105***	-4.00	-0.102***	-3.87	-0.098***	-3.70
Revenue	-0.107***	-3.94	-0.099***	-3.58	-0.092***	-3.33
Puttable	2.137***	8.58	2.121***	8.61	2.058***	8.46
BankQualified	-0.055	-1.60	-0.050	-1.46	-0.049	-1.41
Competitive	-0.037	-1.17	-0.032	-1.00	-0.029	-0.93
ZeroCoupon	0.645***	6.47	0.602***	5.93	0.584***	5.59
Population	-0.781***	-5.41	-0.573***	-4.41	-0.097***	-3.76
Unemployment	-0.061***	-5.99	-0.071***	-7.10	-0.076***	-7.65
StateTax	-0.042	-1.58	-0.039	-1.39	-0.047	-1.60
GDP	0.005	0.39	0.007	0.52	0.010	0.75
Income	-0.530***	-7.53	-0.521***	-7.06	-0.515***	-6.59
BondBuyer	-0.343***	-36.57	-0.343***	-36.60	-0.343***	-36.57
Intercept	4.528	6.28	6.547	8.76	6.097	8.19
Year fixed effect	Included		Included		Included	
State fixed effect	Included		Included		Included	
N	791,815		791,815		791,815	
R-squared	14.73%		14.42%		14.24%	

*Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-sided), respectively.*

Our results offer new evidence regarding the negative effect of congestion on municipal bond yields. While municipal bonds are an important capital market, most studies have focused on factors such as social capital (Li et al., 2018), climate change (Painter, 2020), rating recalibration (Cornaggia et al., 2018; Tang & Li, 2021), and political polarization (Chen et al., 2022; Li et al., 2024). Our findings examine the unique factor, traffic congestion, and show that high congestion can result in higher bond yields for municipalities.

4.2. Bond yields and traffic congestion during COVID-19

COVID-19, first identified in December 2019, is a contagious disease caused by the SARS-CoV-2 virus and is associated with severe acute respiratory symptoms, including fever, cough, and loss of taste or smell. The disease spread rapidly and subsequently triggered a global economic crisis. The pandemic created a rare phenomenon in which businesses shut down and nonessential personnel began working from home. With many jurisdictions enacting stay-at-home orders, traffic volumes declined dramatically, especially during weekday rush hours. According to the Urban Mobility Report (Texas A&M Transportation Institute, 2021), traffic in early 2020 decreased by nearly 50% compared to the same period in 2019. Moreover, any remaining traffic was spread more evenly across the day, as remote work reduced the need for commuting during peak hours, thereby reducing traffic congestion during those times.

Using COVID-19 as a shock to traffic congestion, this study examines the impact of traffic congestion on municipal bond yields by comparing the years 2019 (pre-COVID) to 2020 (during COVID). The Urban Mobility Report 2021 from the Texas A&M Transportation Institute shows that COVID-19 made traffic congestion disappear but not for a long time, and traffic congestion came back to normal in 2021. To capture the COVID-19 impact, we use one year before and one year during the outbreak of COVID-19. We create indicator variables to capture areas with high traffic congestion on each of the three congestion metrics. The high traffic indicator has a value of one for bonds located in areas with traffic congestion levels at or above 75%, and zero otherwise. We also generate a dummy variable named *Covid*, which equals one for observations from the year 2020, and zero otherwise. The variable of interest is the interaction term between the high traffic indicator and the *Covid* variable. The dependent variable is the volume-weighted bond yield. A negative coefficient on this interaction term would suggest that municipal bonds in high-congestion areas experienced a larger decrease in yields during the COVID period, relative to those in low-congestion areas.

$$WeightedYields = \gamma_0 + \gamma_1 HighTraffic * Covid + \gamma_2 HighTraffic + \gamma_3 Covid + \gamma_4 Maturity + \gamma_5 BondSize + \gamma_6 Rating + \gamma_7 Insurance + \gamma_8 General + \gamma_9 Revenue + \gamma_{10} Puttable + \gamma_{11} BankQualified + \gamma_{12} Competitive + \gamma_{13} ZeroCoupon + \gamma_{14} Population + \gamma_{15} Unemployment + \gamma_{16} StateTax + \gamma_{17} GDP + \gamma_{18} Income + \gamma_{19} BondBuyer + \varepsilon \quad (2)$$

Year fixed effects and state fixed effects are both included in the analysis. Standard errors are clustered at the urban level. The final sample consists of 316,749 total observations, including 166,440 observations from the pre-COVID period and 150,309 observations from the COVID period.

Table 5. Impact of traffic congestion on bond yields during COVID-19

Variable	***Model 1***		***Model 2***		***Model 3***	
	Coefficient	***T-stat***	***Coefficient***	***T-stat***	***Coefficient***	***T-stat***
HighCongestion * Covid	**-0.069****	**-2.23**				
HighCongestion	0.230***	3.33				
HighDelay * Covid			**-0.085****	**-2.06**		
HighDelay			0.295***	4.75		
HighTravelTime * Covid					**-0.112*****	**-3.07**
HighTravelTime					0.236***	2.64
Covid	-0.098***	-7.28	-0.101***	-7.88	-0.094***	-7.11
Maturity	0.045***	19.29	0.044***	18.88	0.045***	19.21
BondSize	-0.034**	-2.54	-0.033**	-2.60	-0.035***	-2.64
Rating	-0.024***	-3.10	-0.023***	-3.19	-0.024***	-3.28
Insurance	-0.072	-1.28	-0.066	-1.28	-0.083	-1.56
General	-0.142***	-4.70	-0.131***	-4.17	-0.137***	-4.51
Revenue	-0.100***	-3.14	-0.099***	-3.13	-0.098***	-3.10
Puttable	2.909***	11.97	2.886***	11.81	2.917***	11.97
BankQualified	-0.041	-1.15	-0.014	-0.42	-0.038	-1.06
Competitive	-0.053	-1.56	-0.090**	-2.43	-0.060*	-1.81
ZeroCoupon	0.391***	3.66	0.491***	4.83	0.394***	3.71
Population	-0.075***	-4.10	-0.063***	-4.00	-0.052***	-3.33
Unemployment	-0.086***	-9.77	-0.076***	-8.20	-0.085***	-9.54
StateTax	-0.028	-0.93	-0.001	-0.03	-0.033	-1.07
GDP	0.017	1.31	0.008	0.40	0.014	1.02
Income	-0.523***	-7.22	-0.498***	-6.61	-0.548***	-6.69
BondBuyer	0.422***	50.34	0.421***	49.54	0.422***	49.32
Intercept	7.193	9.05	6.782	8.76	7.268	7.79
Year fixed effect	Included		Included		Included	
State fixed effect	Included		Included		Included	
N	316,749		316,749		316,749	
R-squared	16.48%		16.18%		16.44%	

*Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-sided), respectively.*

Table 5 presents the regression results. The results show that the interaction between the *Covid* variable and high traffic indicators is negative and statistically significant for three different traffic congestion metrics. This result shows that a drastic reduction in congestion due to COVID-19 also reduced bond yields. In particular, municipalities that previously had high congestion and experienced a greater reduction in congestion due to COVID-19 experienced a greater reduction in bond yields. This is consistent with our main findings and shows that lower congestion results in lower bond yields.

Furthermore, we substitute yield spreads for bond yields in Eq. (2) to further examine the impact of COVID-19 on bond risk. Eq. (2) is re-estimated using yield spreads as the dependent variable, and the result is reported in Table 6. The coefficients on the interaction terms between the *Covid* indicator and the high traffic indicators are positive and statistically significant for three different traffic congestion measures. This indicates a larger reduction in yield spreads during the COVID period for areas that previously had high traffic congestion. These findings further confirm that traffic congestion affects municipal bond yields and, as a result, support *H1*.

Table 6. Impact of traffic congestion on yield spreads during COVID-19

Variable	***Model 1***		***Model 2***		***Model 3***	
	Coefficient	***T-stat***	***Coefficient***	***T-stat***	***Coefficient***	***T-stat***
HighCongestion * Covid	**-0.068****	**-2.01**				
HighCongestion	0.202***	3.02				
HighDelay * Covid			**-0.077***	**-1.69**		
HighDelay			0.259***	4.45		
HighTravelTime * Covid					**-0.096****	**-2.28**
HighTravelTime					0.216**	2.54
Covid	0.095***	7.26	0.089***	6.83	0.095***	6.59
Maturity	0.010***	4.22	0.009***	3.91	0.010***	4.23
BondSize	-0.030**	-2.35	-0.029**	-2.37	-0.031**	-2.44
Rating	-0.019***	-2.61	-0.018***	-2.69	-0.019***	-2.77
Insurance	-0.057	-1.15	-0.050	-1.08	-0.068	-1.43
General	-0.132***	-4.55	-0.121***	-4.02	-0.128***	-4.43
Revenue	-0.099***	-3.26	-0.099***	-3.25	-0.098***	-3.24
Puttable	2.349***	10.58	2.327***	10.33	2.355***	10.72
BankQualified	-0.057	-1.61	-0.032	-0.96	-0.055	-1.55
Competitive	-0.056*	-1.72	-0.091**	-2.56	-0.062**	-1.96
ZeroCoupon	0.508***	5.73	0.609***	7.23	0.512***	5.77
Population	-0.064***	-3.77	-0.053***	-3.76	-0.047***	-3.28
Unemployment	-0.060***	-7.01	-0.051***	-5.59	-0.060***	-6.83
StateTax	-0.036	-1.23	-0.004	-0.18	-0.039	-1.36
GDP	0.014	1.20	0.005	0.28	0.011	0.91
Income	-0.413***	-6.09	-0.393***	-5.41	-0.440***	-5.76
BondBuyer	-0.678***	-85.78	-0.679***	-84.78	-0.678***	-84.48
Intercept	6.823	9.09	6.505	8.74	6.963	8.01
Year fixed effect	Included		Included		Included	
State fixed effect	Included		Included		Included	
N	316,749		316,749		316,749	
R-squared	18.09%		17.78%		18.07%	

*Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (two-sided), respectively.*

4.3. Discussion of the results

The results show that traffic congestion has a negative capital market consequence and results in higher bond yields for municipalities. By highlighting a direct connection to municipal finance, policymakers would have a stronger fiscal argument for prioritizing projects and policies aimed at alleviating traffic congestion. In particular, our results suggest the importance of proper management, maintenance, and upgrading of infrastructure to reduce congestion. This implies higher capital spending but also suggests that expenditures that reduce congestion could be potentially offset by lower borrowing costs. We also contribute to the discussion of PPPs as a potential avenue for the management and funding of infrastructure projects.

As an alternative to updating and improving infrastructure, congestion can also be decreased by incentivizing public transportation over private vehicles. Major metropolitan areas such as New York City have adopted a congestion pricing plan, which attempts to reduce congestion by increasing tolls during peak commuting times. This approach results in increased toll revenues and increases demand for public transportation. Municipalities may need to invest more in mass transportation and may also benefit from lower bond yields.

5. CONCLUSION

This study investigates how traffic congestion influences the municipal bond market. Prior research suggests that greater congestion may negatively impact a region's economy by reducing economic activity and public health. While the adverse effects of traffic congestion on businesses, commuter well-being, and economic performance are well documented, little is known about whether and/or how municipal bond investors assess the risk of traffic congestion on a region's municipal bonds. This study addresses this gap by examining the effect of traffic congestion on municipal bonds. Our findings are consistent with the literature and reveal a negative capital market consequence: namely, that municipal bond yields are higher in urban areas with elevated traffic congestion.

Additionally, by using the COVID-19 pandemic as a shock to traffic conditions, we find that areas with previously high congestion experienced a more significant decrease in bond yields during the pandemic. This paper has important implications for infrastructure governance. The findings suggest the importance of proper management and upgrading of infrastructure in order to reduce congestion. This implies higher capital spending and highlights the need for greater accountability.

Our study is subject to various limitations. First, while our results show that congestion is associated with higher bond yields, there may be other unobserved effects. In particular, we do not directly observe the effect of traffic on bond yields. Second, the traffic congestion data is limited to 2022, and recent developments, which include employers encouraging workers to go back to the office, are not reflected in this study. We encourage future research to extend our study to recent events that may alter commuting and traffic patterns. We also encourage alternative research designs that may provide more direct evidence of congestion on bond yields.

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APPENDIX

Table A.1. Classification of bond ratings

S&P rating	*Numerical code*
AAA, AA+	6
AA, AA-	5
A+, A, A-	4
BBB+, BBB	3
Below BBB-	2
Not rated	-1

Table A.2. Variable measurement

Variable name	*Description and measurement*
Dependent variables	
WeightedYields	A volume-weighted yield for each bond per week, calculated using secondary market trades.
YieldSpread	The difference between the volume-weighted yield and the yield of a benchmark U.S. Treasury bond, matched by time to maturity and trade date.
Variables of interest	
CongestionCost	The total annual dollar cost associated with travel congestion for commuters in the area, including the value of time lost and additional fuel consumed. The natural logarithm has been applied to the variable.
DelayHour	The total annual hours of traffic delay in the area. The natural logarithm has been applied to the variable.
TravelTime	The ratio of peak-period travel time to free-flow travel time for the same trip.
HighCongestion	An indicator variable equal to 1 for bonds located in areas at or above the 75th percentile of total annual congestion costs, and 0 otherwise.
HighDelay	An indicator variable equal to 1 for bonds located in areas at or above the 75th percentile of total annual delay hours, and 0 otherwise.
HighTravelTime	An indicator variable equal to 1 for bonds located in areas at or above the 75th percentile of the travel time index, and 0 otherwise.
Covid	An indicator variable equal to 1 if the period is 2020, and 0 otherwise.
Bond level control	
Maturity	The time to maturity of the bond, measured in years.
BondSize	The natural logarithm of the size of the individual bond issue.
Rating	A numerical classification of the bond's credit rating assigned by S&P. See Table A.1 for the classification scale.
Insurance	An indicator variable equal to 1 for bonds with insurance, and 0 otherwise.
General	An indicator variable equal to 1 for general obligation bonds, and 0 otherwise.
Revenue	An indicator variable equal to 1 for revenue bonds, and 0 otherwise.
Puttable	An indicator variable equal to 1 for bonds that give bondholders the option to sell the security back to the issuer at a specified price and time, and 0 otherwise.
BankQualified	An indicator variable equal to 1 for bank-qualified, which allows banks to deduct interest expenses associated with purchasing or carrying the obligations, and 0 otherwise.
Competitive	An indicator variable equal to 1 for bonds issued via competitive offerings, and 0 otherwise.
ZeroCoupon	An indicator variable equal to 1 for zero-coupon bonds (i.e., bonds that do not pay periodic interest), and 0 otherwise.
County-level demographic control	
Population	The population at the county level. The natural logarithm is applied.
Unemployment	The annual county-level unemployment rate, as reported by the U.S. Bureau of Labor Statistics.
StateTax	The maximum state personal income tax rate
GDP	The annual GDP at the county level, collected from the U.S. Bureau of Labor Statistics. The natural logarithm is applied to the variable.
Income	County-level per capita income, deflated using the Consumer Price Index. The natural logarithm is applied to the variable.
Macroeconomic control	
BondBuyer	The Bond Buyer index consists of a selection of 20 general obligation bonds maturing in 20 years.
TreasuryYield	Yields on U.S. Treasury securities, estimated from daily yield curves fitted using Svensson's (1994) model.

Table A.3. Correlation matrix

Variable	***(1)***	***(2)***	***(3)***	***(4)***	***(5)***	***(6)***	***(7)***	***(8)***	***(9)***	***(10)***	***(11)***	***(12)***	***(13)***	***(14)***	***(15)***	***(16)***	***(17)***	***(18)***	***(19)***	***(20)***	***(21)***	***(22)***	***(23)***
(1) *WeightedYields*	1																						
(2) *YieldSpread*	0.67*	1																					
(3) *CongestionCost*	0.02*	0.02*	1																				
(4) *DelayHour*	0.02*	0.02*	0.99*	1																			
(5) *TravelTime*	0.03*	0.03*	0.80*	0.82*	1																		
(6) *Covid*	-0.18*	0.30*	0.01*	0.01*	0.01*	1																	
(7) *Maturity*	0.20*	0.04*	0.01*	0.01*	-0.01*	-0.00*	1																
(8) *BondSize*	0.03*	-0.02*	0.12*	0.12*	0.15*	0.01*	0.36*	1															
(9) *Rating*	-0.05*	-0.05*	0.06*	0.07*	0.03*	0.00	0.13*	0.07*	1														
(11) *Insurance*	0.03*	0.01*	0.01*	0.02*	-0.01*	-0.01*	0.08*	-0.20*	0.35*	1													
(12) *General*	-0.05*	-0.03*	0.00*	0.01*	0.02*	-0.01*	-0.20*	-0.25*	-0.04*	0.09*	1												
(13) *Revenue*	-0.01*	-0.02*	0.08*	0.08*	0.10*	0.01*	0.09*	0.16*	0.01*	-0.03*	-0.48*	1											
(14) *Puttable*	0.03*	0.03*	-0.01*	-0.01*	-0.01*	0.00	0.00	-0.00	-0.01*	-0.01*	-0.02*	-0.00*	1										
(15) *BankQualified*	0.02*	0.01*	-0.01*	-0.01*	-0.03*	-0.01*	-0.01*	-0.33*	0.02*	0.20*	0.16*	-0.09*	-0.00*	1									
(16) *Competitive*	-0.03*	-0.02*	0.03*	0.03*	0.07*	-0.00*	-0.11*	-0.17*	-0.01*	-0.00*	0.26*	-0.11*	-0.02*	0.06*	1								
(17) *ZeroCoupon*	0.05*	0.06*	0.03*	0.03*	0.00*	0.00	0.09*	-0.08*	0.06*	0.15*	0.05*	0.01*	-0.00	0.03*	-0.06*	1							
(18) *Population*	-0.04*	-0.04*	0.96*	0.98*	0.74*	0.01*	0.01*	0.10*	0.09*	0.04*	0.01*	0.05*	-0.01*	0.00	0.01*	0.05*	1						
(19) *Unemployment*	-0.09*	-0.08*	0.04*	0.05*	-0.06*	0.02*	0.16*	0.08*	0.30*	0.02*	-0.09*	0.06*	0.01*	0.00	-0.10*	0.07*	0.09*	1					
(20) *StateTax*	-0.06*	-0.05*	0.04*	0.03*	0.25*	0.00*	-0.05*	-0.00*	-0.05*	-0.10*	0.05*	-0.06*	-0.01*	-0.09*	-0.02*	0.02*	0.00	-0.02*	1				
(21) *GDP*	-0.01*	-0.02*	0.51*	0.53*	0.55*	0.01*	0.07*	0.26*	0.09*	-0.01*	-0.11*	0.09*	-0.00	-0.05*	0.03*	0.00	0.50*	0.02*	-0.10*	1			
(22) *Income*	-0.06*	-0.05*	0.40*	0.42*	0.56*	0.01*	-0.04*	0.03*	-0.06*	-0.06*	0.10*	0.01*	-0.01*	-0.03*	0.09*	-0.01*	0.38*	-0.27*	0.37*	0.26*	1		
(23) *BondBuyer*	0.45*	-0.28*	-0.01*	-0.01*	-0.01*	-0.69*	0.01*	-0.00	-0.01*	0.01*	0.01*	-0.01*	-0.00	0.01*	0.00	-0.01*	-0.01*	-0.03*	-0.01*	-0.01*	-0.01*	1	
(24) *TreasuryYield*	0.55*	-0.25*	-0.01*	-0.01*	-0.01*	-0.57*	0.23*	0.06*	0.00	0.02*	-0.03*	0.01*	-0.00	0.01*	-0.01*	0.00	-0.02*	-0.03*	-0.02*	0.01*	-0.01*	0.91*	1

*Note: This table reports Pearson correlations for key variables for the sample from 2018 to 2022. * Significance at the 1% level or lower is indicated with an asterisk. See Table A.2 for variable definitions.*