

Municipal bond sectoral risk and information intermediation in uncertain times: Evidence from the Covid-19 pandemic

Lang (Kate) Yang¹  | Ruth Winecoff²

¹Trachtenberg School of Public Policy and Public Administration, George Washington University, Washington, District of Columbia, USA

²Bloustein School of Planning and Public Policy, Rutgers University-New Brunswick, New Brunswick, New Jersey, USA

Correspondence

Lang (Kate) Yang, Trachtenberg School of Public Policy and Public Administration, George Washington University, Washington, DC, USA.
Email: langyang@gwu.edu

Abstract

The municipal bond market is not homogeneous but consists of varying credits supporting different governmental activities. In this paper we discuss how sectors form and how they are differentially subject to market risks, using the Covid-19 pandemic as a case study. The pandemic has disrupted all financial markets, particularly some municipal bond sectors supported by nongeneral obligation credits, such as health care, arts, and transportation. By comparing the sectors that face a greater increase in risk with others, we empirically examine the market uncertainty hypothesis that intermediation provides stronger certification value when sectoral risk increases. We find an increased use of insurance among high-risk-elevation bonds. Bond insurance, nevertheless, is not associated with larger reductions in offering yields in the high-risk-elevation sectors on average, but only for issuers consistently insuring all issuances. The yield difference between unrated and rated bonds expands more in the high-risk-elevation sectors; for an average unrated bond in such sectors, receiving any investment-grade rating is associated with yield reductions.

INTRODUCTION

The novel coronavirus pandemic has brought unprecedented challenges to the economy and public health in early 2020. State and local governments have not been spared from its negative impacts. Even having since rebounded, state tax collections declined by 5.5% in FY 2020 with record-high unemployment and stay-at-home orders reducing income and sales tax collections (Walczak, 2020). The municipal bond market, like many other financial markets, experienced a level of volatility unseen in recent years. In March 2020, trading volume more than doubled from the average level, and the liquidity crunch led to a drop in bond prices and a spike in transaction costs on the secondary market (Wu & Ostroy, 2020). Faced with market volatility, many governments may have to reassess their plans to access the market to fund capital projects, while others turn to the market to remedy cash flow problems. The unique public health threat

underpinning the recession has increased the uncertainty around some credits within the market that traditionally had low default probabilities, such as toll facilities, hotels, and higher education.

Given the uneven risk elevation in different sectors of the market, this paper examines the market uncertainty hypothesis of intermediation, which postulates that the certification value of information intermediaries is stronger where market uncertainty is higher. Theories of information asymmetry (Campbell & Kracaw, 1980; Millon & Thakor, 1985; Thakor, 1982) suggest that intermediation including bond insurance, negotiated underwriting, and credit ratings send additional signals regarding the creditworthiness of issuers and bonds to investors. The signaling effect may be more pronounced when sectoral risk is increasing: intermediaries convey information that helps investors distinguish among bonds affected by the same risk factor. We first test if issuers hold such a perception, that is, whether the use of intermediaries has increased more among bonds experiencing higher risk elevation. Following a difference-in-differences empirical approach using nationwide primary market data, we observe an increased pursuit of bond insurance in high-risk-elevation sectors.

Government borrowers are interested in whether intermediation leads to investors demanding lower yields. We find that bonds in sectors facing elevated risk after the pandemic indeed see a relative increase in yields. Through triple-difference regressions, we examine whether intermediaries are associated with larger reductions in yields in the high risk-elevation sectors than in other sectors, while controlling for market-wide and sector-wide changes in yields. The spread between unrated and rated bonds increases more in sectors facing larger increases in risk, suggesting greater certification value of ratings. On average, insurance does not carry a greater certification value in the high risk-elevation sectors. However, after adjusting for the selection into insurance by focusing on issuers who consistently do or do not insure their bonds, insurance is associated with a larger yield reduction in the high risk-elevation sectors.

This paper makes three contributions to the literature. First, we offer an approach to conceptualize the categorization of bond sectors. Sectors form as the creditworthiness of bonds within is affected by common factors. In the pandemic, changing economic behaviors due to lockdown measures and health concerns negatively affect the revenue generation of some projects such as recreation and transportation. Without perfect information about each bond, investors may perceive all bonds for such purposes to be riskier. Meanwhile, a general obligation (GO) pledge may mitigate the risk perception associated with the purpose of issue, due to the decoupling between the use of proceeds and the revenue pledge, as well as the relative stability of property taxes. We propose a framework in which sectors form based on both the use of proceeds and the revenue pledge. Second, there is a rich literature on the certification value of information intermediaries but limited attention to how the effects differ in a high-uncertainty environment. This paper tests the market uncertainty hypothesis by comparing sectors facing a larger increase in uncertainty to others and extends the hypothesis beyond the method of sale decision to other forms of intermediation. Lastly, primary market data suggest that issuers may perceive the market uncertainty hypothesis to be true: they are more likely to pursue insurance for bonds in the high risk-elevation sectors. However, on average, insurance is not associated with more yield reductions in these sectors. While having a credit rating is associated with yield reductions, only investment-grade ratings can meaningfully bring down yields in the high risk-elevation sectors. The findings provide policy-relevant and timely evidence that information intermediaries do not guarantee borrowing cost savings in uncertain times.

MUNICIPAL BOND SECTOR

The municipal market consists of heterogeneous and diverse issues. Sectors form when the creditworthiness of bonds within is affected by common factors. The conventional factor used to categorize sectors is the purpose of issue or use of proceeds, such as education, housing, and

health care (Cestau et al., 2019; Li et al., 2021). This categorization makes sense as the different types of activities financed through a bond have different prospects of generating revenue to repay the debt.¹ Sector-wide shifts, such as changing education or health care consumption patterns, affect the creditworthiness of all bonds within the sector. Economy-wide recessions also present a source of sectoral risk. On the one hand, some credits may be more resilient than others in a recession that affects all sectors of the economy. Guzman and Moldogaziev (2012) postulate that bonds issued for purposes with relatively inelastic demand may be less risky because activities financed by these bonds are more likely to endure during a recession. For example, in an economic downturn, people are more likely to cut back on recreational consumption but not on utilities. As a result, the recession may exacerbate existing risk differentials across sectors. On the other hand, not all recessions are created equal. A recession caused by a housing market crash may negatively affect the housing bond sector while a recession caused by a pandemic may do just the opposite. This paper examines the uneven changes in risk across sectors due to the Covid-19 pandemic.

The pledge of general revenue instead of project revenue may weaken the link between changes in bond-financed activities and bond creditworthiness, and as a result, mitigate the sectoral risk an issue is subject to. In the absence of a legal prohibition, state and local governments may pledge full faith and credit to finance any type of project. When a GO bond is issued to finance a parking facility, for instance, reduced traveling and commuting due to public health concerns do not threaten the repayment prospect of the bond as much as it does to similar bonds backed by parking fees. This observation is not a new one: industry participants often consider GO bonds as their own sector regardless of the use of proceeds (Morningstar, 2007). Both issue purpose and revenue pledge are relevant in assessing sectoral risk.

With this understanding of bond sectors in mind, we categorize sectors into one group facing a higher increase in risk due to the Covid-19 pandemic and one with lower risk elevation, as shown in Table 1. This categorization focuses not on the fundamental risk of each sector, but on how the unexpected pandemic exogenously elevates the riskiness of some sectors more than the rest. For example, the pandemic has brought more uncertainty to the higher education sector than the housing sector, but we do not argue that higher education bonds on average are riskier than housing bonds. This also implies that changes to sectoral risk are context-specific and dependent on the nature of a particular shock. In the first dimension of the table, based on the purpose of issue, we identify projects subject to high-risk elevation, including transportation, recreation, health care, economic development, higher education, and arts and museums. The Bureau of Economic Analysis' industry gross output data show that transportation, education, health care, arts, and recreation are among the most affected private industries, reflecting the change in consumer behavior during the pandemic.²

While detailed data on public sector output and public service consumption are not available, industry analysis and news reports shed light on which activities are most affected.³ For example, the health care sector has seen reduced demand for elective procedures and long-term care facilities, leading to a dramatic decline in the revenue stream of some projects (Shields & Slavin, 2020). With states imposing shelter-in-place orders and residents unwilling to travel,

¹ Statistics from the past five decades show that the health care and housing sectors experienced the highest frequencies of defaults (Moody's, 2017). Yusuf and Liu (2008) report education, transportation, utility, and general purpose bonds to have lower true interest cost (TIC) than others. Guzman and Moldogaziev (2012) find housing and development bonds to have higher and utility and environmental facility bonds to have lower TIC. Overall, defaults in the municipal market remain rare (Yang & Abbas, 2020).

² Specifically, we calculate the percent change in the industry gross output in the second quarter of 2020 as compared to the second quarter of 2019.

³ Purposes of issue included in the low risk-elevation sectors may also see increased risk in the pandemic, although we expect the increase to be not as strong as that for the high risk-elevation sectors. For example, the moratorium placed on utility charges may threaten utilities' cash flow, but the Bureau of Economic Analysis' data show the decrease in the utility sector's output to be small. Empirically, categorizing these purposes of issue into the low-risk-elevation sectors may bias our estimates toward zero; that is, the estimates reported in the study are conservative.

TABLE 1 Categorization of sectoral risk elevation during the Covid-19 pandemic

Use of proceeds	Type of revenue pledge	
	General-purpose GO	Other
Higher increase in risk:		
Higher education, library and museum, health care, recreation, transportation, economic development	Low risk-elevation sectors	High-risk-elevation sectors
Lower increase in risk:		
agriculture, K-12 education, public facilities, housing, pollution, sanitation, public safety, utilities, veterans, water and sewer	Low risk-elevation sectors	Low risk-elevation sectors

Note: GO stands for general obligation. The riskiness in the use of proceeds is relative to each other and specific to the changes in risk caused by the Covid-19 pandemic.

Abbreviation: GO, general obligation.

transportation and recreational credits are particularly affected (Williamson, 2020). Economic development-related capital projects are put to a halt with the priority set for operating needs and business retention (Girardi, 2021). Higher education institutions, especially community colleges, see a sharp reduction in enrollment, which affects their overall revenue (Zerbino, 2021).

The second dimension of the table reflects the revenue pledge to repay the bond. Ideally, one would examine the specific revenue pledged to determine the impact of the pandemic. However, such granular data are only available from individual official statements. Municipal bond databases, including the one used in this paper, rarely report more than the simple dichotomy of GO versus non-GO bonds. Given that general-purpose governments have a more diverse portfolio of and higher discretion over general revenue, and that property taxes are relatively stable following the pandemic, we consider a general-purpose GO pledge to mitigate the risk elevation associated with the purpose of issue.⁴ In sum, we categorize bonds issued after March 2020 into two groups: those used to finance “at-risk” purposes and not backed by general-purpose GO face a larger increase in risk, while other purposes of issue and general-purpose GO bonds face a lower increase in risk. The latter group, combined with bonds issued before March 2020, constitute the comparison group for our later regression analysis.

INFORMATION INTERMEDIARIES

The municipal securities market suffers from information asymmetry (Diamond, 1984; Millon & Thakor, 1985). Information intermediaries address this asymmetry by providing third-party certification. Credit rating agencies evaluate the issuer's fiscal position and ability to service the debt, providing their initial and ongoing judgment and increasing investor confidence (Ely et al., 2013; Millon & Thakor, 1985). By demonstrating the willingness to underwrite and through information collected in the underwriting process, underwriters provide a signal of the creditworthiness of the bond to investors (Booth & Smith, 1986; Campbell & Kracaw, 1980; Klein & Leffler, 1981). In the case of bond insurance, not only does the insurer replace the issuer's credit with the firm's credit through a guarantee that the firm will pay debt service costs should

⁴ Although the dichotomy between general purpose GO and others enables us to set up an empirical comparison between high and low risk-elevation sectors, we must acknowledge that GO pledges are not uniform. While the most nonrestrictive type of full faith and credit means that investors may compel the issuer to raise taxes and fees through a writ of mandamus, many GO bonds restrict the recourse to only the general fund or only property taxes. Developments in the bankruptcy courts have been constantly reshaping the definition of GO (Cestau et al., 2019; Yang, 2019). Lastly, our analysis treats double-barreled bonds as GO bonds.

the issuer fail to do so, but insurance also conveys information about the insurability and thus the creditworthiness of the security (Thakor, 1982).

A long line of empirical research examines when information intermediaries are used and the borrowing cost implications of information signals provided by the intermediaries. The certification hypothesis is most developed and applied in the domain of underwriting. In a negotiated sale, there is a greater opportunity for information discovery by the underwriter, because the negotiation takes time and the underwriter is given significant access to the documentation of the issuer's fiscal position. Several authors have found empirical support for the hypothesis that the decision to issue through a negotiated underwriting is associated with higher magnitudes of asymmetric information (Booth & Smith, 1986; Peng & Brucato, 2004; Smith, 1987; Sorenson, 1979).⁵ As a result, for bonds where certification value is higher as indicated by low credit ratings or lack of issuer experience, negotiated sales may lower borrowing costs or perform no worse than competitive sales (Bland, 1985; Liu, 2018; Smith, 1987). Similar findings are reported regarding the certification value of bond insurance. For instance, Kidwell et al. (1987) show that the magnitude of interest cost savings associated with insurance inversely relates to credit rating. Lastly, the finding that a second or third credit rating reduces borrowing costs (Hsueh & Kidwell, 1988; Johnson & Kriz, 2002) attests to the certification value of ratings.

The focus of this paper is to test the market uncertainty hypothesis, which extends the certification hypothesis and postulates that the certification value provided by intermediation is stronger when the market, or the market sector, faces higher uncertainty. In the case of underwriting, when demand uncertainty increases with unsettled markets, negotiated underwriters may be able to use their superior information flow to reduce underwriter risk, and consequently reduce borrowing costs. Several studies have considered how the method of sale interacts with market conditions and offered mixed findings. Tallman et al. (1974) find that issuers using the competitive method during a period of unstable market conditions could have saved money had they used the negotiated method. Joehnk and Kidwell (1984), on the other hand, find that an increase in market volatility is associated with a larger increase in underwriter spread for negotiated issues, possibly due to underwriters charging more for the intensified search cost. We could not identify any empirical studies that examine how the certification values of insurance and credit rating change with regard to the market condition. Thus, we extend the market uncertainty hypothesis to these types of intermediation in addition to the method of underwriting.

Unlike earlier papers that focus on the overall market uncertainty, we take advantage of the sectoral differences in risk increase to examine if sectors facing a higher elevation in risk due to the pandemic respond differently from other sectors. The main advantage of this approach is that we can control for factors common to all sectors. Specifically, we examine two empirical questions. First, the amount of intermediation purchased by an issuer should be at least partially based on the degree of uncertainty regarding their issues. The need for intermediation may be greater for all issuers in times of market volatility, with those in sectors most severely affected by the pandemic likely having the greatest need. Hence, during the pandemic, are bonds in the high risk-elevation sectors more likely to rely on intermediation, including negotiated sales, bond insurance, and credit ratings? Second, even if issuers perceive intermediation to be more valuable with increased sectoral risk, investors may not. Is intermediation associated with additional yield reductions for bonds in the high risk-elevation sectors?

⁵This also extends to private placement sales, as Moldogaziev et al. (2019) show that smaller issues and those with lower credit quality are more likely to be privately placed. They also find that, conditional on the selectivity in the method of sale, private placements are associated with borrowing cost savings, especially following the Great Recession. We do not include private placement in this study, because our data source does not sufficiently capture them.

DATA AND METHODOLOGY

Data

Municipal bond primary market data are from the Ipreo Muni Analytics, covering all bonds issued from January 2016 through June 2020. Each issuance may consist of multiple series and each series consist of multiple bonds with unique Committee on Uniform Securities Identification Procedures (CUSIP) numbers. As a result, we use two formats of the same data focusing on different levels of observation. First, the unit of observation is bond series as choices of information intermediaries usually take place on the series level. The unit of observation in the second dataset is individual bond/CUSIP. Offering yield, the interest rate at which a bond is offered to investors on the primary market, is reported for each bond.

We identify bonds issued in the high risk-elevation sectors during the pandemic, that is, bonds issued to finance “at-risk” activities not supported by general-purpose government GO. Because information on the spread of Covid-19 in the United States became known to the market after the start of March 2020, the “treated” group of bonds face elevated risk if the sale date is after March 1, 2020 (the posttreatment period). The low risk-elevation sectors constitute the comparison group. The data also contain information on bond characteristics, such as par value, maturity, tax status, refunding status, and callability. Data on the use of information intermediaries include whether a bond is insured or placed through negotiated sales, as well as the underlying and enhanced ratings.⁶

Table 2 presents the summary statistics of bond series. The high-risk-elevation sectors constitute less than 15% of the market. Again, we do not claim that other sectors are unaffected by the pandemic. They very much are, given the overall economic recession. Rather, our identification strategy focuses on the difference between the two types of sectors due to the different degrees of risk increases. Negotiated offering is still the predominant method of sale. The sample period is after the Great Recession and the demise of the monoline insurance industry; only about 20% of the series are insured. About 83% are rated, including those with only enhanced rating (4%), only underlying rating (54%), and both enhanced and underlying ratings (25%).

Empirical setup

The first part of the empirical analysis examines whether the pandemic increases the use of information intermediaries among the high risk-elevation sectors relative to other sectors. Because these decisions are made on the bond series level, the unit of analysis is bond series. The fundamental risk factors and tendency to use information intermediaries likely differ across sectors and issuers. As a result, we adopt a difference-in-differences (DID) approach, which controls for these time-invariant factors and focuses specifically on how intermediation decisions change before and after the pandemic for the types of bonds that face higher risk elevation, relative to other bonds. For bond series i issued by issuer c in month t , we estimate the following:

$$I_{it} = \alpha_0 + \alpha_1 \text{Risk}_i + \alpha_2 \text{Risk}_i * \text{Post}_t + \gamma X_{it} + \mu_c + \tau_t + \epsilon_{it}, \quad (1)$$

⁶For all rating variables, we identify the highest rating from Moody's, Standard and Poor's (S&P's), and Fitch and create rating variables based on the highest rating. Besides the binary variable of whether rated, we also create a series of binary variables that represent prime (triple-A) rating, high rating (above A1 for Moody's, A+ for S&P's and Fitch), medium rating (above A3 for Moody's, A- for S&P's and Fitch), low rating (above Ba1 for Moody's, BB+ for S&P's and Fitch), and speculative rating.

TABLE 2 Summary statistics of bond series

	Mean	Standard deviation	Minimum	Maximum
High-risk-elevation sector	0.143	0.350	0	1
Negotiated	0.613	0.487	0	1
Insured	0.195	0.396	0	1
Rated	0.829	0.376	0	1
Rated prime	0.126	0.331	0	1
Rated high	0.583	0.493	0	1
Rated medium	0.093	0.290	0	1
Rated low	0.021	0.145	0	1
Rated speculative	0.007	0.082	0	1
Par logged	16.04	1.628	4.317	23.84
Maturity in year	9.763	5.598	0.795	100.2
General obligation	0.642	0.479	0	1
Financial advisor	0.738	0.439	0	1
Federally taxable	0.106	0.308	0	1
Subject to AMT	0.012	0.107	0	1
Callable	0.795	0.404	0	1
Refunding	0.435	0.496	0	1

Note: Bond series issued on the primary market between January 1, 2016 and June 30, 2020, obtained from Ipreo Muni Analytics. AMT is federal alternative minimum tax. Indicator variables for each purpose of issue are also controlled for in later regressions but not reported here due to space constraints.

where I_{it} is an indicator variable representing the use of one of the following information intermediaries: negotiated sale, insurance, and underlying credit rating.⁷ In this classic DID setup, the variable $Risk_i$ represents the high risk-elevation sectors as defined in Table 1, and controls for the probability of intermediation averaged across these sectors during the whole sample period, relative to that of the low risk-elevation sectors. The month fixed effects τ_t represent the second dimension of differences that the market-wide probability of intermediation changes over time, including after the onset of the pandemic. Lastly, the difference between these two differences is captured by the interaction term $Risk_i * Post_t$ where the indicator variable $Post_t$ equals one if the bond sale date is after March 2020. The interaction term captures how the probability of intermediation changes before and after the pandemic for the high risk-elevation sectors, relative to the change in the low risk-elevation sectors.

Further, X_{it} controls for the vector of bond characteristics that affect the probability of intermediation. First, the choices of different intermediaries may be intertwined (Kriz, 2000). For example, if a bond is already insured and thus has an enhanced rating, the probability of obtaining an underlying rating may be different from that of an uninsured bond. Therefore, when I_{it} is negotiated sale, we control for both the underlying and the enhanced ratings, as well

⁷ We estimate ordinary least square (OLS) regressions. Even though the dependent variables are binary, OLS regressions will generate consistent estimates and statistical inference will be valid as long as robust standard errors are applied (Wooldridge, 2010). Estimating OLS regressions also enables us to easily include multiple fixed effects and thus control for many unobserved factors.

as insurance status. When I_{it} is insurance, we control for the method of sale and underlying ratings. When I_{it} is whether to pay for an underlying rating, we control for the method of sale, insurance, and enhanced ratings. In addition, X_{it} includes logged series par value, average maturity in years, purpose of issue indicators, whether using a financial advisor, and whether the bond is taxable, subject to alternative minimum tax, GO, callable, or a refunding bond. Finally, the probability of intermediation may differ across issuers, and thus issuer fixed effects μ_c control for any time-invariant, issuer-specific factors that will affect intermediary choices.⁸ Standard errors are clustered at the issuer level to address heteroscedasticity and autocorrelation.

Ultimately, policymakers are interested in knowing whether intermediation helps government issuers—especially those facing elevated risk—bring down borrowing costs. We explore this question in the second part of the empirical analysis. The best measure of borrowing cost is true interest cost (TIC) because it captures not only the interest rate demanded by investors but also transaction costs during the issuance process. Unfortunately, the Ipreo data does not contain TIC information for all bonds. Therefore, our analysis focuses on the impact of intermediation on the interest rate paid to investors but not on issuance costs.⁹ Because offering yields are measured on the individual bond level, the unit of analysis here is each bond with a unique CUSIP number. For bond j of series i issued by government c in month t , we estimate the following triple-difference regression:

$$\text{Yield}_{jt} = \beta_0 + \beta_1 \text{Risk}_i + \beta_2 \text{Risk}_i * \text{Post}_t + \beta_3 I_{it} * \text{Post}_t + \beta_4 \text{Risk}_i * I_{it} * \text{Post}_t + \lambda X_{jt} + \theta_c + \pi_{it} + e_{it} \quad (2)$$

where the dependent variable Yield_{jt} represents the offering yield measured in percentage points. Similar to Equation (1), $\text{Risk}_i * \text{Post}_t$ represents the DID estimate and captures how the pandemic is associated with differential changes in yields for bonds in the high risk-elevation sectors relative to other sectors. To the extent that the former is more negatively impacted by the pandemic, we expect β_2 to be positive. We also control for the interaction between a given intermediary, say, bond insurance, and the postpandemic indicator ($I_{it} * \text{Post}_t$ with I_{it} representing whether insured) to capture if the yield differential between insured and uninsured bonds changes after the pandemic. The coefficient of the triple interaction term is the coefficient of interest. A negative β_4 would support the market uncertainty hypothesis of intermediation: comparing high-risk-elevation sectors to other sectors, intermediation is associated with more yield reductions as uncertainty rises more in these sectors following the pandemic. That is, the certification value of intermediation is stronger for those facing a greater sectoral risk elevation.

In this yield regression, we control for issuer fixed effects θ_c , as well as month fixed effects and sector-specific month trends π_{it} . The vector of bond characteristics X_{jt} is now specific to the serial bond instead of the whole series.¹⁰ We cluster standard errors on the issuer level.

⁸We rely on the first six digits of a CUSIP to create the issuer identifier. This is technically more stringent than simple issuer fixed effects as the first six digits represent a specific type of credit for a given issuer. For example, Annapolis, Maryland has five different combinations of CUSIP6, respectively for GO, sewer revenue, economic development revenue, other revenue, and tax incremental revenue bonds.

⁹State-specific data sources may contain more complete information on TIC. For instance, the California Debt and Investment Advisory Commission provides primary market data, including TIC, for bonds issued by governments within the state. However, narrowing the sample to one state means a reduction in sample size and statistical power. Because so few high risk-elevation bonds were issued by Californian issuers during the first half of 2020, meaningful statistical analysis is not feasible.

¹⁰Because the pandemic and the use of information intermediaries may affect ratings directly, including ratings could lead to over-control and thus biases. On the other hand, if ratings are omitted but capture creditworthiness information known to issuers and investors but not the authors, not controlling for credit rating may result in omitted variable bias. Although the paper reports results with rating controls, the findings are fully robust to the exclusion of rating controls.

Validity of empirical approach and measures

The validity of the DID estimates rests on the assumption of a “parallel pre-trend.” That is, prior to the treatment (the pandemic in our context), the trends in the outcome variable are similar between the treated and comparison groups (high and low risk-elevation sectors). As a result, one may attribute any difference observed between sectors afterward to the pandemic. We test the parallel pre-trend through event study analyses, by replacing the interaction term in Equation (1) with a series of indicators representing a specific period to the start of the pandemic only for the high-risk-elevation sectors.¹¹ If the coefficient estimates for the treated group-specific indicators representing periods before the pandemic are statistically indistinguishable from zero, we have evidence suggesting parallel pretrends and the validity of the DID research design is supported.

Figure 1 presents results from the event study analysis on the three intermediaries and offering yield. We normalize the estimates to the two months before the start of the pandemic (i.e., January and February 2020). Each dot, therefore, represents the difference between high and low risk-elevation sectors during a given period, relative to the difference in the first two months of 2020. The lines represent the 95% confidence interval. All pre-periods are grouped on a quarterly basis. Almost all pretreatment estimates are statistically indistinguishable from zero, providing support to a parallel pretrend. A caveat, however, is that by zooming in on each period, the number of observations in the high risk-elevation sectors during the period may be small. As a result, the statistical power and precision are reduced. We group the short post-period into two, with the first representing March and April 2020 and the second representing May and June. Again, the small numbers of bond series lead to large confidence intervals and statistically insignificant estimates for the intermediation outcomes. In contrast, the estimates in Figure 1d are more precise, due to the larger number of CUSIP-level observations on yields. The high risk-elevation sectors show a statistically significant increase in yield in May and June 2020.

If the high risk-elevation sectors on average experience a yield increase postpandemic, which purposes of issue among them are particularly affected? Table 3 presents the DID estimates on (1) differential change in yield between GO and non-GO bonds, and (2) yield for each purpose of issue facing high-risk elevation, compared to the low risk-elevation sectors, which includes all GO bonds but also low risk-elevation non-GO sectors. Column 1 shows that non-GO bonds experience 4.5 basis point higher increase in yield than general-purpose GO bonds. However, some non-GO sectors experience more risk elevation than others do. Indeed, when we combine the low risk-elevation non-GO with GO and compare them with each high risk-elevation non-GO sector, the change in yield differential is consistently larger, as shown in columns 2 to 7.¹² The magnitude of the coefficient estimates is the largest for the library and museum sector and the health care sector, indicating yields of such bonds increased by 36 to 40 basis points more than any yield increase experienced by the low-risk elevation sectors. The coefficient estimates are consistently positive for all six purposes of issues, lending support to our categorization of these purposes as the high risk-elevation sectors.¹³

¹¹We also include offering yield as one of the outcome variables here. In conducting the event study analysis on yield, we control for serial bond-level covariates akin to those included in Equation 2.

¹²Therefore, the high risk-elevation group as a whole experienced larger increase in yield than the low risk-elevation group because of the pandemic. Further analysis (not tabulated but available upon request) shows that the difference is even more pronounced among bonds with shorter maturities.

¹³However, we do not think one should identify the high risk-elevation sectors based on the relative increase in yields. Instead, a categorization based on industry observations and informed by a contextual understanding of the market is preferred. An important limitation of the data-driven approach is that small sectors where not many bonds are regularly issued will lack the statistical power to be correctly categorized.

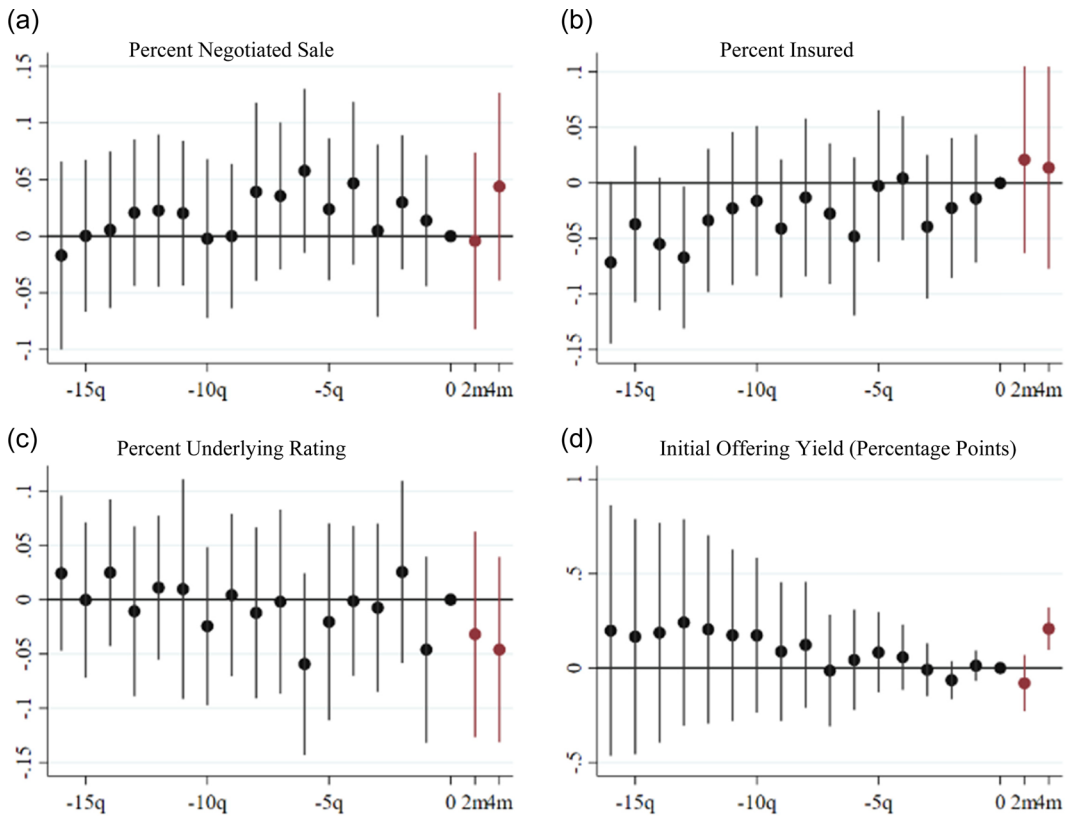


FIGURE 1 Event study analysis results. (a) Percent Negotiated Sale. (b) Percent Insured. (c) Percent underlying rating. (d) Initial Offering Yield (percentage points). *Note:* The x-axis is normalized to the first two months of 2020 (represented by 0 on the axis). Negative numbers on the x-axis represent quarters before the pandemic, and positive numbers represent postpandemic periods. Specifically, "2m" represents the first 2 months of the pandemic (March and April of 2020) and "4m" is May and June of 2020. Dots represent point estimates and lines represent 95% confidence intervals.

RESULTS

Results on Information Intermediary Uses

Table 4 presents results from the DID regressions on whether bond series are issued with intermediation. The interaction terms identify how the use of intermediaries changes before and after the pandemic differentially for the high and low risk-elevation sectors. Column 1 shows that the probability of negotiated offerings increases by 1.1 percentage points more in the high risk-elevation sectors, an estimate that is statistically insignificant and economically small.

Column 2 focuses on whether a bond is insured as the dependent variable. The probability of insurance in the high risk-elevation sectors increases by 4.8 percentage points following the pandemic, relative to the prepost change in the insurance probability among the low risk-elevation sectors. Bond insurance has played a declining role in the municipal market after the failure of monoline insurers in the Great recession. Considering that the average likelihood for a bond to be insured during the sample period is 20%, the increase of 4.8 percentage points translates into a sizeable 24% increase. Finally, column 3 focuses on whether a series carries an underlying rating, and the coefficient estimate of the interaction term is statistically insignificant.

TABLE 3 Regression results on yield by purpose of issue

	(1) Non-GO vs. GO	(2) Economic development	(3) Higher Ed	(4) Library and Museum	(5) Health Care	(6) Recreation	(7) Transportation
Risk X post	0.045** (0.020)	0.139 (0.152)	0.136*** (0.048)	0.398*** (0.051)	0.363*** (0.097)	0.127 (0.096)	0.174** (0.073)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. Obs.	584,393	506,513	535,491	502,752	516,236	506,216	520,325
N. Treated Obs.	-	228	1879	58	483	198	835
N. Treated Series	-	24	178	5	65	24	71

Note: Column 1 compares general purpose GO bonds with non-GO bonds. Each other column reports results from a separate regression that compares a high risk-elevation purpose of issue to the low risk-elevation sectors (which include both general purpose GO and low risk-elevation non-GO). Covariates include logged bond par value, maturity in years, whether using a financial advisor or negotiated placement, indicator variables for each category of the highest credit rating (with unrated as the omitted group), whether the bond is insured, general obligation, taxable, subject to alternative minimum tax, callable, or a refunding bond, and a series of binary variables indicating each purpose of issue. "N. Obs." reports the total number of bond observations in the regression. "N. Treated Obs." represents the number of observations for the high risk-elevation purpose during the postpandemic period, and "N. Treated Series" reports the number of bonds represented by these observations. Standard errors are clustered on the issuer level.

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

That is, bonds in the high risk-elevation sectors are not more likely to pay for an underlying rating (after controlling for the availability of enhanced ratings).

The list of controls regarding series characteristics is included in all regressions but their coefficient estimates are not reported due to space constraints. In line with prior literature, bonds with larger par value, shorter maturity, and non-GO pledge are more likely to be placed through negotiated sales (Peng & Brucato, 2003; Robbins & Simonsen, 2007). Larger issues and those with lower underlying ratings are more likely to obtain insurance (Robbins & Simonsen, 2013). Finally, bonds that are insured and larger in par value are more likely to carry an underlying rating (Greer 2016). In sum, the coefficient estimates for the covariates support the notion that intermediaries are important in mitigating information asymmetry in the municipal market, particularly for issues where the perceived risk and uncertainty are high.

Results on yield

Table 5 presents results from the triple-difference regressions with offering yields as the dependent variable. The double interaction term risk xpost identifies how yields have changed following the pandemic for the high risk-elevation sectors, relative to the changes in the low risk-elevation sectors. Different specifications consistently show a positive and sizeable estimate for this interaction term (statistically significant in columns 4 and 7), suggesting that high risk-elevation sectors experience larger yield increases following the pandemic.

The magnitude of the shock to the high risk-elevation sectors may or may not depend on the severity of Covid-19 in the issuer's geographic region. On the one hand, governments located in areas with a large number of Covid-19 cases and deaths may see a sharper decline in

TABLE 4 Regression results on information intermediary uses

	(1) Negotiated	(2) Insured	(3) Underlying
Risk \times post	0.011 (0.024)	0.048 (0.028)*	-0.037 (0.025)
Covariates	Yes	Yes	Yes
Enhanced rating	Yes	No	Yes
Underlying rating	Yes	Yes	No
Month FE	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes
Observations	47,162	47,162	47,162

Note: Negotiated represents whether the bond series is placed through negotiated sales. The variable underlying represents whether the bond series carries an underlying rating. Covariates include logged series par value, average maturity in years, whether using a financial advisor, whether the bond is general obligation, taxable, subject to alternative minimum tax, callable, or a refunding bond, and a series of binary variables indicating each purpose of issue. When included, enhanced (underlying) rating controls for a set of binary variables indicating five categories of enhanced (underlying) rating with the unrated as the omitted group. Coefficient estimates of covariates are not reported to preserve space. Standard errors are clustered on the issuer level.

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

economic activities, as more stringent lock-down measures need to be adopted and residents are more concerned about leaving their homes. On the other hand, without an effective vaccine or cure, individuals may still be hesitant about engaging in activities that support government projects, such as taking public transit or visiting public recreational facilities, even when the cases and deaths are low. We obtain data on state-level Covid-19 cases and deaths per 1000 people collected by the New York Times from state and local governments and health departments. Given the pattern that fewer cases are confirmed on weekends, we calculate the average number of cases and deaths seven days before the sale date. We then replace the risk \times post term with risk \times case or risk \times death, which compare the yield change for high risk-elevation bonds from states with large numbers of cases/deaths to high risk-elevation bonds from states with low virus spread and low risk-elevation bonds. Again, the coefficient estimates are consistently positive and mostly significant, showing the relative increase in yields in the high risk-elevation sectors intensifies with more widespread infections.

Given the high risk-elevation sectors on average experience relative yield increase postpandemic, the triple interaction term identifies whether intermediation is associated with more yield reductions in the high risk-elevation sectors than other sectors. Columns 1 through 3 focus on negotiated sales as the method of intermediation. The estimates for the triple interaction term are statistically insignificant. Therefore, we find no evidence of more yield reduction associated with negotiated sales for bonds facing greater increases in risk. Columns 4 to 6 examine the implications of bond insurance. The estimates for the triple-interaction term are consistently negative but statistically insignificant. Thus, bond insurance is not statistically significantly associated with differential yield reductions in different sectors postpandemic.

Lastly, columns 7 through 9 present results on the yield implication of having a credit rating, while controlling for the specific rating received. The negative estimates for the triple interaction term indicate that paying for a credit rating is associated with a larger yield reduction for bonds in the high risk-elevation sectors. In other words, the yield spread between unrated and rated bonds expands more during the pandemic for the high risk-elevation sectors. This provides support to the market uncertainty hypothesis with regard to credit ratings: the informational value of this intermediation is stronger in unstable markets. The lack of a rating may send a

TABLE 5 Regression results on yield implication of intermediary uses

	I = negotiated			I = insured			I = Rated		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Risk × post × I	0.076 (0.075)			-0.012 (0.081)			-0.286 (0.199)		
Risk × post	0.106 (0.067)			0.169 (0.040)***			0.435 (0.195)**		
Risk × case × I		0.010 (0.012)			-0.002 (0.013)			-0.145 (0.040)***	
Risk × case		0.021 (0.010)**			0.033 (0.008)***			0.174 (0.039)***	
Risk × death × I			0.047 (0.234)			-0.035 (0.215)			-2.461***
Risk × death			0.328 (0.214)			0.395 (0.120)***			2.804***
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	584,393	584,393	584,393	584,393	584,393	584,393	584,393	584,393	584,393

Note: The variable I stands for information intermediaries. It represents negotiated sales in columns 1 to 3, bond insurance in columns 4 to 6, and credit rating in columns 7 to 9. Interaction term "I × post" is controlled for. Other covariates include logged bond par value, maturity in years, whether using a financial advisor, indicator variables for each category of the highest credit rating (with unrated as the omitted group), whether the bond is general obligation, taxable, subject to alternative minimum tax, callable, or a refunding bond, and a series of binary variables indicating each purpose of issue. The controls also include all three information intermediaries. Coefficient estimates of covariates are not reported to preserve space. Standard errors are clustered on the issuer level.

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

negative signal to investors, especially in sectors where the perceived risk is on the rise and uncertainty is high. This finding is in line with recent market observations regarding investor flight to quality (Funk, 2020).

Does this mean that borrowers, especially those planning to issue in the high risk-elevation sectors, should always pay for a credit rating? To answer this question, we conduct a supplemental analysis by comparing bonds rated at a specific level (prime, high, medium, low, or speculative) to unrated bonds. We estimate the same regression as Equation (2) and report results in Table 6. First, the estimates for I show the pre-pandemic spread between unrated bonds and those rated at a certain level; ratings were consistently associated with lower yields. Second, the estimates for the $I \times \text{post}$ interaction represent the change in the rated-unrated yield spread post-pandemic. Columns 1 and 2 show that the yield spread between unrated bonds and those with prime and high ratings widens after the pandemic, while columns 4 and 5 show the spread to narrow for bonds rated low or speculative. The coefficient estimate of the triple-interaction represents if the change in the yield spread post-pandemic is different for the high risk-elevation sectors as compared to low risk-elevation sectors. Except for speculative ratings, receiving a rating is associated with greater yield reductions in the high risk-elevation sectors, even though the estimate is only statistically significant for the low-rating category. The positive estimate for the speculative rating triple interaction in column 5 should be interpreted with caution because only 18 bond series issued during the pandemic are rated speculative.

When a bond in the high risk-elevation sectors receives a rating, the indicator variable I turns from zero to one. Therefore, we calculate the sum of all terms that contain variable I ($\text{risk} \times \text{post} \times I + I \times \text{post} + I$), which represents the average net effect of obtaining a rating for a high risk-elevation bond following the pandemic. If this net effect is negative and larger than the post-pandemic yield increase represented by $\text{risk} \times \text{post}$, obtaining a rating makes sense if the issuer knows the rating they are likely to receive. Results in Table 6 show that all types of ratings, except speculative rating, are associated with large enough yield reductions to offset the yield increase brought to the high risk-elevation sectors by the pandemic.

Robustness checks

The findings on yield should not be interpreted causally due to the possibility of selection. The triple-difference regressions use the yield spread between low risk-elevation bonds with and without intermediation as the comparison. To the extent that selection into intermediation affects yields and the dynamic is identical between high and low risk-elevation sectors, this comparison eliminates the bias arising from the selection. However, this assumption is strong. The decision to adopt intermediation is related to the changing levels of risks and thus is likely sector-specific. If less creditworthy bonds in the high risk-elevation sectors are more likely to be insured than their counterparts in the low risk-elevation sectors, the differential selection into insurance will cause our estimates to be too conservative. That is, the coefficient estimates of the triple interaction will be closer to zero even if bond insurance, *ceteris paribus*, reduces the yields of high risk-elevation bonds more following the pandemic.

Earlier research addresses the issue of choice into intermediation through two-stage regressions (e.g., Liu, 2018) or propensity score matching algorithms (e.g., Cornaggia et al., 2021). Both approaches attempt to completely model and thus control for the selection. Simultaneously modeling the selection into all three intermediaries is a daunting but worthwhile task we leave to future research; instead, we conduct a simple robustness check by limiting the sample to issuers who consistently pursue a type of intermediation. Table 7 presents results from the same set of regressions as shown in Table 5, but columns 1 to 3 limit the sample to only issuers who have either always or never conducted negotiated sales

TABLE 6 Regression results on yield, spread between rated categories and unrated bonds

	I = Prime rating (1)	I = High rating (2)	I = Medium rating (3)	I = Low rating (4)	I = Speculative rating (5)
Risk × post × I	-0.242 (0.159)	-0.290 (0.181)	-0.223 (0.196)	-0.662 (0.270)**	1.699 (0.329)***
Risk × post	0.300 (0.149)**	0.355 (0.173)*	0.516 (0.166)***	0.342 (0.134)**	0.242 (0.152)
I × post	-0.216 (0.042)***	-0.071 (0.037)*	0.055 (0.069)	0.804 (0.226)***	0.644 (0.253)**
I	-0.941 (0.214)***	-0.508 (0.043)***	-0.836 (0.091)***	-1.079 (0.099)***	-0.786 (0.151)***
Risk × post × I + I × post + I	-1.399 (0.270)***	-0.869 (0.186)***	-1.004 (0.217)***	-0.938 (0.246)***	1.556 (0.272)***
Covariates	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes
Observations	136,967	430,530	102,099	58,774	49,691

Note: The variable I stands for the indicator variable of each category of rating. Unrated bonds constitute the comparison category. Prime rating is triple-A. High rating represents above A1 for Moody's and above A+ for S&P's and Fitch. Medium rating is above A3 for Moody's and above A- for S&P's and Fitch. Low rating is above Ba1 for Moody's and above BB+ for S&P's and Fitch. Coefficient estimates of covariates are not reported to preserve space. Standard errors are clustered on the issuer level.

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

TABLE 7 Regression results on yield, subgroup of consistent intermediary users

	I = Negotiated (1)	(2)	(3)	I = Insured (4)	(5)	(6)	I = Rated (7)	(8)	(9)
Risk × post × I	0.045 (0.070)			-0.195 (0.077)**			-0.111 (0.150)		
Risk × post	0.129 (0.058)**			0.188 (0.040)***			0.255 (0.146)*		
Risk × case × I		0.010 (0.013)			-0.019 (0.014)			-0.092 (0.060)	
Risk × case		0.030 (0.009)***			0.027 (0.008)***			0.118 (0.060)**	
Risk × death × I			-0.001 (0.247)						-5.928**
Risk × death			0.474 (0.205)**						6.241***
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	484,216	484,216	484,216	518,577	518,577	518,577	542,001	542,001	542,001

Note: Results are from the same regressions as those in Table 5 but estimated using the subgroup of issuers who consistently do or do not use an intermediary during the data period (2016–2020). Standard errors are clustered on the issuer level.

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

throughout the data period. Selection may be less of an issue for these consistent users and non-users of intermediation.¹⁴

Table 7 shows largely similar results to Table 5, with one notable difference. Comparing issuers that consistently insure all bonds to those who never purchase insurance, insurance is associated with more yield reductions in the high risk-elevation sectors than other sectors. Column 4 shows that bonds facing larger risk elevation due to the pandemic pay 18.8 basis points more, but the use of bond insurance is associated with a 19.5-basis point yield reduction in these sectors, roughly offsetting the sectoral yield increase. This contrasts with the statistically insignificant triple interaction estimate from Table 5, suggesting that selection into insurance biases the estimate towards zero. After mitigating the selection issue, there is suggestive evidence for the market uncertainty hypothesis that insurance provides additional certification value in uncertain markets.

DISCUSSION AND CONCLUSION

This study provides an empirical test of the market uncertainty hypothesis of information intermediaries, which postulates intermediaries provide certification value in a market with asymmetric information and the certification value is greater when market uncertainty increases. By comparing bond sectors that face high and low elevations in risk following the Covid-19 pandemic, we test the hypothesis while controlling for factors common to the municipal market as a whole. The high risk-elevation sectors exhibit a larger increase in yields during the pandemic compared to other sectors, providing empirical support to the categorization of sectoral risk.

We first examine whether sectors that experience heightened risk due to the pandemic are more likely to rely on intermediation. Results show that, following the pandemic, issuers are more likely to obtain bond insurance for issuances in the high risk-elevation sectors. Thus, issuers likely perceive the market uncertainty hypothesis to be true and use bond insurance to mitigate the elevated risk. It is worth noting that we only observe the intermediation of bonds actually issued. The amount of bond issuance has declined following the pandemic, most notably in March 2020. Some issuers may have originally planned to access the market but choose not to due to concerns over market uncertainty. If this group is even more likely to rely on intermediaries had they decided to issue, our estimate of the probability of intermediation would be a conservative one.

We then directly test the market uncertainty hypothesis of intermediation by examining whether the intermediaries are associated with a larger reduction in yields for high risk-elevation sectors than low risk-elevation sectors. Unlike Tallman et al. (1974), which report negotiated sales to have lower borrowing costs than competitive sales in an unstable market, we do not find the yield spread between negotiated and competitive sales to change statistically differently following the pandemic. Further, our study provides the first empirical test of the market uncertainty hypothesis concerning insurance and credit rating. The yield implications of bond insurance are, on average, not statistically significantly different between sectors during the pandemic. Selection into intermediation may bias the estimate toward zero: the less creditworthy issues may be more likely to purchase insurance and at the same time pay higher yields. By looking at only bonds of issuers who consistently do or do not insure their bonds, we find insurance to be associated with more yield reduction in the high risk-elevation sectors,

¹⁴This approach mitigates but does not eliminate potential selection biases. Selection on the intensive margin may occur even within the group of consistent users of intermediation. Further, frequent borrowers on the market are more likely to be excluded from this analysis due to the increased probability of being observed to change choices regarding intermediation.

providing suggestive evidence for the market uncertainty hypothesis regarding insurance. Further research that better accounts for the selection problem is needed.

In comparison, the empirical evidence supporting the market uncertainty hypothesis regarding credit rating is strong. The spread between the yields of unrated and rated bonds widens more in sectors facing greater risk increases. That is, from the perspective of investors, the certification value of rating strengthens when sectoral uncertainty abounds. Analyses of specific rating categories show that obtaining an investment-grade rating is associated with net yield reductions for bonds in the high risk-elevation sector.

This study is subject to two main limitations. First, a reduction in yield does not necessarily imply borrowing cost savings. If bonds facing greater increases in risks also need to pay a higher transaction cost to receive intermediation, then this additional cost would offset any savings in offering yield. Therefore, our estimate may be an overestimate for the net borrowing cost savings associated with intermediation during market uncertainty. Future work with better access to data on TIC and issuance cost may further shed light on the issue. Second, neither the choice to issue bonds or paying for intermediation is exogenous. Our estimates are based on governments that have repeatedly issued bonds, including after the onset of the pandemic. The triple-difference framework enables us to use the low risk-elevation sectors as a counterfactual; however, omitted variable bias could still be present if there are sector-specific, unobserved factors affecting both intermediation decisions and yield. In pursuit of a causal estimate, future work may focus on a truly exogenous shock, such as a change in state requirements on the method of sale, to examine the yield implication of intermediaries, especially in times of market uncertainty.

Despite these limitations, this study provides timely and policy-relevant observations about the municipal market. As many state and local governments reassess their choices to access the market following the pandemic, continuous monitoring of the yields of other bonds in the same risk sector is warranted. While issuers have the option of making a GO pledge for at-risk activities financed by the debt, the option is problematic and may lead to a disconnect between the benefits and costs of these projects. Instead, as many have already done, issuers may explore the use of intermediaries. The information signal carried by credit ratings is particularly strong in an uncertain market and investment-grade ratings are associated with yield reductions for bonds in the high risk-elevation sectors. Issuers should recognize the additional certification value of investment-grade ratings in an uncertain market. Obtaining an enhanced rating that is higher than one's underlying rating through purchasing insurance is a viable path, but the savings potential rests on the cost of insurance. After accounting for the effect of the enhanced rating, we find bond insurance is not associated with more yield reductions in the high risk-elevation sectors on average but only for issuers consistently insuring their bonds. Therefore, insurability may carry more valuable signals to investors in uncertain markets than in relatively stable markets, but this does not automatically imply yield reductions due to the fundamental risk that induces the selection into insurance.

ORCID

Lang (Kate) Yang  <http://orcid.org/0000-0003-2780-6242>

REFERENCES

- Bland, Robert L. 1985. "The Interest Cost Savings from Experience in the Municipal Bond Market." *Public Administration Review* 45: 233–37.
- Booth, James R., and Richard L. Smith, II. 1986. "Capital Raising, Underwriting and the Certification Hypothesis." *Journal of Financial Economics* 15(no. 1–2): 261–81.
- Campbell, Tim S., and William A. Kracaw. 1980. "Information Production, Market Signalling, and the Theory of Financial Intermediation." *The Journal of Finance* 35(no. 4): 863–82.
- Cestau, Dario, Burton Hollifield, Dan Li, and Norman Schürhoff. 2019. "Municipal Bond Markets." *Annual Review of Financial Economics* 11: 65–84.

- Cornaggia, Kimberly, John Hund, and Giang Nguyen. 2021. "The Price of Safety: The Evolution of Municipal Bond Insurance Value."
- Diamond, Douglas W. 1984. "Financial Intermediation and Delegated Monitoring." *The Review of Economic Studies* 51 (no. 3): 393–414.
- Ely, Todd L., Christine R. Martell, and Sharon N. Kioko. 2013. "Determinants of the Credit Rating Fee in the Municipal Bond Market." *Public Budgeting & Finance* 33(no. 1): 25–48.
- Funk, L. 2020. "Municipal Bond Yields Fall Again on Fed Hopes, Potential Coronavirus Plateau." *The Bond Buyer*, April 6.
- Girardi, T. 2021. "Business as Unusual: The Impact of Covid-19 on Economic Development." *Global Trade*, May 6.
- Greer, Robert A. 2016. "Local Government Risk Assessment: The Effect of Government Type on Credit Rating Decisions in Texas." *Public Budgeting & Finance* 36(no. 2): 70–90.
- Guzman, Tatyana, and Temirlan Moldogaziev. 2012. "Which Bonds Are More Expensive? The Cost Differentials by Debt Issue Purpose and the Method of Sale: An Empirical Analysis." *Public Budgeting & Finance* 32(no. 3): 79–101.
- Hsueh, L. Paul, and David S. Kidwell. 1988. "Bond Ratings: Are Two Better Than One?" *Financial Management* 17(no. 1): 46–53.
- Joehnk, Michael D., and David S. Kidwell. 1984. "The Impact of Market Uncertainty on Municipal Bond Underwriter Spread." *Financial Management* 13: 37–44.
- Johnson, Craig L., and Kenneth A. Kriz. 2002. "Impact of Three Credit Ratings on Interest Cost of State GO Bonds." *Municipal Finance Journal* 23(no. 1): 1–16.
- Kidwell, David S., Eric H. Sorensen, and John M. Wachowicz. 1987. "Estimating the Signaling Benefits of Debt Insurance: The Case of Municipal Bonds." *Journal of Financial and Quantitative Analysis* 22(no. 3): 299–313.
- Klein, Benjamin, and Keith B. Leffler. 1981. "The Role of Market Forces in Assuring Contractual Performance." *Journal of Political Economy* 89(no. 4): 615–41.
- Kriz, Kenneth. 2000. "Do Municipal Bond Underwriting Choices Have Implications for Other Financial Certification Decisions." *Municipal Finance Journal* 21(no. 3): 1–23.
- Li, Yi, Maureen O'Hara, and Xing Alex Zhou. 2021. "Mutual Fund Fragility, Dealer Liquidity Provisions, and the Pricing of Municipal Bonds." *Dealer Liquidity Provisions, and the Pricing of Municipal Bonds* (September 2021).
- Liu, Gao. 2018. "The Effect of Sale Methods on The Interest Rate of Municipal Bonds: A Heterogeneous Endogenous Treatment Estimation." *Public Budgeting & Finance* 38(no. 2): 81–110.
- Millon, Marcia H., and Anjan V. Thakor. 1985. "Moral Hazard and Information Sharing: A Model of Financial Information Gathering Agencies." *The Journal of Finance* 40(no. 5): 1403–22.
- Moldogaziev, Tima T., Robert A. Greer, and Jekyung Lee. 2019. "Private Placements and the Cost of Borrowing in the Municipal Debt Market." *Public Budgeting & Finance* 39(no. 3): 44–74.
- Moody's Investor Services. 2017. "US Municipal Bond Defaults and Recoveries, 1970–2016."
- Morningstar. 2007. "Municipal Bond Sectors." http://morningstardirect.morningstar.com/clientcomm/municipal_bond_sectors.pdf
- Peng, Jun, and Peter F. Brucato. 2004. "An Empirical Analysis of Market and Institutional Mechanisms For Alleviating Information Asymmetry in the Municipal Bond Market." *Journal of Economics and Finance* 28(no. 2): 226–38.
- Peng, Jun, and Peter F. Brucato, Jr. 2003. "Another Look at the Effect of Method of Sale on the Interest Cost in the Municipal Bond Market—A Certification Model." *Public Budgeting & Finance* 23(no. 1): 73–95.
- Robbins, Mark D., and Bill Simonsen. 2007. "Competition and Selection in Municipal Bond Sales: Evidence From Missouri." *Public Budgeting & Finance* 27(no. 2): 88–103.
- Robbins, Mark D., and Bill Simonsen. 2013. "Municipal Bond New Issue Transaction Costs." *Public Budgeting & Finance* 33(no. 1): 1–24.
- Shields, Y., and R. Slavin. 2020. "Fiscal Fallout from Covid-19 Looms for Healthcare Sector." *The Bond Buyer*, March 20.
- Smith, Richard L. 1987. "The Choice of Issuance Procedure and the Cost of Competitive and Negotiated Underwriting: An Examination of the Impact of Rule 50." *The Journal of Finance* 42(no. 3): 703–20.
- Sorenson, Eric H. 1979. "Negotiated Municipal Bond Underwritings: Implications for Efficiency: Note." *Journal of Money, Credit, and Banking* 11(no. 3): 366–70.
- Tallman, Gary D., David F. Rush, and Ronald W. Melicher. 1974. "Competitive Versus Negotiated Underwriting Costs for Regulated Industries." *Financial Management* 3: 49–55.
- Thakor, Anjan V. 1982. "An Exploration of Competitive Signalling Equilibria With "Third Party" Information Production: The Case of Debt Insurance." *The Journal of Finance* 37(no. 3): 717–39.
- Walczak, J. 2020. "New Census Data Shows States Beat Revenue Expectations in FY 2020." *Tax Foundation*, September.
- Williamson, R. 2020. "Canceled Events and Closed Attractions Will Take a Fiscal Toll." *The Bond Buyer*, March 14.
- Wooldridge, Jeffrey M. 2010. *Econometric Analysis of Cross-Section and Panel Data*. Cambridge, MA: Cambridge, MA: MIT Press.
- Wu, S. Z., and N. J. Ostroy. 2020. "COVID-19 Crisis Drives Spike in Transaction Costs for Municipal Securities." *Municipal Securities Rulemaking Board*, May.
- Yang, Lang. 2019. "Negative Externality of Fiscal Problems: Dissecting the Contagion Effect of Municipal Bankruptcy." *Public Administration Review* 79(no. 2): 156–67.

- Yang, Lang, and Yulianti Abbas. 2020. "General-Purpose Local Government Defaults: Type, Trend, and Impact." *Public Budgeting & Finance* 40(no. 4): 62–85.
- Yusuf, Juita-Elena, and Gao Liu. 2008. "State Infrastructure Banks and Intergovernmental Subsidies for Local Transportation Investment." *Public Budgeting & Finance* 28(no. 4): 71–89.
- Zerbino, Nicolas. 2021. "How the Covid-19 Pandemic has Impacted Higher Education." Brookings Institution, March 1.

How to cite this article: Yang, Lang (Kate), and Ruth Winecoff. 2022. "Municipal Bond Sectoral Risk and Information Intermediation in Uncertain Times: Evidence from the Covid-19 Pandemic." *Public Budgeting & Finance*. 1–20. <https://doi.org/10.1111/pbaf.12333>