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Abstract

Municipal (muni) bonds are an important source of funding for state and local governments. During the Covid-19 pandemic, muni debt markets became severely distressed. In response, the Federal Reserve established the Municipal Liquidity Facility (MLF). Meanwhile, Congress enacted extensive fiscal measures that included direct aid to cities and states. To understand whether and how these policies worked, we employ a state-level regression model to estimate the relative efficacy of monetary and fiscal policy interventions for the term structure of muni-Treasury yield spreads. We find that fiscal and monetary policy together reduced those spreads by as much as 225 basis points. Fiscal policy contributed at least twice as much as monetary policy to the notable decline in shorter-term muni-Treasury spreads. At longer maturities, the contribution of fiscal policy was at least three times as large as that of monetary policy, suggesting that it addressed fundamental credit concerns.

Keywords: Monetary Policy, Policy Effects, Stabilization, Bond Market, Security Markets, Government Bonds, Local Government Bonds

JEL codes: E50, G51, H74.

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Subject: Conflict of Interest Statement for all authors

For the submitted manuscript, “The Impact of Covid-19 Related Policy Responses on Municipal Debt Markets,” Robert Bernhardt, Stefania D’Amico, and Santiago I. Sordo Palacios declare that they have no conflict of interest related to the research described in this paper.

Sincerely,

Robert Bernhardt, Stefania D’Amico, and Santiago I. Sordo Palacios

1 Introduction

Municipal (muni) bonds are a key source of funding for state and local governments, primarily used to finance the construction of physical public capital. The muni debt market is large (about $3.8 trillion of debt outstanding), mostly (more than 80%) rated investment grade (IG), and characterized by extremely low default rates.[1] Starting in mid-March 2020, the muni market became severely strained: massive outflows from municipal bond mutual funds sparked fire-sales of muni securities, muni spreads to Treasuries peaked at about 450 basis points, and issuance in primary market was close to zero for several weeks.[2]

As a result, the focus of investors quickly shifted to fundamental credit concerns as many municipalities were facing fast growing pandemic-related expenditures and drops in tax and other revenues. For the first time, the Federal Reserve (Fed) intervened in muni debt markets by establishing the Municipal Liquidity Facility (MLF), a primary-market facility focused on the purchase of certain short-term notes. Simultaneously, Congress passed the CARES Act on March 27, allocating over $200 billion in federal aid to states and municipalities while also expanding the scope and duration of unemployment benefits without affecting state unemployment accounts.

These policy interventions are potentially relevant for muni debt markets because, during budget crises, the inability to issue and refinance debt at low interest rates could cause growing deficits to become unsustainable. This could result in widespread credit rating downgrades and defaults as well as cuts in spending and/or increases in taxes, as most states have to balance budgets. This would deprive taxpayers of valuable services and disposable income during times of economic distress, and eventually even impede the economic recovery (Auerbach, et al., 2020). This could, in turn, negatively affect the U.S. economic outlook as state and local governments contribute almost 11 percent to GDP and 13 percent to total employment.

[1] For a detailed overview of the muni bond market see Bergstresser (2021).
[2] See Cipriani et al. (2020) for more details.

Despite the importance of those fiscal policy (FP) and monetary policy (MP) interventions and their *simultaneous* implementation, there is no empirical evidence on the relative efficacy of the two types of policy during municipal debt crises. To fill this gap in the literature, we evaluate the persistent impact of FP and MP interventions in muni debt markets and compare their effects.[3] This analysis should be of interest to policymakers, researchers, and investors alike, who strive to draw lessons from the latest crisis. Pivotally, the Covid-19 crisis has been unique in many ways, including the scope and speed of the policy interventions in muni markets. It is worth keeping in mind that the financial impact does not necessarily reflect the full effect of these interventions, particularly for FP which is usually less geared at improving financial market conditions.

Specifically, we evaluate the impact of FP and MP interventions on states' ability to issue and manage their debt. To do so, we estimate a simple panel regression model in which daily variations in states' muni-Treasury yield spreads are explained by high-frequency indicators summarizing economic and public health conditions, fiscal aid allocations to states (FP), the Fed's MLF (MP), and key changes in state-level policies. Then, using the model's estimates, we build counterfactuals showing the projected evolution of muni-Treasury yield spreads in the absence of either FP or MP. A key insight of this exercise is that FP contributed at least twice as much as MP to the notable decline in shorter-term muni-Treasury spreads. At longer maturities, FP contributed at least three times as much as MP, suggesting it addressed fundamental credit concerns.

Our empirical model distills each state's muni-Treasury yield spreads in factors that are common to all states and components that are state-specific (Grigoris, 2020), and allows us to capture effects that are more persistent than those estimated using an event-study or regression-discontinuity design. Specifically, over the period from March 2, 2020 to May 5, 2021, we focus on general obligation bond yields of 20 states, at maturities from one to 30 years. These states account for approximately 80% of both aggregate U.S. GDP and

[3]Another study that analyzes MP and FP simultaneously during the Covid-19 crisis is Christensen and Spiegel (2022), which is focused on expected inflation in Japan.

trading activity in the secondary market for muni debt (Grigoris, 2020). Further, we also extend the analysis to include the second half of 2021, a period during which shorter-term muni-Treasury yield spreads entered into negative territory. Overall, our study significantly expands the scope and sample of the empirical work of Bernhardt, D'Amico, and Sordo Palacios (2020), which examined the impact of the pandemic on Illinois' muni yields.

Since we are dealing with a pandemic that spread extremely quickly, creating human and economic damages at a speed rarely observed before, it is crucial that we measure changes at a very high frequency. For this reason we use a new generation of indicators (see Chetty, Friedman, Hendren, Stepner, and the Opportunity Insights Team, 2020) that measure mobility patterns, macroeconomic outcomes, and Covid-19 related variables at a daily frequency. This is ideal for explaining financial variables, such as muni yields, whose changes quickly reflect forward looking information.

To assess the effects of FP interventions, we include the dates in which major relief bills were passed by Congress interacted with the amount of federal aid received by each state as a share of general own resources as in Auerbach et al. (2020). They show that there is a great deal of variation across states in the amount of aid received, with the smallest states getting relatively more generous aid. We also control for enhanced unemployment benefits that are paid by the federal government and do not affect state unemployment accounts.

To assess the effects of MP interventions, we include the dates of key Fed announcements about the MLF. Those announcements span from April 9, 2020, when the Fed established the MLF to support municipalities through the purchase of up to $500 billion of short-term notes, to August 11, 2020, when the interest rate spread charged at the facility was reduced. We also include the amount issued to the MLF on the day of issuance for the few entities that accessed the facility.

To capture state-level policies we adopt the typology of shutdown and reopening policies used by Gupta, Simon, and Wing (2020). Shutdown policies consist of emergency declarations, school and non-essential business closures, gatherings recommendations or restrictions, and stay-at-home orders. Our work measures key changes in those particular policies by using the date at which these mandates were in effect.

Our estimates suggest that FP and MP interventions account for a cumulative reduction in the 3-year muni-Treasury spread of about 160 and 65 basis points, respectively. At the 5- and 10-year maturities, fiscal policy becomes relatively more effective, indicating that its transmission mechanism worked in part through the credit-risk channel. In particular, fiscal aid that extended beyond 2020 (e.g., the American Rescue Plan and expanded unemployment benefits) has been perceived by investors as alleviating more fundamental credit concerns. Despite the actual MLF issuance being limited only to Illinois and the Metropolitan Transit Authority for a total of $6.6bn, the existence of the MLF met multiple objectives. First, it lowered muni yields, making it easier for municipalities to manage cash flow pressures from the pandemic. Second, it provided a backstop, keeping liquidity in the market and encouraging private investors to reengage in muni securities.

We also analyze whether results obtained using all 20 states vary based on states' characteristics such as, pre-pandemic fiscal risk, population density/degree of urbanization, and political partisanship. We find that the most interesting cut of the data is by fiscal risk. The results indicate that fiscal policy had a greater impact on relatively higher fiscal-risk states. This is because, for these states, fiscal policy's effects were larger in magnitude and also greater than those of monetary policy, whose effects were somewhat larger for states with lower fiscal risk. Finally, when we extend our sample period to include the second half of 2021, we find that the effects of both FP and MP interventions not only persisted but also became larger. This implies that previous studies, focused on the first few months of the Covid-19 crisis, might have underestimated the impact of some of these policies.

Overall, our results indicate that the MLF, amid a few important extensions to its eligibility criteria, has been a helpful addition to the Fed policy toolkit. However, our findings also suggest that, although the MLF should not be a substitute for FP, it could become more effective if some of its terms were less restrictive, for instance by being more similar to those offered at the Fed's corporate facilities. Despite FP not being targeted to improve financial market conditions, we find it had a larger and more persistent impact than the MLF on muni-Treasury spreads. But the cost of FP to taxpayers has been much bigger than that of MP. While the amount borrowed at the MLF totaled \$6.6bn and most likely will be repaid by the borrowers, fiscal aid to states totaled at least \$550bn.[4] However, the larger cost of fiscal interventions could also be justified by their more direct effect on the broader economy, which is not considered by our study.

To the best of our knowledge, there are only a few studies that consider the impact of the Covid-19 pandemic on muni debt markets and those studies are mostly focused on the MLF. In particular, none of the existing papers analyzes the relative and persistent efficacy of FP and MP interventions for US states' borrowing costs.

Our work builds and expands on Bernhardt, D'Amico, and Sordo Palacios (2020) by extending their analysis to 20 states (rather than just Illinois) and by considering each FP and MP intervention jointly. Fritsch, Bagley, and Nee (2021), similarly to Bernhardt, D'Amico, and Sordo Palacios (2020), look at the immediate impact of MP announcements on the aggregate AAA muni yield curve as well as how plans to borrow at the MLF impacted Illinois and New York MTA yields. Li and Lu (2020) consider the role of emergency state declarations in explaining new muni yields and issuance while controlling for Covid-related variables and key MP announcements.

A paper closely related to our study is Bi and Marsh (2021), which uses transaction-level data to analyze the impact that FP and MP announcements had on the liquidity and credit risk of muni bonds, between March and May 2020. Our analysis differs as it uses state-level data over a longer sample period to estimate the persistent and relative efficacy of a larger set of policies, implemented in 2020 and 2021. Further, in the case of FP interventions, we consider the specific amount of aid allocated to each state, as well as expanded unemployment benefits. This allows us to estimate the muni price sensitivity to a given amount of fiscal

[4] By the end of July 2021, Illinois had already paid back about half of the outstanding loan, and by January 2022 it had paid off the remaining amount.

aid.

Our work is also somewhat related to Bordo and Duca (2021), which uses a monthly (or weekly) time series model of the tax-adjusted yield spread between the Baa-rated muni bond and the 10-year Treasury bond, from 1960 to early 2020, to examine the effect of MLF announcements. We also use tax-adjusted muni spreads to Treasuries in our analysis, but we exploit the entire daily term-structure for each state, and we evaluate a variety of policy interventions. Haughwout, Hyman, and Schachar (2021) exploit the MLF eligibility criteria to derive the option value of accessing the facility. They find that eligible low-rated issuers experienced a much larger decline in muni yields in the secondary market and larger issuance in the primary market, even if they did not issue through the MLF. Finally, Li, O'Hara, and Zhou (2021) highlight the role of mutual fund fragility in the muni market and show that, unlike corporate bonds, yields on muni bonds held by mutual funds had a substantial premium due to potential run risk. The authors argue that this premium could be due to the lack of a secondary market facility for muni bonds.

The rest of the paper is organized as follows. In the next section, we summarize the policy interventions. Section 3 describes the data. Section 4 details our empirical strategy and baseline results including all 20 states. In Section 5, we analyze state subgroups to better understand the drivers of our results. Section 6 extends the analysis to the recovery period in which spreads were negative. Section 7 presents some robustness checks and Section 8 offers concluding remarks.

2 Policy Interventions During the Pandemic

In this section, we review the FP and MP interventions that are assessed in our model. To illustrate how conditions in muni debt markets evolved as various policy interventions were announced, Figure 1 plots the 3-year muni-Treasury spread for Illinois and Minnesota, which are at the opposite end of the IG credit risk spectrum, BBB– and AAA respectively. We also plot the spreads that became available to both states through the MLF (horizontal lines).[5] The FP interventions are denoted by vertical solid lines while MP interventions by vertical dashed lines.

With the onset of the pandemic, muni bond spreads widened for both states with Illinois reaching above 450bp and Minnesota around 220bp. As announcements about support to states via FP and MP started coming out in late March, spreads for higher-rated states like Minnesota came down and stabilized around substantially lower levels. Meanwhile, those of lower-rated states like Illinois experienced a short-lived decline before fundamental credit concerns intensified, leading spreads to widen again. It can be noted that only for lower-rated states like Illinois the MLF's pricing was below market rates. Eventually, spreads for all states were below the MLF spread–that is, states could find cheaper funding in the private market. This occurred well before the reduction in MLF spreads in mid-May 2020.

[Figure 1 about here.]

2.1 Fiscal Policy

On March 27, 2020, the Coronavirus Aid, Relief, and Economic Security (CARES) Act was signed into law after being rapidly passed by Congress. At $2.2tn, the CARES Act was an order of magnitude larger than previous response bills passed up to that point. Of the $2.2tn, states and municipalities received over $200bn in federal aid. The largest distribution was $150bn through Coronavirus Relief Fund which was required to be used for COVID-related spending not anticipated in previous state budgets. Other appropriations included $25bn to public transit agencies, $13bn to K-12 education, roughly $6.5bn to public colleges and universities, and $35bn estimated to go to public hospitals and community health centers. Funds were generally distributed on the basis of population, but included a minimum cap of

[5] The MLF spreads are plotted from the period the Fed's term sheet was announced until the program ended on December 31, 2020.

$1.25bn per state, which skewed aid toward smaller states.[6]

The CARES Act also included provisions for a variety of enhanced unemployment benefits. These also constitute federal aid to states as they are funded directly by the federal government, and they do not impact state unemployment accounts. The Pandemic Unemployment Assistance (PUA) program expands benefits to self-employed individuals, freelancers, and independent contractors. The program was extended to September 6, 2021 under the American Rescue Plan (ARP). Pandemic Emergency Unemployment Compensation (PEUC) extends benefits for 13 weeks after regular benefits are exhausted; further extended to 53 weeks under ARP.[7]

On March 11, 2021, the American Rescue Plan (ARP) was signed into law. This $1.9tn stimulus package included $350bn in relief to states, localities, Tribes, and territories. As mentioned above, the ARP also extended enhanced unemployment benefits initiated by the CARES Act.

2.2 Monetary Policy

In response to strains in the U.S. muni market in March, the Fed took a number of actions. On March 23, 2020 certain short-term municipal securities became eligible for the Fed's Money Market Mutual Fund Liquidity Facility and Commercial Paper Funding Facility.

On April 9, the Fed established the Municipal Liquidity Facility (MLF) to support municipalities through the purchase of up to $500bn of IG short-term notes (maturing in at most 24 months) in the primary market until September 30, 2020.[8] Eligible issuers initially included states, Washington D.C., counties with more than two million residents (16), and cities with more than one million residents (10). This was reportedly perceived by some

[6] Vermont's aid was 23% of its own sources general revenue (OSGR), while New York's aid was only 6% of OSGR.

[7] A third program, the Federal Pandemic Unemployment Compensation (FPUC) provided claimants an extra $600/week in unemployment benefits, later reduced to $300/week.

[8] The eligible notes were: tax anticipation notes (TANs), tax and revenue anticipation notes (TRANs), bond anticipation notes (BANs), and other similar short-term notes. See April 9, 2020 MLF Term Sheet for full details: `https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200409a3.pdf`.

market participants as a relatively narrow scope.

On April 27, the Fed announced an expansion of the scope and duration of the MLF by making eligible counties with more than 500,000 residents (140), cities with more than 250,000 residents (87), and multi-state entities. It also increased the maturity of eligible notes from 24 to 36 months and extended the duration of the MLF from September 30 to December 31, 2020. Furthermore, the Fed indicated that loans could be used to pay principal and interest on existing obligations. Additionally, if two rating agencies had assigned an IG rating before April 8, then issuers could still access the MLF even if they were later downgraded at most three notches below BBB–.

On May 11, the Fed published the MLF's pricing methodology: a fixed spread over comparable maturity overnight index swap rates based on the rating of the eligible notes. For higher-rated issuers, the prevailing muni market rates were below those determined by the MLF. For borrowers rated BBB and below, the MLF rates were favorable (e.g., BBB– spread was 380bp), most likely prompting usage of the facility. Market participants viewed the MLF as a backstop because of these terms.

On June 3, the Fed announced the second expansion to the number and type of entities eligible to the MLF, targeting states with few or no cities or counties meeting the population thresholds. The new terms guarantee the eligibility of at least two cities or counties and two revenue-bond issuers from each state by giving Governors the ability to designate such entities even if they did not qualify under the population threshold.

Finally, on August 11, the Fed reduced the interest rate spread on tax-exempt notes for each credit rating category by 50bp. However, before the pricing reduction 97% of eligible entities could already find better funding in the private the market.[9]

[9]See Yale School of Management Systemic Risk Blog post: `https://som.yale.edu/blog/federal-reserve-lowers-pricing-for-municipal-liquidity-facility`.

3 Data

Our baseline regression sample consists of a largely well-balanced panel of 20 states during trading days from March 2, 2020 to May 5, 2021, inclusive. It includes 5901 observations due to a few cases of missing data.[10] We also have an extended sample that goes from March 2, 2020 to December 29, 2021 and includes the same 20 states. Results using this sample are featured in Section 6: Extended Sample Results.

3.1 Tax-Adjusted Muni-Treasury Spreads

We use Bloomberg's BVAL model for General Obligation (GO) municipal yield curves to obtain yields with maturity from one to thirty years for each available state.[11] Smaller US states typically do not have sufficient outstanding GO bonds for Bloomberg to derive a reliable yield curve. We focus on the yields of GO bonds because their cash flows are secured by the full faith, credit, and taxing power of the issuing government. About 90% of state tax revenues derive from sales and income taxes. The weighted average maturity of GO bonds is approximately 12 years and they accounted for 68% of the trading activity in 2019 according to MSRB (Bi and Marsh, 2021).

Municipal bond holders are frequently exempt from paying federal income taxes on interest payments. Moreover, they may also be exempt from the state income tax, often if they reside in the state which has issued the debt. To properly compare muni and Treasury yields, we must adjust the former to account for their tax advantages. We follow the method used by Schwert (2017) and Grigoris (2020). Muni yields are scaled by the following formula: $\frac{1}{(1-\rho_t^{fed})(1-\rho_{i,t}^{state})}$, where ρ_t^{fed} and $\rho_{i,t}^{state}$ are the top federal and top state income tax rates for each state. The federal tax rates are from the Tax Policy Center and the state tax rates are

[10] There are 12 observations for which Bloomberg had insufficient data to compute a BVAL yield, and 27 observations where a positivity rate could not be calculated.

[11] Used with the permission of Bloomberg. Some technical aspects of the BVAL model are discussed in the following paper: `https://data.bloomberglp.com/professional/sites/10/45674_CDS_PRI_BVAL_AAA_Curves_SFCT_DIG1.pdf`

based on 2020 top marginal rates from the Tax Foundation.[12]

Once we compute tax-adjusted muni yields, we subtract the Treasury yields of equivalent maturity to obtain the spreads. The daily Treasury yields from one- to thirty-year maturity are from the the Gürkaynak, Sack and Wright (2007) dataset.

3.2 Macro Controls

We include various macroeconomic controls in our model, depending on the specification. First, to control for each state's default risk, we use either ratings from S&P or credit default swap (CDS) spreads from Bloomberg with maturities ranging from one to thirty years.[13] To create a numerical S&P rating, we map each letter rating to a value, where BBB- is 1 and AAA is 10. Then, if a state has a positive outlook, we add 0.33; if it has a negative outlook, we subtract 0.33.[14] Overall, in our baseline sample period, 8 out of 20 states experienced a change in rating.

In our baseline, we favor the use of ratings because they change at a lower frequency than muni and CDS spreads, hence they should not be affected by endogeneity concerns while still controlling for fundamental default risk. Further, unlike CDS spreads, ratings are available for 20 rather than 18 states and are immune from liquidity issues.

Second, we include Google workplace mobility data, available daily, which measures how the number of visitors to workplaces changes relative to baseline days preceding the pandemic's outbreak (January 3, 2020 to February 6, 2020). This variable should capture future reductions in economic activity as more people stay or work from home. We interpolate these data to smooth brief discrepancies (e.g., holidays). We also considered Google residential mobility data, however the information content is very similar.

[12] See `https://www.taxpolicycenter.org` and `https://taxfoundation.org`

[13] Used with the permission of Bloomberg. See Appendix A in Chen (2007) for discussion of CDS data from Bloomberg: `https://www.proquest.com/docview/821453979?fromopenview=true&pq-origsite=gscholar&parentSessionId=thpBWpWYN0tWIf3wN27r3Pm0rZX67dkonZin3ruY2ts%3D`

[14] For example, a rating of AA+ with a negative outlook corresponds to 8.67. See `https://www.spglobal.com/ratings/en/research/articles/190319-u-s-state-ratings-and-outlooks-current-list-1738758`

We also consider the percentage change in the number of small businesses open compared with January 2020. These are generated by Womply and then aggregated by Opportunity Insight's Economic Tracker.[15] This variable is a seasonally adjusted 7-day moving average, indexed to January 2020. It is available at daily frequency and captures the extensive margin of small business operation. We also experimented with the percentage change in small business revenues, which has similar information content.

Lastly, we include an index measuring seated diners at a sample of restaurants on OpenTable, which includes online reservations, phone reservations, and walk-ins. This variable computes the relative percentage of seated diners compared to the same period in 2019, which constitutes the benchmark year. This variable is meant to capture conditions specific to the leisure/hospitality sector, which was one of the hardest hit sectors during the pandemic. We apply a centered 7-day moving average to the raw data from OpenTable.

3.3 Policy Interventions

3.3.1 Fiscal

In order to control for fiscal policy, we gathered data on the timing of key votes in Congress and passages of the relevant bills into law. We obtained these observations by reviewing compilations of Congressional voting records and news articles.[16] These dates are then used to generate persistent indicators which take the value of one after a milestone has been reached. In our baseline, such milestone is always the time in which the bill is signed into law, because it is unlikely that investors knew the bill's details before then. Differently from other studies, we use information about the content of the bills and not just the days of their passage.

In particular, time dummies are interacted with the specific amount of fiscal support provided to each state. We obtain these measures from two sources. For the CARES Act,

[15] For complete definitions for all variables, see https://github.com/OpportunityInsights/EconomicTracker/blob/main/docs/oi_tracker_data_dictionary.md

[16] See GovTrack.us: https://www.govtrack.us/congress/votes

each state's fiscal aid normalized by Own Sources General Revenues (OSGR) is derived from Auerbach et al. (2020). For the ARP, we use the dollar amounts published by the House Oversight Committee website on budget reconciliation and, for consistency, we normalize them by OSGR using revenue data from the Census Bureau.[17]

Economic Tracker includes administrative data on a variety of unemployment claims variables. We obtain these data from weekly reports and assign them to the release date, when they become known to investors. We focus only on unemployment benefits arising from emergency programs implemented during the pandemic, which are funded by the federal government and do not require expenditure from state governments. Benefits not only provide a direct stimulus to the local economy, but are potentially taxable as income by states and therefore can provide them with additional revenues.[18] Further, once benefits are spent, they might generate sales tax revenues. Specifically, we incorporate measures for initial PUA claims, and continued PEUC claims. We favor initial claims, as we find they are a more responsive measure of unemployment claims, however, these are unavailable for PEUC, prompting the use of continued claims.

3.3.2 Monetary

Monetary policy interventions data are based on public announcements by the Federal Reserve Board of Governors.[19] We use this information to generate persistent indicators which take the value of one starting either on the day of the announcement or the day after if the announcement took place after market close. We focus on the events listed in Section 2.2. Data on MLF issuance is derived from reporting by the Board of Governors to Congress, also publicly available on the Board's website. We use these reports to create a state-level variable with a value equal to the amount (in Billions) of issuance agreed to on the day in

[17]See March 19, 2021 "Wayback Machine" Web Archive version of the Committee webpage for allocations: `https://web.archive.org/web/20210319030920/https://oversight.house.gov/budget-reconciliation`

[18]Auerbach et al. (2020) estimates states receive 3.8% of unemployment benefits as income tax revenue.

[19]See `https://www.federalreserve.gov/monetarypolicy/muni.htm`

which the deal is entered into.

3.4 Public Health Controls

We obtain data on state-level virus mitigation policies, such as Stay-at-Home orders, from Economic Tracker. The variable takes the value of one when the policy is in effect and returns to zero once the mitigation policy is removed.

For each state, we include three public health indicators pertaining to Covid-19. The first is the change in new Covid-19 cases reported by the New York Times, to capture the slope of the infection curve. We take the 7-day backward-looking moving average and convert it to a per 100,000 individuals basis using Census state population data. Next, we include the test positivity rate, defined as the ratio of the 7-day average of new cases per 100,000 divided by the 7-day average of coronavirus tests per 100,000. Our final measure is the 7-day average of the number of daily Covid-19 deaths per 100,000 each day. These last two measures are obtained via Economic Tracker, which itself obtains the data from the CDC before converting them to per 100,000 individuals and applying a 7-day moving average.

4 Empirical Strategy and Results

In this section, we first describe our empirical specification, then discuss in detail the baseline results, and finally present counterfactual trajectories of the tax-adjusted muni-Treasury spreads in the absence of FP and MP interventions.

4.1 Empirical Specification

To quantify the economic impact of FP and MP interventions in muni markets, during a period dominated by the pandemic (March 2, 2020 to May 5, 2021), we estimate a simple panel regression model in which daily variations in the one- to thirty-year muni-Treasury spreads of 18 states are distilled in factors common to all states and state-specific components:

$$Y_{i,t}^{\tau} = \alpha^{\tau} + \beta_1^{\tau} X_{i,t} + \beta_2^{\tau} FP_{i,t} + \beta_3^{\tau} MP_t + \beta_4^{\tau} SLR_{i,t} + \beta_5^{\tau} C19_{i,t} + \lambda_i^{\tau} + \epsilon_{i,t}^{\tau} \tag{1}$$

where, for each state i and time t, $Y_{i,t}^{\tau}$ is the tax-adjusted muni spread of a bond with maturity τ, $X_{i,t}$ is the set of our macro controls, $FP_{i,t}$ captures all the FP interventions, MP_t captures all the MP interventions, $SLR_{i,t}$ is the variable for the state-level responses, $C19_{i,t}$ includes three Covid-19 public health indicators, and λ_i^{τ} are state fixed effects.

Unlike event studies, our state-level panel estimated over the course of 15 (or 22 in the case of the extended sample) months allows us to capture longer-run effects of policy interventions. The examination of each panel's results at different maturities can allow us to distinguish the transmission channel of each policy. It is reasonable to assume that if a policy affected primarily short-term bonds, then it mostly worked through the liquidity-risk channel (or market functioning more in general), which tends to have short-lived effects usually concentrated in eligible bonds. On the other hand, if the same policy also affected longer-term bonds and by a larger amount, then it probably also worked through the credit-risk channel, as it addressed states' fundamental credit concerns.

In our baseline model, the macro controls include credit ratings to capture the credit risk associated with each state, workplace mobility to capture future reductions in economic activity as more people stay or work from home, and the OpenTable Diners Index to proxy for revenues in one of the sectors hit the hardest by the pandemic.

The FP interventions are measured by fiscal aid allocations to states and municipalities interacted with an indicator for when the specific bill became a law. We also include initial PUA claims and continued PEUC claims to control for federal unemployment benefits in each state.

Our MP interventions capture the introduction of and key changes to the MLF. For each announcement described in Section 2.2, we include a dummy set to one starting on the day of the announcement. We also include the amount in millions issued to the MLF on the day a deal is entered.

The SLR is a dummy equal to 1 on days when the state had a stay-at-home order in effect and 0 otherwise. This controls for the economic impacts of the order.

Our Covid-19 public health variables include daily changes in new Covid-19 cases, positivity rate, and daily deaths. These indicators should control for the economic impact of the pandemic above and beyond the macro controls, such as state-level public health expenditures. They can also control for the fear factor and pessimism associated to Covid-19 which could translate in higher risk aversion.

4.2 Baseline Results

Table 1 summarizes the results of our baseline specification for the tax-adjusted muni-Treasury spread at the 2-, 3-, and 4-year maturities. While short-term spreads behave similarly, only maturities of three years or less were eligible for the MLF. To the extent that the MLF created some discontinuity in the pricing of muni bonds, comparing the 3- and 4-year maturities could be of interest. Table 2 instead is focused on the baseline results for longer-maturity bonds, specifically the 5-, 10-, and 30-year tax-adjusted muni-Treasury spreads. These results are important to better understand the transmission mechanism of FP and MP interventions, especially considering that the muni debt market is very active at long maturities.

Our baseline specification explains about 81% of variation in muni spreads across short maturities (Table 1) and about 83% across long maturities (Table 2). We notice first that the estimated coefficients on numerical credit ratings and workplace mobility are statistically significant and display the expected negative sign. Focusing on the 3-year muni spread (the second column of Table 1), a one-notch increase in the rating decreases the muni spread by about 46bp and a positive outlook change lowers it by about 15bp. A one percentage point decrease in the number of people travelling to work increases muni spreads by about 4bp. During our sample period, the average decrease in workplace mobility was about 35%. This implies that all else equal, the associated decline in economic activity resulting from reduced workplace mobility increased muni spreads by about 140bp. A 1 percentage point drop in the OpenTable Diners Index was associated with a 0.36bp reduction in spreads. As the average value of the index was -55.5, the mean affect on yields resulting from reduced restaurant activity was 20bp.

Turning to FP, our estimates indicate that the CARES Act had a large and statistically significant impact on muni spreads. An increase in CARES aid equivalent to 1% of OSGR decreased spreads by almost 16bp. Given that, on average, aid to states was 8.7% of OSGR, the total reduction in spreads from the CARES act equaled almost 140bp. The effect seems to be quite similar across short maturities; but, as shown in Table 2, the magnitude of the coefficient is notably smaller at longer maturities, implying a total effect of 83bp for the 30-year spread. This suggests that almost half of the CARES impact at short maturities was driven by lower liquidity risk, while the remaining part was mostly related to an improvement in longer-term credit concerns.

The coefficient on ARP is also negative and statistically significant (except for the 2-year maturity), but its magnitude is monotonically increasing with maturity. On average, ARP aid equaled 13.4% of state OSGR, implying that the ARP decreased 3-year muni spreads by a total of about 5bp and 30-year spreads by 48bp. This indicates that ARP has been likely viewed by investors not just as an emergency measure addressing short-term liquidity issues, but as improving on more fundamental credit concerns. It is also possible that our estimates do not capture the full extent of the ARP impact as, at the time of writing, not all the funds have been disbursed to states and even those disbursed have not yet been fully appropriated by the states. In Section 6 we investigate ARP effects in a longer sample period.

In addition, PUA and PEUC unemployment claims display negative and statistically significant coefficients. An increase of one initial claim per 100 workers reduced spreads by 6bp for PUA (with an average total effect of 1.5bp), while the same increase in PEUC reduced spreads by 5.5bp (with an average total effect of 9bp). This indicates that these expansions of unemployment benefits financed by the federal government provided some relief at the state level. Further, the magnitude of the PEUC coefficient doubles at long maturities, suggesting that this particular type of expansion was perceived as alleviating longer-term credit risk, most likely by stimulating aggregate demand beyond the pandemic crisis period. As we will show in the next section, these variables become more important in states characterized by a more strained fiscal situation.

Turning to MP, at shorter maturities, except for March 23, all announcements display statistically significant coefficients, accounting for a cumulative 66bp decline in the 3-year muni spread. In particular, the April 9, May 11, and June 3 announcements account for a reduction of 106bp in the muni spread. However, it seems that the MLF's first expansion on April 27 was deemed insufficient by investors, as demonstrated by the positive coefficient. In relatively more rural states, very few additional entities qualified according to the new population thresholds, implying that the announcement was beneficial mostly to states that already benefited under the original terms. Similarly, the 50bp reduction in the MLF's spread announced on August 11 had a positive impact on muni spreads, although smaller in size. This is because, by then, muni spreads available to all states in the private market were well below the new MLF spreads (see Figure 1), making the MLF new pricing worse than expected.[20]

It is also important to point out that the effects of MP announcements at the 2-, 3- and 4-year maturities is quite similar, suggesting that the initial (24 months) and subsequent (36 months) maturity thresholds for eligibility at the MLF did not seem to have triggered price discontinuities in muni bonds. Thus, the impact of the MLF passed through to ineligible bonds making this facility more effective, as the GO muni debt market does not appear to be very segmented along the maturity dimension. This is further corroborated in Table2, as at longer maturities the cumulative effect of the MP interventions remains quite similar to that of shorter maturities. This implies that the transmission channel of the MLF was not limited to liquidity/market-functioning, in which case we would expect the effects to be

[20]See Yale School of Management Systemic Risk Blog post: `https://som.yale.edu/blog/federal-reserve-lowers-pricing-for-municipal-liquidity-facility`.

localized to eligible bonds and their close substitutes.

Lastly, we note that actual MLF issuance is marginally significant at the 2- and 3-year maturities, which are the only maturities where MLF issuance took place. The estimated coefficients indicate that, for instance, a one-billion dollar issuance at the MLF would increase 3-year muni spreads by 21bp.

Our control for stay-at-home orders indicates that those Covid-19 mitigation measures had a statistically significant impact on muni spreads, increasing them by about 8bp at short maturities. This is consistent with the findings of Li and Lu (2020), although the size of the effects is not comparable as they use muni offering yields and we employ tax-adjusted muni-Treasury spreads. In contrast to the large impact of workplace mobility, this finding suggest that the fear of the virus and the possibility of working from home had bigger economic effects than the stay at home orders themselves. The small coefficient also hides the fact that this is an average across states; our analysis in the next section will show the difference between low and high population density states.

Turning to the Covid-19 public health indicators, most coefficients are statistically significant, although the negative sign on Covid-19 deaths is puzzling. However, the overall economic significance of these variables is quite small. For instance, if the rate of Covid-19 new cases per 100,000 residents increases by one, the 3-year muni spread increases by about 0.55bp, with an average total effect on spreads of almost zero. Similarly, if the positivity rate increases by one percentage point, the 3-year muni spread increases by about 0.5bp, with a total effect of about 4bp. This suggests that all the other controls in our empirical model already do a good job at explaining the economic relevance of the pandemic and related policy interventions.

[Table 1 about here.]

[Table 2 about here.]

4.3 Counterfactual

Using the estimates from our 3-year adjusted muni-Treasury spread model, we consider the following counterfactual: the projected evolution of muni-Treasury spread in the absence of FP and MP interventions.[21] Figure 2 plots the actual evolution of the average 3-year muni spread in black, the one implied by our model estimates in red, and the one implied by our counterfactual in purple. The green and blue areas highlight the relative contributions of FP and MP interventions to the total counterfactual spread. From this figure, we observe that, by the end of the sample period, FP contributed at least twice as much as MP (about 160bp versus 65bp) to the decline in the 3-year average muni spread.

[Figure 2 about here.]

In the case of the 5- and 10-year muni-Treasury spreads, the counterfactuals (not shown) indicate that the contribution of FP to the spread reduction becomes three times as large as that of MP. For instance, at the five-year maturity FP accounts for 172bp and MP for 54bp, and at the 10-year maturity FP accounts for 190bp and MP for 61bp. This makes sense because the MLF was designed to help states and municipalities to manage cash flow pressures during the pandemic and maintain liquidity in the market; it was not meant to provide long-term support to those entities. Indeed, the MLF was terminated at the end of 2020, while Congress continued to provide fiscal aid to states in 2021. As shown in Section 4.2, ARP and PEUC, fiscal measures that continued to provide support well into 2021, affected longer-term spreads more than shorter-term spreads.

Since we consider changes caused by policy interventions during the pandemic, many factors that we keep fixed in the counterfactual would have likely evolved differently in the absence of FP and MP interventions. For example, if muni spreads had remained elevated, states would have had to take contractionary measures such as cutting expenses or raising taxes. Depending on the impact of these alternative measures on the state budget, aggregate

[21] This is done by setting to zero the effects of our FP and MP interventions in the baseline regression and plotting the resulting fitted values.

demand, and public health, some states might have experienced different trajectories in their muni-Treasury spreads. Overall, since all of these variables are endogenous, it is hard to assess if our counterfactual is providing an upper or lower bound of the total and relative contributions of each policy.

5 Analysis by State Subgroups

To better understand what is driving the results from the baseline specification that included all 20 states, we investigate how our findings vary based on state characteristics that are potentially relevant for differences in the efficacy of policy interventions. In particular, we continue to use the same variable specification used in the baseline, but we divide the states in two mutually exclusive subgroups, based on the following three factors.

First, we zoom in on the state's pre-pandemic fiscal risk, measured by the state's numerical credit rating as of January 2, 2020. States with lower fiscal risk at the onset of the pandemic may have been less impacted by policy interventions because they were better prepared to weather a budget crisis. We divide states into two groups, one with above-median ratings (high) and the other with below-median ratings (low).

Second, we consider the state's level of urbanization. Because Covid-19 is spread through close contact between individuals, a high-population density area such as urban areas may have been impacted more heavily, experiencing worse economic outcomes. In addition, urbanization might be indicative of different types of jobs that would be affected differently by the pandemic. To separate our states into two groups characterized by different population densities, we use the "urbanization index" from FiveThirtyEight, which is based on a weighted average of the population living within 5 miles of each census tract.

Third, we use a state's partisan lean because Republican-leaning "red" states and Democrat-leaning "blue" states have responded somewhat differently to the pandemic. For example, adoption of Covid-19 mitigation measures,[22] face mask utilization,[23] and vaccination rate[24] have been different across red and blue states. As a result, on the one hand, investors may have seen blue states' balance sheets as more vulnerable because more rapid and comprehensive public health responses might have led to broader business closures and therefore lower sales tax revenues. On the other hand, investors may have been more confident in the faster recovery of blue states because of the stronger public health responses. Partisan Lean, also from FiveThirtyEight, measures a state's lean relative to the country based on recent Presidential and State House elections. A lean of 0 indicates that a state votes for each party similarly to the country at large. A negative lean indicates that state's voters favor the Republican Party, while a positive lean indicates that state's voters favor the Democratic Party.

Figure 3 plots the state's urbanization level along the x-axis, its numerical credit rating along the y-axis, and its partisan lean by the color of the circle. Immediately, we can observe that Illinois is a negative outlier with respect to credit rating. As shown in the lower right quadrant, highly-urbanized states that lean Democrat tend to have below-median credit ratings. Meanwhile, relatively more rural states that lean Republican have the highest credit rating, as shown in the upper left quadrant (e.g., 10 corresponds to AAA rating).

[Figure 3 about here.]

5.1 Fiscal Risk

Table 3 summarizes the results for the low and high credit-rating subgroups. First, we observe that the coefficients on credit rating are large, negative, and statistically significant only for low-rated states (columns 1 and 3). This is because low-rated states display more variation across credit ratings and have experienced more downgrades and outlook changes

[22] Gollwitzer et al. (2020) find counties which favored Republican Donald Trump in the 2020 Election featured less social distancing. See `https://www.nature.com/articles/s41562-020-00977-7`.

[23] See `https://delphi.cmu.edu/blog/2020/10/12/new-and-improved-covid-symptom-survey-tracks-testing-and-mask-wearing/`.

[24] See `https://www.nytimes.com/interactive/2021/04/17/us/vaccine-hesitancy-politics.html`.

over our sample period. In contrast, highly-rated states tend to be clustered at the AAA upper-bound or just below it. In the higher-rated group, only New York and Minnesota recorded an outlook shift, making numerical credit rating and state fixed effects almost perfectly collinear.

Secondly, FP was much more effective for lower-rated states as demonstrated by the larger coefficients on all policy interventions. Even PUA and PEUC claims seemed helpful primarily to lower-rated states. Up until the second MLF expansion (June 3, 2020), MP interventions were more beneficial to higher-rated states. The last two changes to the MLF, announced on June 3 and August 11, were relatively more helpful to lower-rated states. On net, at the 3-year maturity, in higher-rated states, MP accounted for about 110bp, while in lower-rated states it accounted only for almost 50bp. This overall implies that, in lower-rated states, the efficacy of FP relative to MP grew even larger.

[Table 3 about here.]

5.2 Urbanization Index

Table 4 summarizes the results for states with low and high levels of urbanization. Since highly-urbanized states tend to have below-median credit ratings the results for the high group are very similar to those for the low groups in Table 3. That is, in highly-urbanized states, FP has been much more effective than MP.

A new finding that emerged from the analysis of these subgroups is that stay-at-home orders had a positive and significant impact only on the muni spreads of highly urbanized states, with a coefficient that is much larger than in the baseline.

[Table 4 about here.]

5.3 Partisan Lean

Finally, given the positive relationship between urbanization and partisan lean displayed in Figure 3, the similarities between the estimates reported in tables 5 and 4 are not surprising. Hence, the analysis of the subgroups based on partisan lean did not provide substantial additional insight except again for stay-at-home orders. This variable has a negative and significant impact on the muni spreads of blue states, a finding consistent with the hypothesis that investors were more confident in the medium and long-term recovery of blue states because of the stronger public health responses.

[Table 5 about here.]

6 Extension to the Recovery Period

By May 2021, economic and public health conditions appeared to stabilize. New Covid-19 cases had fallen, effective vaccines were widely available, and financial markets had recovered. However, the emergence and widespread prevalence of the more virulent delta-variant during the late summer led to trend reversals in pandemic data. The Delta variant was later superseded by the even more infectious Omicron variant, which caused U.S. cases and hospitalizations to reach records highs. Over the same period, the US economy experienced notable job growth and inflation: each month from June to December inclusive, an average of 585,000 jobs were added while CPI inflation averaged more than 0.6% (per the Bureau of Labor Statistics).

Despite rising inflation and virus cases, state finances proved to be tremendously strong. State revenues increased by 24% from 2020 to 2021, with a majority of states reporting they exceeded projections. State reserve funds reached record highs during the 2021 fiscal year. The increased tax revenues were accompanied by $350bn in funds provided by the ARP to state and local governments. Many states experienced surpluses and proposed a variety of short-term uses for such funds, as many lawmakers considered these surpluses likely temporary.[25]

Because of the huge improvement in states' fiscal situation, in the majority of states short-term tax-adjusted muni-Treasury spreads continued to decrease after May 2021 and entered distinctly negative territory. By the end of December 2021, every state in the sample, save for outliers Illinois and New-Jersey, had their 2-, 3-, and 4-year muni-Treasury spreads below zero. A majority of states also had negative 5-year spreads at this time.

[Figure 4 about here.]

Longer-term muni spreads evolved somewhat differently. During the first half of 2021, 30-year muni-Treasury spreads declined for several states. This is because, at the beginning of 2021, muni yields decreased while Treasury yields increased as federal stimulus simultaneously improved the credit quality of municipalities (leading to rating upgrades) and increased the federal debt burden. After July, however, spreads increased substantially for all states in the sample, and only during the last two months of the year began decreasing again. It seems that such behavior was driven by developments related to the Infrastructure Investment and Jobs Act, which passed in November 2021. In particular, from July to the end of October, expectations of larger muni bond supply due to some provisions in the bill pushed prices lower and yields higher, but, as the likelihood of these provisions being included in the final bill dissipated, muni yields reverted the previous months' increase leading to a compression in spreads.

[Figure 5 about here.]

Due to these rare developments in the muni debt market, we have extended the estimation of our baseline panel regressions to this longer sample.[26] This exercise should help us understand the drivers of the negative muni-Treasury spreads and evaluate the robustness of

[25] Vielkind, Jimmy. 2022. States Are Swimming in Cash Thanks to Booming Tax Revenue and Federal Aid. *The Wall Street Journal.*

[26] Since 1960, longer-term tax-adjusted Muni-Treasury spreads turned negative only one other time, from 1978-80, as shown in Bordo and Duca (2021).

our results. Importantly, it provides a longer period during which we can better assess the effects of later policy interventions such as the ARP, which passed in March 2021. Moreover, ARP funds were not disbursed all at once; states have until the end of 2024 to allocate to projects those funds, which then must be spent by 2026. Through December 2021, many states had yet to allocate most (or any) of their funds.[27]

Table 6 reports the results for short-term (2-, 3-, 4-year) maturities in the extended sample. Most of the baseline results remained highly significant with the correct sign, although R-Squared values tended to decrease slightly. The only exceptions are the OpenTable Diners Index and Covid-19 related variables that reversed sign.

Importantly, the CARES Act remained extremely significant and its coefficient marginally increased in magnitude. The ARP aid coefficient gained both in significance and magnitude, a result that was anticipated due to the longer time necessary for the more recent bill to exert its effects on the markets. Unemployment claims variables remained significant and preserved the corrected sign; however, it fell in magnitude, a result consistent with their phaseout during the latter part of the extended sample. Overall, these changes in the coefficients related to FP imply that the total effect of these interventions grew from 160bp to 185bp in the extended sample period, an increase largely driven by ARP.

Turning to MP, we note that the April 9, May 11, and June 3 announcements, which primarily contributed to the MLF's compression of spreads in the baseline, became larger in magnitude. Moreover, the August 11 announcement became negative and significant. As a result, the estimated total MP impact at shorter maturities increased by about 40-45bp relative to the baseline sample period. Notably, the coefficient for MLF issuance became larger and more significant as well, suggesting there was an increase in spreads when an MLF deal was entered into.

Many of the same trends also applied to longer (5-, 10-, 30-year) maturities. In particular, the CARES Act and ARP's coefficients generally increased in magnitude, most notably the

[27]Lazere, Ed. 2022. How States Can Best Use Federal Fiscal Recovery Funds: Lessons From State Choices So Far. Center for Budget and Policy Priorities.

ARP at the 5-year maturity. The continued claims variable was associated with similar effects, while the initial claims variable's magnitude declined. On net, this implies that the total effect of FP increased by 20-25bp at longer maturities.

[Table 6 about here.]

In Table 7, four of the five MLF coefficients are negative and became larger in size, as the August 11 coefficient turned negative and significant. Accordingly, the net total MP impact increased by about 15-40bp across the three maturities. Differently from the baseline results, the MLF issuance coefficient became significant across all three maturities and increased in size. One possible explanation could be that entities that accessed the MLF are expected to run into fiscal difficulties in the longer run.

[Table 7 about here.]

Overall, our findings in the longer sample period suggest that the effects of both FP and MP interventions not only persisted but grew larger. In turn, this implies that many studies focused on the first few months of the Covid-19 crisis might have underestimated the impact of these policies, which continued to affect the muni debt market almost two years after the beginning of the crisis.

7 Robustness of the Baseline

In this section, we analyze the robustness of our results to: using muni-Treasury spreads that are not tax adjusted, controlling for CDS spreads rather than credit ratings, and the exclusion of Illinois an outlier with the lowest credit ratings.

As found in Tables 8 and 9, the results obtained using unadjusted muni-Treasury spreads are very similar to those for tax-adjusted muni-Treasury spreads (Tables 1 and 2). Therefore the main message about the relative efficacy of FP and MP interventions is unchanged.

The only meaningful difference is the magnitude of all coefficients, which is larger for tax-adjusted spreads. This is somewhat mechanical because, under the assumption of no changes in state tax laws, the tax-adjusted muni-Treasury spreads are on average 1.6 times larger than unadjusted muni-Treasury spreads.

However, the transformation is not linear, as the difference between adjusted and unadjusted yields is not a straightforward level shift or scaling. Because the adjustment factor converting yields is multiplicative, the difference between an adjusted an unadjusted yield is non-constant and depends on yield level. Additionally, the adjustment factor depends on a state's income tax rate, resulting in heterogeneity across states.

[Table 8 about here.]

[Table 9 about here.]

Tables 10 and 11 summarize the results obtained replacing credit rating with CDS spreads in the baseline specification. The coefficients on CDS spreads are positive and significant at all maturities and their size is smaller for longer-term muni bonds. Since FP and MP interventions affect state CDS spreads and muni yields contemporaneously, even if we use lagged CDS spreads, their coefficients still capture part of the effects of the various policy interventions, that is, the portion related to credit risk. This makes the overall impact of FP on muni spreads smaller because, as shown in Section 4, ARP and PEUC have been particularly effective at reducing longer-run credit concerns. In contrast, MP interventions account for a larger share of the total decline in muni spreads. For instance, at the 3-year maturity, MP explains 92bp rather than 65bp reported in the baseline results. Further, MLF Issuance and stay at home orders lose their explanatory power.

[Table 10 about here.]

[Table 11 about here.]

Next, Table 12 reports the estimates for the state subgroups based on credit ratings, that is, the same specification of Table 3, but without IL. The absence of this state, having the lowest credit rating, should affect only the results for the lower-rated group. While it is still true that FP interventions were relatively more effective in lower-rated states, it is interesting to note that in the absence of IL, the coefficients for PUA and PEUC claims are much smaller. This implies that these unemployment benefits were large in IL and must have been important in reducing its muni yields. For instance, as pointed out in Dadayan (2020), "the additional $600 weekly unemployment insurance benefit not only helped many Americans continue to pay for everyday necessities, it also may have helped the 35 states with a broad-based income tax that tax unemployment benefits partially sustain withholding revenues." Finally, without IL, the earlier MLF announcements have a larger effect, indicating that initially the MLF was not particularly helpful to vulnerable states like IL.

[Table 12 about here.]

8 Conclusions

By the end of 2021, tax-adjusted muni-Treasury spreads had returned to their pre-pandemic levels or even turned negative, after reaching a peak of about 450bp. Our estimates suggest that fiscal and monetary policy together reduced muni-Treasury spreads by about 225bp at short maturities and around 250bp at longer maturities. Fiscal policy contributed twice as much as monetary policy to the notable reduction in shorter-term spreads. At longer maturities, the contribution of fiscal policy was at least three times as large as that of monetary policy, suggesting that fiscal policy was much more effective at reducing states' fundamental credit risk.

Further, our findings in the longer sample period suggest that the effects of both fiscal and monetary policy interventions not only persisted but grew larger. In turn, this implies that many studies focused on the first few months of the Covid-19 crisis might have underestimated the impact of these policies, which continued to affect the muni debt market almost two years after the beginning of the crisis.

Despite only Illinois and the New York Metropolitan Transit Authority issuing \$6.6bn to the MLF, the facility met two main objectives. First, by reducing muni yields at the height of the Covid-19 crisis, it helped states and municipalities manage cash flow pressures from the pandemic. And second, by providing a backstop, it maintained liquidity in the market and encouraged private investors to return to municipal securities.

Fiscal policy appeared to be more effective in reducing muni spreads of states with relatively higher population density and lower credit ratings, while the impact of monetary policy on the muni spreads of those same states was somewhat smaller. Indeed, while in existence, the MLF needed some extensions to be helpful to a larger number of states, but its terms remained more restrictive than those offered at the Fed's corporate facilities. Although the MLF should not be a substitute for fiscal policy, it could likely become more effective if some of its terms were to be revised. For example, the MLF was limited to the primary market, notes with no more than 36 months until expiration, and its pricing was at a significant "penalty rate" above the typical market rate.

Finally, in evaluating the relative efficacy of fiscal and monetary policy, the cost to the taxpayers should be considered by policymakers. While fiscal aid to states totaled about \$550bn, if all loans are paid back to the MLF, its overall cost would mainly consist of the negligible administrative costs of the facility. Hence, the cost benefit ratio suggests that the MLF was quite successful. However, the role of fiscal policy in muni debt market has been much larger, and we have not considered its effect on the broader economy, which could be the subject of future research.

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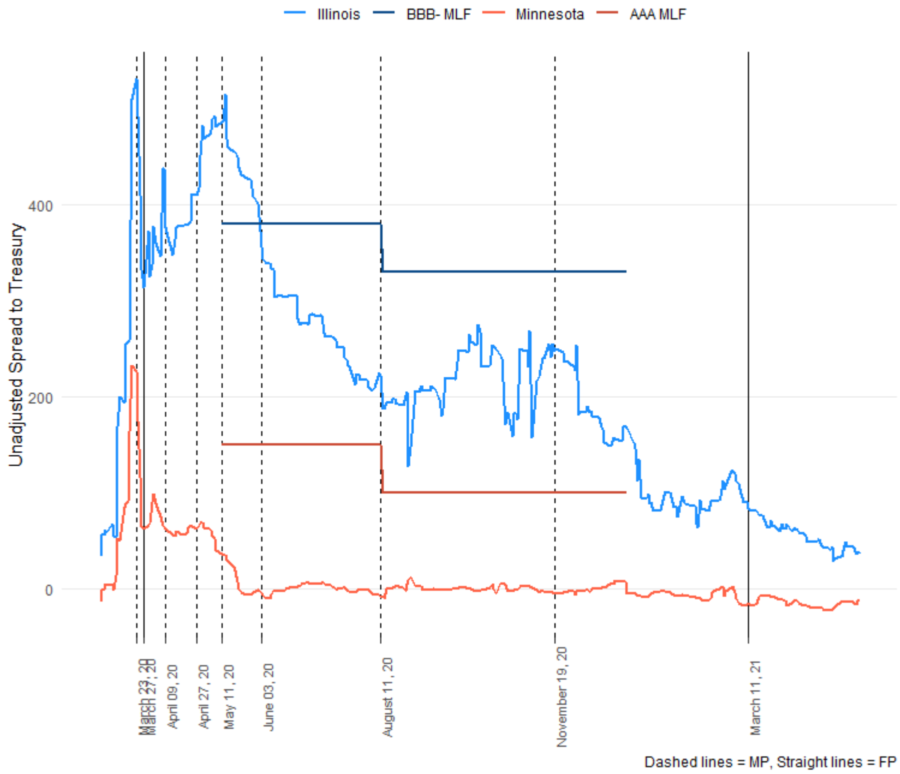

Figure 1: 3-year muni-Treasury Spreads for the states of Illinois and Minnesota. The vertical lines mark the dates of fiscal policy (solid) and monetary policy (dotted) interventions. The horizontal lines show the spread charged at the MLF facility for the states of Illinois (blue) and Minnesota (red).

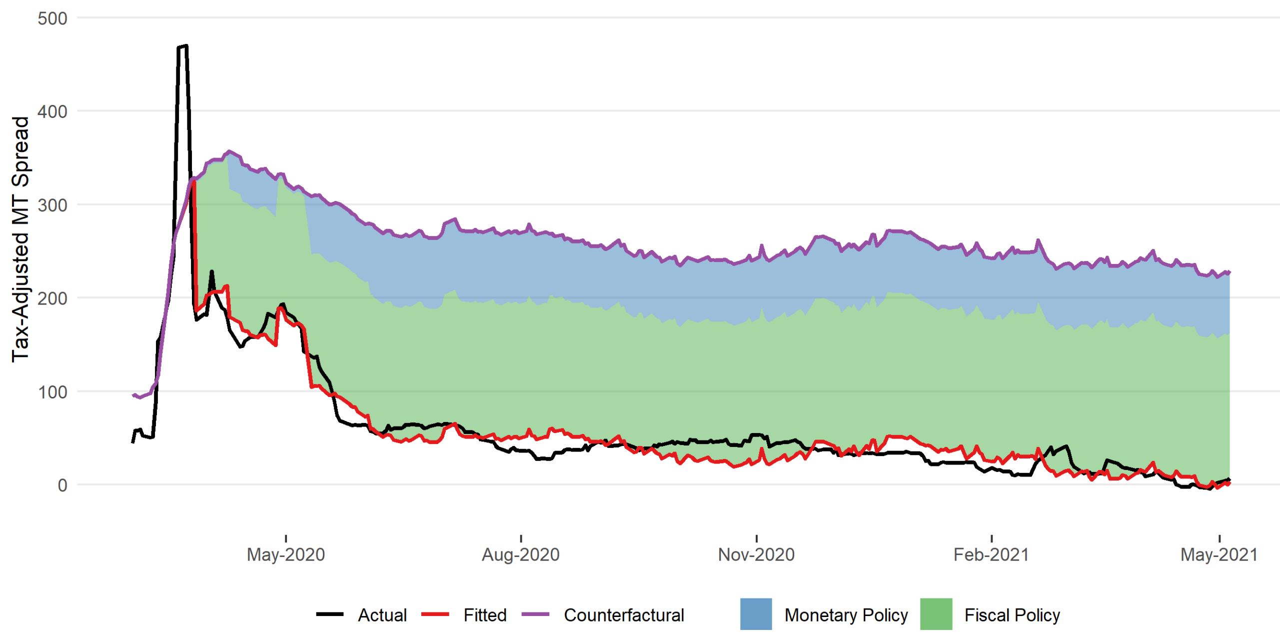

Figure 2: Counterfactual trajectory for the average tax-adjusted 3-year muni-Treasury spread. That is, the projected evolution of the muni-Treasury spread in the absence of FP (green area) and MP (blue area) interventions.

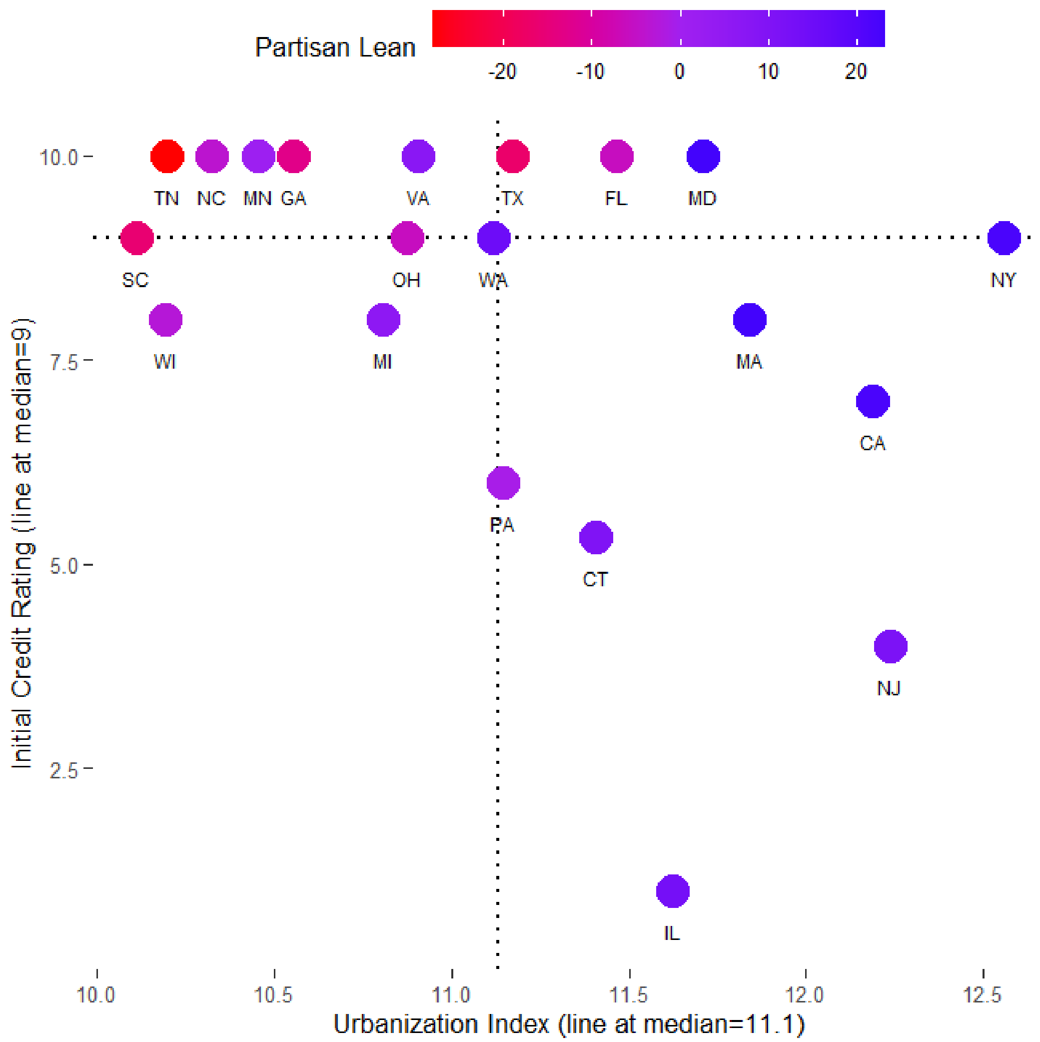

Figure 3: Visualization of state subgroups. States are differentiated by urbanization level (x-axis), numerical credit rating (y-axis), and partisan lean (color of each circle).

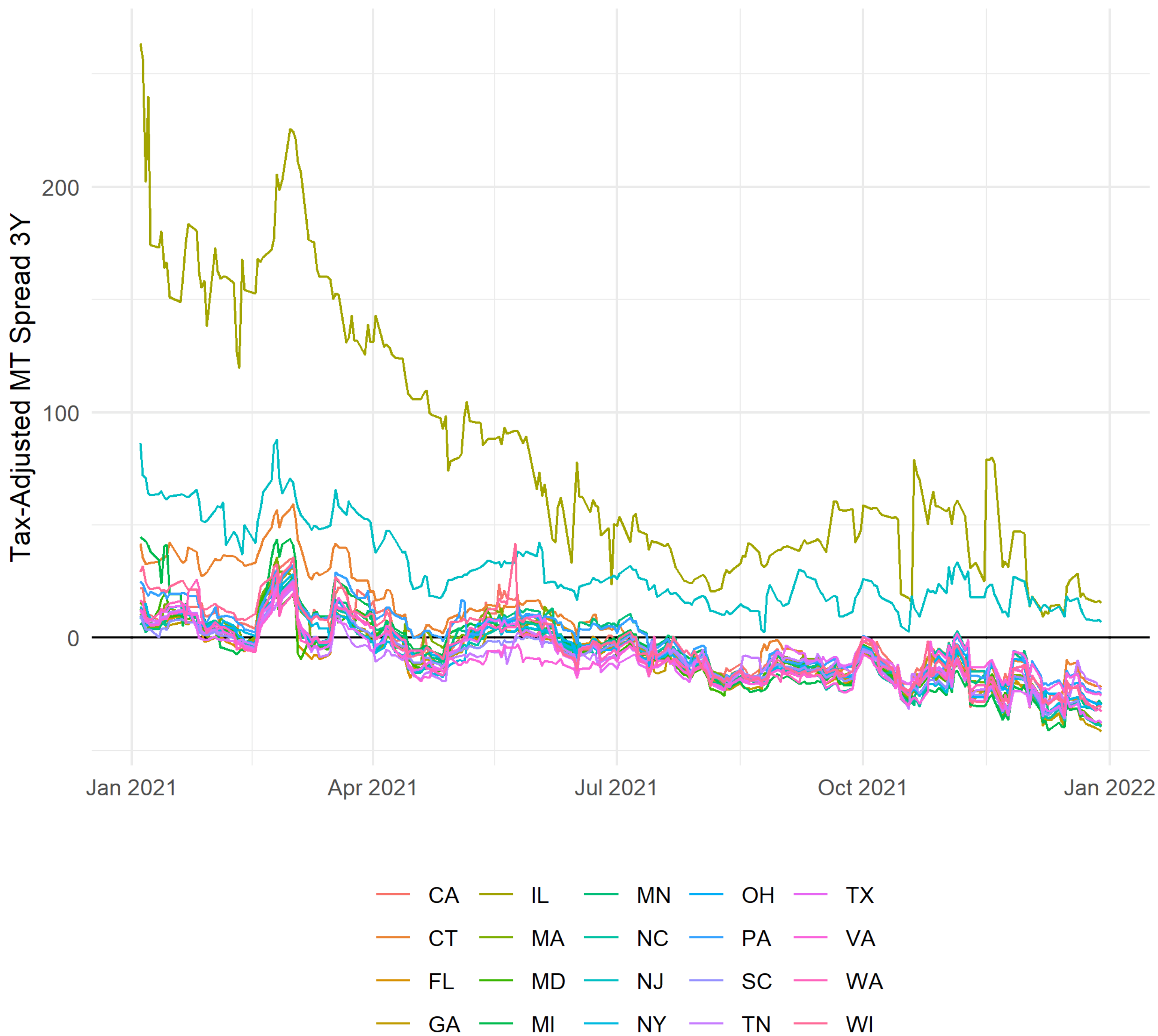

Figure 4: 3-year Tax-adjusted Muni-Treasury Spreads in 2021 for all 20 states in the sample.

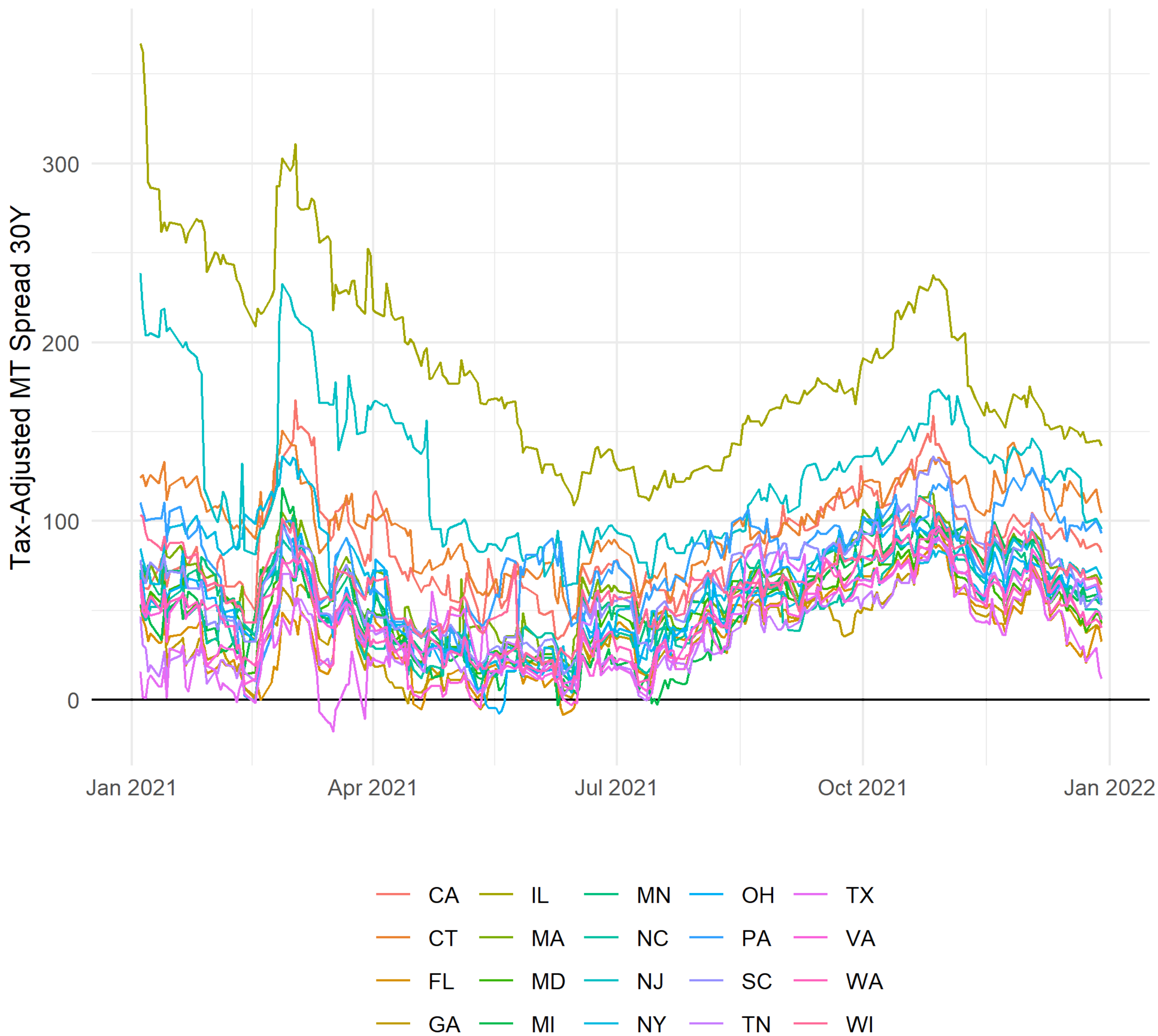

Figure 5: 30-year Tax-adjusted Muni-Treasury Spreads in 2021 for all 20 states in the sample.

Tax-Adjusted MT Spread	2Y	3Y	4Y
Numerical Credit Rating (S&P)	-47.11***	-46.49***	-48.55***
Interp. Workplace Mob.	-4.070***	-3.880***	-3.740***
OpenTable Diners	-0.385***	-0.357***	-0.275***
CARES Aid × Signed into Law	-16.33***	-15.76***	-15.55***
ARP Aid × Signed into Law	-0.0739	-0.348**	-0.580***
Init. Claims Rate PUA	-6.592***	-5.964***	-5.466***
Cont. Claims Rate PEUC	-5.270***	-5.522***	-6.333***
FED Ann. 3-23-20 Post Ind.	-13.62*	-4.085	7.456
MLF Ann. 4-9-20 Post Ind.	-36.46***	-35.85***	-32.67***
MLF Ann. 4-27-20 Post Ind.	28.30***	34.64***	39.12***
MLF Ann. 5-11-20 Post Ind.	-54.67***	-56.96***	-51.40***
MLF Ann. 6-3-20 Post Ind.	-3.087	-13.43***	-23.22***
MLF Ann. 8-11-20 Post Ind.	11.54***	9.882***	5.360**
MLF Issuance Enter Value	0.0236*	0.0213*	0.0186
Stay-at-Home Order in Effect	7.329**	8.305**	8.681**
Δ Daily Cases/100,000 7d avg.	0.545**	0.556**	0.616**
Positivity Rate (Adj. Smooth)	0.589***	0.481***	0.346***
New Deaths/100,000 7d avg.	-13.80***	-12.58***	-13.32***
Constant	369.5***	368.4***	391.0***
Observations	5,901	5,901	5,901
R-squared	0.789	0.815	0.823
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 1: Baseline results for the regression specified in equation (1) and estimated using the tax-adjusted 2-, 3-, and 4-year muni-Treasury spreads as dependent variable.

Tax-Adjusted MT Spread	5Y	10Y	30Y
Numerical Credit Rating (S&P)	-52.21***	-56.18***	-63.98***
Interp. Workplace Mob.	-3.794***	-3.952***	-3.743***
OpenTable Diners	-0.212***	0.0331	0.0158
CARES Aid × Signed into Law	-15.53***	-12.95***	-8.903***
ARP Aid × Signed into Law	-0.977***	-3.284***	-3.573***
Init. Claims Rate PUA	-5.181***	-4.742***	-5.226***
Cont. Claims Rate PEUC	-7.470***	-10.46***	-10.46***
FED Ann. 3-23-20 Post Ind.	9.671	0.375	6.198
MLF Ann. 4-9-20 Post Ind.	-30.83***	-40.22***	-17.03***
MLF Ann. 4-27-20 Post Ind.	44.79***	56.11***	36.98***
MLF Ann. 5-11-20 Post Ind.	-47.52***	-47.71***	-61.08***
MLF Ann. 6-3-20 Post Ind.	-28.07***	-30.49***	-37.24***
MLF Ann. 8-11-20 Post Ind.	-1.800	0.959	-9.373***
MLF Issuance Enter Value	0.0162	0.0111	0.0118
Stay-at-Home Order in Effect	7.518**	5.005	6.096*
Δ Daily Cases/100,000 7d avg.	0.709***	1.128***	1.313***
Positivity Rate (Adj. Smooth)	0.259**	0.0776	-0.286**
New Deaths/100,000 7d avg.	-15.65***	-24.85***	-25.41***
Constant	426.0***	517.3***	624.3***
Observations	5,901	5,901	5,901
R-squared	0.830	0.835	0.842
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 2: Baseline results for the regression specified in equation (1) and estimated using the tax-adjusted 5-, 10-, and 30-year muni-Treasury spreads as dependent variable.

Initial Credit Rating	Low	High	Low	High
Tax-Adjusted MT Spread	3Y	3Y	10Y	10Y
Numerical Credit Rating (S&P)	-61.69***	10.63	-82.33***	41.82***
Interp. Workplace Mob.	-4.331***	-3.068***	-4.283***	-3.154***
OpenTable Diners	-0.483***	-0.552***	-0.135	-0.0903**
CARES Aid × Signed into Law	-19.38***	-12.86***	-15.61***	-10.77***
ARP Aid × Signed into Law	-1.683***	0.443***	-4.384***	-2.849***
Init. Claims Rate PUA	-25.40***	1.591	-19.63***	1.220
Cont. Claims Rate PEUC	-6.416***	-0.706	-11.61***	-5.041***
FED Ann. 3-23-20 Post Ind.	20.65	-5.718	21.30	2.288
MLF Ann. 4-9-20 Post Ind.	-13.73	-39.84***	-19.03*	-48.24***
MLF Ann. 4-27-20 Post Ind.	72.78***	12.91***	91.55***	38.19***
MLF Ann. 5-11-20 Post Ind.	-49.36***	-64.64***	-44.71***	-50.15***
MLF Ann. 6-3-20 Post Ind.	-58.54***	-0.996	-77.35***	-12.83***
MLF Ann. 8-11-20 Post Ind.	-14.80***	19.04***	-18.68***	7.090***
MLF Issuance Enter Value	0.0376	-0.00341	0.0188	-0.0116
Stay-at-Home Order in Effect	-12.57*	-3.326	-23.90***	5.037
Δ Daily Cases/100,000 7d avg.	0.516	0.651***	1.087**	1.066***
Positivity Rate (Adj. Smooth)	1.262***	-0.145**	1.601***	-0.908***
New Deaths/100,000 7d avg.	-28.46***	-8.149***	-43.17***	-22.69***
Constant	459.9***	-8.280	688.2***	-293.4***
Observations	2,367	3,534	2,367	3,534
R-squared	0.813	0.839	0.839	0.793
StateFE	Yes	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 3: Results for the regression specified in equation (1) and estimated using the tax-adjusted 3- and 10-year muni-Treasury spreads as dependent variable within two subgroups of the 20 states: those with low and high initial credit rating.

Urban Index	Low	High	Low	High
Tax-Adjusted MT Spread	3Y	3Y	10Y	10Y
Numerical Credit Rating (S&P)	-17.40**	-45.77***	24.39**	-64.29***
Interp. Workplace Mob.	-3.106***	-5.009***	-2.972***	-4.901***
OpenTable Diners	-0.560***	-0.0867	-0.152***	0.157
CARES Aid × Signed into Law	-12.23***	-20.30***	-10.30***	-15.82***
ARP Aid × Signed into Law	0.0429	-1.851***	-3.152***	-4.520***
Init. Claims Rate PUA	0.133	-15.31***	-0.593	-12.55***
Cont. Claims Rate PEUC	0.659	-3.371***	-3.253***	-9.202***
FED Ann. 3-23-20 Post Ind.	-2.155	-4.727	8.032	-7.562
MLF Ann. 4-9-20 Post Ind.	-41.35***	-14.54*	-51.11***	-16.50*
MLF Ann. 4-27-20 Post Ind.	13.88***	54.93***	42.18***	70.82***
MLF Ann. 5-11-20 Post Ind.	-69.18***	-49.87***	-55.43***	-43.64***
MLF Ann. 6-3-20 Post Ind.	-1.374	-38.08***	-11.28***	-56.31***
MLF Ann. 8-11-20 Post Ind.	18.61***	-5.639	7.399***	-7.667*
Stay-at-Home Order in Effect	-9.528***	13.66**	-1.021	3.953
Δ Daily Cases/100,000 7d avg.	0.578**	0.432	1.129***	0.954**
Positivity Rate (Adj. Smooth)	-0.0960	0.825***	-0.648***	0.666**
New Deaths/100,000 7d avg.	-15.93***	-23.01***	-37.00***	-35.95***
MLF Issuance Enter Value		0.0213		0.0106
Constant	281.3***	348.3***	-100.1	558.2***
Observations	2,948	2,953	2,948	2,953
R-squared	0.835	0.816	0.794	0.841
StateFE	Yes	Yes	Yes	Yes

*** $p<0.01$; ** $p<0.05$; * $p<0.1$

Table 4: Results for the regression specified in equation (1) and estimated using the tax-adjusted 3- and 10-year muni-Treasury spreads as dependent variable within two subgroups of the 20 states: those with low and high Urbanization Index.

2020 Partisan Lean	Red	Blue	Red	Blue
Tax-Adjusted MT Spread	3Y	3Y	10Y	10Y
Numerical Credit Rating (S&P)	50.26***	-62.71***	68.12***	-75.84***
Interp. Workplace Mob.	-3.295***	-4.284***	-3.063***	-4.328***
OpenTable Diners	-0.654***	-0.409***	-0.457***	0.0927
CARES Aid × Signed into Law	-13.00***	-19.45***	-11.14***	-15.27***
ARP Aid × Signed into Law	0.314***	-1.794***	-2.609***	-5.053***
Init. Claims Rate PUA	2.258**	-23.97***	-2.966**	-16.96***
Cont. Claims Rate PEUC	-0.548	-4.380***	-5.600***	-9.031***
FED Ann. 3-23-20 Post Ind.	-4.770	9.589	-3.382	15.72
MLF Ann. 4-9-20 Post Ind.	-40.00***	-11.51	-50.11***	-16.80*
MLF Ann. 4-27-20 Post Ind.	14.26***	60.41***	47.84***	73.29***
MLF Ann. 5-11-20 Post Ind.	-61.09***	-55.05***	-45.57***	-46.67***
MLF Ann. 6-3-20 Post Ind.	3.760	-58.06***	-1.395	-77.19***
MLF Ann. 8-11-20 Post Ind.	26.53***	-5.949	18.65***	-12.04***
Stay-at-Home Order in Effect	-1.017	-12.09*	7.683**	-19.53***
Δ Daily Cases/100,000 7d avg.	0.429*	0.587	0.846***	1.078***
Positivity Rate (Adj. Smooth)	-0.236***	0.680***	-0.699***	0.655***
New Deaths/100,000 7d avg.	-16.70***	-22.91***	-44.42***	-33.64***
MLF Issuance Enter Value		0.0185		0.00793
Constant	-424.0***	486.8***	-579.7***	662.6***
Observations	2,951	2,950	2,951	2,950
R-squared	0.854	0.815	0.832	0.839
StateFE	Yes	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 5: Results for the regression specified in equation (1) and estimated using the tax-adjusted 3- and 10-year muni-Treasury spreads as dependent variable within two subgroups of the 20 states: those that lean Democrat (blue) and those that lean Republican (red).

Tax-Adjusted MT Spread	2Y	3Y	4Y
Numerical Credit Rating (S&P)	-83.30***	-91.29***	-95.65***
Interp. Workplace Mob.	-1.698***	-1.815***	-1.756***
OpenTable Diners	0.0344	0.0700*	0.151***
CARES Aid $\times$ Signed into Law	-17.27***	-16.90***	-16.86***
ARP Aid $\times$ Signed into Law	-1.276***	-1.593***	-1.842***
Init. Claims Rate PUA	-4.408***	-3.192**	-2.393*
Cont. Claims Rate PEUC	-5.022***	-4.856***	-5.367***
FED Ann. 3-23-20 Post Ind.	0.489	2.516	11.54
MLF Ann. 4-9-20 Post Ind.	-41.25***	-40.28***	-37.09***
MLF Ann. 4-27-20 Post Ind.	15.09***	22.75***	28.12***
MLF Ann. 5-11-20 Post Ind.	-65.61***	-66.45***	-60.01***
MLF Ann. 6-3-20 Post Ind.	-11.98***	-21.75***	-31.30***
MLF Ann. 8-11-20 Post Ind.	-6.265***	-7.754***	-12.71***
MLF Issuance Enter Value	0.0372***	0.0358***	0.0336***
Stay-at-Home Order in Effect	23.23***	24.19***	24.57***
Δ Daily Cases/100,000 7d avg.	-0.0699	-0.0260	-0.00586
Positivity Rate (Adj. Smooth)	-0.0460**	-0.0513***	-0.0586***
New Deaths/100,000 7d avg.	3.149**	2.794**	1.184
Constant	782.7***	832.7***	867.9***
Observations	8,893	8,893	8,893
R-squared	0.752	0.778	0.784
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 6: Results for the regression specified in equation (1) and estimated using the tax-adjusted 2-, 3-, and 4-year muni-Treasury spreads as dependent variable over the sample period ending in December 2021.

Tax-Adjusted MT Spread	5Y	10Y	30Y
Numerical Credit Rating (S&P)	-93.78***	-83.67***	-79.83***
Interp. Workplace Mob.	-1.477***	-0.880***	-0.429***
OpenTable Diners	0.245***	0.466***	0.298***
CARES Aid $\times$ Signed into Law	-16.84***	-13.65***	-8.654***
ARP Aid $\times$ Signed into Law	-2.082***	-4.065***	-4.288***
Init. Claims Rate PUA	-2.620*	-3.021**	-4.449***
Cont. Claims Rate PEUC	-7.028***	-11.60***	-13.04***
FED Ann. 3-23-20 Post Ind.	21.90***	33.90***	49.62***
MLF Ann. 4-9-20 Post Ind.	-36.04***	-50.11***	-29.46***
MLF Ann. 4-27-20 Post Ind.	33.52***	43.86***	26.67***
MLF Ann. 5-11-20 Post Ind.	-56.96***	-58.12***	-70.11***
MLF Ann. 6-3-20 Post Ind.	-37.73***	-40.94***	-45.47***
MLF Ann. 8-11-20 Post Ind.	-21.15***	-20.36***	-28.94***
MLF Issuance Enter Value	0.0317***	0.0275**	0.0268**
Stay-at-Home Order in Effect	23.53***	19.52***	16.66***
Δ Daily Cases/100,000 7d avg.	0.0847	0.260*	0.207
Positivity Rate (Adj. Smooth)	-0.0587***	-0.0549***	-0.0680***
New Deaths/100,000 7d avg.	0.00303	-4.095***	-5.226***
Constant	876.8***	884.4***	894.8***
Observations	8,893	8,893	8,893
R-squared	0.791	0.800	0.815
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 7: Results for the regression specified in equation (1) and estimated using the tax-adjusted 5-, 10-, and 30-year muni-Treasury spreads as dependent variable over the sample period ending in December 2021.

Unadjusted MT Spread	2Y	3Y	4Y
Numerical Credit Rating (S&P)	-31.87***	-30.84***	-31.19***
Interp. Workplace Mob.	-2.522***	-2.405***	-2.327***
Diners (Centered 7d MA)	-0.231***	-0.210***	-0.157***
CARES Aid $\times$ Signed into Law	-9.346***	-8.928***	-8.741***
ARP Aid $\times$ Signed into Law	-0.120	-0.673***	-1.229***
Init. Claims Rate PUA	-3.627***	-3.351***	-3.193***
Cont. Claims Rate PEUC	-2.880***	-3.353***	-4.219***
FED Ann. 3-23-20 Post Ind.	-1.781	3.223	9.356**
MLF Ann. 4-9-20 Post Ind.	-19.44***	-18.46***	-16.01***
MLF Ann. 4-27-20 Post Ind.	18.12***	21.72***	24.27***
MLF Ann. 5-11-20 Post Ind.	-31.53***	-32.76***	-29.60***
MLF Ann. 6-3-20 Post Ind.	-1.103	-7.026***	-12.74***
MLF Ann. 8-11-20 Post Ind.	7.991***	6.063***	2.284*
MLF Issuance Enter Value	0.0142*	0.0132*	0.0121
Stay-at-Home Order in Effect	3.815*	4.262**	4.378**
Δ Daily Cases/100,000 7d avg.	0.295*	0.320**	0.384**
Positivity Rate (Adj. Smooth)	0.324***	0.260***	0.181***
New Deaths/100,000 7d avg.	-8.198***	-7.975***	-9.084***
Constant	217.7***	211.2***	216.3***
Observations	5,901	5,901	5,901
R-squared	0.779	0.810	0.822
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 8: Results for the regression specified in equation (1) and estimated using the unadjusted 2-, 3-, and 4-year muni-Treasury spreads as dependent variable over the baseline sample period.

Unadjusted MT Spread	5Y	10Y	30Y
Numerical Credit Rating (S&P)	-32.47***	-31.64***	-37.20***
Interp. Workplace Mob.	-2.372***	-2.531***	-2.386***
Diners (Centered 7d MA)	-0.115***	0.0513	0.0560*
CARES Aid $\times$ Signed into Law	-8.676***	-7.095***	-4.655***
ARP Aid $\times$ Signed into Law	-1.849***	-4.204***	-4.002***
Init. Claims Rate PUA	-3.153***	-3.357***	-3.728***
Cont. Claims Rate PEUC	-5.252***	-8.182***	-7.874***
FED Ann. 3-23-20 Post Ind.	9.838**	0.723	7.238
MLF Ann. 4-9-20 Post Ind.	-14.43***	-19.08***	-4.660
MLF Ann. 4-27-20 Post Ind.	27.61***	34.92***	18.86***
MLF Ann. 5-11-20 Post Ind.	-27.61***	-29.54***	-41.00***
MLF Ann. 6-3-20 Post Ind.	-15.67***	-17.58***	-21.85***
MLF Ann. 8-11-20 Post Ind.	-3.173**	-6.403***	-13.40***
MLF Issuance Enter Value	0.0111	0.00961	0.00966
Stay-at-Home Order in Effect	3.584*	2.531	3.743
Δ Daily Cases/100,000 7d avg.	0.470***	0.837***	0.923***
Positivity Rate (Adj. Smooth)	0.128*	0.0109	-0.172**
New Deaths/100,000 7d avg.	-11.17***	-19.09***	-19.16***
Constant	228.5***	247.7***	280.0***
Observations	5,901	5,901	5,901
R-squared	0.833	0.838	0.847
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 9: Results for the regression specified in equation (1) and estimated using the unadjusted 5-, 10-, and 30-year muni-Treasury spreads as dependent variable over the baseline sample period.

Tax-Adjusted MT Spread	2Y	3Y	4Y
Lag CDS Spread	1.485***	1.443***	1.384***
Interp. Workplace Mob.	-4.145***	-3.823***	-3.533***
OpenTable Diners	-0.204***	-0.198***	-0.142***
CARES Aid × Signed into Law	-16.58***	-16.01***	-15.72***
ARP Aid × Signed into Law	0.568***	0.546***	0.538***
Init. Claims Rate PUA	-6.852***	-6.396***	-6.214***
Cont. Claims Rate PEUC	-1.147**	-0.658	-0.665
FED Ann. 3-23-20 Post Ind.	-20.34***	-9.708	3.679
MLF Ann. 4-9-20 Post Ind.	-47.30***	-49.76***	-49.90***
MLF Ann. 4-27-20 Post Ind.	-13.93***	-13.02***	-12.55***
MLF Ann. 5-11-20 Post Ind.	-59.13***	-62.05***	-57.34***
MLF Ann. 6-3-20 Post Ind.	12.34***	6.751*	1.111
MLF Ann. 8-11-20 Post Ind.	22.83***	25.80***	25.94***
MLF Issuance Enter Value	0.00137	-0.00179	-0.00495
Stay-at-Home Order in Effect	3.566	5.189	5.723*
Δ Daily Cases/100,000 7d avg.	0.204	0.155	0.164
Positivity Rate (Adj. Smooth)	0.702***	0.630***	0.514***
New Deaths/100,000 7d avg.	-17.38***	-16.72***	-17.45***
Constant	20.61***	17.05***	18.82***
Observations	5,308	5,308	5,308
R-squared	0.846	0.875	0.889
State FE	Yes	Yes	Yes

*** $p<0.01$; ** $p<0.05$; * $p<0.1$

Table 10: Results for the regression specified in equation (1), estimated using the tax-adjusted 2-, 3-, and 4-year muni-Treasury spreads as dependent variable over the baseline sample period, and replacing the numerical credit ratings with the lagged CDS spread.

Tax-Adjusted MT Spread	5Y	10Y	30Y
Lag CDS Spread	1.299***	0.887***	0.0136***
Interp. Workplace Mob.	-3.463***	-3.715***	-3.754***
OpenTable Diners	-0.104**	0.135***	0.0538
CARES Aid × Signed into Law	-15.56***	-12.96***	-8.480***
ARP Aid × Signed into Law	0.233	-2.297***	-4.007***
Init. Claims Rate PUA	-6.078***	-6.418***	-7.564***
Cont. Claims Rate PEUC	-1.310***	-4.552***	-8.250***
FED Ann. 3-23-20 Post Ind.	8.034	1.780	7.539
MLF Ann. 4-9-20 Post Ind.	-50.46***	-55.71***	-10.84**
MLF Ann. 4-27-20 Post Ind.	-9.090**	22.00***	39.38***
MLF Ann. 5-11-20 Post Ind.	-54.29***	-52.63***	-64.25***
MLF Ann. 6-3-20 Post Ind.	0.222	-19.06***	-43.95***
MLF Ann. 8-11-20 Post Ind.	22.20***	23.37***	-9.383***
MLF Issuance Enter Value	-0.00765	-9.94e-06	0.00908
Stay-at-Home Order in Effect	5.474*	5.619*	0.383
Δ Daily Cases/100,000 7d avg.	0.231	0.710***	1.296***
Positivity Rate (Adj. Smooth)	0.422***	0.313***	-0.410***
New Deaths/100,000 7d avg.	-19.57***	-27.66***	-23.68***
Constant	23.69***	74.31***	170.2***
Observations	5,308	5,308	5,308
R-squared	0.899	0.887	0.841
State FE	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 11: Results for the regression specified in equation (1), estimated using the tax-adjusted 5-, 10-, and 30-year muni-Treasury spreads as dependent variable over the baseline sample period, and replacing the numerical credit ratings with the lagged CDS spread.

Initial Credit Rating	Low	High	Low	High
Tax-Adjusted MT Spread	3Y	3Y	10Y	10Y
Numerical Credit Rating (S&P)	42.95***	10.63	11.72**	41.82***
Interp. Workplace Mob.	-3.506***	-3.068***	-3.656***	-3.154***
OpenTable Diners	-0.586***	-0.552***	-0.136**	-0.0903**
CARES Aid × Signed into Law	-18.46***	-12.86***	-15.29***	-10.77***
ARP Aid × Signed into Law	-0.0236	0.443***	-2.940***	-2.849***
Init. Claims Rate PUA	-9.546***	1.591	-6.997***	1.220
Cont. Claims Rate PEUC	-3.544***	-0.706	-8.630***	-5.041***
FED Ann. 3-23-20 Post Ind.	18.43*	-5.718	21.93**	2.288
MLF Ann. 4-9-20 Post Ind.	-22.06***	-39.84***	-27.50***	-48.24***
MLF Ann. 4-27-20 Post Ind.	32.35***	12.91***	62.67***	38.19***
MLF Ann. 5-11-20 Post Ind.	-73.54***	-64.64***	-61.62***	-50.15***
MLF Ann. 6-3-20 Post Ind.	-13.16***	-0.996	-42.81***	-12.83***
MLF Ann. 8-11-20 Post Ind.	15.30***	19.04***	2.008	7.090***
Stay-at-Home Order in Effect	-9.649**	-3.326	-22.35***	5.037
Δ Daily Cases/100,000 7d avg.	0.446*	0.651***	0.835***	1.066***
Positivity Rate (Adj. Smooth)	-0.415***	-0.145**	0.00120	-0.908***
New Deaths/100,000 7d avg.	-9.551***	-8.149***	-24.76***	-22.69***
MLF Issuance Enter Value		-0.00341		-0.0116
Constant	-255.7***	-8.280	46.19	-293.4***
Observations	2,070	3,534	2,070	3,534
R-squared	0.832	0.839	0.823	0.793
StateFE	Yes	Yes	Yes	Yes

*** p<0.01 ; ** p<0.05 ; * p<0.1

Table 12: Results for the regression specified in equation (1) and estimated using the tax-adjusted 3- and 10-year muni-Treasury spreads as dependent variable within the low- and high-rated states; but, the low-rated group does not include the state of Illinois, which is an outlier.