Municipal Finance During the COVID-19 Pandemic: Evidence from Government and Federal Reserve Interventions*

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This draft: November 2020

Abstract

We study the functioning of the municipal bond market during the COVID-19 pandemic. The average offering yield increases while the number of new issues drops when county-level COVID-19 case and death counts rise. Exploiting the differential timing of local policy actions, we find that emergency declarations lead to a 69 basis-point increase in offering yields and a significant drop in new issuance. Investors shun transportation and dedicated tax bonds or bonds issued in fiscally unhealthy states. The Federal Reserve's unprecedented interventions through two municipal liquidity facilities have calmed the market. The reopening of local economies has led to a significant drop in offering yields.

JEL classification: G14, G18, G24, H74

Keywords: Municipal bond, new issuance, COVID-19, mitigating policies, Federal Reserve interventions, Municipal Liquidity Facility

*The authors have benefited greatly from comments and suggestions made by Manuel Adelino, Mark Flannery, Christopher James, Song Ma, Andy Naranjo, Jay Ritter, Eddie Sanchez, Michael Schwert, Carolyn Takeda, Yongqin Wang, Xiaoqian Zhang, and seminar participants at the University of Florida and Fudan University.

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1. Introduction

The $3.9 trillion municipal bond market is the lifeblood of state and local governments when they finance public-purpose projects, such as airports, schools, and water and sewer systems. In the past decade, more than 50,000 municipal issuers sold an average of $435 billion in new debt per year, according to the Municipal Securities Rulemaking Board (MSRB). Municipal debt is generally regarded as a haven by investors seeking the benefits of tax-exempt investments and relative safety.[1]

Amid the U.S. coronavirus (COVID-19) outbreak in March 2020, municipal debt experienced a sharp sell-off, with the broad-based S&P Municipal Bond Index losing more than 10% in the two weeks ending March 20. Municipal bonds lost their safe-haven status and were suddenly considered risky assets. This did not appear to be exclusively a liquidity crunch. State and local governments, on the front lines of the response to the pandemic, are projected to face severe fiscal stress as sales tax revenue dwindles, unemployment soars, and healthcare costs rise. A recent survey shows that 96% of U.S. municipalities anticipate a revenue decline this year (National League of Cities, 2020).[2] In April 2020, Standard & Poor's gave all municipal sectors negative outlooks and indicated that additional downgrades are likely to occur during the remainder of the year.

The deteriorating fiscal situation has presented a potential credit risk to bondholders, especially with municipal bonds that rely on sales taxes and narrow pledges of revenue. Delinquencies in the municipal bond market are expected to increase, with a dozen significant defaults announced and nearly 3,000 coronavirus-related disclosures by issuers in recent months (MSRB, 2020).[3] As buyers disappeared and yields soared, new bond issuance ground to a halt. In inflation-adjusted terms, there was less bond issuance in the week of March 16 ($2.2 billion) than at any point during the 2008-2009 financial crisis, as shown in Appendix Figure A1.

[1] According to Moody's Investors Services, the cumulative default rate for investment-grade municipal bonds over the 2007–2016 period was 0.18%, while for investment-grade corporate bonds the cumulative default rate was 1.74%.

[2] For example, New York City's budget office estimated in April 2020 that the city would suffer a combined shortfall of $9.7 billion in tax revenues from its major tax sources for fiscal years 2020 and 2021. The City of Los Angeles estimated a revenue loss of up to $400 million in the 2020-2021 fiscal year.

[3] Among the defaulted bonds, the default of municipal bonds associated with a tire-recycling plant in Indiana was the first directly related to Covid-19, while the default of a group of senior-living revenue bonds worth $220 million was the largest.

In this paper, we offer the first evidence regarding whether and how specific COVID-19 mitigating policies, such as emergency declarations or a stay-at-home (SAH) orders, adversely affect demand for new municipal bonds, at both the extensive margin (frequency of new issuances and number of issues) and the intensive margin (offering yields). We manually collect and classify major policies at both the county and state levels, and utilize differential timing of local COIVD-19 policy responses to quantify the effects. Furthermore, we examine whether the Federal Reserve's (Fed's) interventions, including backstopping municipal money-market mutual funds in late March and creating a new liquidity facility in early April to directly purchase municipal debt, helped stabilize the primary market for municipal bonds.

Before presenting our main results, we start with a descriptive analysis of whether municipal offering yields and issuance frequency are related to local COVID-19 measures, such as infections and deaths, which potentially reflect economic tolls at the local level. Controlling for bond characteristics and a number of fixed effects, we find that the average offering yield increases by 7.3 and 11.3 basis points (bps) when county-level coronavirus case and death counts, respectively, double. These represent marginal increases of 4.1% and 6.4%, respectively, from the average offering yield. Although the biweekly growth rate in case counts does not appear to correlate with offering yields, biweekly growth in deaths is significantly related to yields at issue.

Turning to the extensive margin, we find that the probability of new issuance decreases when confirmed cases or deaths increase, with marginal effects of 40% and 58%, respectively, at weekly frequency. Growth in death counts also significantly predicts a drop in new bond issuance. These results, taken together, suggest that municipal bond investors are more concerned about coronavirus-related mortality than about reported cases, consistent with public health experts' view that the number of deaths is a more reliable COVID-19 indicator as it is less affected by variations in testing (Karaca-Mandic, Georgiou, and Sen, 2020). Although the relationships we uncover are economically and statistically significant, we are careful not to claim causality because both investor demand for municipal debt and COVID-19 infections/mortality can be affected by government responses and Fed interventions.

As the coronavirus began to spread, state and local governments initially reacted by announcing the first case in a state or locality. This was usually followed by a declaration of a state of emergency to free up resources for immediate assistance. Numerous states and municipalities took further steps to reduce COVID-19 transmission, including closing schools and imposing restrictions on the sizes of gatherings. In most cities and states, these measures were eventually followed by SAH orders (also known as shelter-in-place orders) and nonessential business closures. Given the close timing of school closures and gathering restrictions, we separately study the effects of first-case announcements, emergency declarations, and SAH orders. Our main analysis is carried out at the county level while state-level robustness analysis yields consistent results.

Using an event-study methodology, we find that, while controlling for bond attributes, at the intensive margin first-case announcements do not appear to affect offering yields at the county level. Emergency declarations, however, lead to a 69 bps increase in the average offering yield during the event week, compared with yields in the previous week. This effect is substantial given that the sample average offering yield is 174 bps. The effect continues into the following week before dropping off slightly afterwards. We emphasize the lack of any significant pre-trend prior to emergency declarations. If anything, offering yields on municipal bonds actually trended downward slightly before the declarations. We take the lack of a pre-trend as additional evidence in support of the direct effects of emergency declarations on offering yields. Interestingly, we find that offering yields had already jumped before SAH orders were implemented, suggesting that policies such as emergency declarations affected investor sentiment.

At the extensive margin, we find that first-case announcements have weak negative effects while emergency declarations reduce the probability of new issuance by 2.8 percentage points during the event week, representing a marginal effect of 76%. Like first-case announcements, SAH orders also have weak negative effects on issuance during the event week, with no noticeable effects in the following week. Replacing issuance probability with the number of issues, we obtain similar results. The results we find regarding both the intensive and extensive margins suggest that municipal bond investors took local emergency declarations seriously and expected further restrictive actions from governments. Bondholders therefore started to regard municipal bonds as riskier assets, demanding

higher returns on new issues. Investors, however, did not appear to react to announcements of first cases, indicating that coronavirus-related credit risk was not a major concern during the outbreak's initial stage.

Not all municipal bonds are created equal in the age of COVID-19. Investors may favor the steady nature of water and sewer authorities over entities such as airports and toll roads that have been hampered by falling revenues and uncertain outlooks. Comparing issues of new municipal bonds during the month before emergency declarations and the month after, we show that water/sewer bonds experience an increase in dollar volume while utility and housing sectors drop less than 20%. We deem these resilient sectors. Perhaps not surprisingly, transportation and dedicated tax revenues are hit the hardest. The middle group includes the education, general obligation, and healthcare sectors. We find that, around emergency declarations, offering yields increase 38.3 bps less for bonds from the resilient sectors than for bonds from other sectors.

Equally importantly, we find that bonds issued by municipalities from fiscally challenged states, such as Illinois, New Jersey, and Kentucky, experience weaker investor demand than those from fiscally healthier localities. Offering yields for the former issuers rise, holding all else equal, about 20 bps more than those from the latter issuers around emergency declarations. This suggests that municipal bond investors monitored credit quality as municipalities collected fewer revenues from sales and other taxes while spending more on unemployment benefits and emergency healthcare.

In an effort to calm the municipal finance market, the Fed announced that it would backstop short-term municipal debt through its Money Market Mutual Fund Liquidity Facility (MMLF), effective March 23, 2020. As offering yields rose sharply and then dropped precipitously, our event-study at the intensive margin is conducted at daily frequency. Our main results indicate that, on average, offering yields on March 23 dropped around 200 bps below yields on March 20. Offering yields continued to trend downward throughout the week before increasing somewhat. Interestingly, yields on municipal notes (securities with maturity less than three years) did not drop until several days later, while longer-dated bonds saw an immediate drop in offering yields. This corroborates the pattern observed in the secondary market, in which the municipal-to-Treasury-yield ratio on short-term municipal debt, including variable rate notes, remained elevated above the ratio involving longer-term bonds. This may

partially reflect issuing municipalities' weakened fiscal conditions in the near term. At the extensive margin, new issues began picking up in the second week after the intervention, with the number of issues increasing 27%.

In another attempt to ease funding strains on municipalities, the Fed on April 9, 2020 announced a Municipal Liquidity Facility (MLF) aimed at purchasing up to $500 billion in high-quality notes directly from states and local governments. The program initially included only states and large municipalities and was subsequently revised to include eligible municipalities regardless of size. Our estimates reveal that the announcement of the MLF reduced offering yields by nearly 24 bps during the following day, a finding that is significant at the 5% level. Both issuance frequency and the number of issues also increased substantially. It is important to note that this was purely an announcement effect as the program was not operational as of May 23, 2020.[4] Our results suggest that the establishment of the MMLF and MLF was effective in calming the primary market for municipal debt. Throughout our study, replacing offering yields with yield spreads over comparable Treasuries generates similar results.

Since late April 2020, states and localities have started to reopen their economies in some form, with the majority reopening in May. We find that reopening leads to a 14 bps decrease in the average offering yield during the event week, compared with yields in the previous week. The effect continues into the fourth week after the event week, with a drop of nearly 30 bps in the offering yield. At the extensive margin, we find that new issuance continues to trend up after local economies reopen. These results suggest that municipal bond investors welcomed local authorities' decisions to reopen after months of lockdowns, and the timing of reopening was not entirely expected.

To the best of our knowledge, ours is the first study indicating how government policies aimed at mitigating a health crisis have had unintended consequences for municipal finance. These mitigating actions were relatively exogenous to the functioning of the primary market for municipal bonds, which had enjoyed years of growth before the COIVD-19 outbreak. Yet, we find that the policies we analyzed—emergency declarations in particular—led to a large drop in investor demand for municipal

[4] To date, the State of Illinois is the only entity that tapped into the MLF, selling $1.2 billion worth of one-year notes to the Fed on June 2, 2020 (Fed, 2020).

debt, at both the intensive (offering yields) and extensive (issuance frequency) margins. It is worth noting that our focus on primary market activities makes examining the extensive margin possible.

We also provide a timely assessment of the Fed's ongoing liquidity facilities that targeted municipal bonds, which were successful in bringing down soaring borrowing costs at a time when municipal governments were experiencing both revenue and expense shocks. The Fed did not roll out such programs during the 2008-2009 financial crisis, when municipal finance was hit less directly and swiftly. For example, the 10-year AAA municipal-to-Treasury-yield ratio spiked to more than 350% in March 2020, well exceeding the 200% observed during the worst depths of the financial crisis.

We note that the Fed created the MLF under the Coronavirus Aid, Relief, and Economic Security Act (CARES Act), which was signed into law on March 27, 2020. The Act itself provides $150 billion for state and local governments to cover non-budgeted, COVID-19-related necessary health emergency expenses incurred through December 2020. The CARES Act might have contributed to calming down the municipal bond market, which presumably would dampen the MLF's positive announcement effect. That is, in the absence of direct federal aid to municipal governments, the MLF would have had a larger announcement effect on the municipal bond market.

We emphasize that our municipal-bond-market setting offers several advantages. First, municipal bonds are sold by local issuers, namely municipalities or entities associated with specific projects. This enables us to explore variations in COIVD-19 policy responses at the local level. We are also able to utilize variations in local fiscal conditions. In contrast, equities or corporate bonds are typically sold by companies that operate nationally. Second, municipal issuers have a relatively simple capital structure as they typically engage solely in debt financing. Third, the daily frequency of municipal bond issuance makes it possible to differentiate the effects of multiple policies, such as emergency declarations and SAH orders, which were typically implemented weeks apart. In contrast, most studies on the impacts of COVID-19 responses on macroeconomic or labor outcomes do not differentiate between policy outcomes (e.g. Coibion, Gorodnichenko, and Weber, 2020).

It is worth noting that our results overall suggest that credit risk likely played an important role in the municipal debt crisis of March 2020. In other words, this was unlikely to be merely a liquidity crisis. First, the Fed's unprecedented interventions eased some of the short-term selling pressure and brought

down yields but they have remained elevated above normal levels. Second, we find that essential service sectors, such as water/sewer and utilities, and fiscally healthy issuers were less adversely affected during the crisis. The lack of indiscriminate sell-offs suggests that municipal bond investors incorporated longer-term credit quality during the pandemic. This is consistent with Schwert (2017), who finds that default risk accounts for 74% to 84% of the average municipal bond spread over the period running from 1998 through 2015. In future studies, it would be useful to examine the extent to which credit risk contributed to the yield spike in recent months.

Our study is related to the literature that exploits cross-sectional shocks to local government financing and expenditures. Adelino, Cunha, and Ferreira (2017) document that credit rating upgrades by Moody's have a significant effect on reducing municipal bond yields and increasing issue volume in new issues. Similarly, Cornaggia, Cornaggia, and Israelsen (2017) find that rating upgrades reduce secondary market yields substantially. Cohen, Coval, and Malloy (2011) find that state fiscal spending shocks dampen corporate-sector investment. Such shocks, however, increase overall employment, as Chodorow-Reich et al. (2012) show.

Although we do not directly study municipal bond default risk, our paper is related to the literature on municipal credit risk premiums. Wang, Wu, and Zhang (2008) and Ang, Bhansali, and Xing (2014) examine default risk, liquidity risk, and tax components of municipal bond yield spreads, and find that all three components are priced. Schwert (2017) shows that default risk is the most important driver of municipal bond yield and that there is substantial cross-sectional variation in the spreads. Gao, Lee, and Murphy (2019) show that such cross-sectional variation can be partially explained by reference to state policies supporting distressed local municipalities, which affects creditor protections and local credit risk.

We contribute to the literature that studies the primary market for municipal bonds. Painter (2020) finds that counties that are severely affected by climate change pay more in offering yields to issue municipal bonds. Butler (2008) shows that local underwriters charge lower fees and sell municipal bonds at lower yields, suggesting that local underwriters are better able to assess soft information. In addition, Green, Hollifield, and Schürhoff (2007), Schultz (2012), Cestau, Green & Schürhoff (2013), and Cohen and Bergstresser (2015) study topics related to underpricing.

We also contribute to the fast-growing literature on the financial-market consequences of the COVID-19 pandemic. Gormsen and Koijen (2020) and Giglio et al. (2020) examine the impact of the pandemic on stock prices and growth expectations. Haddad, Moreira, and Muir (2020), O'Hara and Zhou (2020), and Kargar et al. (2020) study disruptions in the corporate bond market, with a focus on liquidity. Li et al. (2020) present evidence pertaining to money-market runs during the pandemic. Ding et al. (2020), Bartik et al. (2020), and Hassan et al. (2020) focus on cross-sectional firm exposure to COVID-19.[5] Our study differs in that we focus on disruptions in the market for municipal government financing, which operates on the front lines of the COVID-19 pandemic response.

2. Background

2.1 The COVID-19 pandemic in the United States

The first confirmed COVID-19 case in the U.S. was reported in Snohomish County, Washington, on January 21, 2020. On January 30, the first case of person-to-person transmission was confirmed in Chicago. The outbreak appeared contained through February although the Centers for Disease Control and Prevention (CDC) warned Americans in late February that coronavirus would spread in the U.S. (Schuchat, 2020). By mid-March, however, transmission of the disease had accelerated and become widespread. On March 11, the WHO declared the coronavirus outbreak a pandemic. By May 31, 2020, the CDC had reported 1,761,503 COVID-19 cases in the U.S., the highest number of confirmed cases in the world, and 103,700 coronavirus-related deaths (CDC, 2020).

To "flatten the curve" or slow transmission of the virus, public health responses have included efforts to detect cases by expanding testing capacity and contact tracing, and the implementation of mitigation measures. In the absence of a vaccine, state and local authorities have emphasized a social distancing strategy, widely regarded as the best available mitigation means to slow the spread of coronavirus (Ferguson et al., 2020).

[5] A number of recent studies on the economic consequences of the COVID-19 pandemic focus on variables such as consumer spending, employment, macroeconomic effects, food price, and political partisanship. On consumer spending, see e.g. Andersen et al. (2020), Chen et al. (2020), Baker et al. (2020), and Coibion et al. (2020). On employment, see e.g. Baek et al. (2020), Gupta et al. (2020), Coibion et al. (2020), and Campello et al. (2020). On macroeconomic effects, see e.g. Atkeson (2020), Eichenbaum et al. (2020), Barro et al. (2020), Hall et al. (2020). On food price, see Yang and Asche (2020). On political partisanship, see e.g. Barrios and Hochberg (2020) and Allcott et al. (2020).

2.1.1 State and local information and policy actions

When coronavirus started to spread in the U.S., state and local governments initially reacted by announcing the first case in a state or locality. As the COVID-19 pandemic began to deepen, a number of state and municipal governments took the lead in implementing social distancing measures, given that constitutional authority for ordering major public health interventions, such as mass quarantines and social distancing, lies primarily with U.S. states and localities. One of the first actions taken by many officials was to declare a state of emergency, which activates authorities and resources that are unavailable in non-emergencies. The emergency declarations presumably created a sense of urgency among residents. All 50 states and the District of Columbia declared states of emergency, with 20 counties declaring their own before their state declarations. Following such declarations, numerous states and municipalities took further mitigating steps to reduce transmission of the virus, such as closing schools and imposing restrictions on gatherings. In most states, these measures were eventually followed by SAH orders, which were often accompanied by nonessential business closures.

On March 17, 2020, the first SAH order in the U.S. was imposed by health authorities in the San Francisco Bay Area, followed by the first statewide SAH order in California on March 19. New Jersey's governor ordered on March 21 that all nonessential retail businesses close their stores and almost all state residents stay home to curb the spread of the coronavirus. Illinois's order went into effect on the same day, with New York's SAH mandate becoming effective on March 22. As of April 7, 42 states and the District of Columbia issued SAH orders. Ninety-four percent of the U.S. population were under SAH orders banning them from leaving their residences for all but "essential reasons" (Secon, 2020).[6]

Alaska's SAH order expired on April 24, 2020. On the same day, the governor eased restrictions on several types of businesses, giving Alaska among the first states to reopen. By the end of April, seven states' SAH orders had expired and businesses had begun to reopen. As of May 31, all states but New Jersey had started to reopen, with California, Illinois, Michigan, New York, Oregon, Pennsylvania, Tennessee, and Washington implementing regional reopening.

[6] Seven states, Arkansas, Iowa, Nebraska, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming, did not issue statewide SAH orders. Several counties in Oklahoma, Utah, and Wyoming imposed their own orders. Additionally, a number of counties in states that issued statewide orders early April, such as Florida, Texas, and Pennsylvania, began local lockdowns up to two weeks before the state orders were imposed.

2.2 The municipal bond market during the pandemic

Before the pandemic started, many state and local governments' finances were in relatively good shape and most municipal bonds were considered safe investments. Municipal bonds had seen strong investor demand, with municipal bond funds posting record inflows in 2019 (McDevitt and Watson, 2020). The S&P Municipal Bond Index, designed to measure the broad tax-free municipal bond market,[7] had been steadily increasing until February 2020, generating a total return of over 56% for investors during the previous decade (S&P Global, 2020). In the meantime, new issuance volume remained stable, averaging $430.2 billion per year during the period from 2015 to 2019 (MSRB, 2019).

Starting early March 2020, fears of an economic fallout from the COVID-19 pandemic had exerted unprecedented downward pressure on municipal bonds, leading to wild price fluctuation in the usually placid market. Municipal bonds lost their relative safe-haven status and were suddenly considered risky assets. The S&P Municipal Bond Index fell 10.5% during the two-week period ending March 20, 2020, with the average yield increasing from 2.3% to almost 4% during the same period. This period also saw the 10-year AAA municipal-to-Treasury-yield ratio more than double to 290% by March 20, a clear signal of market stress.

Not surprisingly, the new issue market was adversely affected. Between March 9 and March 20, state and local governments managed to sell only less than $6 billion of the $16 billion in municipal bonds they sought to issue (Schuele and Sheiner, 2020).

2.2.1 Federal Reserve interventions

In an effort to stabilize the municipal bond market, the Fed announced on March 20 that it would accept short-term municipal debt purchased from money market mutual funds as collateral for lending to banks through the recently reopened MMLF, which was established during the 2008-2009 financial crisis. The facility began operations on March 23. On the same day, the Fed expanded the MMLF and the Commercial Paper Funding Facility to include a wider range of municipal bonds.

[7] The index includes municipal bonds of all qualities, excluding defaulted bonds, and from all sectors of the municipal bond market.

These Fed facilities enabled financial institutions to turn municipal bonds into cash more easily, making them more attractive to hold. The Fed actions appeared to have achieved their desired effect. Between March 23 and March 30, the average yield of bonds in the S&P municipal index fell by more than one percentage point, with the yield spread over Treasuries shrinking significantly as well (Schuele and Sheiner, 2020).

To ease funding strains for state and local governments experiencing simultaneous revenue drops and rising expenses caused by the pandemic, the Fed on April 9, 2020 established the MLF, which would purchase up to $500 billion in short-term securities directly from states, the District of Columbia, counties with at least two million residents, and cities with at least one million residents. These municipal issuers were deemed as eligible issuers.

On April 27, the Fed announced an expansion of the scope and duration of the MLF. The central bank would now allow participation by one borrower from each county of at least 500,000 people and city of at least 250,000, down from earlier thresholds of two million and one million, respectively. The Fed would also purchase securities with maturities of up to three years, instead of an earlier cap of two years. The MLF's first transaction took place on June 2, 2020 (Fed, 2020a).[8]

On June 3, the Fed again announced an expansion in the number and type of entities eligible to directly use its MLF. Under the new terms, at least two cities or counties from each state are eligible to directly issue notes to the MLF regardless of population. The previous terms continue to apply.

We note that the CARES Act, enacted on 27 March, offers $150 billion in direct federal aid to states and municipalities to cover necessary expenditures related to COVID-19 that were not previously accounted for in their budgets. The Act also mandates the Treasury to provide $35 billion of credit protection to the Fed for the MLF.

3. Data and Sample Description

3.1 COVID-19 infection and mortality data

[8] On May 15, 2020, the Federal Reserve Bank of New York began to solicit interest from eligible municipal issuers in selling notes to the MLF. This is the initial step for an issuer to provide information to the MLF for review.

We compile a panel of county-specific daily counts of COVID-19 infections from January 21, 2020 through April 30, 2020. Our main data source is CoronaDataScraper.com, a popular open source COVID-19 dashboard that pulls coronavirus case and mortality data from state and local governments and health departments.[9] We collect the following information: county and state names, date, cumulative counts of coronavirus cases and deaths, and new case and death counts. The first confirmed case was reported in Snohomish County, Washington, on January 21, 2020. On March 17, West Virginia became the last state to report an initial COVID-19 case. On February 29, Washington's King county reported the first death nationwide, while Wyoming is the last state to confirm a coronavirus-related death (April 13). Such delays in deaths are expected given the incubation period for COVID-19 extends to two weeks (Lauer et al., 2020) and the median time to acute respiratory distress syndrome ranges from eight to 12 days among patients who develop severe diseases (Huang et al., 2020).

In Appendix Figure A2, we plot America's total cumulative and new cases/deaths over our sample period. Both case and death counts grew exponentially since they were initially reported, with total cases breaching one million and total deaths approaching 40,000 as of April 30.[10] This figure suggests a delay in the growth of death counts, as compared to cases. In Appendix Figure A3, Panel A, we plot cumulative cases for the 10 counties that saw most cases as of April 30, 2020. Not surprisingly, seven counties in New York are among the top 10, with Queens and Kings (Brooklyn) counties having much higher growth trends. The high population density in places such as New York City likely facilitated the spread of COVID-19 in these counties (e.g., Rosenthal, 2020).

In Figure A3, Panel B, we show coronavirus-related mortality for the top 10 counties by number of deaths. Only two counties, Bergen and Essex counties of New Jersey, are not among the top 10 counties by case. Consistent with the picture for cases, three boroughs in New York City, Kings (Brooklyn), Queens, and Bronx counties, have much higher growth trends in deaths.

[9] To ensure that data quality, we compare our case and death counts with those recorded by USAFacts.org, another data aggregator that references state and local public health agencies directly. The correlations are 0.9995 and 0.9867, respectively.

[10] New York City revised its death count higher by 3,778 on April 14, 2020, which contributed to the spike of new death counts that day. The number includes people who had never tested positive for the virus but were presumed to have died of it.

3.2 State and local government actions

Our preliminary set of statewide policy data are collected by Fullman et al. (2020), a group of researchers at the University of Washington. The data are primarily sourced from individual state government websites, and are supplemented by the National Governors Association and Kaiser Family Foundation. We gather dates for five major policy events: emergency declaration, school closure, gathering restriction, nonessential business closure, and SAH order. Fullman et al. (2020) provide the policy sources, which we use to double check the date for each state policy. For nonessential business closures we supplement this data with data from the Institute for Health Metrics and Evaluation (2020).[11]

Several counties declared emergencies before their state did. In addition, many counties in a number of states, such as Florida, Texas, and Pennsylvania, issued their own SAH orders well before the statewide orders came into effect. Most of these SAH orders were accompanied by nonessential business closures. We therefore obtain from the National Association of Counties (NACo, 2020) a list of county names and dates for emergency declarations, SAH orders, and nonessential business closures at the county level. County-level K-12 school or school district closure data are obtained from Education Week (2020). To ensure that our data are comprehensive, we conduct extensive news searches and compile a list of county-level official announcements that are not covered by NACo. We use the date of a county's order if it was issued before the state order. If a county did not issue its own law, we use the statewide order instead. The granular countywide orders are crucial because our main analysis explores variations in the timing of government COVID-19 responses at the county level. To the best of our knowledge, we are among the first researchers that utilize a comprehensive map of U.S. county-level COVID-19 responses.

As announcements of first statewide cases are potentially important information events for bond investors, we gather the date of the first case in each state from CoronaDataScraper and compare it with the date reported by New York Times (2020). When the two dates are different, we use the New York Times date. We carry out the same exercise for each county. This serves as robustness analysis

[11] Of the 42 nonessential business closures, 31 are covered by Fullman et al. (2020). The remaining 11 are taken from Institute for Health Metrics and Evaluation (2020).

because most first-case announcements at the county level took place well after the first state case announcements. For each county, we also obtain its population estimates for 2019 from the U.S. Census Bureau.

As shown in Figure 1, Washington is the only state that issued an emergency declaration for COVID-19 before March 2, 2020. Another nine and 40 states declared states of emergency during the weeks of March 2 and March 9, respectively. West Virginia was the only state that issued an emergency declaration after March 15. In total, 20 counties declared their own states of emergency before the state announcements, with six issuing emergency declarations before March 2. In Appendix Figure A4, we show a similar map for SAH orders at the county level.[12] Statewide policy dates are listed in Appendix Table A1.

[Insert Figure 1 here]

To assess whether we can separately study the effects of certain policies, we plot the cumulative number of states that adopted a policy, including announcement of the first case, on a given day. (The county level chart is similar.) This approach is similar to the one used in Gupta et al. (2020). In Figure 2, we see that first-case announcements are well before other policy events. Emergency declarations also appear to be separate. School closures and gathering restrictions, however, are too closely related to be separately identified. They also largely take place between emergency declarations and SAH orders. There is also a strong correlation between nonessential business closures and SAH orders because a SAH order essentially implies businesses would also close. We therefore focus our analysis on the announcement of the first confirmed case statewide and county-level emergency declarations and SAH orders.

[12] As shown in Figure 1, four states, California, Illinois, New Jersey, and New York, issued SAH orders that came into effect on or before March 22. Notably, counties in the San Francisco Bay Area were the first to adopt a SAH order on March 17, 2020. In addition, several counties in Alaska, Colorado, Georgia, Hawaii, and Idaho, including Clarke and Dougherty in Georgia, adopted their SAH laws before March 22. During the week of March 23, statewide orders issued by another 22 states took effect, followed by 15 more statewide orders in the following week. The week of April 6 saw only two statewide orders, issued by Missouri and South Carolina on April 6 and 7, respectively. By April 7, 2020, 42 states and the District of Columbia had issued SAH orders. Among the seven states that did not issue statewide SAH orders, three, Oklahoma, Utah, and Wyoming, saw some the counties imposing their own orders. In addition, a number of counties in states that issued statewide orders early April started local lockdowns well before the state orders were adopted.

[Insert Figure 2 here]

3.3 Municipal bonds

We obtain data on municipal bond offerings from Bloomberg L.P. The sample includes 36,337 municipal bonds sold by 2,652 unique issuers between January 1, 2020 and April 30, 2020. In our main analysis which is carried out at the county level, we exclude bonds that were issued by state entities. In robustness analysis, we include all issued bonds. We identify 147 state issuers by reading the list of issuer names and access these state entities' websites to verify their identity. This leaves us with 33,028 bonds offered by counties and municipalities. Excluding bonds missing characteristics such as par value, we end up with 32,990 unique bonds. For 789 of these bonds, Bloomberg does not record the counties of issuance. Certain issuer names contain their municipality names, which we use to locate their counties. For the remaining issuers, we access their official websites to determine their jurisdictions.

We use this database to identify bond characteristics. Specifically, for each newly issued bond, the database records its issuer name, state and county of issuance, settlement and maturity dates, coupon rate, offering yield (also known as yield at issue), bond size, sector, and bond ratings from Standard & Poor's and Moody's if the bond is rated. It also provides information on whether the bond is taxable, insured, callable, or a general obligation bond which is backed by the full faith and credit of the issuing municipality.

3.4 Summary statistics

In Figure 3, we provide information on weekly aggregate new municipal issuance. Panel A plots the number of weekly bond issues and Panel B shows the total par amount issued per week. The primary market enjoyed a strong start in 2020, with an average weekly volume of $10.1 billion in January and February. During this period, approximately 91% of the issues were sold by local governments, representing 72.5% of the total amount raised. As the pandemic wreaked havoc on the municipal market in March, issuance activity began to plummet. During the week of March 16, municipalities and states were only able to sell $2.2 billion worth of bonds, with roughly 53% of that amount being sold by municipalities. After the Fed announced on March 20 that it would backstop municipal money

market mutual funds, new issuance began to recover. Still, total offering volume in March 2020 was only $21.9 billion, down 31% from either March 2018 or March 2019, as shown in Appendix Figure A5. Importantly, the amount sold by local governments dropped 41%, while par value sold by state governments was only down by about 13%. This suggests that issuance by municipal governments was disproportionally affected by the pandemic.

[Insert Figure 3 here]

As Figure 4 shows, daily average offering yield and yield spread over equivalent risk-free bonds trended downward in the first two months of 2020 as the municipal bond market peaked. The average yield at issue started to increase entering March as issuance slowed, reaching an eye-popping high of 5.3% on March 20. Yields dropped rapidly after the Fed's MMLF began operations on March 23, dipping below 2% at the end of March. The average offering yield decreased another 32.0 bps after the establishment of the MLF program on April 9. The yield spread followed a similar pattern.

In Table 1, we list the top 20 counties by issue volume between January and April 2020. Franklin County, Ohio issued nearly $6 billion worth of municipal debt during this period, more than any other U.S. county. New York County ranked second with $5.7 billion, followed by Harris County, Texas. Counties from 11 states are on the list, with six counties from California and five from Texas.

[Insert Table 1 here]

Table 2, Panel A presents summary statistics for our sample bonds. Columns (1)-(4) report data for our main sample, which includes only bonds issued by municipalities (excluding bonds issued by state entities). The average offering yield for municipal bonds issued in the first four months of 2020 is 1.8%, with a median of 1.7%. The average bond par amount is $2.9 million, while the median is $595,000, indicating that bond size is right skewed. The average and median maturities are 9.9 and 8.6 years, respectively, which are lower than municipal bond maturities documented in earlier years (e.g., Gao, Lee, and Murphy, 2019). Nearly half of the bonds (49%) are callable, 71% are general obligation bonds, and 21% are insured. Interestingly, over a third of the newly issued bonds are refunding bonds, with which issuers refinance outstanding bonds by issuing new bonds. This fraction is significantly higher than the 6% refunding rate for the 2004-2017 period (Painter, 2020), suggesting that municipal issuers

are taking advantage of the generally low interest environment to replace outstanding bonds sold at a higher interest rate.

[Insert Table 2 here]

The majority of our sample bonds are tax exempt, 88% federally exempt and 70% state exempt. As S&P issues 38% more ratings than Moody's for our sample bonds, we use S&P's rating when it is available. When S&P does not rate a bond, we use Moody's rating. Nearly 90% of the bonds are assigned an investment grade rating. About 41% of the offerings are issued in a competitive manner, in which multiple underwriters bid for the right to issue a bond. The bond is awarded to the underwriter presenting the best bid (with lowest interest expense to the issuer). The remaining 59% are negotiated sales, in which an underwriter is selected by the issuer through a proposal process.

Columns (5)-(8) report summary statistics for bonds issued by state entities, which we use for robustness analysis at the state level. State entities issued about 90% fewer bonds than local governments. State-issued bonds have an average par value of $13.8 million, much larger than the $2.9 million of municipality-issued bonds. Interestingly, only 12.5% of bonds are general obligation bonds and 2.6% are insured, both of which are significantly smaller than the fractions for bonds issued by local governments. In addition, offering yields of state bonds on average are 16.3 bps higher than offering yields of local bonds, potentially compensating for higher risks associated with a longer maturity, a lower percentage of general obligation and insured bonds. All these differences are statistically significant at the 1% level.

Similar to Gao, Lee, and Murphy (2019) and Morningstar (2007), we break down local and state municipal bonds into nine sectors: Education, General Obligation, Transportation, Healthcare, Water/Sewer, Utilities, Housing, Dedicated tax revenue (e.g., sales tax and hotel occupancy tax) Improvement/Development, and Other. Table 2, Panel B reports statistics related to each sector. For bonds issued by local governments, the two largest sectors by total amount issued are Education (31.4%) and General obligation (20.0%), which account for more than half of the par value issued. In contrast, for state-issued bonds, general obligation (25.0%) is a larger sector than Education (19.8%), followed by Healthcare (15.5%).

4. Empirical Methodology

4.1 Panel data regression

To examine whether municipal bond offering yields are correlated with coronavirus-related shocks at the local level, we start with a descriptive analysis with the following structure:

$$Yield_{ict} = \alpha + \beta COVID\ Severity_{ct} + \gamma X_i + \delta_c + \theta_t + \delta_c \times t + \varepsilon_{ct} \quad (1)$$

in which the dependent variable is the offering yield or yield spread for bond *i* issued in county *c* on day *t*. The independent variable of interest, $COVID\ Severity_{ct}$, measures the severity of COVID-19 at the county level. It is proxied by the logarithm of the number of COVID-19 cases, the logarithm of the death counts, the growth rate of case counts in the past two weeks, or the growth rate of death counts in the past two weeks. In addition to controlling for bond characteristics X_i, we also include δ_c, a set of county fixed effects that capture time-invariant differences in offering yields across counties; θ_t is a set of trading day fixed effects that control for time trends that are common across all counties; $\delta_c \times t$ represent county-specific linear time trends that capture any unmeasured county-level trends that could be coincidentally associated with the timing of coronavirus cases and deaths. In alternative specification checks, we also include state-day fixed effects which control for unobserved day-to-day shocks that are common to counties within each state. Standard errors are clustered at the county level.

To study whether the frequency of municipal bond new issuance is also affected by the COVID-19 pandemic, we adopt the county-week level regression below as new issuance is relatively infrequent on a daily basis:

$$Issuance_{ct} = \alpha + \beta COVID\ Severity_{ct} + \delta_c + \theta_t + \delta_c \times t + \varepsilon_{ct} \quad (2)$$

in which $Issuance_{ct}$ is an indicator equal to one if there is at least one municipal issue in county *c* in week *t*, and zero otherwise. We use a linear probability model to take advantage of county and week fixed effects. In addition to this dummy variable, we also use the number of new issues taking place in county *c* in week *t* as an alternative dependent variable. All other variables are identical to those in equation (1) except that *t* denotes week in equation (2).

4.2 County-level event studies

To examine whether local government actions had any effect on offering yields, we use an event-study regression model with the following structure:

$$Yield_{ict} = \alpha + \sum_{\tau=-4}^{-1} \beta_\tau Govt\ Policy(\tau)_{ct} + \sum_{\tau=0}^{4} \beta_\tau\ Govt\ Policy(\tau)_{ct} + \gamma X_i + \delta_c + \delta_c \times t + \varepsilon_{ct} \quad (3)$$

where the dependent variable is the offering yield or yield spread for bond *i* issued in county *c* in week *t*. $Govt\ Policy(\tau)$ is a dummy variable that takes a value one if it is "τ" weeks before (after) the event week in which a local government policy is enacted and zero otherwise.[13] All other variables are identical to those in equation (1). To examine the probability of new issuance and the number of issues at the county-week level, we use the following modified model:

$$Issuance_{ct} = \alpha + \sum_{\tau=-4}^{-1} \beta_\tau Govt\ Policy(\tau)_{ct} + \sum_{\tau=0}^{4} \beta_\tau\ Govt\ Policy(\tau)_{ct} + \delta_c + \delta_c \times t + \varepsilon_{ct} \quad (4)$$

where $Issuance_{it}$ is the occurrence of issuance or the number of issues in county *c* during week *t*. All other variables are identical to those in equation (2).

To avoid bias arising from other possible systematic events at the national level, for equations (3) and (4) the event window runs from four weeks before the event week to four weeks after the event week. In both models, standard errors are corrected for autocorrelation and are clustered at the county level (Bertrand et al., 2004).

To evaluate the effects of the Fed's MMLF and MLF programs, we use models that are similar to equations (3) and (4) except that there is no variation in timing of the policy for each county. That is, we replace $Govt\ Policy(\tau)_{ct}$ with $MMLF(\tau)_t$ or $MLF(\tau)_t$. As offering yields rose sharply and dropped precipitately around the establishment of the MMLF, our event-study on offering yields is conducted at the daily frequency. We set the length of the focal event window to run from 10 days before the event to 10 days after the event.

[13] The model is similar to Abeberese et al. (2020) and Gupta et al. (2020).

In addition to the event studies, we also perform cross-sectional analysis for various subsamples by restricting to a short window around each event. In robustness analysis, we apply the above models at the state level.

5. COVID-19 and Municipal New Issuance

5.1 COVID-19 and offering yields

Because the first confirmed case in the U.S. was reported on January 21, 2020, we use an estimation window that runs from January 21 to April 30, 2020, the end of our sample period.

Column (1) of Table 3 presents evidence on the relationship between the number of COVID-19 cases and offering yields, controlling for primary determinants of offering yields, including bond size, maturity, credit rating, and tax provision. Under this specification, when county-level case counts double offering yields increase by 7.3 bps, significant at the 1% level. We note that the average county sees case counts double in only 8.8 days during our sample period. Given the unconditional average offering yield is 1.77%, this represents a 4.1% marginal increase from the average offering yield. Similarly, column (2) reports that offering yields increase 11.3 bps when the number of a county's coronavirus-related deaths doubles. Death counts on average double in 9.0 days. With the marginal effect being 6.4%, it suggests that municipal bond investors are more concerned about coronavirus-related deaths than reported cases. This is consistent with public health experts' belief that "the only consistent and reliable daily data point available from all 50 states is the number of deaths" because it is less affected by testing,[14] which sees wide variation among states (Karaca-Mandic, Georgiou, and Sen, 2020).[15]

[Insert Table 3 here]

[14] For example, as of May 17, 2020, New York had administered the largest number of tests at 1,338,048 but Rhode Island administered the largest number of tests per 1000 people at 99.1 per 1000, followed by New York and Massachusetts. Three states–Maine, Idaho, and Arizona– tested less than 20 people per every 1000 people (Davis, 2020).

[15] While the number of daily deaths is important, some health experts have called for consistent reporting of daily hospitalization, which can help paint a fuller picture of the impact of the COVID-19 pandemic on each county's (or state's) healthcare infrastructure. COVID-19 hospitalizations are not consistently reported across states as of June, 2020 (Karaca-Mandic et al., 2020).

Consistent with other findings in the municipal bond offering literature, we find that offering yields are higher for longer-dated, non-investment grade, and callable bonds. Moreover, refunding bonds enjoy lower offering yields as municipalities refinance their existing debt with cheaper new debt. General obligation bonds also have lower yields as they are backed by the full faith and credit of the issuing municipality and are perceived safer instruments relative to revenue bonds.

In columns (3) and (4), we examine how biweekly growth in case counts and deaths may influence offering yields. Controlling for bond characteristics, we find that biweekly growth in case counts is not correlated with offering yields. Biweekly growth in death counts, however, is significantly related to offering yields. When the biweekly growth rate in death counts increases by one standard deviation, offering yields increase by 9.1 bps, representing a marginal effect of 5.1%. These results confirm that investors tend to pay more attention to coronavirus fatality than infections.

In addition to offering yields, we also use yield spreads as an alternative measure of issuance costs. A yield spread is defined as the difference between a municipal bond yield and the yield on an equivalent risk-free bond. We follow the procedure adopted by Gao, Lee, and Murphy (2019), which is similar to Longstaff, Mithal, and Neis (2005).[16] As shown in columns (5)-(8) of Table 3, the relationship between COVID-19 cases/deaths and yield spreads is similar to what we find in columns (1)-(4).[17]

5.2 COVID-19 and new issuance

As reported in column (1) of Table 4, when county-level case counts double the probability of new issuance decreases by 1.5 percentage points, significant at the 1% level. Given the unconditional probability of new issuance is 3.8%, this represents a 39.5% marginal decrease in issuance frequency on a weekly basis. Column (2) reports that the probability of new issuance drops 2.2 percentage points when the number of a county's coronavirus-related deaths doubles. This implies a 57.9% marginal

[16] Specifically, for the yield on an equivalent risk-free bond in a specific month, we calculate the sum of the present value of future cash flows associated with a municipal bond using the off-the-run zero-coupon Treasury yield curve as discount rates (Gürkaynak, Sack, and Wright, 2007). This is the equivalent risk-free bond's price, which we use to calculate the yield to maturity of this bond.

[17] As a robustness check, we also use yield spreads over similar-maturity Treasuries as an alternative measure, following Green, Li, and Schürhoff (2010). We use the daily constant maturity Treasury rates provided by the St. Louis Federal Reserve. These rates are for maturities of 1, 3, and 6 months, 1, 2, 3, 5, 7, 10, 20, and 30 years. For intermediate maturities we interpolate using a standard cubic spine. The regression results are qualitatively similar.

decrease in issuance probability. Consistent with findings in Table 3, while biweekly growth in infections is not related to issuance probability, biweekly growth in deaths significantly predicts new issuance. Taken together, these results suggest that the occurrence of new municipal issuance decreases when growth in coronavirus-related deaths pick up. The relationship is weaker for case counts, presumably attributable to differing testing intensities across counties.

[Insert Table 4 here]

In columns (5)-(8), we repeat the analysis by replacing the dependent variable with the number of new issues per week. The results are highly consistent with those found in columns (1)-(4). For example, when the number of a county's coronavirus-related deaths doubles the number of new issues per week drops by 0.053. Given the unconditional mean is 0.051 new issues per week, this implies a substantial decrease in new issuance activity.

Overall, the results shown in this section suggest that during the first four months of 2020 investors' appetite for a county's new municipal bonds is associated with the pandemic's severity, especially when measured by the number of deaths. The relationship is both economically and statistically significant. We are careful not to claim causality because both investor demand for municipal bonds and coronavirus-related cases/deaths can be affected by state and local government policies aimed at containing the pandemic. The same relationship can also be impacted by the Fed's interventions in the municipal bond market. In the next two sections, we examine how these policy shocks affected municipal new issuance.

6. State and Local Government Actions

As explained in section 3.2, of the various mitigating policies adopted by state and local governments, we focus our analysis on emergency declarations and SAH orders. In addition, we also examine whether the new issuance market responds to the announcement of the first confirmed case statewide, which is a potentially important information event that generally takes place before an emergency declaration.

6.1. County-level event studies

6.1.1. Offering yields

In Table 5, Panel A, we report results on the effects of each government action on offering yields. In columns (1), (3), and (5), we control for county fixed effects and county by week trends, while in columns (2), (4), and (6), we further include major bond characteristics that are identical to those in Table 3. As shown in columns (1) and (2), first-case announcements do not appear to affect offering yields, whether we control for bond attributes or not. We report in columns (3) and (4) that emergency declarations, however, lead to a 68.8 to 74.1 bps increase in offering yields in the event week, relative to the week immediately before the declarations. This order of magnitude is large considering that the average offering yield for newly issued municipal bonds during the event window is 1.74%. Offering yields continue to increase during the following week, before dropping off slightly during the second week after the event. The decline of offering yields accelerates starting the third week, likely reflecting the effect of the Fed's March intervention in the municipal bond market.[18]

[Insert Table 5 here]

Interestingly, as shown in columns (5) and (6), offering yields jump sharply during the week before SAH orders are imposed, indicating that policies such as emergency declarations already induce investors to respond before SAH orders are put in place. In Appendix Figure A6, we plot the estimated coefficients for the three event types (controlling for bond characteristics), which help the reader visualize the effect of each event. We emphasize the lack of any significant pre-trend prior to emergency declarations. If anything, offering yields of municipal bonds actually trended down slightly before the declarations. We take the lack of a pre-trend as additional evidence in support of emergency declarations' direct effect on offering yields.

These results combined suggest that emergency declarations occurred relatively early in the pandemic and they were interpreted by bond investors as an event that conveyed the seriousness of the situation at the local level. In contrast, the first COVID-19 case was reported up to several weeks before the emergency declaration and during that time investors might not appreciate how much economic damage the highly contagious disease would have caused.

[18] We note that most emergency declarations took place during the weeks of March 2 and March 9, while the Fed's MMLF began operations during the week of March 23.

6.1.2. Occurrence of new issuance

In Table 5, Panel B, we examine how the three event types affect the occurrence of new issuance. As shown in column (1), first-case announcements appear to have a weak negative effect on issuance frequency during the event week, with the effect strengthening in the following several weeks. In contrast, emergency announcements have an immediate negative effect on new issuance, with the probability of new issuance dropping 2.8 percent points during the event week (significant at the 1% level). Issuance continues to drop the following week, before recovering somewhat during the next two weeks. These effects are substantial considering that the average probability of issuance is 3.7% during the two months around an emergency announcement. Similar to first-case announcements, SAH orders also have a weak negative effect on issuance frequency during the event week, with no noticeable effect during the following week. Using the number of issues per week as an alternative dependent variable, we obtain consistent results. The estimated coefficients for the three event types (controlling for bond characteristics) are plotted in Appendix Figure A7.

These results corroborate our finding on the effects of the three event types on offering yields. Together they indicate that bond investors took local emergency declarations seriously and began to view municipal bonds as riskier assets, and therefore started demanding higher returns on new issues. State and local budgets have been hit hard by the coronavirus, with tax revenues falling, and spending on unemployment insurance and Medicaid rising. However, investors did not seem to react to announcements of first cases, suggesting that credit risk was not a major concern before March 2020 (most states reported their first COVID-19-related cases in February). On the other hand, SAH orders typically arrived after a series of government actions, including emergency declarations, school closures, and gathering restrictions. It is therefore not surprising that by the time SAH orders were implemented, municipal bond investors already responded to a collection of policy responses.

6.2. Cross-sectional analysis around emergency declarations

Having documented that on average municipal bond new issues negatively responded to emergency declarations for COVID-19, we now examine how different municipal sectors fared around emergency declarations.

6.2.1. Municipal sectors

Industry commentators have pointed out that essential service bonds such as water/sewer bonds, housing bonds,[19] and electric revenue bonds are traditionally viewed as being more defensive compared with bonds in other revenue sectors (Stern, 2020). Residents and businesses generally prioritize the payment of water, sewer, and electric bills and essential service bonds are typically designed to permit rate hikes, as needed, to offset declines in water or energy usage. On the other hand, with a collapse of travel and many areas on lockdown the transportation sector, including airports, public transit, toll roads, and ports, have faced pressure on revenues. Likewise, dedicated tax bonds such as sales and excise tax and hotel occupancy tax bonds are likely to decline facing an economic slowdown.

In Table 6, we sort municipal sectors based on the change of total amount issued from one month before emergency declarations to one month after the declarations. Among the resilient sectors, defined as the total amount issued increasing or dropping less than 20%, water/sewer bonds' dollar volume increased by over 17% although the number of issues dropped somewhat. The utility sector saw a small decline in volume while housing bond issuance increased both in dollar volume and number of issues. This supports the view that essential service bonds are indeed more defensive during a downturn.

[Insert Table 6 here]

Consistent with our expectation, transportation was the hardest hit sector, seeing its issue volume dropping by nearly 88% around emergency declarations, followed by the dedicated tax category. Measured by volume, education overtook general obligation as the largest sector during the post-emergency declaration period. However, higher education's volume dropped to $821.9 million from $2.2 billion, a reduction of 62%. This reflects adverse financial impacts from lost auxiliary revenues, cuts in state funding, and declines in fall 2020 enrollments. General obligation bond volume shrank by 68%, potentially reflecting a deteriorating outlook for municipalities, especially those relying heavily on sales and income tax revenues or less rainy day funds. Perhaps somewhat surprisingly, the healthcare sector overall saw only a 23.4% decrease in amount raised, given that increased coronavirus-

[19] Nursing homes, assisted living facilities and independent living facilities are usually classified in the healthcare sector.

related hospitalizations could pressure high-occupancy hospitals and potentially crowd out other services, and the sector tends to be lower-rated on average.[20]

Having shown the distribution of issuance across municipal sectors, we proceed to studying whether offering yields change differentially for bonds from resilient sectors (water/sewer, utilities, and housing) and those from the rest of the municipal sectors. We regress offering yields on a dummy variable that equals one for the month after emergency declarations and an interaction term representing the product of this dummy variable and whether a bond is from a resilient sector. A negative coefficient on the interaction term indicates that water/sewer, utility or housing bonds are less adversely affected by emergency declarations. Before presenting regression results, we check whether offering yields exhibit differential trends before emergency declarations. As shown in Figure 5, Panel A, between resilient bonds and other bonds there is no noticeable difference in the trend of offering yields during the four-week period before the declarations.

[Insert Figure 5 here]

In columns (3) and (4) of Table 7, we show that around emergency declarations, offering yields indeed increase 38.3 to 41.5 bps less for resilient municipal bonds, compared with bonds from other sectors. The estimate is significantly at the 1% level. The main effect of emergency declarations is between 77.3 and 81.5 bps, close to the univariate results shown in columns (1) and (2).

[Insert Table 7 here]

6.2.2. Municipal fiscal health

We conjecture that in the COVID-19 era, bonds issued by fiscally healthy municipal governments would see more investor demand than those from states facing significant fiscal challenges. Credit quality would deteriorate as states and municipalities collect fewer revenues from sales and other taxes while spending more on unemployment benefits and emergency healthcare. To determine which states are fiscally healthy, we rely on Moody's Analystics's 2019 state stress tests.[21] The tests assume a fiscal shock with a moderate recession scenario (implying a 10% economic downside) and calculate the total

[20] Within the healthcare sector, issues for senior living facilities dropped from $51.6 million to zero.
[21] The full report can be access via https://www.moodysanalytics.com/-/media/article/2019/stress-testing-states-2019.pdf

surplus or shortfall as a percentage of estimated fiscal 2019 revenue.[22] Ten states, including Illinois, New Jersey, and Kentucky, have a shortfall more than 5% of their total revenue, and are considered fiscally unhealthy. Twelve states have a shortfall below 5% while the remaining states have enough funds to weather a modest recession. Together they are considered fiscally healthy. Figure A8 shows a map of the three groups of states.

As reported in columns (5) and (6) of Table 7, we find that that around emergency declarations, offering yields of bonds issued by municipalities in fiscally unhealthy states rise 19.7 to 24.1 bps more, relative to those issued by fiscally healthy localities. This estimate is significantly at the 5% level. The effect is economically large as the average offering yield during our estimation window is 174 bps. It is worth noting that we use a state's fiscal situation to proxy for its municipalities' fiscal health. We believe that this is a reasonable proxy because local government fiscal conditions depend in large part on the amount of aid and support they receive from states. Consistent with this, we show in Appendix Table A2 that our results hold when performing the analysis at the state level.

Results in both subsections 6.2.1 and 6.2.2 suggest that the dramatic increase in offering yields was unlikely due to a liquidity crisis alone, in which case municipal bond yields would rise on an indiscriminate basis.

6.2.3. Maturity of municipal debt

Lastly, in columns (7) and (8) of Table 7, we show results for an additional test comparing municipal notes and bonds around the declarations.[23] Our estimates imply that offering yields for bonds increase only four bps after emergency declarations, relative to short-term notes. Statistical significance is also marginal. This is surprising given that yields for longer-maturity bonds in general are much more sensitive to adverse economic news. This might reflect bond investors' expectation that the coronavirus pandemic is a short-term phenomenon that would weaken issuing municipalities' fiscal conditions in the near term and municipalities' finances would recover in the longer term. In fact, short-term costs for municipal bonds jumped significantly around Mid-March (see Appendix Figure A9). For example,

[22] State revenue includes its rainy-day balance, which is surplus revenue set aside for use during unexpected deficits.
[23] Figure 5, Panel C shows that offering yields for notes and bonds follow similar trends during the period before the declarations.

rates shot up to 5.2% on March 18 from 1.28% a week before on variable rate municipal bonds (called variable rate demand obligations or VRDOs) that reset their rates every week based on what bondholders are willing to pay (Wei and Yue, 2020).[24] We repeat our analysis for yield spreads and present consistent results in Appendix Table A3.

7. Federal Reserve Interventions

Despite the fact that the Fed cut the federal funds rate twice and resumed asset purchases in the first two weeks of March 2020, municipal bond yields kept rising along with yields on other fixed income assets. The Fed announced on March 20 that it would start to backstop municipal bond money market funds on March 23. In addition, it created the MLF on April 9 to directly purchase securities from municipalities. In this section, we examine the efficacy of these interventions in terms of offering yields and the occurrence of issuance. As offering yields rose quickly and dropped steeply around March 23 (see Figure 3), our event study for offering yields is carried out at the daily frequency.

7.1 Operation of the MMLF on March 23

7.1.1 Offering yields

In Figure 6, Panel A, we present the event-study coefficients. Relative to offering yields on March 20 (Day = -1), yields dropped about 200 bps on March 23, the day on which the MMLF became operational. Offering yields continued to trend down throughout the week, after which it increased somewhat. This suggests that the establishment of the MMLF was effective in calming the primary market for municipal bonds. It is not surprising that estimated coefficients for the "before" period are also negative, indicating market stress around mid-March.

[Insert Figure 6 here]

Interestingly, although the MMLF targets short-term municipal notes, the effect is stronger and more immediate for bonds with longer maturities. As shown in Panel B, for notes with a maturity less than three years, offering yields did not drop until the end of the week (Day = +4). This pattern is consistent

[24] A significant share of municipal debt is variable interest rate notes. According to the Securities Industry and Financial Markets Association (SIFMA), the total size of the municipal floating-rate note market was approximately $230 billion at the end of 2018. See https://www.sifma.org/wp-content/uploads/2019/02/US-Municipal-Report-2019-02-11-SIFMA.pdf.

with the results in subsection 6.2.3 and with what we observe in the secondary market where the spreads on short-term municipal debt remained more elevated than longer-dated bonds (see Appendix Figure A9), possibly reflecting issuing municipalities' weakened fiscal conditions in the near term. For bonds with a maturity over three years, however, their offering yields dropped 217 bps on March 23. By the end of the week, yields were nearly 300 bps lower than they were on March 20.

The results for yield spreads are similar for both the main and subsample analyses, which we present in Appendix Table A4. The results above suggest that although the MMLF aims to support short-term municipal debt, it has significant spillovers to municipal securities with longer maturities and the Fed has largely achieved its goal in calming the overall municipal bond market.

7.1.2 Occurrence of new issuance

Interestingly, unlike offering yields that responded immediately to the establishment of the MMLF, new issuance only started to pick up during the second week after the intervention. As shown in Figure 6, Panel C, compared to that in the week of March 16, the probability of issuance during the week of March 30 is 1.1 percentage points higher. This is substantial considering that the unconditional probability of issuance at the county level is 3.3%. Similarly, the number of issues increased 27% over the same period.

7.2 Announcement of the MLF on April 9

We repeat the analysis in subsection 7.1 for the MLF program that aims to buy securities directly from municipal governments. The results are shown in Table 8. Panel A reports results on offering yields. Controlling for bond characteristics, the announcement of the MLF lowered the average offering yield by 23.8 bps on the following trading date, with the effect persisting into the ninth trading day after the announcement. Most of the estimates are statistically significant at the 5% level. In columns (2) and (3), we find that the effect of the MLF is somewhat similar for municipal notes and bonds, with the effect on bonds slightly larger and more persistent. Considering that the average offering yield hovered around 200 bps during this period, the effect of the mere announcement of the MLF program was substantial. Note that as of May 23, 2020, the MLF was still not operational (Fed, 2020b). As reported

in Appendix Table A5, the results for yield spreads are similar, with the effect being slightly smaller and less persistent.

In Table 8, Panel B, we report results for the effect of the MLF on new issuance. We show that relative to the prior week, new issuance in the event week did not change. This is likely due to the fact that the MLF was announced April 9, 2020, a Thursday. Indeed, new issuance increased by 1.9 percentage points in the following week (p-value < 0.01), with the effect persisting into week +2. It is perhaps not surprising that issuance during the week of March 23 (t = -2) was significantly lower, as the municipal bond market was just recovering from unpresented stress during the week of March 16 (t = -1). Similarly, the number of issues increased 0.027 during the event week on average, representing a marginal increase of 65.9%.

8. State-Level Analyses

Our main analyses in Sections 6 and 7 focus on municipal bonds issued by local governments as we explore county-level variations that may affect new issuance and offering yields. However, as Figure 3 shows, approximately 9% of all issues in our sample were sold by state governments, representing nearly a third of the total amount raised. Therefore, in this section, we perform robustness analysis by including bonds issued by states.

We first examine whether offering yields respond to any of the three representative government policy events studied in Section 6. Figure 7 plots the estimated coefficients. Similar to county-level results found earlier, Panel A reveals that there is no change in offering yields during the week when the first COVID-19 case is announced, compared with yields in the prior week. Offering yields continue to climb in the following weeks, likely due to emergency declarations or other related events. Panels B and C show that emergency declarations have an immediate and large effect on offering yields while SAH orders, although the culmination of social distancing measures, appear to take place after investors already responded to government policies curbing the spread of coronavirus, including declarations of emergency.

[Insert Figure 7 here]

In Figure 8, we show that consistent with our county-level studies, both the Fed's MMLF and MLF programs have achieved their desired goals in bringing down offering yields. The MMLF also has differential effects on short-term and long-term municipal debt, while the MLF does not have such an effect. Replacing offering yields with yield spreads in the above tests also generates qualitatively similar results, which we do not report due to space limitations.

[Insert Figure 8 here]

9. Conclusion

The COVID-19 pandemic has exacerbated uncertainties regarding the financial health of state and local governments, which have had difficulty accessing the municipal bond market to address capital needs or to fund services. Using granular county-level data, we find that the average offering yield (on the intensive margin) increases while the number of new issues (on the extensive margin) drops when county-level COVID-19 case and death counts rise, with bond investors paying more attention to coronavirus-related mortality than to other factors.

More importantly, using an event-study methodology, we show that, among the various government-sourced mitigating policies, declarations of states of emergency, which likely affected investor sentiment, exerted the most negative impacts on new issuance. Investors shunned transportation and dedicated tax bonds while favoring essential service bonds such as water/sewer bonds. Similarly, bonds issued in fiscally unhealthy states experienced weaker investor demand than those from fiscally strong localities.

We also find that the Federal Reserve's unprecedented interventions through the MMLF and MLF were successful in calming the municipal bond market. Offering yields on average dropped 200 bps on March 23 alone, when the MMLF became operational. New issue volume also rose gradually.

Finally, we note that investors welcomed the reopening of economics starting in April 2020 and the municipal bond crisis had largely subsided by summer 2020. Given the ongoing challenges that municipal governments face, however, it is not clear whether the Fed's liquidity facilities and direct funding under the CARES Act will be able to plug shortfalls for all state and local governments.

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Figure 1: State and Local Government Emergency Declarations

This figure shows the dates of government emergency declarations for COVID-19 at the county level. If a county issued its own emergency declaration before the state declaration, we use the former date. Otherwise, we use the date of state emergency declaration as state declarations typically supersede local ones.

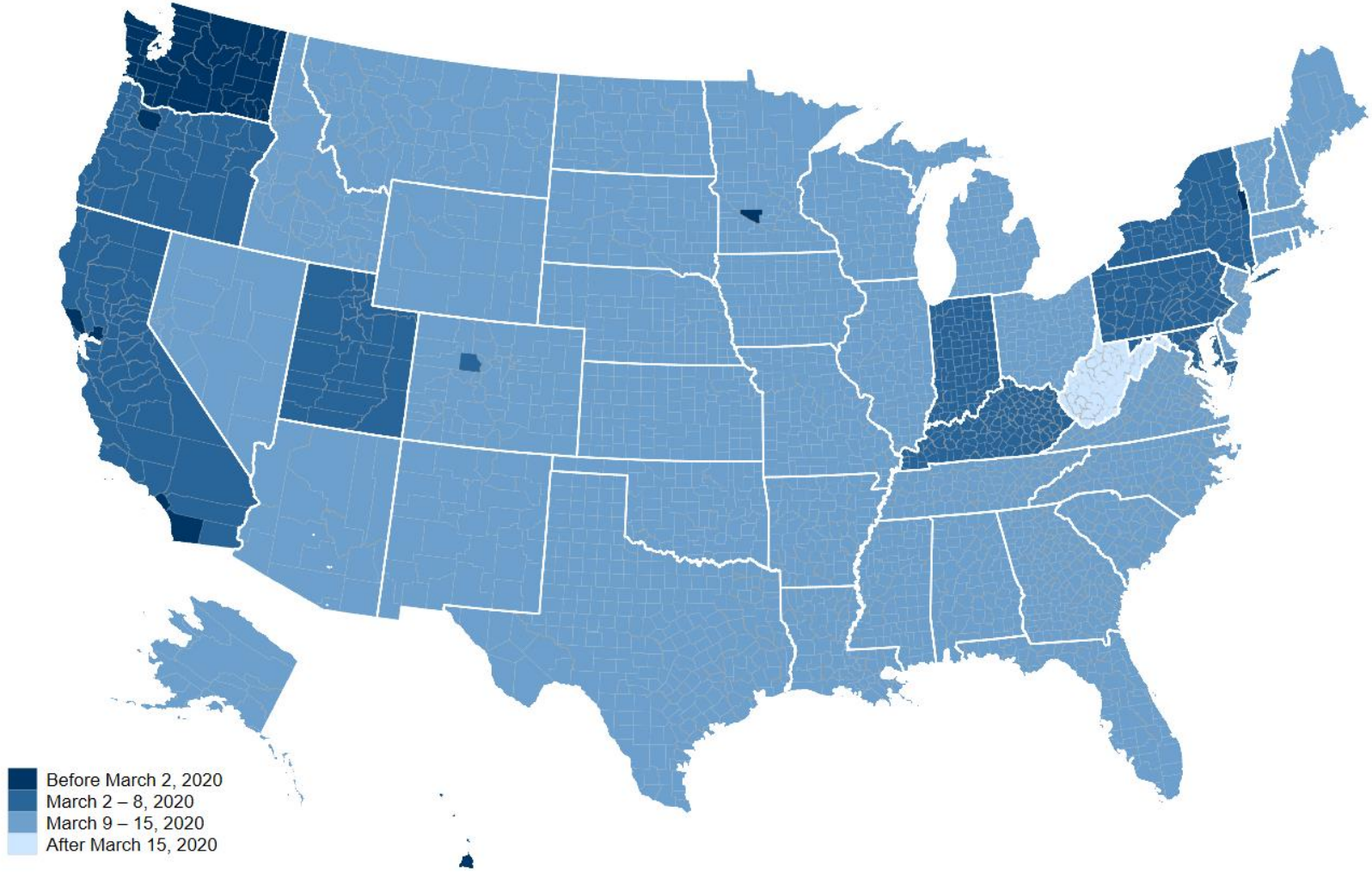


Figure 2: Count of State-Level Information and Policy Events

In this figure, we plot the cumulative number of states (shown in circles) that engaged in the following information and policy events between January 21, 2020 and April 30, 2020: first-case announcement, emergency declaration, school closure, gathering restriction, nonessential business closure, and stay-at-home order.

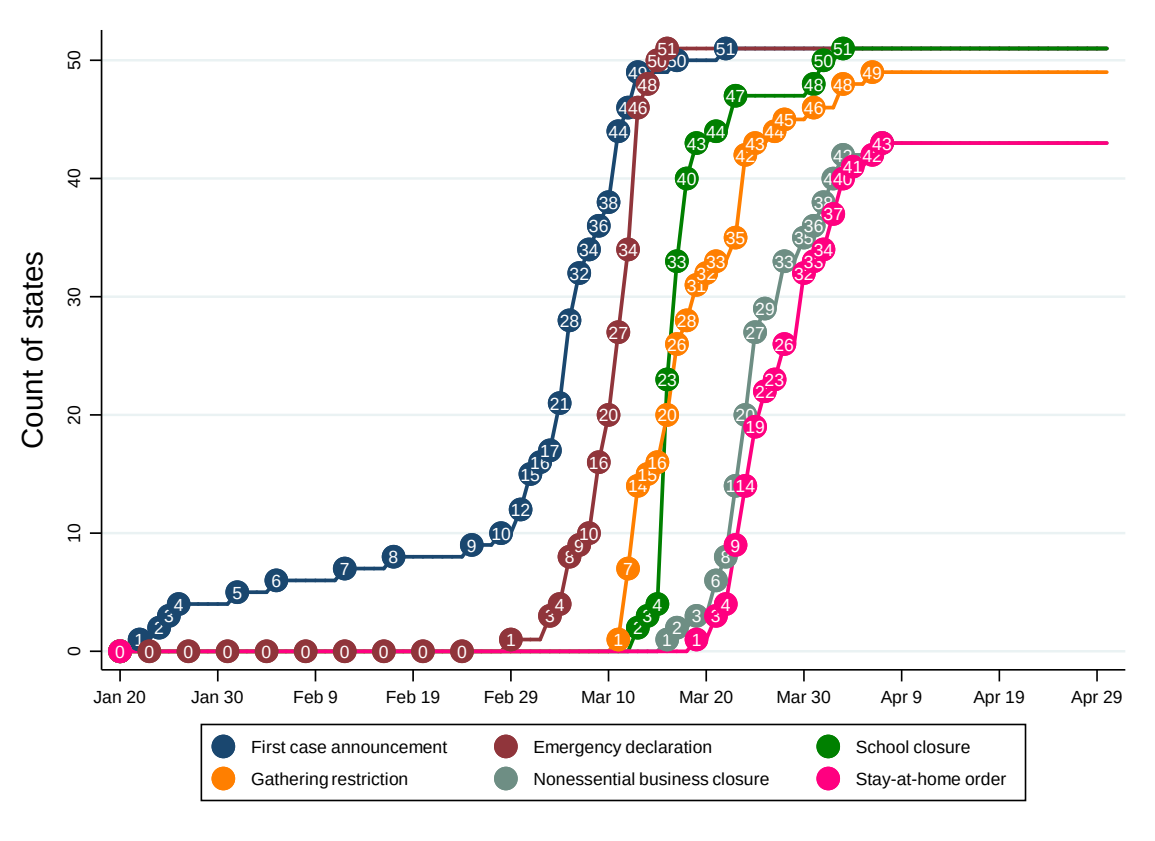
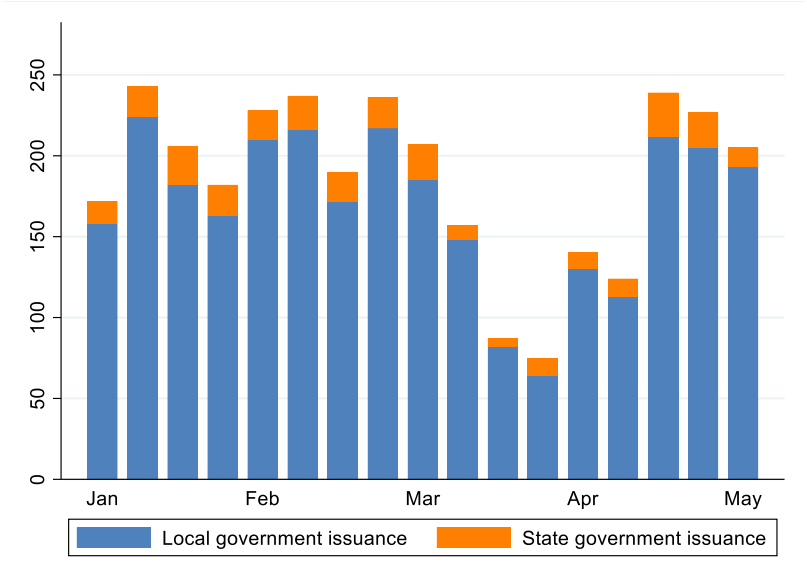


Figure 3: Weekly Municipal Bond Issuance

In Panel A, we plot the number of new issues per week between January and April 2020. In Panel B, we show the par amount issued in billions of dollars per week during the same period. In both panels, the blue bars represent issues by municipalities while the orange bars represent issues by states.

Panel A. Number of new issues per week



Panel B. Par amount issued ($ billion) per week

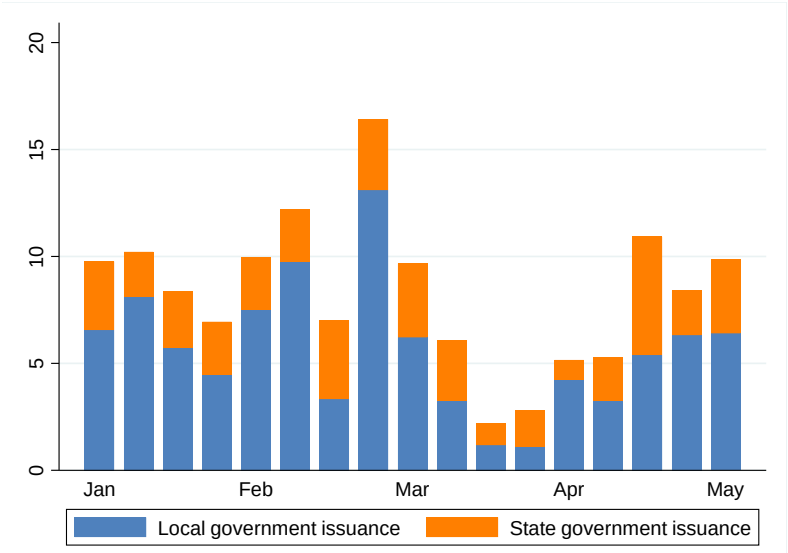


Figure 4: Daily Offering Yields and Yield Spreads for New Issues

This figure shows movements in municipal bond offering yields and yield spreads over equivalent risk-free rates from January to April 2020. The figure also presents the timeline of the establishment of Federal Reserve's (Fed) Money Market Liquidity Facility (MMLF) and Municipal Liquidity Facility (MLF).

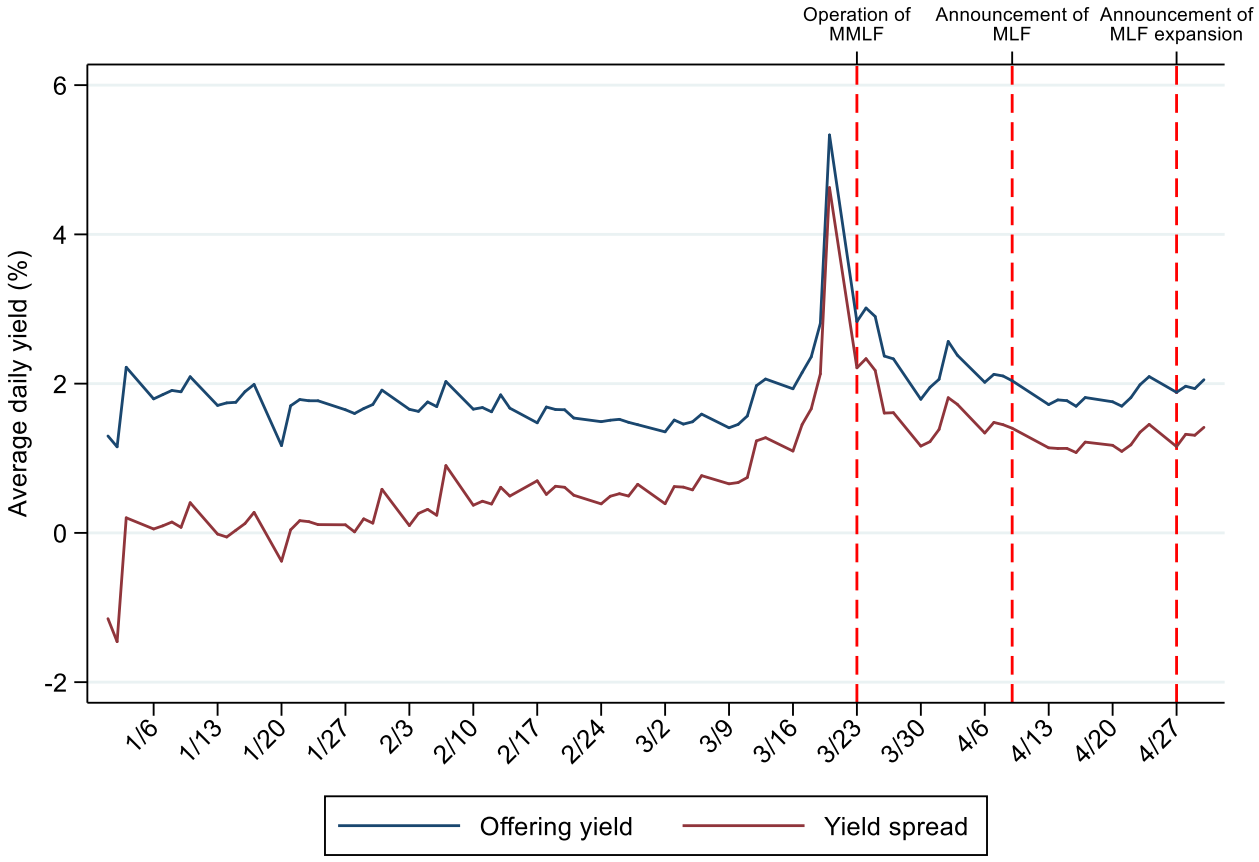
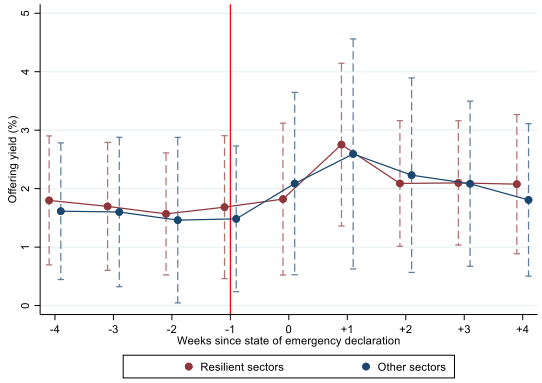


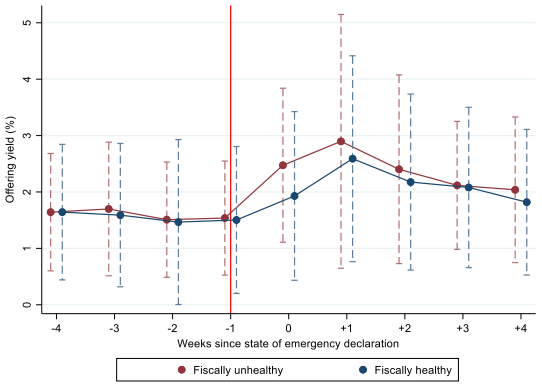
Figure 5: Offering Yields Around Emergency Declarations

This figure displays offering yields of municipal bonds around county-level emergency declarations for the period running from four weeks before a declaration to four weeks after the declaration. Panel A plots yields for bonds in resilient sectors (water/sewer, utilities, and housing) and bonds in other sectors. Panel B shows yields for securities issued by municipalities from fiscally unhealthy states and the rest of the states. A fiscally unhealthy state has a shortfall of more than 5% of their 2019 revenue in a moderate recession. Panel C plots yields for bonds (maturity greater than three years) and notes (maturity up to three years).

Panel A. Bonds issued by resilient and other sectors



Panel B. Bonds issued in fiscally healthy and unhealthy states



Panel C. Municipal bonds and notes

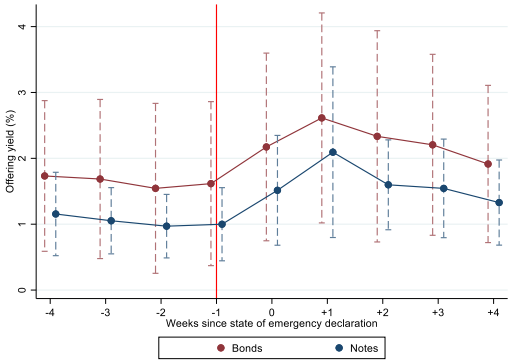
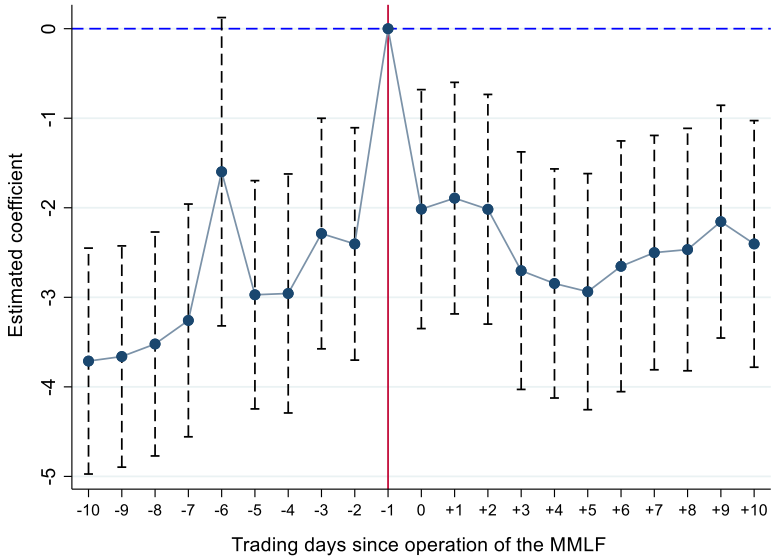


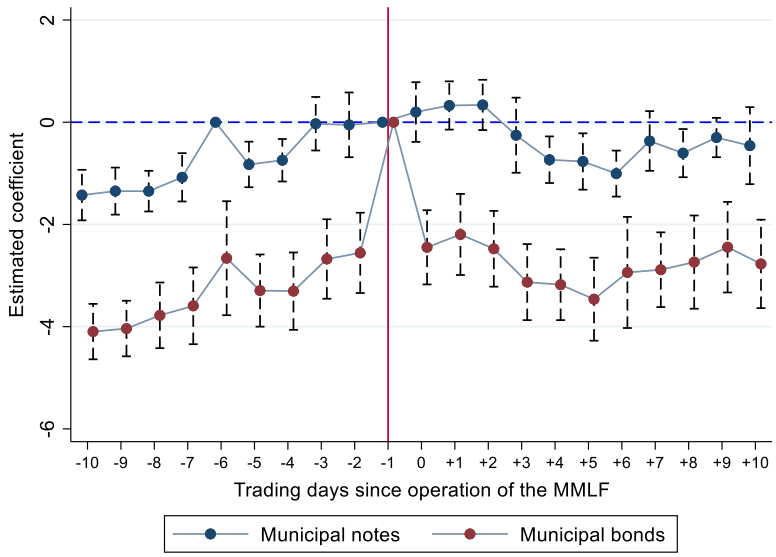
Figure 6: County-Level Event-Study of Federal Reserve Intervention in March 2020

These plots summarize the evidence from county-level event-study regressions (equations 3 and 4) of the effect of the MMLF, operational on March 23, 2020, on municipal bond new issuance. In Panels A and B, we show the estimated coefficients on "trading days since intervention" along with the 95% confidence intervals. Panel B plots the coefficients for municipal notes (maturities up to three years) and bonds (maturities above three years) separately. Panels C shows the estimated coefficients on "weeks since intervention" for the occurrence of issuance and number of issues, along with the 95% confidence intervals. All regressions include bond controls, county fixed effects, and county by day (week) time trends. Standard errors are corrected for autocorrelation and clustered at the county level.

Panel A. Offering yield during the event window



Panel B. Offering yields for municipal notes and bonds



Panel C. Weekly issuance and number of issues

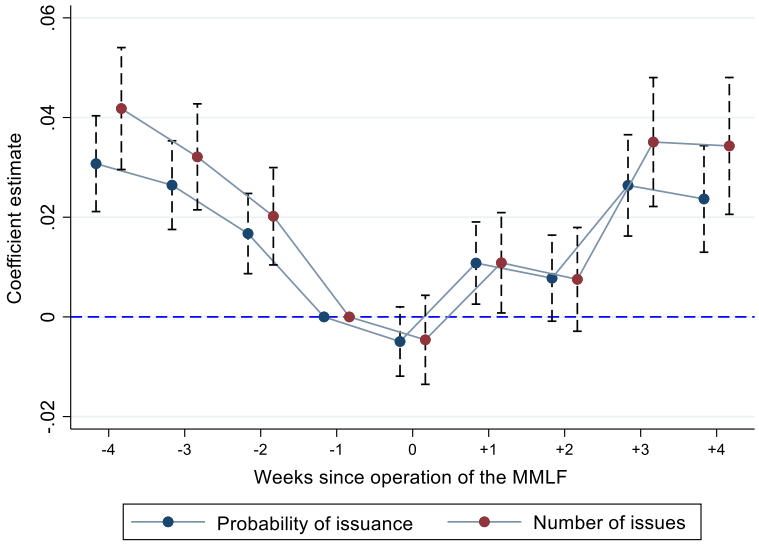
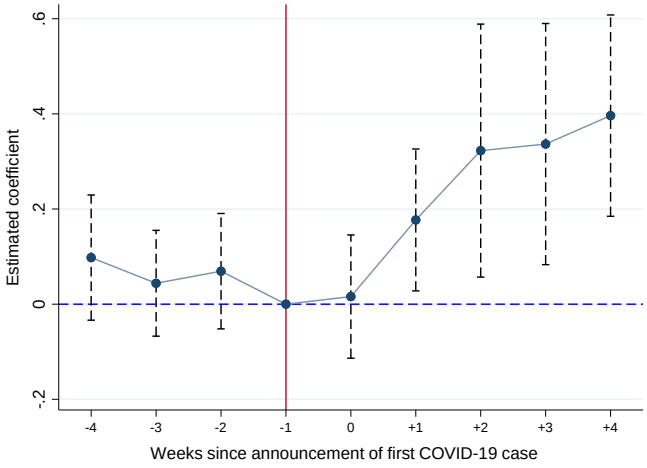


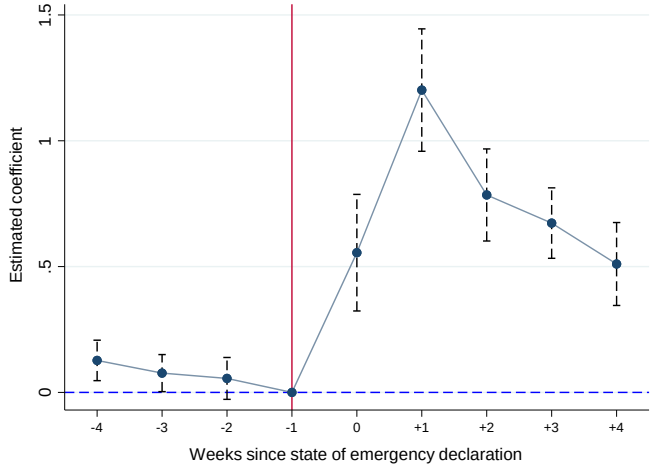
Figure 7: State-Level Event-Study of Offering Yield Around Government Policy Events

These plots summarize the evidence from state-level event-study regressions (equation 3) of the effects of three policy events, announcements of first statewide COVID-19 cases (Panel A), state-level emergency declarations (Panel B), and state-level stay-at-home orders (Panel C), on offering yields of municipal bonds. The sample includes all municipal bonds issued by states and municipalities. In all panels, we show the estimated coefficients on "weeks since event" along with the 95% confidence intervals. All regressions include bond controls, state fixed effects and state by week time trends. Standard errors are corrected for autocorrelation and clustered at the state level.

Panel A. Announcement of first COVID-19 case



Panel B. State-level emergency declaration



Panel C. State-level stay-at-home order

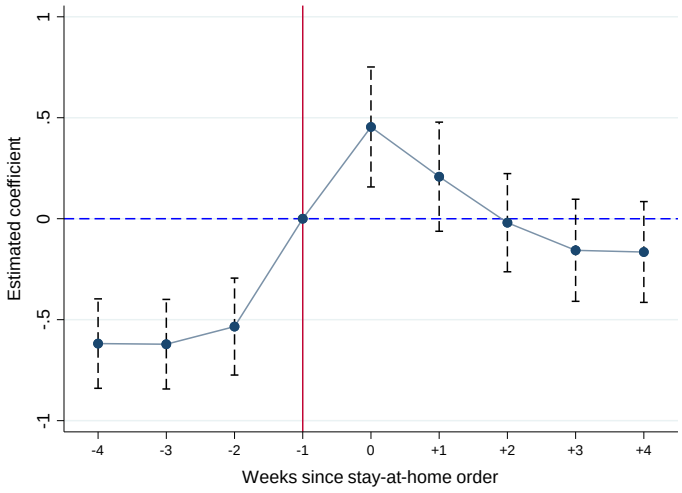
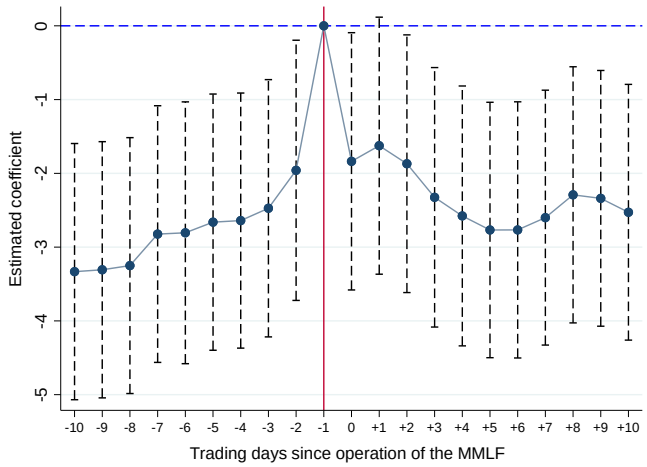


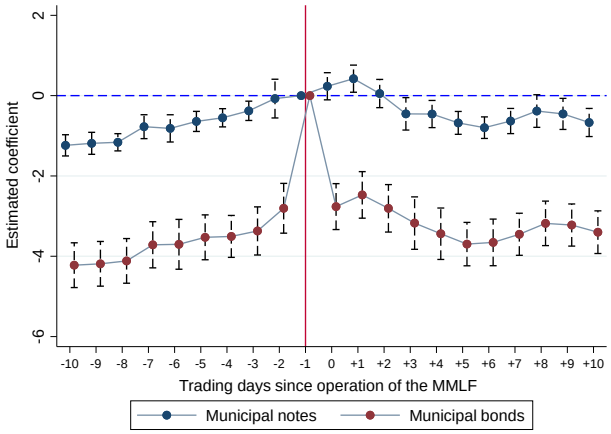
Figure 8: State-Level Event-Study of Offering Yield Around Federal Reserve Interventions

Panels A and B plot evidence from state-level event-study regressions (equation 3) of the effect of the MMLF and the MLF on municipal bond offering yields, respectively. The sample includes all municipal bonds issued by states and municipalities. In both panels, we show the estimated coefficients on "trading days since intervention" along with the 95% confidence intervals. All regressions include bond controls, state fixed effects, and state by day time trends. Standard errors are corrected for autocorrelation and clustered at the state level.

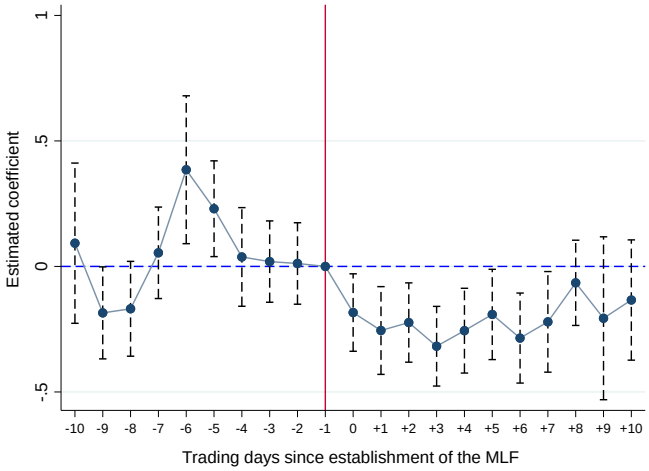
Panel A. Effect of the MMLF on offering yield



Panel B. Effect of the MMLF on offering yields of municipal notes and bonds



Panel C. Effect of the MLF on offering yield



Panel D. Effect of the MLF on offering yields of municipal notes and bonds

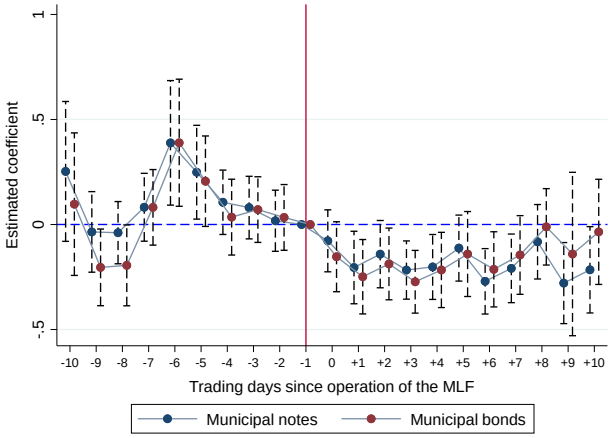


Table 1: Top 20 Counties by Municipal Bond Issuance Volume

This table reports the top 20 U.S. counties by municipal bond issuance volume in millions of dollars between January and April 2020. In addition to amount issued, we report the number of issues and number of bonds issued for each county. Municipal bonds issued by state entities are excluded.

Rank	County	State	Amount issued ($ million)	Number of issues	Number of bonds
1	Franklin County	OH	5,978	15	106
2	New York County	NY	5,685	20	166
3	Harris County	TX	4,231	69	1,077
4	Los Angeles County	CA	3,757	33	420
5	Cook County	IL	2,046	39	400
6	Maricopa County	AZ	1,289	19	222
7	Travis County	TX	1,257	27	354
8	Tarrant County	TX	1,251	16	255
9	Bexar County	TX	995	6	111
10	Orange County	CA	987	8	143
11	Sacramento County	CA	979	8	139
12	Clarke County	AL	929	2	20
13	San Diego County	CA	875	11	192
14	Cobb County	GA	865	2	3
15	Riverside County	CA	838	10	104
16	Baltimore County	MD	831	4	78
17	El Paso County	TX	795	7	118
18	Multnomah County	OR	714	3	61
19	Boone County	MO	645	2	17
20	Alameda County	CA	632	7	153

Table 2: Characteristics of Newly Issued Municipal Bonds

In Panel A, we report summary statistics for the sample of bonds acquired from Bloomberg, covering bonds and notes that were issued by municipalities and state entities from January 1, 2020 through April 30, 2020, respectively. *Offering yield* is the yield a bond is issued at. *Yield spread* is the difference between a municipal security and the yield on an equivalent risk-free bond, following Gao, Lee, and Murphy (2019). *Coupon rate* is the annual coupon payments relative to the par value, which is the face amount issued. We also report bond maturity in years, dummy variables that equal one if a bond is callable, insured, pre-refunded, competitively issued, or exempt from federal and state taxes. In addition, we report whether a bond is a *general obligation* bond, which is backed by the general revenue of the issuing municipality and whether a bond is assigned an *investment grade* rating by Standard & Poor's or Moody's if Standard & Poor's rating is not available. *N* denotes the number of observations for each variable that has non-missing values. Panel B reports the sector breakdown for bonds issued by municipalities and states, respectively.

Panel A. Bond characteristics

	Bonds issued by municipalities				Bonds issued by states			
	Average (1)	Median (2)	Std. Dev. (3)	N (4)	Average (5)	Median (6)	Std. Dev. (7)	N (8)
Offering yield (%)	1.770	1.690	0.688	32,113	1.933	1.800	0.932	3,248
Yield spread (%)	0.658	0.656	0.832	32,113	0.751	0.663	0.937	3,248
Coupon rate (%)	3.230	3.000	1.242	32,441	3.494	4.000	1.452	3,287
Par value ($M)	2.917	0.595	23.479	32,990	13.778	2.545	49.353	3,289
Maturity (year)	9.927	8.570	6.987	32,990	11.111	9.381	8.148	3,289
General obligation	0.708	1	0.455	32,990	0.125	0	0.330	3,289
Investment grade	0.895	1	0.306	32,990	0.943	1	0.232	3,289
Insured	0.214	0	0.410	32,990	0.026	0	0.160	3,289
Refunding bond	0.358	0	0.479	32,990	0.188	0	0.391	3,289
Competitive	0.414	0	0.493	32,990	0.188	0	0.391	3,289
Federal exempt	0.884	1	0.320	32,990	0.777	1	0.417	3,289
State exempt	0.701	1	0.458	32,990	0.849	1	0.358	3,289
Callable	0.491	0	0.500	32,990	0.435	0	0.496	3,289
# bonds per issue	11.515	11	8.819	2,865	11.917	7	12.521	276

Panel B. Sector breakdown

	Bonds issued by municipalities		Bonds issued by states	
Municipal sector	Amount issued ($ million)	Percent of total amount issued	Amount issued ($ million)	Percent of total amount issued
Education	30,174	31.4%	8,986	19.8%
General obligation	19,226	20.0%	11,329	25.0%
Transportation	8,361	8.7%	3,507	7.7%
Healthcare	6,476	6.7%	7,011	15.5%
Water/sewer	6,114	6.4%	1,103	2.4%
Utilities	3,757	3.9%	1,235	2.7%
Housing	2,803	2.9%	4,569	10.1%
Dedicated tax revenue	3,515	3.7%	1,469	3.2%
Improvement/development	1,389	1.4%	697	1.5%
Others	14,414	15.0%	5,410	11.9%

Table 3: COVID-19 Counts and Municipal Offering Yields

This table presents the results of ordinary least squares regressions of equation (1). Our sample includes only bonds issued by municipalities (excluding bonds issued by states). Log (1+ # cases) and Log (1+ # deaths) are the logarithm of total case and death counts as of day *t*-1, respectively. Biweekly growth rate in # cases and Biweekly growth rate in # deaths are the growth rates during the previous two weeks. Growth rates from zero to a positive number are not defined and therefore are excluded. All other variables are as defined in Table 2. Reported standard errors are clustered at the county level. ∗, ∗∗ and ∗∗∗ indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Offering yield (%)				Yield spread (%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (1+ # cases)	0.073***				0.074***			
	(0.017)				(0.017)			
Log (1+ # deaths)		0.113***				0.108***		
		(0.031)				(0.029)		
Biweekly growth rate in # cases			0.087				0.089	
			(0.065)				(0.064)	
Biweekly growth rate in # deaths				0.115**				0.105**
				(0.053)				(0.051)
Log (bond size)	0.007	0.008	0.007	-0.010	-0.012**	-0.012**	-0.016	-0.028**
	(0.005)	(0.005)	(0.010)	(0.012)	(0.005)	(0.005)	(0.010)	(0.011)
Investment grade	-0.674***	-0.674***	-0.725***	-0.840**	-0.646***	-0.647***	-0.704***	-0.825***
	(0.055)	(0.055)	(0.126)	(0.324)	(0.054)	(0.054)	(0.122)	(0.313)
Refunding bond	-0.036**	-0.034**	-0.082*	-0.029	-0.023	-0.020	-0.065	-0.010
	(0.017)	(0.017)	(0.043)	(0.056)	(0.017)	(0.017)	(0.041)	(0.055)
General obligation	-0.055**	-0.056**	-0.020	-0.131	-0.055**	-0.057**	-0.020	-0.145*
	(0.025)	(0.025)	(0.069)	(0.086)	(0.024)	(0.024)	(0.066)	(0.082)
Competitive	-0.087***	-0.086***	-0.189***	-0.141*	-0.085***	-0.084***	-0.184***	-0.142*
	(0.023)	(0.023)	(0.061)	(0.078)	(0.022)	(0.022)	(0.058)	(0.075)
Log (maturity)	0.312***	0.312***	0.309***	0.331***	0.156***	0.155***	0.088***	0.101***
	(0.007)	(0.007)	(0.010)	(0.012)	(0.006)	(0.006)	(0.009)	(0.010)
Federal exempt	-0.675***	-0.674***	-0.524***	-0.511***	-0.687***	-0.685***	-0.536***	-0.521***
	(0.028)	(0.028)	(0.058)	(0.085)	(0.027)	(0.027)	(0.055)	(0.077)
State exempt	0.124	0.119	-0.306*	-0.469**	0.125	0.120	-0.310*	-0.451*
	(0.102)	(0.102)	(0.183)	(0.233)	(0.103)	(0.103)	(0.181)	(0.231)
Callable	0.387***	0.387***	0.434***	0.466***	0.254***	0.254***	0.296***	0.327***
	(0.010)	(0.010)	(0.016)	(0.020)	(0.009)	(0.009)	(0.014)	(0.018)
County FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County × Day trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,441	27,441	8,521	4,003	27,441	27,441	8,521	4,003
Adj. R-squared	0.78	0.78	0.78	0.81	0.81	0.81	0.75	0.72

Table 4: COVID-19 Counts and New Issuance

This table presents the results of ordinary least squares regressions of equation (2). In columns (1)-(4), the dependent variable equals one if there is at least one municipal bond issuance in a county-week pair. In columns (5)-(8), the dependent variable is the total number of issues in a county-week pair. Log (1+ # cases) and Log (1+ # deaths) are the logarithm of total case and death counts as of day *t*-1, respectively. Biweekly growth in # cases and Biweekly growth in # deaths are the growth rates during the previous two weeks. Growth rates from zero to a positive number are not defined and therefore are excluded. All other variables are as defined in Table 2. Reported standard errors are clustered at the county level. ∗, ∗∗ and ∗∗∗ indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Dummy for issuance				Number of issues			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (1+ # cases)	-0.015***				-0.024***			
	(0.002)				(0.003)			
Log (1+ # deaths)		-0.022***				-0.053***		
		(0.006)				(0.010)		
Biweekly growth in # cases			0.0003				0.0004	
			(0.001)				(0.001)	
Biweekly growth in # deaths				-0.006***				-0.009***
				(0.002)				(0.002)
County FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Week FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County × Week trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,380	31,380	31,380	31,380	31,380	31,380	31,380	31,380
Adj. R-squared	0.16	0.16	0.16	0.16	0.21	0.21	0.20	0.20

Table 5: County-Level Event-Study of Government Policy Events

In this table, we report the evidence from county-level event-study regressions (equation 3) of the effects of three policy events, announcements of first statewide COVID-19 cases, county-level emergency declarations, and county-level stay-at-home orders, on offering yields of municipal bonds (Panel A) and occurrence of issuance (Panel B). We include only bonds and notes issued by municipalities. In both panels, we show the estimated coefficients on "weeks since event" along with the 95% confidence intervals. All regressions include county fixed effects and county by week time trends. Standard errors are corrected for autocorrelation and clustered at the county level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A. Effects on offering yields

Dependent variable:	Offering yield (%)					
	First case announcement		Emergency declaration		Stay-at-home order	
	(1)	(2)	(3)	(4)	(5)	(6)
Week = -4	0.021	0.086	0.246***	0.220***	-0.629***	-0.591***
	(0.101)	(0.069)	(0.052)	(0.041)	(0.082)	(0.086)
Week = -3	-0.002	0.039	0.149**	0.095**	-0.697***	-0.625***
	(0.079)	(0.055)	(0.063)	(0.045)	(0.096)	(0.094)
Week = -2	0.080	0.090	0.028	0.081	-0.695***	-0.581***
	(0.076)	(0.058)	(0.076)	(0.059)	(0.104)	(0.100)
Week = 0	-0.044	-0.001	0.741***	0.688***	0.449***	0.499***
	(0.076)	(0.055)	(0.097)	(0.094)	(0.109)	(0.125)
Week = +1	0.088	0.087	1.055***	1.052***	0.135	0.225**
	(0.091)	(0.068)	(0.099)	(0.115)	(0.114)	(0.108)
Week = +2	0.125	0.133	0.918***	0.923***	-0.102	0.055
	(0.110)	(0.084)	(0.094)	(0.084)	(0.108)	(0.108)
Week = +3	0.146	0.061	0.761***	0.752***	-0.468***	-0.256**
	(0.109)	(0.085)	(0.086)	(0.078)	(0.103)	(0.106)
Week = +4	0.313***	0.264***	0.394***	0.491***	-0.491***	-0.269**
	(0.121)	(0.095)	(0.087)	(0.077)	(0.114)	(0.115)
Bond controls	No	Yes	No	Yes	No	Yes
County FEs	Yes	Yes	Yes	Yes	Yes	Yes
County × Week trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,483	16,447	14,417	14,398	12,701	12,690
Adj. R-squared	0.35	0.76	0.47	0.80	0.43	0.78

Panel B. Effects on occurrence of issuance

Dependent variable:	Dummy for issuance			Number of issues		
	First case announcement	Emergency declaration	Stay-at-home order	First case announcement	Emergency declaration	Stay-at-home order
	(1)	(2)	(3)	(4)	(5)	(6)
Week = -4	-0.006	-0.002	0.030***	-0.008	0.001	0.042***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.006)	(0.008)
Week = -3	-0.007	-0.006	0.017***	-0.006	-0.004	0.027***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.006)	(0.007)
Week = -2	-0.011**	-0.006	0.008	-0.010	-0.010	0.014**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Week = 0	-0.009*	-0.028***	-0.009*	-0.008	-0.036***	-0.009
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Week = +1	-0.016***	-0.033***	-0.001	-0.015**	-0.042***	0.000
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)
Week = +2	-0.026***	-0.021***	0.014**	-0.025***	-0.030***	0.017**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)
Week = +3	-0.029***	-0.021***	0.022***	-0.029***	-0.032***	0.028***
	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)
Week = +4	-0.020***	-0.003	0.023***	-0.021***	-0.008	0.033***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)
County FEs	Yes	Yes	Yes	Yes	Yes	Yes
County × Week trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,064	28,278	21,258	28,064	28,278	21,258
Adj. R-squared	0.16	0.14	0.15	0.26	0.21	0.22

Table 6: Sector Breakdown of Municipal Issuance Around Emergency Declarations

In this table, we report the number of bonds and issues and amount issued for various sectors pre-and post-emergency declarations at the county level.

	Period before emergency declaration (weeks -4 to -1)			Period after emergency declaration (weeks 0 to +4)		
	Number of bonds (issues)	Total amount issued ($ million)	Percent of total amount issued	Number of bonds (issues)	Total amount issued ($ million)	Percent of total amount issued
Resilient sectors (amount issued increased or dropped < 20%)						
Water/sewer	495 (36)	1,240.0	4.6%	383 (27)	1453.7	11.6%
Utilities	662 (43)	619.2	2.3%	424 (30)	530.3	4.2%
Housing	10 (5)	245.2	0.9%	25 (8)	296.6	2.4%
Less resilient sectors (amount issued dropped 20% - 80%)						
Education	3,642 (272)	6,488.5	24.3%	2,313 (218)	4814.4	38.5%
General obligation	2,816 (237)	7,311.9	27.4%	2,095 (188)	2344.1	18.7%
Others	690 (46)	6,987.3	26.1%	195 (25)	1548.3	12.4%
Healthcare	113 (9)	1,178.7	4.4%	46 (6)	902.6	7.2%
Improvement/development	68 (18)	413.5	1.5%	30 (14)	296.0	2.4%
Hard-hit sectors (amount issued dropped > 80%)						
Transportation	45 (5)	1,455.5	5.4%	4 (3)	177.7	1.4%
Dedicated tax revenue	314 (24)	784.1	2.9%	66 (4)	148.6	1.2%
Total	8,855 (695)	26,724.1	100%	5,581 (523)	12,512.2	100%

Table 7: Cross-Sectional Results Around Emergency Declarations

In this table, we report cross-sectional changes in offering yields around county-level emergency declarations for the period running from four weeks before a declaration to four weeks after the declaration. We include only bonds and notes issued by municipalities. Columns (1) and (2) report results for the full sample. Columns (3) and (4) show results for bonds in resilient sectors (water/sewer, utilities, and housing) and bonds in other sectors. Columns (5) and (6) show results for securities issued by municipalities from fiscally unhealthy states and the rest of the states. A fiscally unhealthy state has a shortfall of more than 5% of their 2019 revenue in a moderate recession. Columns (7) and (8) report results for bonds (maturity greater than three years) and notes (maturity up to three years). All regressions include county fixed effects and county by week time trends. Standard errors are corrected for autocorrelation and clustered at the county level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Offering yield (%)							
	Full sample		Resilient vs. other sectors		Fiscally unhealthy vs. healthy		Bonds vs. notes	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COVID emergency	0.781***	0.737***	0.815***	0.773***	0.748***	0.715***	0.740***	0.715***
	(0.069)	(0.063)	(0.068)	(0.065)	(0.074)	(0.068)	(0.064)	(0.063)
COVID emergency × Resilient sector			-0.415**	-0.383***				
			(0.163)	(0.142)				
Resilient sector			0.059	-0.037				
			(0.078)	(0.083)				
COVID emergency × Fiscally unhealthy					0.241**	0.197**		
					(0.103)	(0.089)		
COVID emergency × Bond							0.040*	0.040**
							(0.022)	(0.020)
Bond							0.542***	0.193***
							(0.013)	(0.010)
Bond controls	No	Yes	No	Yes	No	Yes	No	Yes
County FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County × Week trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,417	14,398	14,417	14,398	14,417	14,398	14,417	14,398
Adj. R-squared	0.45	0.79	0.45	0.79	0.45	0.79	0.53	0.74

Table 8: Effects of the Municipal Liquidity Facility

In this table, we report results from regressions estimating the effect of the MLF, announced on April 9, 2020, on offering yields and occurrence of issuance. For Panel A, we estimate the following equation:

$$Yield_{ict} = \alpha + \sum_{\tau=-10}^{-1} \beta_\tau MLF(\tau)_t + \sum_{\tau=0}^{10} \beta_\tau MLF(\tau)_t + \gamma X_i + \delta_c + \delta_c \times t + \varepsilon_{ct}.$$

$MLF(\tau)_t$ is a dummy variable that takes a value of one if it is τ trading days before (after) the establishment of the MLF and zero otherwise. Bond characteristics and county fixed effects are denoted by X_i and δ_c, respectively. The coefficients on MLF (Day = -5) to MLF (Day = +10) are reported due to space. For Panel B, we apply the model at the county-week level for four weeks before and three weeks after the Fed intervention given our data end on April 30, 2020. Reported standard errors are corrected for autocorrelation and clustered at the county level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A. Effect of the MLF on bond yields

Dependent variable:	Offering yield (%)		
	Full sample	Municipal notes	Municipal bonds
	(1)	(2)	(3)
MLF (Day = -5)	0.197	0.334*	0.178
	(0.164)	(0.176)	(0.164)
MLF (Day = -4)	-0.033	-0.041	0.012
	(0.148)	(0.168)	(0.154)
MLF (Day = -3)	-0.148	-0.089	-0.064
	(0.105)	(0.140)	(0.094)
MLF (Day = -2)	-0.061	-0.037	0.053
	(0.162)	(0.117)	(0.173)
MLF (Day = 0)	-0.238**	-0.172	-0.169*
	(0.098)	(0.107)	(0.096)
MLF (Day = +1)	-0.340***	-0.236*	-0.302**
	(0.124)	(0.122)	(0.137)
MLF (Day = +2)	-0.403***	-0.244**	-0.353***
	(0.110)	(0.123)	(0.113)
MLF (Day = +3)	-0.526***	-0.313**	-0.496***
	(0.133)	(0.132)	(0.142)
MLF (Day = +4)	-0.384***	-0.263**	-0.353***
	(0.121)	(0.114)	(0.114)
MLF (Day = +5)	-0.352**	-0.053	-0.309*
	(0.157)	(0.148)	(0.167)
MLF (Day = +6)	-0.494***	-0.278**	-0.437**
	(0.160)	(0.116)	(0.176)
MLF (Day = +7)	-0.273*	-0.091	-0.198
	(0.149)	(0.128)	(0.161)
MLF (Day = +8)	-0.220*	-0.005	-0.162
	(0.125)	(0.108)	(0.135)
MLF (Day = +9)	-0.500*	-0.180	-0.493*
	(0.281)	(0.198)	(0.265)
MLF (Day = +10)	-0.295	-0.116	-0.248
	(0.186)	(0.177)	(0.215)
Bond controls	Yes	Yes	Yes
County FEs	Yes	Yes	Yes
County × Day trend	Yes	Yes	Yes
Observations	7,196	1,207	5,989
Adj. R-squared	0.77	0.75	0.81

Panel B. Effect of the MLF on the occurrence of issuance

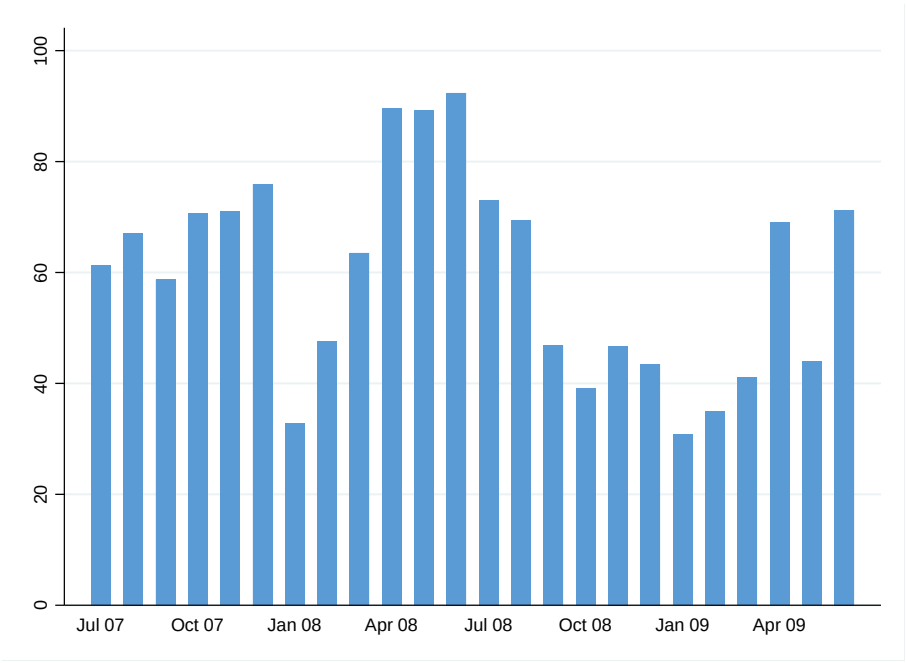
Dependent variable:	Dummy for issuance	Number of issues
	(1)	(2)
MLF (Week = -4)	0.006	0.011*
	(0.005)	(0.006)
MLF (Week = -3)	-0.011**	-0.010*
	(0.004)	(0.005)
MLF (Week = -2)	-0.016***	-0.015***
	(0.004)	(0.005)
MLF (Week = 0)	-0.003	-0.004
	(0.004)	(0.005)
MLF (Week = +1)	0.016***	0.023***
	(0.005)	(0.006)
MLF (Week = +2)	0.013**	0.022***
	(0.005)	(0.007)
MLF (Week = +3)	0.006	0.014**
	(0.005)	(0.007)
County FEs	Yes	Yes
County × Week trend	Yes	Yes
Observations	25,136	25,136
Adj. R-squared	0.15	0.22

Appendix

Figure A1: Municipal Bond Issuance from July 2007 to June 2009

In Panels A, we plot monthly par amount issued in billions of dollars from July 2007 to June 2009, approximately the financial crisis period. In Panel B, we show weekly par amount issued in billions of dollars during the same period. In both panels, par amounts are inflation adjusted and represent nominal values as of January 2020.

Panel A. Monthly par amount issued ($ billion)



Panel B. Weekly par amount issued ($ billion)

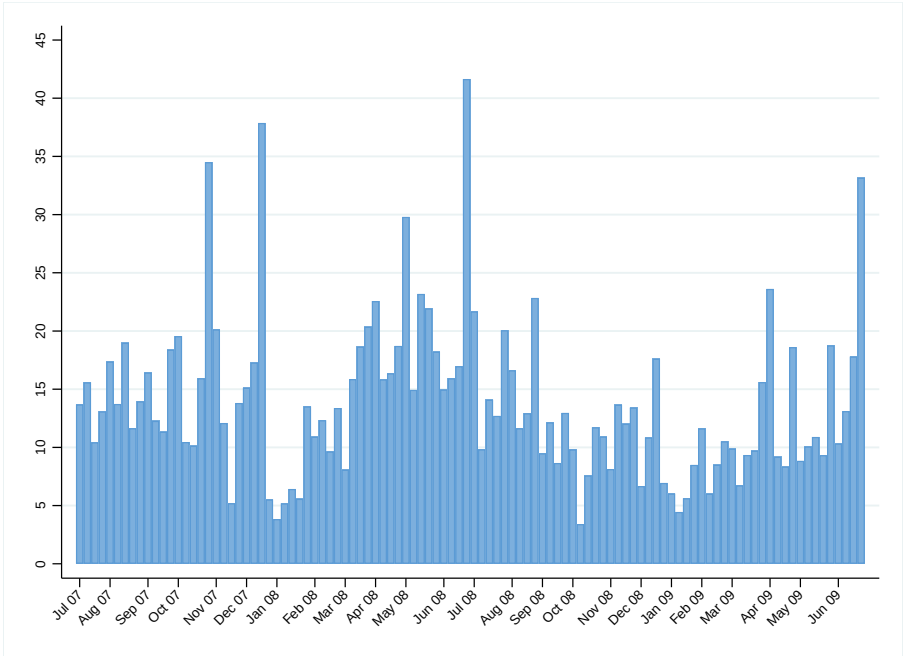
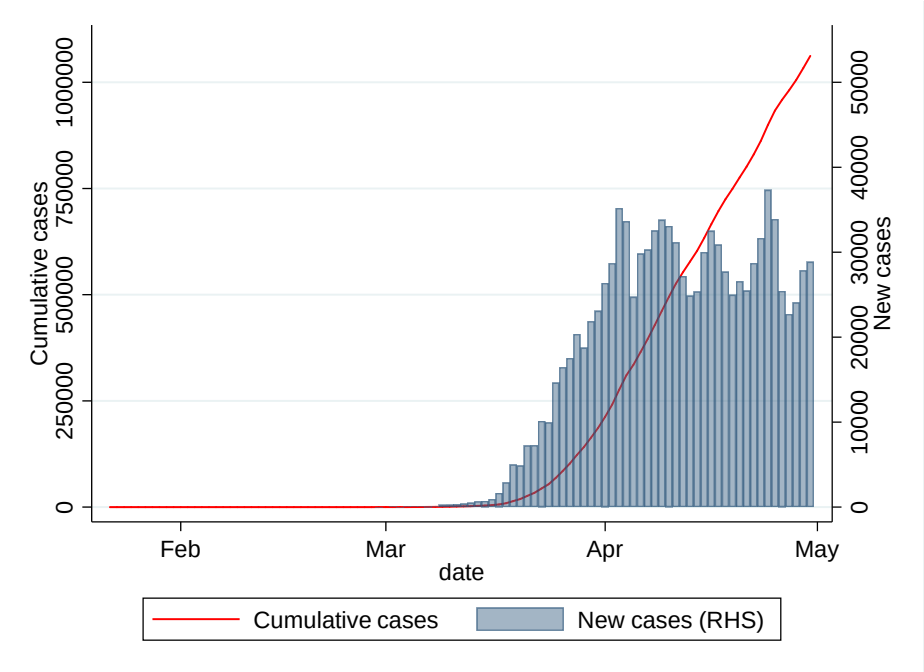


Figure A2: Case and Death Counts in the U.S.

Panel A reports the total and new case counts in the U.S. between January 1, 2020 and April 30, 2020. Panel B reports the total and new death counts in the U.S. during the same period.

Panel A. Total and new case counts in the U.S.



Panel B. Total and new death counts in the U.S.

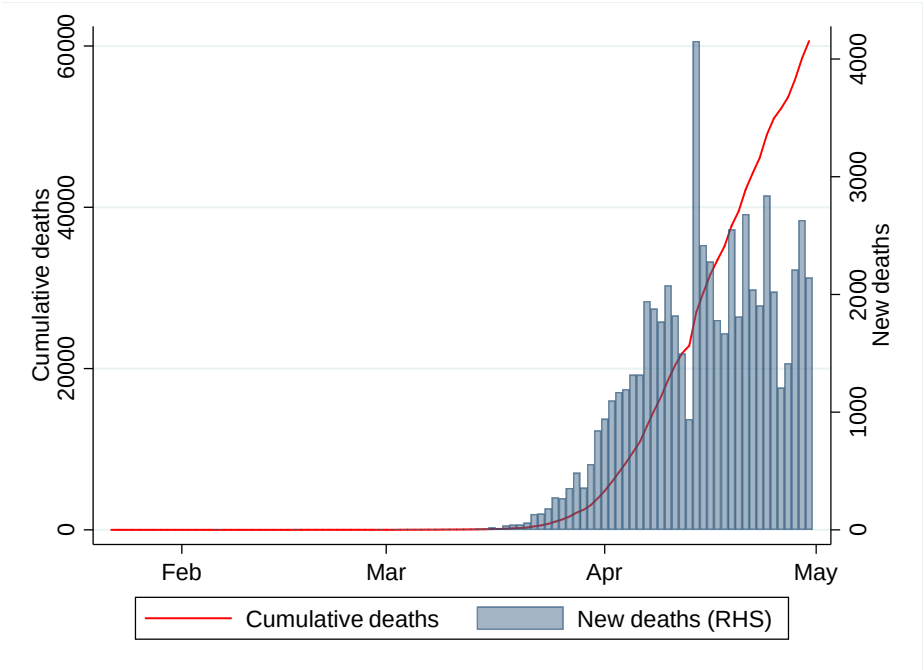
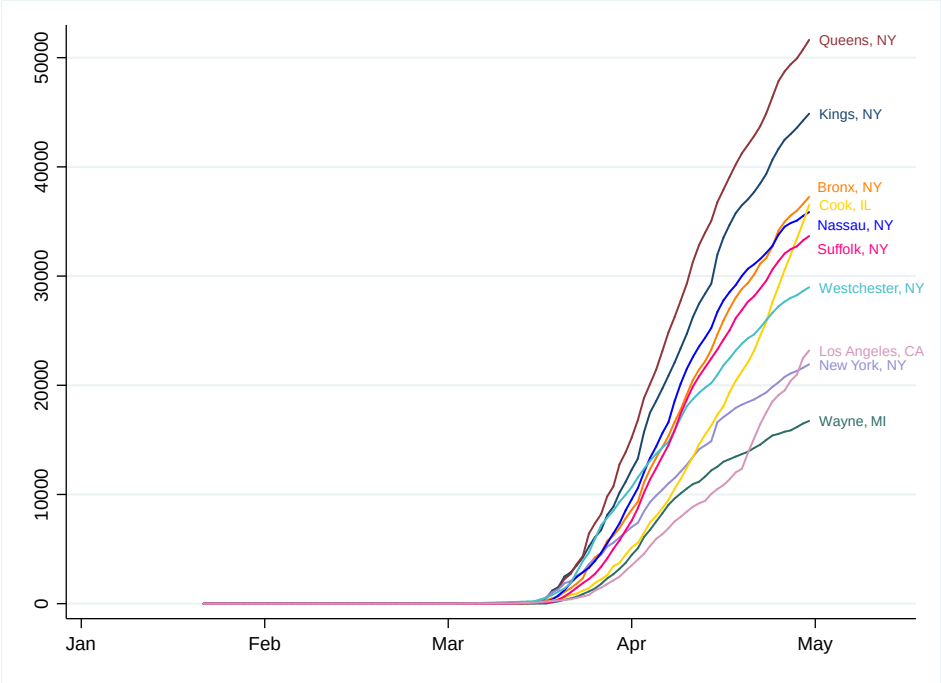


Figure A3: Top 10 Counties by Case and Death Counts

We plot cumulative case and death counts for top 10 counties in the U.S. in Panel A and Panel B, respectively. County rankings are based on case and death counts as of April 30, 2020.

Panel A: Cumulative case counts for top 10 counties



Panel B: Cumulative death counts for top 10 counties

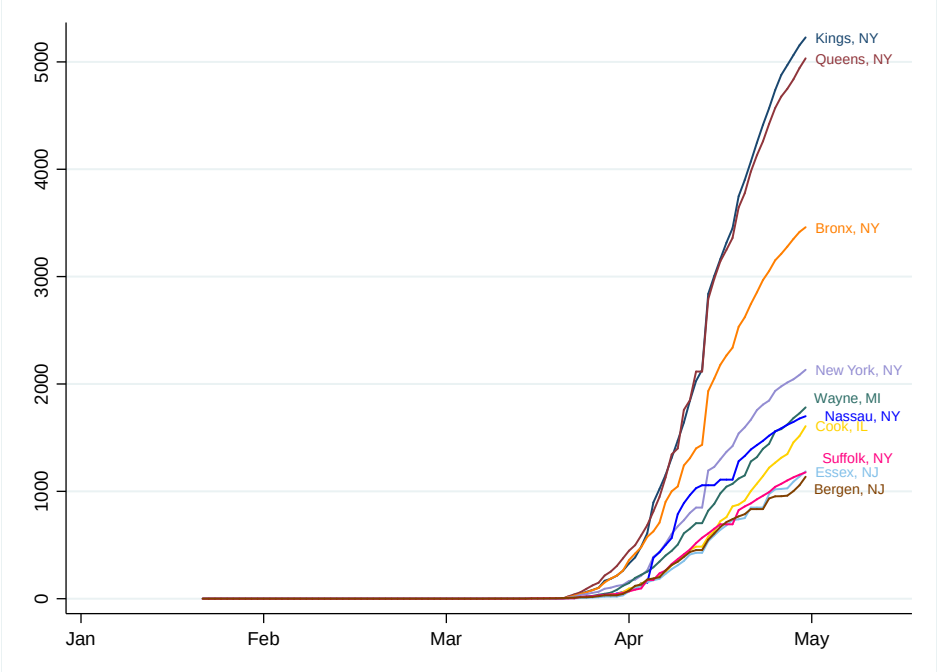


Figure A4: Effective Dates of Stay-at-Home Orders

This figure shows the effective dates of stay-at-home (SAH) orders for COVID-19 at the county level. If a county issued its own SAH order before the state order, we use the former date. Otherwise, we use the effective date of state SAH order as state SAH orders typically supersede local ones.

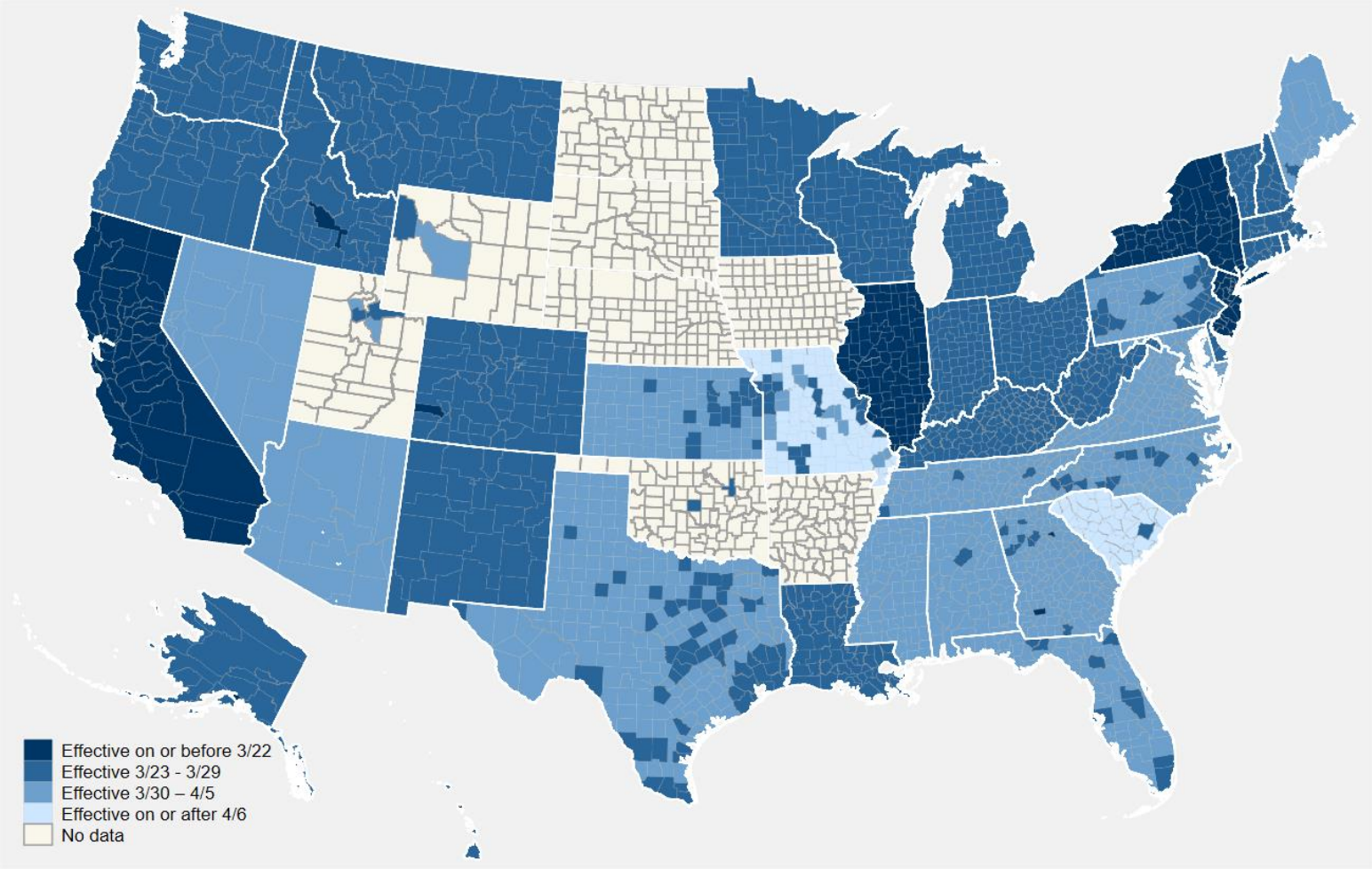
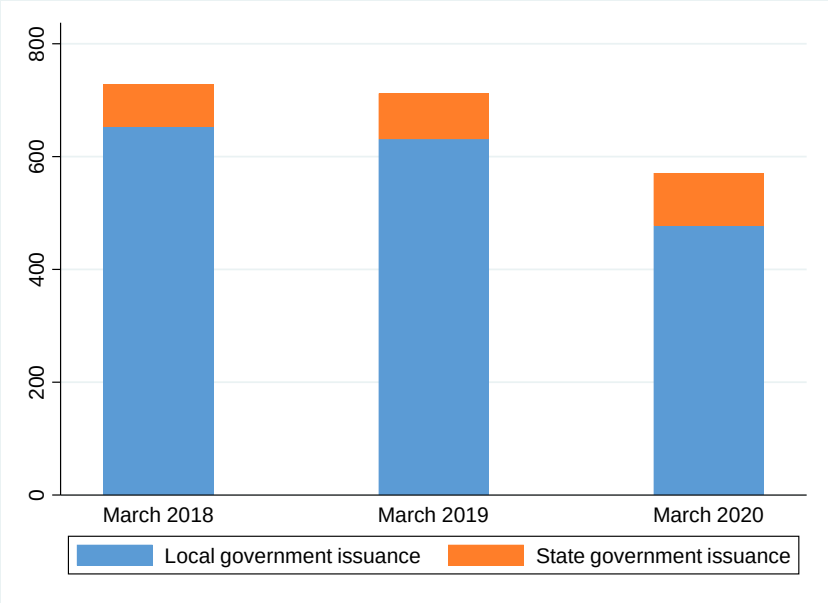


Figure A5: Municipal Bond Issuance in March 2018-2020

In Panel A, we plot the number of new issues in March 2018, March 2019, and March 2020, respectively. In Panel B, we show the par amount issued in billions of dollars during the same months. In both panels, the blue bars represent issuance by municipalities while the orange bars represent issuance by states.

Panel A. Number of new issues



Panel B. Par amount issued ($ billion)

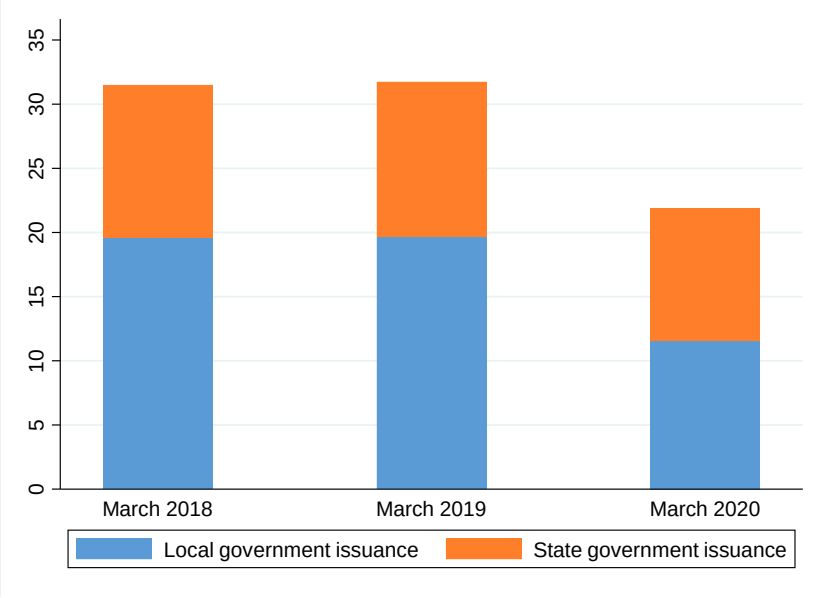
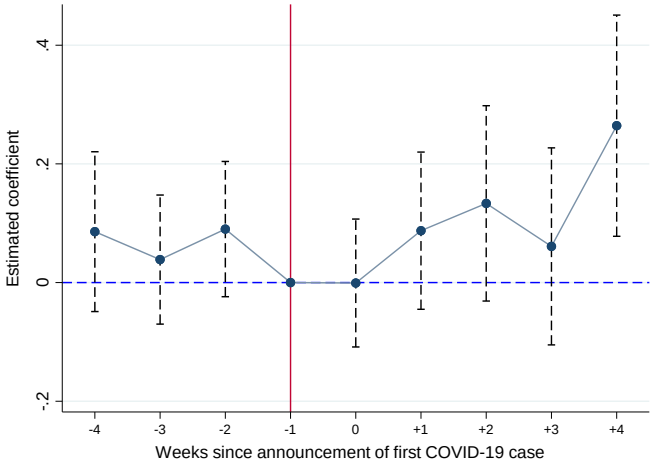


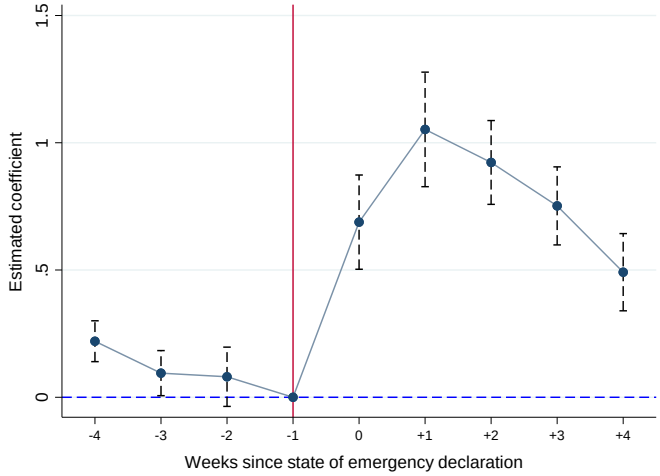
Figure A6: County-Level Event-Study of Offering Yield Around Government Policy Events

These plots summarize the evidence from county-level event-study regressions (equation 3) of the effects of three policy events, announcements of first statewide COVID-19 cases (Panel A), county-level emergency declarations (Panel B), and county-level stay-at-home orders (Panel C), on offering yields of municipal bonds. In all panels, we show the estimated coefficients on "weeks since event" along with the 95% confidence intervals. All regressions include bond controls, county fixed effects, and county by week time trends. Standard errors are corrected for autocorrelation and clustered at the county level.

Panel A. Announcement of first COVID-19 case



Panel B. County-level emergency declaration



Panel C. County-level stay-at-home order

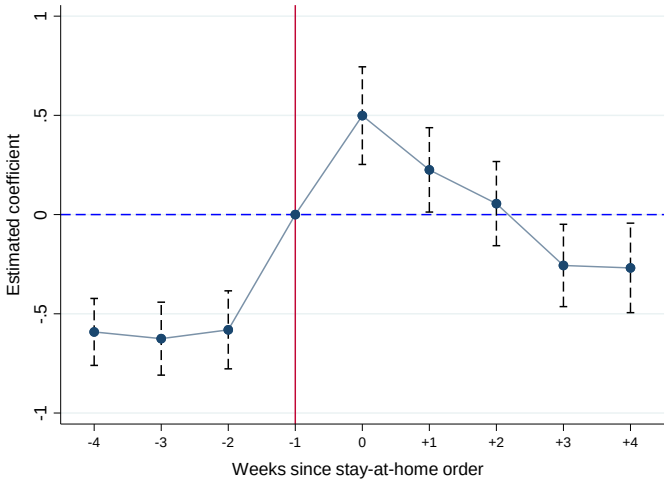
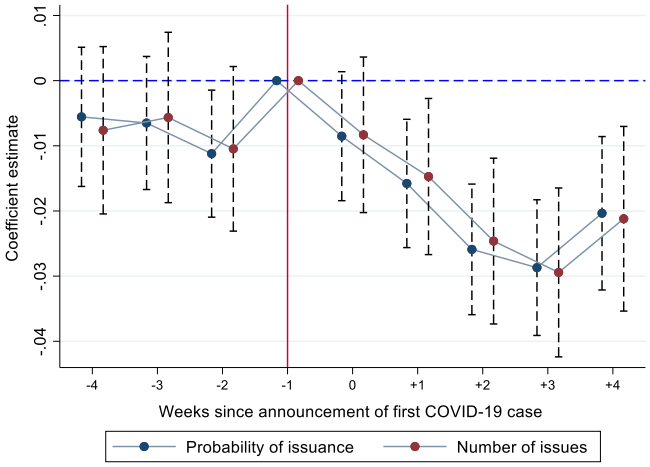


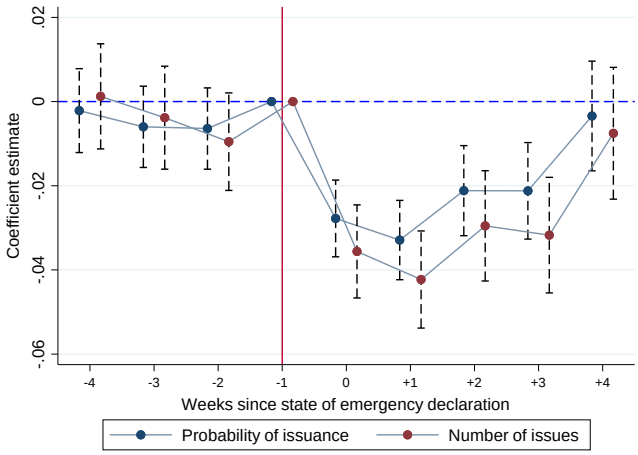
Figure A7: County-Level Event-Study of Issuance Around Government Policy Events

These plots summarize the evidence from county-level event-study regressions (equation 4) of the effects of three policy events, announcements of first statewide COVID-19 cases (Panel A), county-level emergency declarations (Panel B), and county-level stay-at-home orders (Panel C), on the probability of issuance and number of issues. In all panels, we show the estimated coefficients on "weeks since event" along with the 95% confidence intervals. All regressions include bond controls, county fixed effects, and county by week time trends. Standard errors are corrected for autocorrelation and clustered at the county level.

Panel A. Announcement of first COVID-19 case



Panel B. County-level emergency declaration



Panel C. County-level stay-at-home order

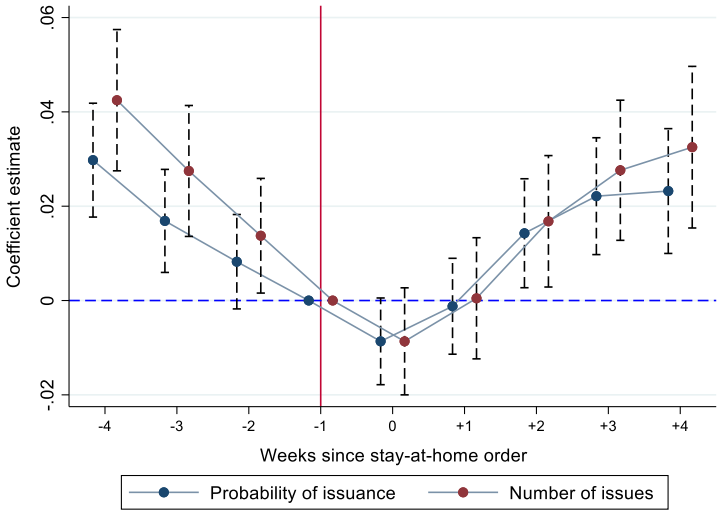


Figure A8: Fiscal Strength of States in 2019

In this figure, we show the fiscal health of each state, relying on Moody's Analytics's 2019 state stress tests. The tests assume a fiscal shock with a moderate recession scenario (implying a 10% economic downside) and calculate the total surplus or shortfall as a percentage of estimated fiscal 2019 revenue.

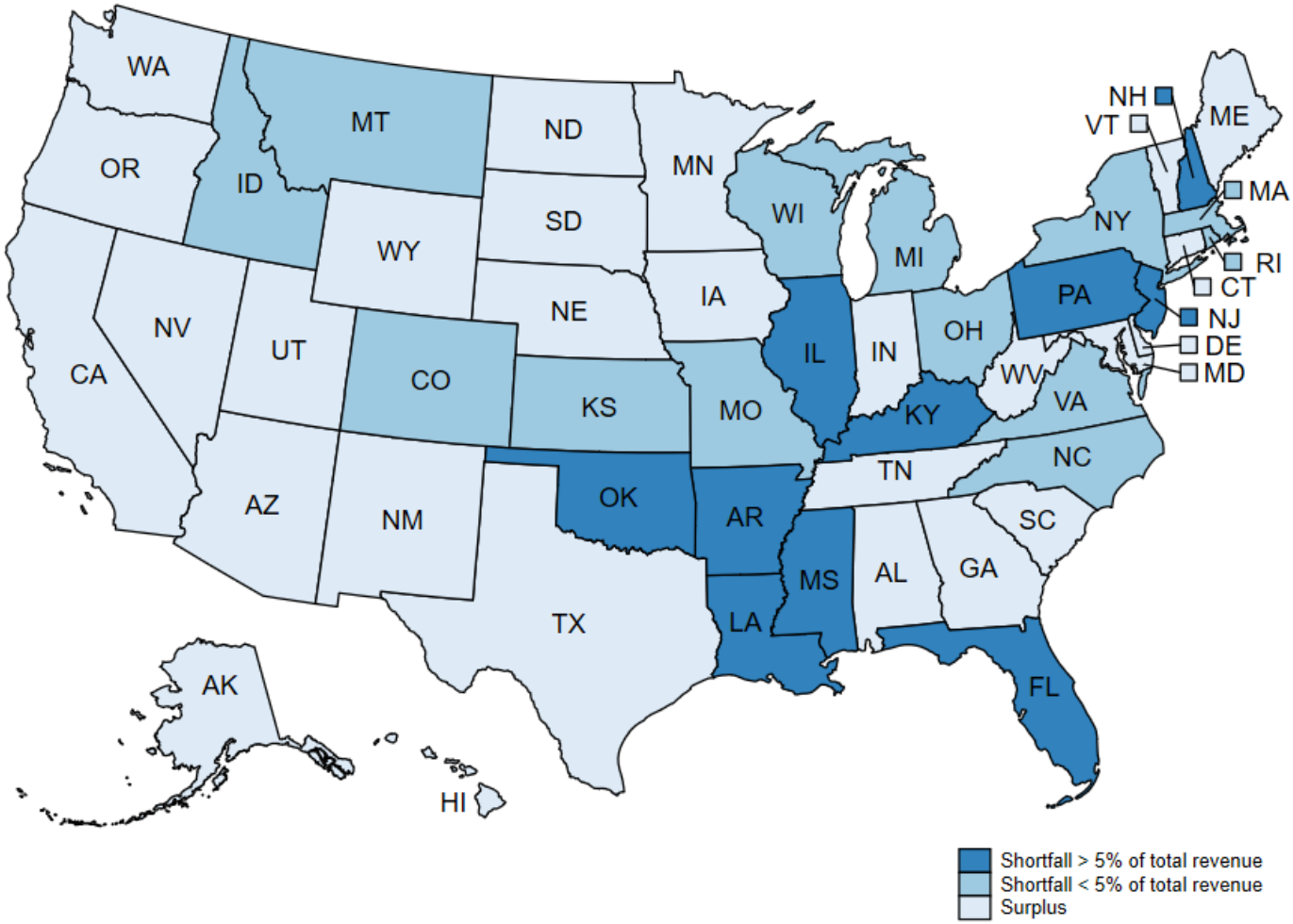
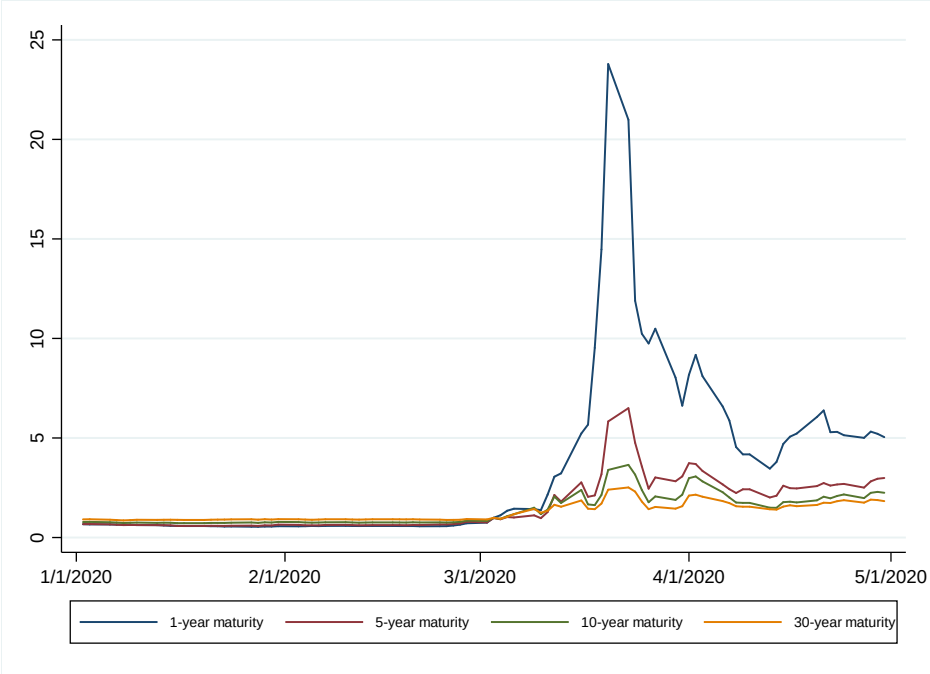


Figure A9: Secondary Market Municipal Bond Yields

In Panel A, we plot the ratios of AAA-rated municipal bond yields to similar-maturity Treasury yields for one-year, five-year, 10-year, and 30-year maturities from January to April 2020. In Panel B, we plot the ratios of AAA-rated municipal bond yields to similar-maturity Treasury yields for one-year, and 10-year maturities from January 2007 to April 2020. The data source is Bloomberg.

Panel A. Municipal bond-to-Treasury-yield ratio, January 2020 to April 2020



Panel B. Municipal bond-to-Treasury-yield ratio, January 2007 to April 2020

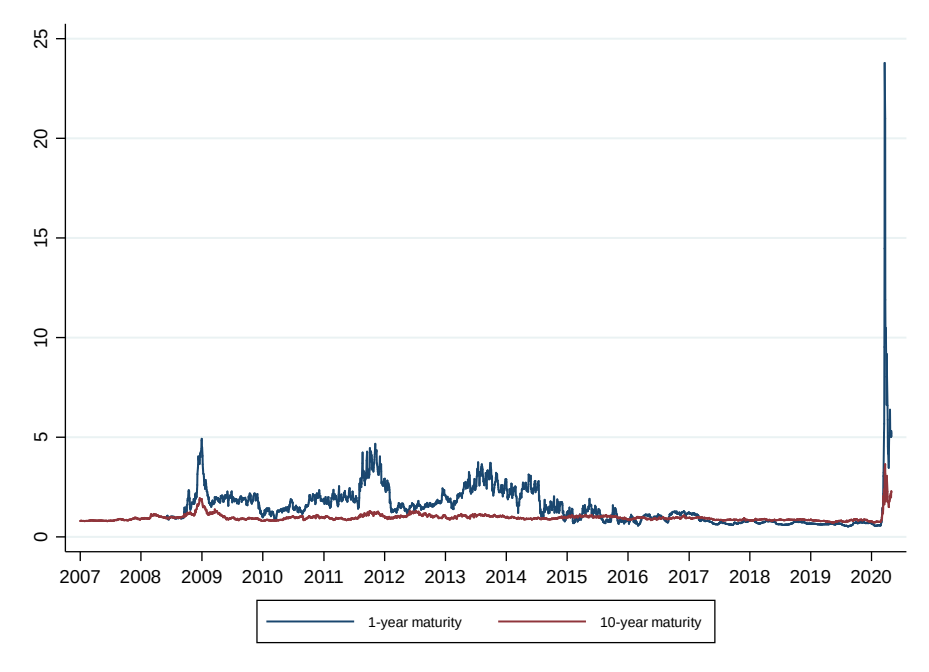


Table A1: State-Level Information and Policy Event Dates

This table shows a list of state first-case announcement dates and dates for five major policy events. Data are as of June 3, 2020.

State	First confirmed case	Emergency declaration	School closure	Gathering restriction	Nonessential business closure	Stay-at-home order
AL	3/13/2020	3/13/2020	3/18/2020	3/19/2020	3/28/2020	4/4/2020
AK	3/12/2020	3/11/2020	3/16/2020	3/24/2020	3/28/2020	3/28/2020
AZ	1/26/2020	3/11/2020	3/16/2020	3/31/2020	3/31/2020	3/30/2020
AR	3/11/2020	3/11/2020	3/17/2020	3/27/2020		
CA	1/25/2020	3/4/2020	3/31/2020	3/11/2020	3/19/2020	3/19/2020
CO	3/5/2020	3/11/2020	3/23/2020	3/19/2020	3/26/2020	3/26/2020
CT	3/8/2020	3/10/2020	3/17/2020	3/12/2020	3/23/2020	3/23/2020
DE	3/11/2020	3/12/2020	3/13/2020	3/16/2020	3/24/2020	3/24/2020
DC	3/7/2020	3/11/2020	3/16/2020	3/13/2020	3/25/2020	3/30/2020
FL	3/1/2020	3/9/2020	3/17/2020	4/3/2020	4/2/2020	4/3/2020
GA	3/2/2020	3/14/2020	3/18/2020	3/24/2020	4/3/2020	4/3/2020
HI	3/6/2020	3/4/2020	3/16/2020	3/17/2020	3/25/2020	3/25/2020
ID	3/13/2020	3/13/2020	3/23/2020	3/25/2020	3/25/2020	3/25/2020
IL	1/24/2020	3/9/2020	3/17/2020	3/13/2020	3/21/2020	3/21/2020
IN	3/6/2020	3/6/2020	3/19/2020	3/12/2020	3/24/2020	3/25/2020
IA	3/8/2020	3/9/2020	4/3/2020	3/17/2020	3/17/2020	
KS	3/7/2020	3/12/2020	3/17/2020	3/17/2020		3/30/2020
KY	3/6/2020	3/6/2020	3/16/2020	3/19/2020	3/26/2020	3/26/2020
LA	3/9/2020	3/11/2020	3/13/2020	3/13/2020	3/22/2020	3/23/2020
ME	3/12/2020	3/15/2020	4/1/2020	3/18/2020	3/25/2020	4/2/2020
MD	3/5/2020	3/5/2020	3/16/2020	3/16/2020	3/23/2020	3/30/2020
MA	2/1/2020	3/10/2020	3/17/2020	3/13/2020	3/24/2020	3/24/2020
MI	3/10/2020	3/10/2020	3/16/2020	3/13/2020	3/23/2020	3/24/2020
MN	3/6/2020	3/13/2020	3/18/2020	3/28/2020	3/16/2020	3/28/2020
MS	3/11/2020	3/14/2020	3/19/2020	3/24/2020	4/3/2020	4/3/2020
MO	3/7/2020	3/13/2020	3/23/2020	3/23/2020		4/6/2020
MT	3/13/2020	3/12/2020	3/15/2020	3/24/2020	3/28/2020	3/26/2020
NE	2/17/2020	3/13/2020	4/1/2020	4/3/2020		
NV	3/5/2020	3/12/2020	3/16/2020	3/24/2020	3/21/2020	3/31/2020
NH	3/2/2020	3/13/2020	3/16/2020	3/16/2020	3/28/2020	3/27/2020
NJ	3/4/2020	3/9/2020	3/18/2020	3/16/2020	3/21/2020	3/21/2020
NM	3/11/2020	3/11/2020	3/16/2020	3/12/2020	3/24/2020	3/24/2020
NY	3/2/2020	3/7/2020	3/18/2020	3/12/2020	3/22/2020	3/22/2020
NC	3/3/2020	3/10/2020	3/16/2020	3/14/2020	3/30/2020	3/30/2020
ND	3/11/2020	3/13/2020	3/16/2020			
OH	3/9/2020	3/9/2020	3/17/2020	3/12/2020	3/23/2020	3/23/2020
OK	3/6/2020	3/15/2020	3/17/2020	3/24/2020	4/1/2020	
OR	2/28/2020	3/8/2020	3/16/2020	3/12/2020	3/23/2020	3/23/2020
PA	3/6/2020	3/6/2020	3/16/2020		3/23/2020	4/1/2020
RI	3/1/2020	3/9/2020	3/16/2020	3/17/2020	3/30/2020	3/28/2020
SC	3/6/2020	3/13/2020	3/16/2020	3/18/2020	4/7/2020	4/7/2020
SD	3/10/2020	3/13/2020	3/17/2020	4/6/2020		
TN	3/5/2020	3/12/2020	3/16/2020	3/23/2020	4/1/2020	4/2/2020
TX	2/12/2020	3/13/2020	3/21/2020	3/21/2020	4/2/2020	4/2/2020
UT	2/25/2020	3/6/2020	3/16/2020	3/17/2020		
VT	3/7/2020	3/13/2020	3/18/2020	3/13/2020	3/25/2020	3/24/2020
VA	3/22/2020	3/12/2020	3/16/2020	3/15/2020	3/24/2020	3/30/2020
WA	1/22/2020	2/29/2020	3/17/2020	3/13/2020	3/25/2020	3/23/2020
WV	3/17/2020	3/16/2020	3/14/2020	3/24/2020	3/24/2020	3/25/2020
WI	2/5/2020	3/12/2020	3/18/2020	3/17/2020	3/25/2020	3/25/2020
WY	3/11/2020	3/13/2020	3/19/2020	3/20/2020		

Table A2: Cross-Sectional Results Around State-Level Emergency Declarations

In this table, we report cross-sectional changes in offering yield around state-level emergency declarations for the period running from four weeks before a declaration to four weeks after the declaration. We include all bonds and notes issued by states and municipalities. Columns (1) and (2) report results for the full sample. Columns (3) and (4) show results for bonds in resilient sectors (water/sewer, utilities, and housing) and bonds in other sectors. Columns (5) and (6) show results for securities issued by municipalities from fiscally healthy states and the rest of the states. A fiscally healthy state has a shortfall of more than 5% of their 2019 revenue in a moderate recession. Columns (7) and (8) report results for bonds (maturity greater than three years) and notes (maturity up to three years). All regressions include state fixed effects and state by week time trends. Standard errors are corrected for autocorrelation and clustered at the state level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Offering yield (%)							
	Full sample		Resilient vs. other sectors		Fiscally weak vs. strong states		Bonds vs. notes	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COVID emergency	0.772***	0.710***	0.803***	0.741***	0.740***	0.694***	0.732***	0.679***
	(0.077)	(0.077)	(0.080)	(0.080)	(0.084)	(0.084)	(0.077)	(0.081)
COVID emergency × Resilient sector			-0.347**	-0.279**				
			(0.142)	(0.132)				
Resilient sector			0.096	0.014				
			(0.074)	(0.066)				
COVID emergency × Fiscally weak state					0.212**	0.189**		
					(0.088)	(0.087)		
COVID emergency × Bond							0.031	0.059**
							(0.028)	(0.030)
Bond							0.610***	0.231***
							(0.017)	(0.016)
Bond controls	No	Yes	No	Yes	No	Yes	No	Yes
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Week trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,014	15,984	16,014	15,984	16,014	15,984	16,014	15,984
Adj. R-squared	0.18	0.62	0.18	0.62	0.18	0.62	0.27	0.56

Table A3: Cross-Sectional Results Around County-Level Emergency Declarations

In this table, we replicate Table 7 by replacing the dependent variable with yield spreads. All regressions include county fixed effects and county by week time trends. Standard errors are corrected for autocorrelation and clustered at the county level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Yield spread (%)							
	Full sample		Resilient vs. other sectors		Fiscally unhealthy vs. healthy		Bonds vs. notes	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COVID emergency	0.905***	0.892***	0.937***	0.925***	0.903***	0.868***	0.944***	0.937***
	(0.070)	(0.069)	(0.069)	(0.070)	(0.070)	(0.071)	(0.068)	(0.068)
COVID emergency × Resilient sector			-0.415***	-0.387***				
			(0.149)	(0.146)				
Resilient sector			0.092	0.026				
			(0.061)	(0.085)				
COVID emergency × Fiscally unhealthy					0.234**	0.195**		
					(0.099)	(0.096)		
COVID emergency × Bond							0.050**	0.048**
							(0.021)	(0.021)
Bond							0.219***	0.077***
							(0.014)	(0.013)
Bond controls	No	Yes	No	Yes	No	Yes	No	Yes
County FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County × Week trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,417	14,398	14,417	14,398	14,417	14,398	14,417	14,398
Adj. R-squared	0.69	0.79	0.69	0.79	0.65	0.76	0.70	0.78

Table A4: Effects of the Money Market Liquidity Facility

In this table, we report results from regressions estimating the effect of the MMLF, operational on March 23, 2020, on offering yields, yield spreads, and occurrence of issuance. For Panel A, we estimate the following equation:

$$Yield_{ict} = \alpha + \sum_{\tau=-10}^{-1} \beta_\tau MMLF(\tau)_t + \sum_{\tau=0}^{10} \beta_\tau MMLF(\tau)_t + \gamma X_i + \delta_c + \delta_c \times t + \varepsilon_{ct}.$$

$MMLF(\tau)_t$ is a dummy variable that takes a value one if it is τ trading days before (after) the establishment of the MMLF and zero otherwise. Bond characteristics and county fixed effects are denoted by X_i and δ_c, respectively. The coefficients on MMLF (Day = -5) to MMLF (Day = +10) are reported due to space. For Panel B, we apply the model at the county-week level for four weeks before and four weeks after the Fed intervention. Reported standard errors are corrected for autocorrelation and clustered at the county level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A. Effect of the MMLF on offering yields

Dependent variable:	Offering yield (%)		
	Full sample	Municipal notes	Municipal bonds
	(1)	(2)	(3)
MMLF (Day = -5)	-2.971***	-0.826***	-3.294***
	(0.648)	(0.227)	(0.359)
MMLF (Day = -4)	-2.957***	-0.744***	-3.305***
	(0.679)	(0.211)	(0.385)
MMLF (Day = -3)	-2.288***	-0.030	-2.676***
	(0.655)	(0.266)	(0.395)
MMLF (Day = -2)	-2.404***	-0.052	-2.556***
	(0.660)	(0.322)	(0.399)
MMLF (Day = 0)	-2.015***	0.199	-2.448***
	(0.678)	(0.297)	(0.369)
MMLF (Day = +1)	-1.892***	0.327	-2.196***
	(0.657)	(0.240)	(0.403)
MMLF (Day = +2)	-2.017***	0.338	-2.476***
	(0.652)	(0.250)	(0.377)
MMLF (Day = +3)	-2.702***	-0.254	-3.129***
	(0.674)	(0.373)	(0.378)
MMLF (Day = +4)	-2.845***	-0.734***	-3.179***
	(0.650)	(0.232)	(0.352)
MMLF (Day = +5)	-2.937***	-0.768***	-3.463***
	(0.670)	(0.280)	(0.413)
MMLF (Day = +6)	-2.653***	-1.005***	-2.939***
	(0.712)	(0.229)	(0.552)
MMLF (Day = +7)	-2.501***	-0.367	-2.886***
	(0.665)	(0.297)	(0.372)
MMLF (Day = +8)	-2.467***	-0.605**	-2.737***
	(0.688)	(0.239)	(0.464)
MMLF (Day = +9)	-2.155***	-0.300	-2.445***
	(0.661)	(0.196)	(0.450)
MMLF (Day = +10)	-2.403***	-0.458	-2.772***
	(0.700)	(0.383)	(0.440)
Bond controls	Yes	Yes	No
County FEs	Yes	Yes	Yes
County × Day trend	Yes	Yes	Yes
Observations	4,042	679	3,363
Adj. R-squared	0.90	0.95	0.92

Panel B. Effect of the MMLF on yield spreads

Dependent variable:	Yield spread (%)		
	Full sample	Municipal notes	Municipal bonds
	(1)	(2)	(3)
MMLF (Day = -5)	-2.921***	-0.941***	-3.072***
	(0.596)	(0.226)	(0.368)
MMLF (Day = -4)	-3.097***	-0.909***	-3.346***
	(0.627)	(0.210)	(0.387)
MMLF (Day = -3)	-2.696***	-0.233	-2.906***
	(0.609)	(0.242)	(0.415)
MMLF (Day = -2)	-2.611***	-0.233	-2.663***
	(0.604)	(0.325)	(0.403)
MMLF (Day = 0)	-1.850***	0.248	-2.171***
	(0.627)	(0.293)	(0.367)
MMLF (Day = +1)	-1.869***	0.292	-2.053***
	(0.606)	(0.236)	(0.404)
MMLF (Day = +2)	-2.086***	0.369	-2.390***
	(0.599)	(0.246)	(0.383)
MMLF (Day = +3)	-2.731***	-0.218	-2.982***
	(0.620)	(0.372)	(0.384)
MMLF (Day = +4)	-2.729***	-0.606***	-2.933***
	(0.597)	(0.229)	(0.357)
MMLF (Day = +5)	-2.832***	-0.740**	-3.184***
	(0.620)	(0.286)	(0.422)
MMLF (Day = +6)	-2.545***	-0.909***	-2.690***
	(0.660)	(0.227)	(0.550)
MMLF (Day = +7)	-2.384***	-0.252	-2.597***
	(0.613)	(0.291)	(0.380)
MMLF (Day = +8)	-2.279***	-0.479**	-2.434***
	(0.634)	(0.239)	(0.459)
MMLF (Day = +9)	-2.054***	-0.300	-2.143***
	(0.607)	(0.197)	(0.454)
MMLF (Day = +10)	-2.361***	-0.328	-2.552***
	(0.645)	(0.383)	(0.434)
Bond controls	Yes	Yes	No
County FEs	Yes	Yes	Yes
County × Day trend	Yes	Yes	Yes
Observations	4,042	679	3,363
Adj. R-squared	0.86	0.95	0.88

Panel C. Effect of the MMLF on the occurrence of issuance

Dependent variable:	Dummy for issuance	Number of issues
	(1)	(2)
MMLF (Week = -4)	0.031***	0.042***
	(0.005)	(0.006)
MMLF (Week = -3)	0.026***	0.032***
	(0.005)	(0.005)
MMLF (Week = -2)	0.017***	0.020***
	(0.004)	(0.005)
MMLF (Week = 0)	-0.005	-0.005
	(0.004)	(0.005)
MMLF (Week = +1)	0.011**	0.011**
	(0.004)	(0.005)
MMLF (Week = +2)	0.008*	0.008
	(0.004)	(0.005)
MMLF (Week = +3)	0.026***	0.035***
	(0.005)	(0.007)
MMLF (Week = +4)	0.024***	0.034***
	(0.005)	(0.007)
County FEs	Yes	Yes
County × Week trend	Yes	Yes
Observations	28,278	28,278
Adj. R-squared	0.15	0.22

Table A5: Effects of the Municipal Liquidity Facility on Yield Spreads

In this table, we report results from regressions estimating the effect of the MLF, announced on April 9, 2020, on yield spreads. We estimate the following equation:

$$Yield\ spread_{ict} = \alpha + \sum_{\tau=-10}^{-1} \beta_\tau MLF(\tau)_t + \sum_{\tau=0}^{10} \beta_\tau\, MLF(\tau)_t + \gamma X_i + \delta_c + \delta_c \times t + \varepsilon_{ct}.$$

$MLF(\tau)_t$ is a dummy variable that takes a value one if it is τ trading days before (after) the establishment of the MLF and zero otherwise. Bond characteristics and county fixed effects are denoted by X_i and δ_c, respectively. The coefficients on MLF (Day = -5) to MLF (Day = +10) are reported due to space. Reported standard errors are corrected for autocorrelation and clustered at the county level. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Yield spread (%)		
	Full sample	Municipal notes	Municipal bonds
	(1)	(2)	(3)
MLF (Day = -5)	0.243	0.379**	0.236
	(0.155)	(0.178)	(0.159)
MLF (Day = -4)	-0.010	-0.052	0.032
	(0.142)	(0.167)	(0.153)
MLF (Day = -3)	-0.133	-0.107	-0.083
	(0.101)	(0.140)	(0.095)
MLF (Day = -2)	-0.040	-0.047	0.024
	(0.160)	(0.117)	(0.174)
MLF (Day = 0)	-0.228**	-0.203*	-0.190**
	(0.094)	(0.108)	(0.096)
MLF (Day = +1)	-0.341***	-0.248**	-0.326**
	(0.118)	(0.122)	(0.133)
MLF (Day = +2)	-0.284***	-0.203*	-0.254**
	(0.107)	(0.123)	(0.111)
MLF (Day = +3)	-0.392***	-0.267**	-0.377***
	(0.128)	(0.133)	(0.139)
MLF (Day = +4)	-0.306***	-0.215*	-0.292**
	(0.112)	(0.115)	(0.113)
MLF (Day = +5)	-0.229	-0.004	-0.218
	(0.154)	(0.149)	(0.166)
MLF (Day = +6)	-0.333**	-0.234**	-0.294*
	(0.152)	(0.117)	(0.172)
MLF (Day = +7)	-0.157	-0.053	-0.111
	(0.143)	(0.128)	(0.159)
MLF (Day = +8)	-0.078	0.037	-0.053
	(0.120)	(0.108)	(0.132)
MLF (Day = +9)	-0.361	-0.146	-0.373
	(0.248)	(0.198)	(0.247)
MLF (Day = +10)	-0.208	-0.093	-0.195
	(0.184)	(0.179)	(0.212)
Bond controls	Yes	Yes	Yes
County FEs	Yes	Yes	Yes
County × Day trend	Yes	Yes	Yes
Observations	7,196	1,207	5,989
Adj. R-squared	0.67	0.75	0.69