Banks' Reaching for Yield and the Safe Asset Class

Ramona Dagostino*

April 2020

ABSTRACT

In this paper I investigate whether banks reach for yield in the municipal bond market. I first show that regulation creates yield-seeking incentives for banks in this asset class. Using the *story bond* segment, I am able to identify banks' holdings of municipal bonds at the granular level. Contrary to popular wisdom, I find that banks' increased demand does not appear consistent with a *within class* reaching-for-yield hypothesis. Relative to other market participants, banks invest predominantly in lower-yield municipal bonds, even conditional on their risk weighting. Using a shock to the supply of municipal bonds, I then show that banks' behavior is consistent with reaching for yield *across asset classes*, as banks substitute away from treasuries into municipal bonds, thereby increasing their exposure to liquidity risk rather than credit risk.

*I would like to thank Francisco Gomes, Anna Pavlova, Christopher Hennessy, Stephen Schaefer, Daniel Bergstresser, Joao Cocco, Peter Feldhutter, Ralph Koijen, Stefan Lewellen, Tarun Ramadorai, Helene Rey, Scott Richardson, Rui Silva, Vania Stavrakeva, Vikrant Vig, and seminar participants at HEC, Georgetwon, WAPFIN@Stern and LBS Alumni Symposium for their comments on the paper. Finally, I thank the AQR Asset Management Institute for generous financial support. All remaining errors are my own.

I. Introduction

Understanding whether intermediaries do reach for yield, particularly during extended periods of loose monetary policy, is of first-order importance in order to maintain and monitor market stability (Stein (2013)). While there is growing evidence that insurance companies and mutual funds engage in yield-seeking behavior (Becker and Ivashina (2015), Choi and Kronlund (2017)), being able to identify this practice in banks has proved more difficult. The availability of credit registries on loan applications outside the U.S. has been helpful in investigating banks' yield-seeking behavior for loan outcomes (Jimenez et al. (2014)). However, there is less compelling evidence on banks' behavior in their securities holdings.

There are many ways in which banks can reach for yield. Given coarse risk weighting schemes and capital regulation, banks can gain exposure to credit risk, by loading up on high-yield investments within the capital buckets. While this might create losses down the road, this behavior is hard to identify ex-ante due to lack of granularity in call report data. Banks can also gain exposure to other risks, such as prepayment risk or interest rate risk. These types of exposures are also particularly hard to monitor since before the implementation of Basel III any fluctuation in interest rates giving rise to unrealized gains or losses would not need to be realized or marked to market. Aggregate evidence on yield-oriented investors is also confounded by concomitant demand and supply channels. A leading example would be households refinancing their mortgages in response to lower interest rates, making it harder to identify the active role of banks in shifting the investment horizon in response to a shock to the prevailing rates (Hanson (2014), Stein and Hanson (2015)). Additionally yield seeking behavior does not necessarily need to carry through across different asset classes that exhibit different risk profiles. Yet, a common concern among policy makers is whether regulating one asset class does shift banks' reach-for-yield practices towards less obvious securities (Stein (2013), Yellen (2011)).

In this paper I attempt to establish a fact: whether banks reach for yield in the municipal bond market. This is a particularly interesting class to investigate for several reasons. First,

municipal bonds would qualify as an asset class that has fallen "under the radar": for the most part regulation treats municipal bonds as a safe asset class in terms of both credit risk weights and liquidity regulation. This regulatory framework has remained unchanged even while municipal bonds exhibited market wide downgrades and a handful of defaults, potentially distorting banks' incentives to hold such securities. Second, banks' aggregate behavior appears consistent with yield-seeking concerns as bank holdings of municipal securities almost tripled during downgrades. Finally, a unique feature of the municipal market allows to back out bank holdings of municipal bonds at a much more granular level than available on call reports.

I start by documenting three major shifts in the structure of the municipal bond primary market. I show that banks' holdings of municipal bonds have more than doubled since 2009, while, at the same time, aggregate holdings by retail investors have steadily declined. Banks' holdings of municipal bonds went from historically below 6% to over 14% of the total par outstanding. Second, I show that, concomitant with banks' increased appetite for municipal securities, the dispersion in offering yields on municipal bond issuance almost doubled. Finally, I document a reversal in offering yields on municipal bonds over Treasuries: municipal spreads over matched Treasuries went from being negative to roughly 50bps for 7 years consecutively post-crisis.

Given this aggregate evidence, I then investigate the composition of banks' investments in municipal market. Specifically, I ask whether, given the monetary policy environment and the regulatory incentives in place, banks exhibit yield-seeking behavior. The combination of accounting rules and capital regulation does in fact create the incentives for banks to reach for yield. Across all bank capital regulations, from Basel I to Basel III, all general obligation municipal bonds carry a 20% risk weight, regardless of whether the particular security is investment or speculative grade, or even unrated and uninsured. Moreover, the extended period of near-zero rates has drastically reduced the disallowance tax that banks face on their municipal bond holdings, thereby increasing banks' effective yield on their municipal bond investments.

I investigate two possibilities: whether banks reach for yield within the municipal asset class, or whether they do so across asset classes. Ideally, one would observe granular holdings

of municipal securities at the bank level. This data is however not readily available. In order to identify banks' yield-seeking behavior, I therefore use a unique institutional feature of the municipal market, the so-called *story bond* segment. Story bonds are unrated and uninsured municipal bond issuances that require investors both to be familiar with the economic and political history of the local issuer and to be able to independently assess the creditworthiness of the borrower. Under existing regulations, broker-dealers are de facto deterred from marketing story bonds for direct retail ownership. Given detailed holding positions of other non-bank institutional investors, and absent direct retail ownership, I am then able to back out banks' holdings of municipal securities at the bond level. Looking at story bonds clearly presents a trade-off: on the one hand story bonds represent only a small segment of the market, yet on the other hand this setting allows to identify bond-level bank holdings of municipal securities in a relevant setting where one would expect to see yield-seeking behavior.[1]

Contrary to popular wisdom, looking at granular bond holdings, I find that banks' increased demand for municipal bonds does not appear consistent with reaching for yield. In fact, while banks' demand for municipal bonds has increased, relative to other participants in the market banks invest predominantly in lower-yield municipal bonds, even conditional on their risk weighting. In other words, *within the municipal bond asset class* banks do not appear to be reaching for yield.

While I do not find evidence of banks increasing their credit risk exposure in the municipal market, I investigate whether banks' appetite for municipal securities is consistent with a different form of yield-seeking behavior, that is *across asset classes*. Specifically, I test whether given both the underlying and regulatory credit risk profile of municipal securities, banks appear to substitute away from treasuries into municipal bonds, thereby increasing their exposure to liquidity risk rather than credit risk.

To answer this question, I exploit a shock to the supply of municipal bonds that plausibly affected banks heterogeneously, as an instrument for banks' cross-sectional holdings of municipal bonds. I show that banks increase their municipal bond holdings at the expense of treasury

[1]Story bonds are an opaque setting, where banks face no regulatory penalty for holding higher risk.

holdings. Given the highly illiquid secondary market for municipal securities, this behavior is consistent with banks increasing their exposure to liquidity risk.

The findings in this paper contribute to the literature on the investment decisions of institutional investors, particularly their risk-taking behavior, incentives, and determinants (Stein (2013), Hanson and Stein (2015)). Most of this literature has gathered compelling evidence on the risk-taking behavior of insurance companies and mutual funds (Becker and Ivashina (2015), La Spada (2015), Choi and Kronlund (2017)), while emerging evidence on banks has mainly come from the loan side of banks' balance sheets, rather than from their securities holdings (Kandrac and Schlusche (2017), Paligorova and Santos (2014), Dell'Arriccia (2013), Jimenez et al. (2014)).

This paper also connects to the literature on the recent European sovereign debt crisis and in particular to the debate on the determinants of banks' exposure to sovereign debt, or what has otherwise been labeled as the "vicious cycle" (Uhlig (2013), Ongena et al. (2016), Altavilla et al. (2017), Acharya et al. (2015) among others). The biggest challenge in this literature has been to disentangle risk-taking forces from moral suasion incentives. Differently from the European setting, moral suasion forces are likely not as strong in the municipal market, as a single municipality would find it harder to credibly promise a bank bailout, therefore making it a cleaner setting to investigate yield-seeking incentives.

II. Data

This paper relies on multiple sources of data. Municipal bond issuance data comes from Ipreo MuniIC. Holdings data come from Ipreo BDA. Aggregate ownership statistics come from the Federal Reserve Flow of Funds. Secondary market trading statistics come from the MSRB. Finally bank level data comes from Call Reports.

Ipreo is a leading provider of municipal bond data. The MuniIC dataset contains detailed information on U.S. state and local governments' bond issuance. The issuance data used in

this paper covers the years from 2000 to 2014. The BDA platform has data on municipal bond holdings by funds, insurance companies, and pension funds. Ipreo purchases data from Morningstar, Factset, and NAIC, merges the data from those providers to maximize coverage and timeliness, and then supplements them with internal research to pin down the quarter in which the position reported in the filings has been acquired.[2] The holdings data used in this paper covers the years from 2010 to 2014.

III. Institutional Framework

Municipal bonds are the instrument through which state and local governments finance the nation's needs such as infrastructure, education, health care, and public safety. In the years between 2000 and 2014, nearly two million bonds were issued. The municipal market is a $3.7 trillion market, around a third of the size of the U.S. Treasury market.

Over 93% of municipal bonds issued are exempt from federal taxation.[3] The tax-exempt status has historically made the municipal market a refuge asset class for high-wealth individuals.[4] Retail investors hold about 70% of the market, either directly or through funds and pass-through intermediaries. The rest is vastly held by banks and insurance companies.[5] Figure 1 shows total holdings of municipal bonds by investor type.

[2]Specifically, around 95% of insurance firms are general accounts, while the remaining ones are separate accounts. Most general accounts report quarterly, while separate accounts report yearly. There is no such a convention for mutual funds, money market, and pension funds. Ipreo records both the report date and the date the position was first acquired, as obtained by internal research. All holdings are reported at book value. Ipreo has full coverage of the insurance sector and coverage of mutual and money market funds in the upper 90-percentile in terms of total assets under management. Pension funds are covered under the Freedom of Information Act.

[3]While coupon payments are exempt from federal income tax, any profit derived from trading is subject to taxation. When the bond is purchased at discount, the capital gain is subject to either income tax or capital tax. In determining which tax applies, the investor has to calculate whether the discount falls within a *de minimis* exemption: when the discount is low, the capital tax applies; otherwise, the income tax is used. When computing the discount the investor needs to take into account the price of the bond at issuance and the presence of any original issue discount.

[4]In fact, the top 0.5% of the wealthiest U.S. individuals appears to hold over 40% of the municipal bonds outstanding (Bergstresser et al. (2016))

[5]There are other minor holders of municipal obligations: corporations and foreign investors. Corporations hold on average less than 0.6% of the municipal market, since they are subject to the AMT. Foreign investors have historically made less than 1% of total ownership. Foreign investors do not pay U.S. taxes and therefore do not benefit from the tax-exemption. Pension funds make up less than 0.1% of municipal market holdings.

A. *Tax exemption for Banks*

With the passage of the Tax Reform Act of 1986, banks cannot deduct the interest expense incurred to acquire or carry tax-exempt assets. This is known as the prorata disallowance. By forbidding deductions, the disallowance increases a bank's taxable base and thus operates as a form of implicit taxation of municipal bond holdings. There is an exception to the general rule (§265(b)(3) of the Act), however: any municipal issuer raising no more than $10M in a calendar year is able to designate its bonds as *bank-qualified*;[6] when a bank purchases a bank-qualified tax-exempt municipal bond, the bank is allowed to deduct 80% of the cost of carrying the obligation (compared to zero, for any other tax-exempt municipal bond). Bank-qualified bonds hence receive a preferential tax treatment.

The pro-rata disallowance is so calculated:

$$\frac{\text{Tax Exempt Obligations}}{\text{All Assets}} \times \text{Year-to-Date Interest Expense} \times \text{D}$$

where D is the percentage disallowed, that is, 20% for bank-qualified bonds, and 100% for non-qualified bonds.[7]

B. *Banks' Capital Regulation*

There are two main types of municipal bonds: general obligations and revenue bonds. General obligations carry the full faith of the issuer;[8] instead, revenue bonds are payable only from a pre-specified source of funds, such as tolls and fees. The treatment of municipal bonds under capital regulation has been left unchanged since Basel I.[9] Specifically, general obligation claims

[6]The American Recovery and Reinvestment Act raised the threshold to $ 30 million, for a temporary period of two years (2009-2010).

[7]The Tax Reform Act also affected insurers. The insurance sector is subject to a proration provision, which adds 15% of tax-exempt income back into the regular taxable income. The effective after-tax yield, adjusted for proration, that an insurance company earns on a tax-exempt municipal bond is equivalent to the unadjusted yield multiplied by a factor of: $(1 - 15\%\tau)$, where τ is the insurer tax rate.

[8]Under the legal definition, general obligations issued by States carry the full faith as the legislature allows appropriations to pay back borrowed funds.

[9]Capital requirements are not the only consideration for a bank. Liquidity regulation, such as the Liquidity Coverage Ratio (LCR), matters too. The FDIC, OCC, and Fed first excluded municipal bonds from the list of

are subject to a 20% risk weight, while revenue bonds fall under the 50% risk weight category.

The risk weighting scheme for municipal bonds does not depend on the credit quality of the issuer. Credit ratings in fact do not matter when determining the risk weight attached to municipal obligations. Specifically, it does not matter whether the bond is investment or speculative grade, or whether it is unrated altogether. To compare this to other asset classes, a mortgage backed security can be recorded in the 20% risk weight category if the lowest of the ratings (when two are present) is above AA. An unrated general obligation issued by Puerto Rico would occupy the same risk weight bucket.

This regulatory approach to municipal bonds is unique to banks. Credit ratings do in fact matter for insurance companies, mutual funds and dealers alike. Insurance companies' holdings of municipal bonds follow the NAIC designation, and unrated municipal securities have to undergo internal credit assessment to be classified in the correct NAIC category. Moreover, as clarified by the Government Finance Officers Association, ratings are a crucial consideration for retail investors; customarily, at least two ratings are required to place a bond with a retail investor.[10]

IV. Aggregate Evidence

Before the financial crisis, the municipal bond market was characterized by negative municipal spreads over matched Treasuries, low yield dispersion, and high ratings, which contributed to the notion that municipal bonds were a *safe asset*. The recent crisis significantly altered this market: spreads turned positive, yield dispersion almost doubled, and the ownership profile of this asset class saw a reduction in retail holdings and a steady increase in bank ownership. In what follows I provide evidence of these shifting patterns and discuss implications for investors'

high-quality liquid assets (HQLA). Only subsequently, in April 2016, selected municipal securities were allowed to be included in the HQLA category, under caps and haircut conditions. At the moment of writing, the Fed has a different regulation than the FDIC and the OCC. Implementation of the LCR was set to April 2017 for large depository institutions, and to 2018 for modified LCR institutions. The analysis in this paper, however, covers the years before 2014.

[10] Adelino et al. (2017) also discuss the importance of credit ratings in this market.

incentives.

A peculiar characteristic of the municipal market up to 2009, was the presence of credit enhancements and insurance. Before 2008, around 50% of the par amount issued was insured. However, this number dropped to 18% in 2008, and further fell with the Monoline insurance crisis of 2009 to below 6%, with a minimum of roughly 4% in 2012 and 2013.[11]

Figure 2 plots the dispersion of municipal bond yields at issuance for the period 2000-2014. Panel A shows dispersion for tax-exempt not-callable municipal obligations maturing in 5 years, while Panel B covers tax-exempt not-callable municipal obligations maturing in 10 years.[12] The figure shows a significant increase in the dispersion of yields, in line with the municipal market becoming more fragmented following the advent of the crisis and the collapse of the monoline insurance sector.

Figure 3 shows the time-series of municipal spreads over matched Treasuries for new municipal issuances. Historically, municipal bonds exhibited lower yields than the corresponding Treasuries, because of the tax-exemption. However, with the advent of the crisis, municipal spreads over matched Treasuries went from being negative to roughly 50bps.[13] Figure 4 reports the effective yield to maturity obtained by a bank on a 3% hypothetical municipal bond issued at time t, and the corresponding yield of a Treasury issued at time t as well, that matches the coupon, maturity and payment schedule of the municipal obligation.[14] Using a fixed-yield hypothetical municipal bond, it is possible to leave out the confounding effect of the composition of issuers in driving the change in the spread dynamics. The figure shows that, before the financial crisis, a treasury replicating the same coupon and repayment schedules of the municipal security would imply a higher effective yield for the bank. However, this reverses in 2008, when the same coupon and payment schedule implies a higher effective yield on the

[11]The financial crisis led to the bankruptcy and restructuring of the bond insurance sector, largely as a result of financial guarantors' exposure to residential MBS. As downgrades of monoline insurers increased, the demand for municipal bond insurance decreased (Bergstresser, Cohen, Shenai (2010)).

[12]Maturity ranges are constructed with a two year range; so for example, bonds with a 5-year maturity would be maturing in the range of 3 to 7 years.

[13]Schwert (2016) studies the determinants of municipal spreads and the role of default risk.

[14]The synthetic treasury is obtained following Gurkaynak et al. (2006) and Svensson (1994). Section B.2 explains how to construct the synthetic treasury.

municipal bond for the bank.

The ownership structure of municipal bonds also reveals significant changes. Figure 5 plots banks' holdings of municipal bonds as a percentage of total par outstanding.[15] Banks' holdings of municipal bonds went from roughly 6% to about 14% of total par outstanding. A very similar picture emerges from banks' Call Reports. Figure 6 plots aggregate municipal bonds holdings as a percentage of banks' total assets, showing the steady increase of municipal obligations on banks' balance sheets. Banks appear to have increased their holdings both in the qualified and in the non-qualified segments of the market.[16] The proration disallowance, which determines banks' implicit taxation of municipal bond holdings, is calculated as a function of the interest expense of the bank. In 2009 the average banks' interest expense dropped substantially, which effectively reduced the value of the proration, that is, it made the implicit tax on municipal bonds very low. It is interesting to note that this coincides with the cut in federal funds rates. A bank interest expense is in fact the sum of interest on deposits, expense of fed funds purchased and repos sold, and other interest on notes and debentures subordinated to deposits. Figure 7 plots the average interest expense of banks against the effective federal funds rate at the time. The near-zero rates environment might have thus contributed to the thinning out of the municipal bond tax for banks.

The combination of loose monetary policy environment and lax capital regulation makes banks particularly prone to "reaching for yield". With yields on municipal bonds exceeding those on corresponding Treasuries, and banks not being penalized for holding more risk on their balance sheet, and with banks' taxation of municipal securities being reduced, banks' increased appetite for municipal bonds does raise the question of whether banks have been entering the municipal market in search of high yield.

[15] Data comes from Federal Reserve Flow of Funds and starts in 2004. Data before 2004 is subject to an error in the estimation of investors' holdings and does not reflect actual ownership of municipal obligations at the time. See: https://www.bondbuyer.com/news/municipal-holdings-decline-in-1st-quarter.

[16] Non bank-qualified bonds are subject to a less lenient tax treatment, as explained in Section III.

V. Reaching for Yield Within Asset Class

A. Identifying the Banks: the role of Story Bonds

To be able to test for banks' yield-seeking behavior, it is important to observe holdings at a granular level. Banks' call reports only provide total holdings of municipal bonds per bank; the maturity breakdown is not provided at the asset class level. To identify banks' holding at the bond level, I therefore use the peculiar institutional structure of the municipal market, specifically the so-called *story bond* segment.

Story bonds are unrated uninsured municipal issuances. They are known as such because the investors purchasing the story bond must be familiar with the economic and political history of the issuer, and must be capable of assessing the quality of the issue even in the absence of a rating. Municipalities have two main reasons for choosing not to seek a rating. One is that they expect a speculative rating. But the other reason is that, for many high quality issuers, the size or the type of placement of the bond make it uneconomical to seek a rating. The municipal market is constituted by thousands of small issuers. Over 43% of issuers in the period analyzed qualify as *small issuers*, under the legal definition. The ReFund America Project has estimated that issuance costs for small municipalities can be as large as 8% of the issue size, and rating costs constitute a substantial part of the total issuance costs, alongside the underwriter discount and the advisory fees. Local governments may thus choose to access the market without a credit rating, even when they expect it to be investment grade.

Issuing an unrated bond, even when potentially of investment grade quality, does have implications for the placement of the bond. Municipal bonds are in fact loan-like assets, in so far as they are non-standard and have complex redemption features. Additionally, small issuers are exempted from continuing disclosure (Rule 15c2-12, $1M issuers), which is otherwise required by investors to track any credit event. At the same time, comprehensive annual financial reports (CAFR) for small issuers are not easily accessible nor available. Municipal bonds are also extremely illiquid– for instance, in 2011, 99% of outstanding municipal par amount did not

trade on any given day (SEC (2012)), which further reduces the production and dissemination of information. In this light, credit agencies represent a particularly important agent in this market as they remedy the opaqueness by providing credit analysis, continuing monitoring, and revised ratings.

It follows that the decision to issue a story bond affects the ability of an issuer to place its bond in the market. Specifically, if a local government decides to save on credit ratings, this reduces the pool of potential investors by limiting the ability of households to purchase the bond. Similarly to the FINRA Rule 2111, in fact, the MSRB Rules G17 and G19 require the broker-dealers to check the suitability of the proposed investment against the purpose and skill profile of the ultimate retail investor. A broker-dealer is deemed in breach of the suitability rule even by omission of alternative investment strategies. In assessing the suitability of the investment recommendation, the broker-dealer must collect and assess information on the investor's financial profile, objectives, risk tolerance, tax status, liquidity needs, experience with municipal transactions, and most importantly, financial capacity to withstanding losses on the investment. Rule G17 and G19 apply to broker-dealers who execute transactions and provide insularly advise; when instead a dealer acts in an Investment Advisors capacity, he or she is subject to even more stringent rules under the SEC Investment Advisors regulation. There is a presumption of the law that a retail investor does not have the required level of sophistication to assess an unrated municipal bond, particularly in the absence of information on the municipality's budget, and in a credit event the existing rules would put the burden of the proof on the dealer, on whom the due diligence rest. Following the regulation, broker-dealers have developed internal policies against selling unrated bonds directly to retail investors.[17]

I thus exploit the segmentation induced by this regulation to back out banks' holdings of unrated municipal securities at the bond level. I have comprehensive holdings at the bond level of municipal securities by funds, insurance companies, and pension funds from IpreoBDA. Therefore, given that households are discouraged from entering this market as direct holders in

[17]In the words of Bart Mosley, president of Trident Municipal Research: "Most broker-dealers have policies against selling unrated bonds to retail investors.", The Washington Post, 16 August 2012. Adelino et al. (2017) also provide evidence on the importance of credit ratings in the municipal market.

any substantial way, it is possible to back out banks as a residual.[18] The story bond segment is also particularly suited to study banks' behavior, since, again, banks are the only investor for which municipal bonds' credit ratings do not matter for regulatory purposes.

I focus on new issuances in the period going from 2010 to 2014. I focus on yields and holdings at issuance since the municipal market is characterized by low liquidity, its average weekly traded volume having historically been just over 10% of the Treasury trading volume (Wang et al. (2008)).[19] I considered a bond to be purchased at issuance if the position is acquired within the first quarter from issuance. As reaching for yield is defined in relative terms against other institutional investors, I focus on the non-qualified story bonds, making up roughly 67% of the story segment. Finally, I merge bond issuance data with their respective secondary market trades from the MSRB. In robustness tests, as I focus on yields to maturity, I exclude bonds that have traded within 90 days from issuance.

B. Effective Yields

I drop floating and variable rate obligations (VRDOs), retaining only fixed rate and zero-coupon bonds. Fixed-rates and zeros correspond to over 99% of bonds issued in the 2010-2014 period, as the VRDOs market virtually disappeared with the crisis. I focus on yields to maturity and to this purpose, only retain the non-callable portion of the market, corresponding to 67% of the unrated bond issuance.

To obtain banks' effective spreads, I first calculate the pro-rata disallowance for each bond. Then for each bond, I construct a *synthetic Treasury* using the Svensson (1994) curve, that is I construct a synthetic obligation that has the same coupon, coupon payment dates and maturity

[18] A suitable retail investor who is willing to take on a position in an unrated municipal bond is however allowed to do so by entering the position indirectly through a mutual fund. I have detailed data on fund holdings of municipal bonds.

[19] Trading statistics in the municipal market should take into account the structure of the market. The municipal market is very concentrated, with the top 10 dealers carrying about 75% of the transactions. A few dealers purchase large blocks of municipal securities and re-distribute them to retail investors. Trading activity is concentrated in the first month after issuance, reflecting the redistribution period from broker-dealers to individuals, after which trading drops substantially. Par amount traded after 5 days from issuance is already as low as 12% (Green, Hollifield and Schurhoff (2007)).

schedules of the municipal bond it matches, but whose claims are risk-free. After adjusting for the tax-exemption, I then obtain the tax-adjusted effective *spread*.

B.1. Proration

The prorata disallowance implies an haircut on the yield that the bank receives from buying the municipal bond. The haircut is so computed: $h = \text{C}\times\ \text{D}\times\ \tau$. The first term, C, is the bank's cost of borrowed funds, which is captured by the fed funds rate, as a proxy for the cost of raising deposits. The term D captures the disallowance, which is 20% for bank-qualified obligations, and 100% otherwise. The tax rate τ, is the Federal corporate tax rate; the portion D of income that is disallowed from tax-exemption is then taxed at the federal tax rate.[20] I fix the tax-rate at 35%. I divide the effective prorata-adjusted yield by $(1 - \tau)$, to compare the yield on municipal bonds to the Treasury. Remember the prorata haircut is an implicit taxation, but the actual coupon payments of the municipal bond are tax exempt. This gives the tax and prorata adjusted effective yield. This step, including the proration and the tax-adjustment, is not needed for the small percentage of taxable municipal bonds. The last step involves estimating a synthetic curve of risk-free assets.

B.2. Synthetic Treasuries

The dataset contains information on the sale date and the dated date, that is the date interest starts to accrue. I have detailed information on the date when the first coupon is paid and the frequency of coupons, and I know the maturity of the bond. To match the coupon and principal payment schedules, I first estimate a monthly off-the-run curve for treasuries. I follow Gurkaynack et al. (2006) and use the estimated parameters from the Svensson (1994) curve to fit a riskless curve with maturity horizon ranging 1 month to 60 years, for each day in

[20]Municipal bonds are exempt from Federal taxation. State tax exemption varies across states. However, state taxation of depository institutions follows income apportionment formulas, that are the result of case laws, and that are mostly based on the principles economic nexus. So while the state tax affects retail investors ultimate yield, this is not straightforward for banks, as the amount of state taxes due is dependent on the credit activity that a bank has in each state.

2010-2014. For each municipal claim, I compute the price of its matched synthetic treasury by discounting the coupons and principal of the municipal bond at the estimated riskless off-the-run curve. The price of the synthetic treasury matching municipal claim j with dated date t is: $P_t^j = \sum_{n=1}^{N} C_n^j D_n$ where C_n^j is the payment (coupons and principal) at time n and D_n is the discount factor: $D_n = \exp\{-Y_n n\}$. Y_n is the estimated off-the-run yield for a riskless zero coupon bond with maturity n and dated date t. From the price of the synthetic coupon- and maturity-matched treasury, I then solve for its implied yield to maturity. The final step is to calculate the spread for each municipal obligation, which is the effective tax-adjusted yield in Section B.1 minus the matched synthetic treasury.

VI. Story Bonds - Results

Over the years 2010-2014, the story bond segment made up about 4% of the muni market. Banks hold roughly 60% of the story bond market. Funds alone instead hold most of the remaining market. Direct holdings by insurance companies and pension funds are minor, in line with the fact that the National Association of Insurance Commissioners (NAIC) requires ratings for regulatory purposes.

Figure 8 shows how municipal spreads over matched Treasuries in the story bond segment are consistently higher than in the rated or insured portion of the market, with spread increasing at longer maturities. Throughout the paper, the notion of reach for yield is intended as a relative measure, that is, how much banks tilt their portfolio towards higher-yield bonds with respect to other institutional investors. The relative measure follows the literature (Becker and Ivashina (2015), LaSpada (2015)) and is chosen to isolate time-series confounding effects due to supply variation.[21]

I first run a simple regression of relative holdings against the spread as calculated in Section

[21] More low yield issuance would imply more low yield bonds on the investors' portfolios. A regression that does not use a relative measure would only make a statement on the relation between aggregate bond supply and yields.

V (including the proration adjustment). The unit of analysis is at the bond level, that is each observation corresponds to a single bond. The dependent variable is aggregate holdings by banks relative to total institutional holdings for each bond. I control for the bond size and duration, and whether the bond is a General Obligation or Revenue, as that affects the risk-weighting scheme for banks (20% and 50% respectively). I include year-quarter fixed effects, and cluster standard errors by issuer. In robustness I double cluster standard errors by issuer and year-quarter.

Table I shows that across all specifications, the coefficient on the spread is negative, and both statistically and economically significant: from column (3), controlling for size, duration and type of bond, a 100bp increase in spread implies a 3% reduction in aggregate banks holdings. Additionally, banks appear to favor smaller issues and bonds with longer duration. One standard deviation increase in issue size leads to a 12.5% decrease in banks holdings, while one standard deviation increase in bond duration increases banks' aggregate holdings by 2.4 %.

In Table II, Column (1) and (2) I split the sample in general obligation and revenue bonds. The coefficient on the municipal spread is negative and significant for revenue bonds, while it is not precisely estimated for general obligations. In Column (3) I exclude taxable municipal bonds, while in Column (4) and (5) I exclude respectively bonds that have traded within 90 days from issuance and tax anticipation notes. Excluding bonds that have trades recorded a quarter from issuance helps confirm results are not driven by incorrectly capturing holdings at issuance. Tax anticipation notes are a way for local governments to borrow short term to finance a current operation budget gap; these notes are swiftly repaid using taxes. Table II shows that results are robut across specifications and samples.

Finally, in Table III I also control for the use of proceeds and for the offering type, that is whether the bond was a negotiated or competitive placement. Overall, banks appear to tilt their portfolios towards lower yield bonds, compared to funds and insurance companies: a 100bp increase in spread implies a 3-4% reduction in aggregate banks holdings, all else equal.

VII. Reaching for Yield Across Asset Classes

A. Identification Strategy

In Section VI I show that banks' increased demand for municipal securities does not appear consistent with a *within class* reaching-for-yield hypothesis: relative to other market participants, banks invest predominantly in lower-yield municipal bonds, even conditional on their risk weighting. In this section, I investigate whether banks' appetite for municipal securities is instead consistent with a different form of yield-seeking behavior, that is across asset classes. Specifically, I test whether given both the underlying and regulatory credit risk profile of municipal securities, banks appear to substitute away from treasuries into municipal bonds, thereby increasing their exposure to liquidity risk rather than credit risk. To answer this question, I exploit a shock to the supply of municipal bonds that plausibly affected banks heterogeneously, as an instrument for banks' cross-sectional holdings of municipal bonds.

On February 2009 Section 265 of the Internal Revenue Code of 1986 was amended to allow for a temporary two-year increase in the bank-qualification threshold. Dagostino (2019) shows that this shock affected local governments in heterogeneous ways, in particular relaxing the ability of a large mass of municipalities to raise financing through banks. As shown in Figure 6, banks concentrate their municipal holdings in the qualified segment of the market where the tax advantages are the highest. As explained in Section III, bank-qualified bonds are bonds issued by municipalities whose total annual indebtness stays within the $10M limit. The regulatory change shifted the limit for bank-qualification to $30M, thereby expanding the set of municipalities that are able to issue bank-qualified bonds.

I use this shock to replicate a random assignment of municipal securities across banks. The intuition goes as follows. Dagostino (2019) shows that the 2009 regulatory shock resulted in some counties being more affected than others, namely some counties had a larger (or smaller) fraction of municipalities in the 1 to $30M issuance range. It follows that banks with branches in highly affected counties were potentially more exposed to the bank-qualification shock than

banks with branches in less affected counties. This argument rests on the hypothesis that the placement of municipal bond is local, that is municipalities will place their bonds with banks that have a local presence in that geography rather than with banks with no local operations. Verifying the validity of this argument is equivalent to checking that the first stage is strong. Given a strong first stage, I can then use the pre-2009 geographical location of a bank's branches as an instrument for that bank's holdings of municipal bonds.

More specifically, I construct the following measure of bank-level exposure, Z_i:

$$Z_i = \frac{\sum_j w_j * m_{ij} * c_{ij}}{N_i} \tag{1}$$

where the index i represents the bank, and the indices j and k represent respectively the county and the municipality, and where w_j, m_{ij} and c_{ij} are so defined:

$$w_j = \sum_k \mathbb{1}(k = \{affectedissuer\}) * \frac{PreIssuance_k}{PreIssuance_j} \tag{2}$$

$$m_{ij} = \frac{Deposits_{ij}}{AggregateDeposits_j} \tag{3}$$

$$c_{ij} = \frac{Deposits_{ij}}{TotalDeposits_i} \tag{4}$$

The variable w_j captures the exposure of the county j to the 2009 regulatory shock, and it is the fraction of municipalities (indexed k) in the county affected by the regulatory shock, weighted by their average issuance in the 5 years before the regulation change ($PreIssuance$). Intuitively, w_j captures the intensitiy of treatment of county j in terms of potential municipal issuance that becomes newly available to local banks.

The variables m_ij and c_ij capture how much of the county j shock (w_j) a bank i is potentially going to absorb, or more precisely the exposure of bank i to county j shock. This exposure is going to depend on two dimensions: how large bank i presence is in county j (m_ij), and how

much county j matters to bank i (c_ij). On the one hand, suppose a bank is a monopolist in county j, then this bank will be the only bank exposed to the county shock and the only bank available to absorb that shock - I capture this through m_ij . On the other hand, county j shock will matter less for bank i if county j makes up only a negligible part of bank i's balance sheet (as measured by the deposit base)- I capture this through c_ij . Formally, m_ij is measured as the amount of deposits belonging to bank i in county j over the sum of all deposits in county j. The variables c_ij is measured as bank i's deposits in county j divided by bank i's total deposits. Deposits are measured as of 2005, which is the beginning of the pre-treatment period.

As banks operate in multiple counties, a bank's overall exposure to the 2009 bank-qualification shock, Z_i, is then the sum of the bank's exposure across geographies, scaled by the number of counties that the bank has branches in, N_i. Having defined Z_i, I estimate the following 2SLS:

$$MuniHoldings_{i,t} = \quad b_1 Z_i * Post_t + b_2 Post_t + b_3 X_{i,t-1} + a_i + e_{i,t} \tag{5}$$

$$Y_{i,t} = \quad \beta_1 \widehat{MuniHoldings}_{i,t} + \beta_2 Post_t + \beta_3 X_{i,t-1} + a_i + \xi_{i,t} \tag{6}$$

The unit of observation is the bank, i, with variables measured at the bank holding company level. The variable *Post* takes value of one during the regulatory change (2009-2010), and zero otherwise (2005-2008). $MuniHoldings_{i,t}$ are the amount of municipal bonds on bank i balance sheet as of December Call Reports, expressed in logs. I follow Chakraborty, Goldstein and Mackinlay (2019) and include the following bank-level characteristics lagged by one year, $X_{i,t-1}$: the log of assets (excluding muni bonds), the equity ratio, net income scaled by assets, and cash to assets, all measured as of $t-1$. These variables are intended to capture differences in the size and financial health of banks which might affect their investment decisions. Given the set of controls $X_{i,t-1}$, the instrument then captures the residual cross-sectional variation among similar banks due to the pre-shock geographical location of their branches. I also include bank fixed effects, a_i. Z_i is absorbed by the fixed effects. Robust standard errors are clustered at the bank level.

In the second stage, $Y_{i,t}$ is the log of US securities defined as the sum of Treasuries and government agency obligations. I also report results of the reduced form specification. To the extent that Z_i captures a plausibly good as random bank exposure to the shock and that the first stage is strong, then the reduced form provides the most conservative estimate should there be any concern over the exclusion restriction, and allows causal interpretation of the effect of banks' exposure to the regulatory shock on banks' investment behavior.

B. Results

Table IV reports the results of the first stage estimation from Equation 5. Banks with higher exposure to the bank-qualification shock increased their holdings of municipal securities significantly. Specifically, a one standard deviation increase in exposure (0.06) leads to an increase of municipal holdings by banks of 3%. Results are robust across specifications. These findings confirm the notion that municipalities will favor local banks when considering where to place new debt issuance.

I then proceed to inspect whether the increase in municipal holdings by banks did crowd out US Government securities, defined as the sum of Treasuries and government agency obligations. Table V Column (3) reports the second stage results from Equation 5 for the universe of bank holding companies. The increase in municipal bond purchases by banks appears to have crowd out US Government securities. Specifically, a 1% increase in municipal holdings (instrumented) led to a 0.7% decrease in US Government securities. Table V Column (1) and (2) further report the results of the reduced form specification. Crowding out of Treasuries and US agency securities seems both economically meaningful and robust across specifications. From the reduced form, a one standard deviation increase in bank exposure to the shock (0.06) led to a 2.3% decrease in holdings of US Government securities. Translating the elasticity to dollar values, at the average treatment (exposure) of 0.026, this implies that every $1 increase in municipal bond holdings by a bank led to a $0.76 decrease in Treasuries and agency obligations.

VIII. Conclusion

In this paper I first document that, in the aftermath of the financial crisis, both the aggregate ownership profile and the yield dynamics of municipal bonds have substantially changed. The ownership structure reveals a significant upward jump in banks' holdings, going from historically below 6% to over 14% of the total par outstanding. At the same time, for the first time in 20 years, offering yields on municipal bonds have exceeded those on Treasuries. Municipal spreads over matched Treasuries went from being negative to roughly 50bps for 7 years consecutively.

In the second part of the paper I use the so-called *story bond* segment of the municipal market to identify banks' holdings of new municipal bond issuances at the granular level. I show that the post-crisis increase in banks' holdings is mainly explained by the current monetary policy and taxation-disallowance arbitrage. However, contrary to popular wisdom, I find that banks' increased demand does not appear consistent with a reaching-for-yield hypothesis. Relative to other market participants, banks actually invest predominantly in lower-yield municipal bonds, even conditional on their risk weighting.

While it appears that banks do not target high-yield municipal securities, it does appear that banks are substituting away from Treasuries and toward municipal bonds in the presence of high spreads. This evidence is consistent with banks reaching for yield across asset classes. Across all maturities, in fact, municipal bonds are particularly illiquid, their average weekly traded volume having historically been just over 10% of the Treasury trading volume (Wang et al. (2008)). Therefore increased municipal bond holdings might constitute increased bank exposure to illiquidity risk.

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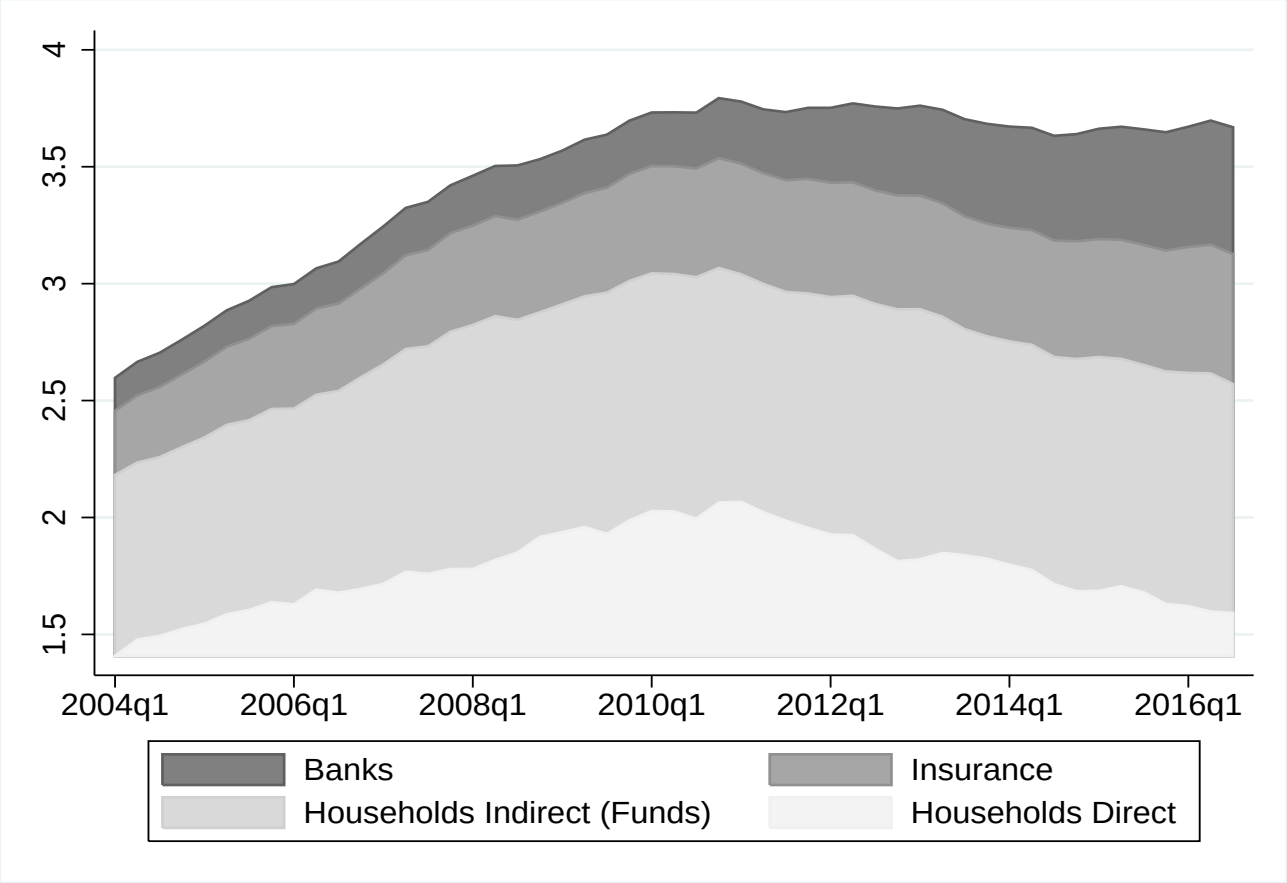
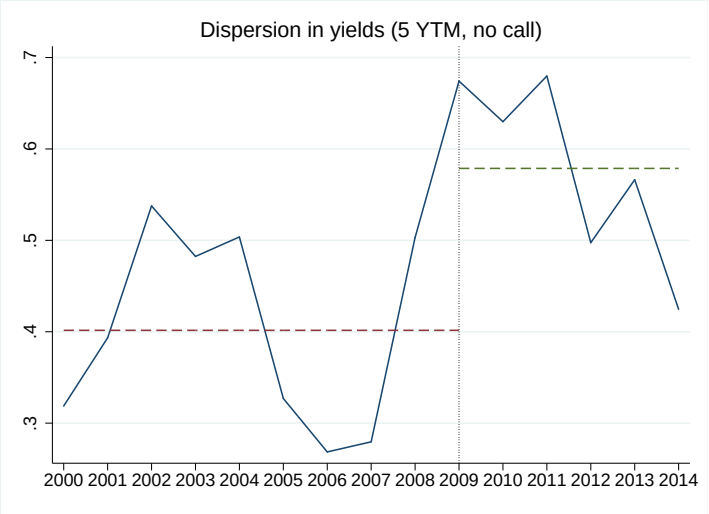
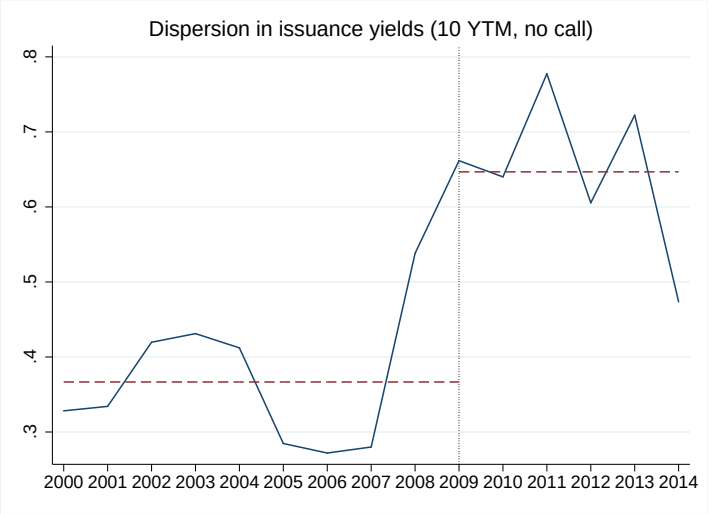


Figure 1. Municipal Bond Holdings. This figure plots holdings of municipal securities by investor type. Data comes from the Federal Reserve, Flow of Funds.



(a)



(b)

Figure 2. Dispersion in Yields. This figure shows the standard deviation in municipal bond yields at issuance for bonds in the 5 year (Panel a) and 10 year (Panel b) maturity range.

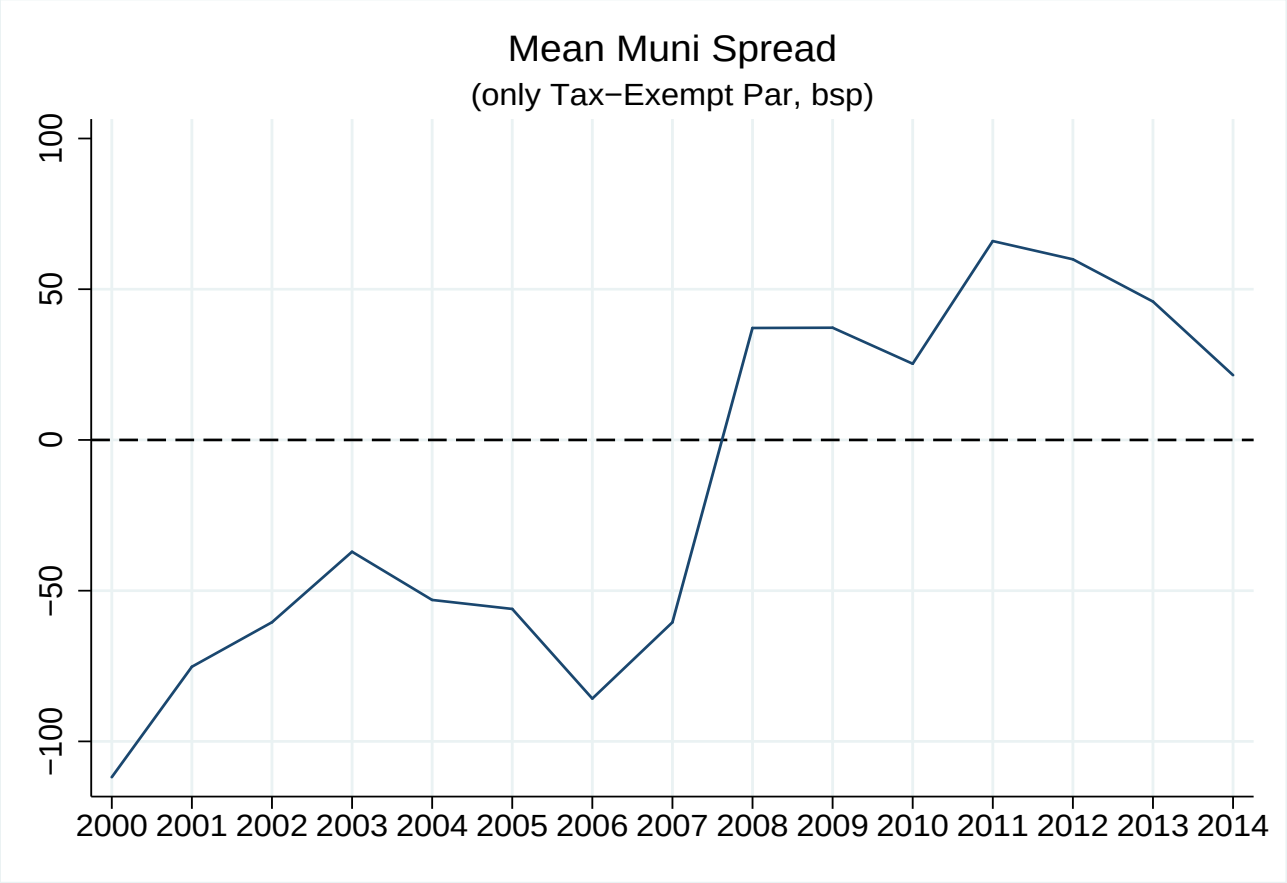


Figure 3. Municipal Bond Spreads. This figure shows average municipal spreads over matched synthetic Treasuries.

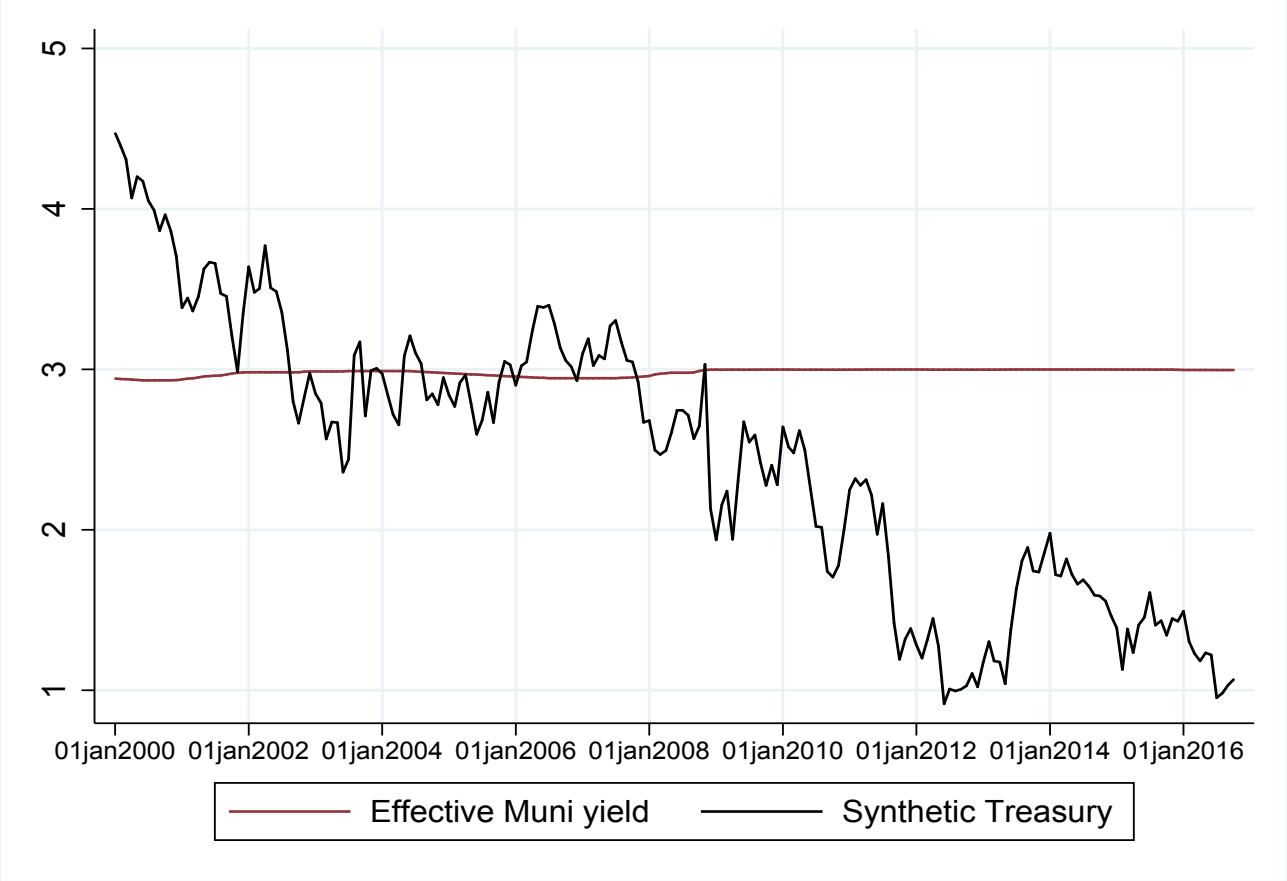


Figure 4. Yields. This figure plots the effective municipal yield for a representative 3% coupon 10-year maturity muni bond issued at par at time $t = [2000, .., 2016]$, against the yield of a corresponding synthetic treasury with identical maturity, coupon value and schedule, and issuance date.

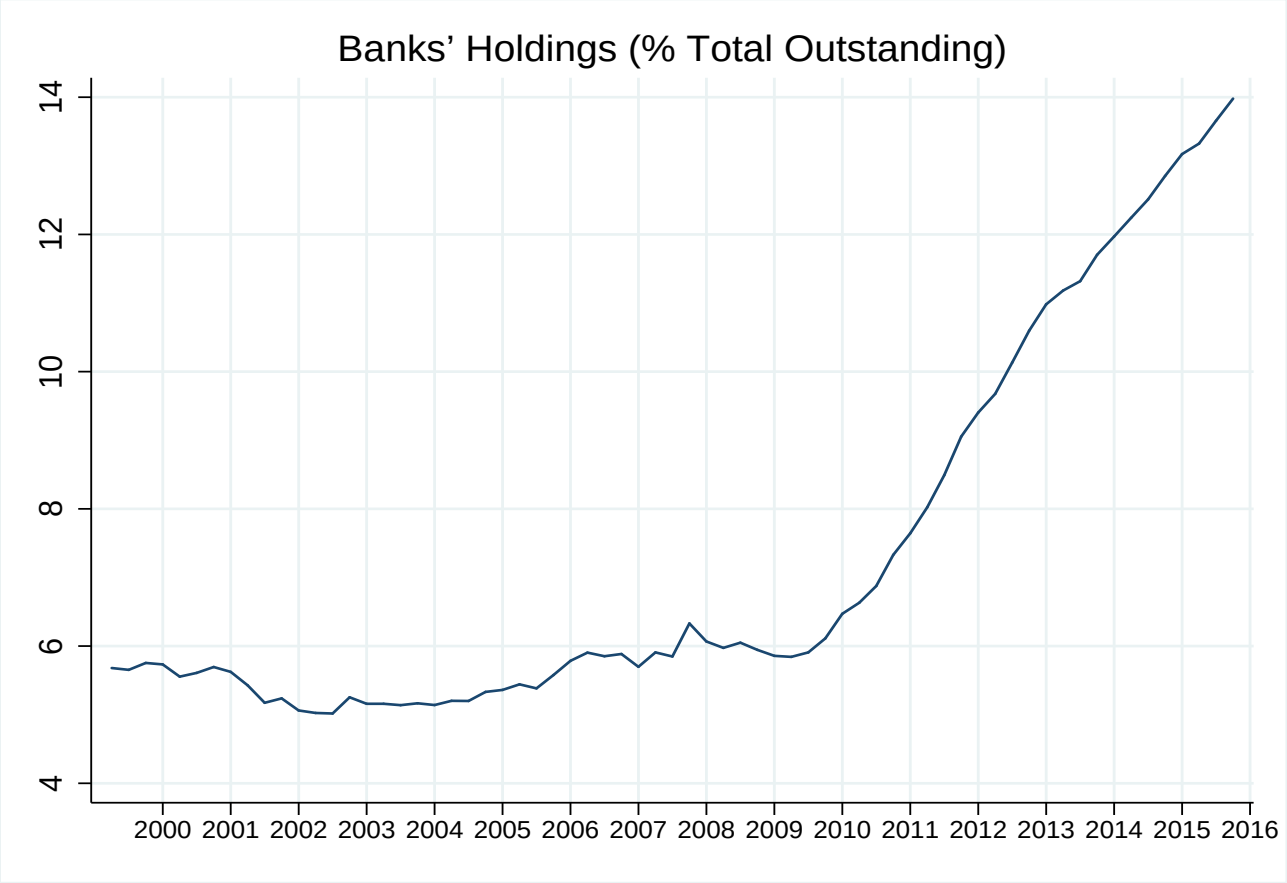


Figure 5. Banks' Holdings of Municipal Bonds. Banks' holdings of municipal bonds, expressed as a percentage of total par outstanding.

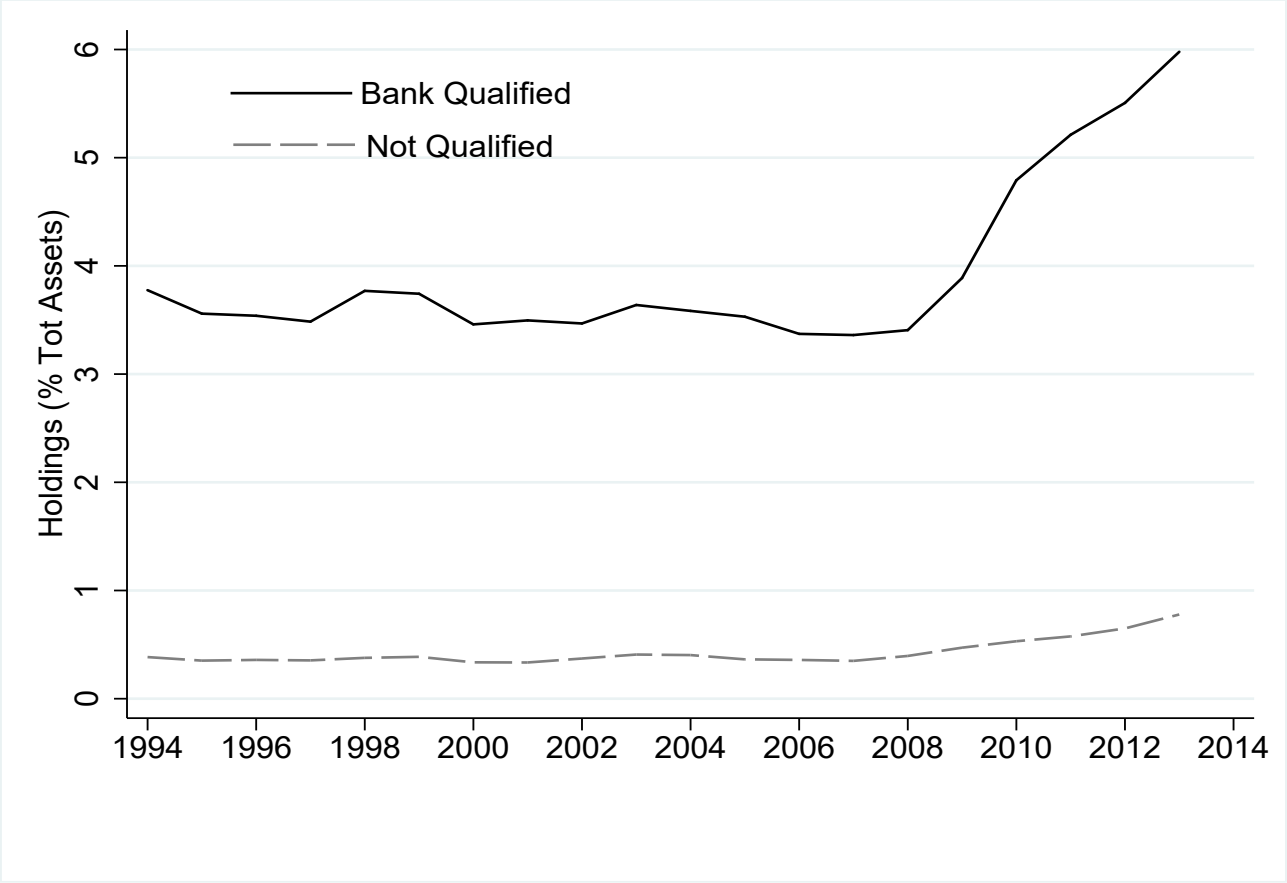


Figure 6. Municipal Bonds on Banks' Balance Sheets. This figure plots average banks' holdings of municipal bonds as a percentage of total assets.

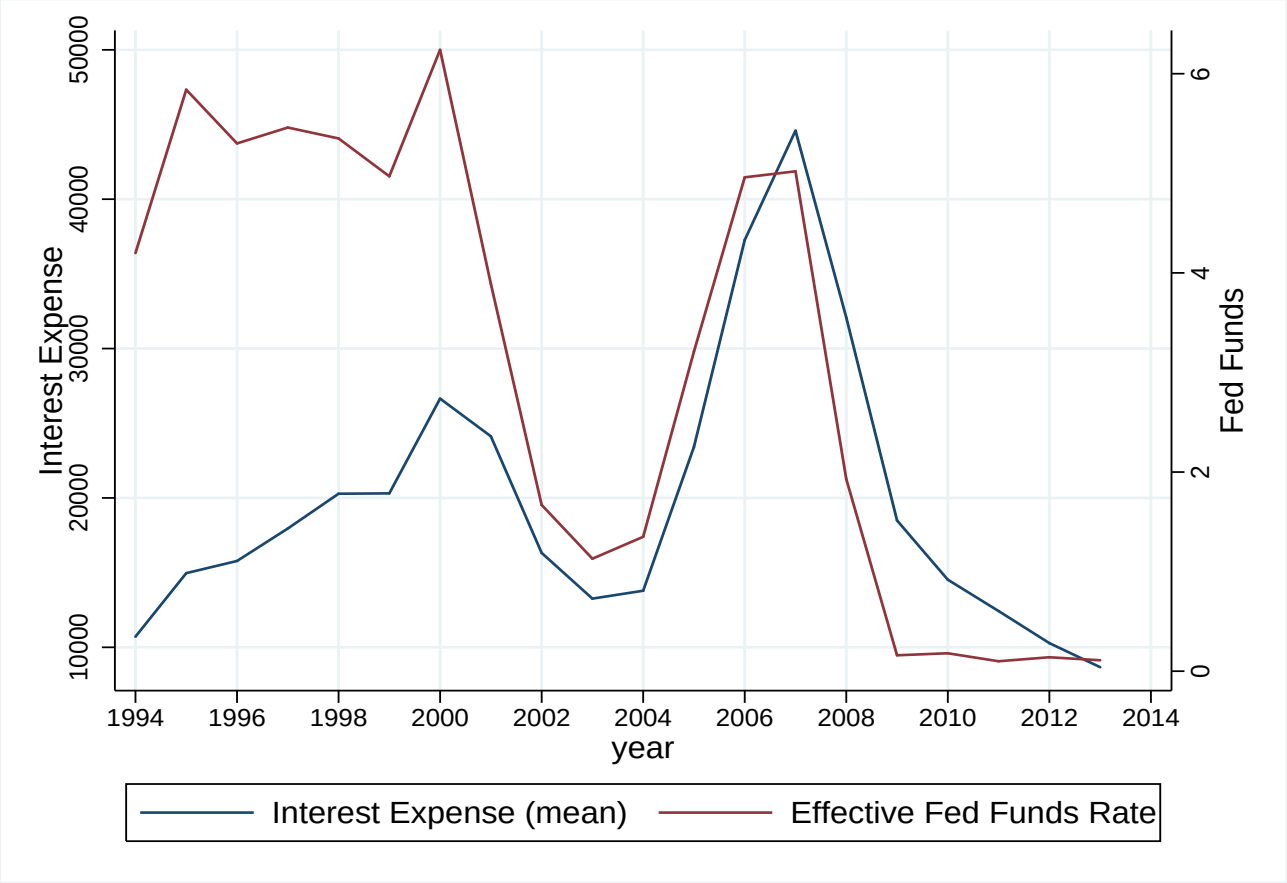


Figure 7. Banks' Interest Expense and Fed Funds Rate. This figure plots banks' average interest expense, against the effective funds rate.

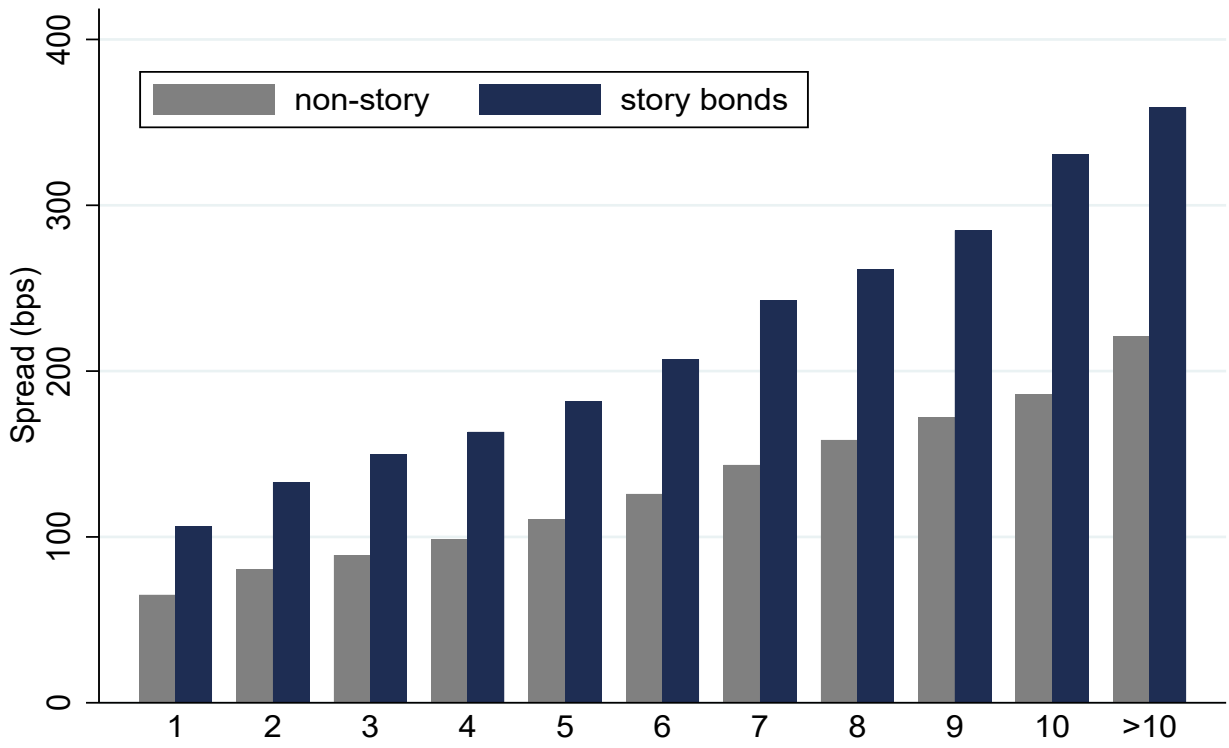


Figure 8. Spreads by Maturity. Municipal spreads over matched Treasuries (in basis points) by years to maturity. Spreads are calculated as in Section V.B without adjusting for the proration.

Table I: The dependent variable is banks' holdings relative to aggregate institutional holdings. Spread is the prorata and tax-adjusted municipal bond yield over the matched synthetic Treasury yield. GO takes value of one for general obligation bonds and zero for revenue bonds. Size represents the size of the bond in millions. Robust standard errors are clustered as indicated and reported in parenthesis. Stars indicate significance at the 1% (***), 5% (**) and 10% (*) level.

	(1)	(2)	(3)	(4)
	Bank Holdings	Bank Holdings	Bank Holdings	Bank Holdings
Spread	-0.7470	-1.8070***	-2.9444***	-2.9444***
	(0.456)	(0.411)	(0.513)	(0.535)
Duration	0.7622***	0.8036***	0.7268***	0.7268**
	(0.284)	(0.263)	(0.255)	(0.303)
Size ($M)		-1.1836***	-1.1387***	-1.1387***
		(0.161)	(0.155)	(0.157)
GO			-7.9966***	-7.9966***
			(1.687)	(1.640)
Observations	7,600	7,597	7,597	7,597
Adjusted R-squared	0.030	0.150	0.159	0.159
Year Quarter FE	YES	YES	YES	YES
Cluster	Issuer	Issuer	Issuer	Issuer & Yr-Qtr

Table II: The dependent variable is banks' holdings relative to aggregate institutional holdings. Spread is the prorata and tax-adjusted municipal bond yield over the matched synthetic Treasury yield. GO takes value of one for general obligation bonds and zero for revenue bonds. Size represents the size of the bond in millions. No Traded sample excludes bonds that have been traded within 90 days of issuance. Robust standard errors are clustered as indicated and reported in parenthesis. Stars indicate significance at the 1% (***), 5% (**) and 10% (*) level.

	(1)	(2)	(3)	(4)	(5)
	Bank Holdings	Bank Holdings	Bank Holdings	Bank Holdings	Bank Holdings
Spread	-0.9843	-3.2464***	-3.4179***	-3.3594***	-3.3050***
	(1.633)	(0.493)	(0.652)	(0.541)	(0.483)
Duration	2.6106***	-0.2865	0.9330**	0.6700*	-0.1587
	(0.603)	(0.285)	(0.371)	(0.337)	(0.253)
Size ($M)	-1.0448***	-0.8639***	-1.0654***	-1.4079***	-0.8927***
	(0.133)	(0.280)	(0.146)	(0.150)	(0.241)
GO			-13.3374***	-8.7171***	-1.9046
			(1.956)	(1.730)	(1.598)
Observations	2,995	4,602	5,845	6,299	6,559
Adjusted R-squared	0.212	0.132	0.160	0.179	0.135
Year Quarter FE	YES	YES	YES	YES	YES
Cluster	Issuer & Yr-Qtr	Issuer & Yr-Qtr	Issuer & Yr-Qtr	Issuer & Yr-Qtr	Issuer & Yr-Qtr
Sample	GO	Revenue	Tax-Exempt	No Traded	No Tax Antic

Table III: The dependent variable is banks' holdings relative to aggregate institutional holdings. Spread is the prorata and tax-adjusted municipal bond yield over the matched synthetic Treasury yield. GO takes value of one for general obligation bonds and zero for revenue bonds. Size represents the size of the bond in millions. No Traded sample excludes bonds that have been traded within 90 days of issuance. Robust standard errors are clustered as indicated and reported in parenthesis. Stars indicate significance at the 1% (***), 5% (**) and 10% (*) level.

	(1)	(2)	(3)
	Bank Holdings	Bank Holdings	Bank Holdings
Spread	-4.1496***	-4.0270***	-4.3335***
	(0.613)	(0.609)	(0.574)
Duration	0.8162*	0.7731*	0.7913*
	(0.391)	(0.396)	(0.400)
Size ($M)	-1.2115***	-1.3559***	-1.1748***
	(0.182)	(0.197)	(0.183)
GO	-18.0631***	-11.0587***	-15.0603***
	(2.432)	(2.762)	(3.090)
Observations	4,903	4,878	4,877
Adjusted R-squared	0.213	0.184	0.218
Year Quarter FE	YES	YES	YES
Use of Funds FE	YES	NO	YES
Offering Type FE	NO	YES	YES
Sample	Tax-Exempt Non-Traded	Tax-Exempt Non-Traded	Tax-Exempt Non-Traded
Cluster	Issuer & Yr-Qtr	Issuer & Yr-Qtr	Issuer & Yr-Qtr

Table IV: This Table reports first stage results from the 2SLS specification in Eq. 5. $MuniHoldings$ are the (log) of bank-level municipal bonds. Z_i measures the bank exposure to the regulatory shock as from Eq. 1. $Post$ takes value of one during the regulatory change (2009-2010), and zero otherwise (2005-2008). $Assets$ is the log of bank assets net of municipal holdings, lagged by one year. $NetIncome$ is scaled by asset and lagged by one year. Robust standard errors are clustered at the bank level and are reported in parenthesis. Significance follows: * 10 percent; ** 5 percent; *** 1 percent.

	(1)	(2)	(3)
	Muni Holdings	Muni Holdings	Muni Holdings
$Z_i * Post$	0.5626***	0.4738***	0.5077***
	(0.172)	(0.171)	(0.167)
Post	0.2646***		0.2074***
	(0.015)		(0.016)
$LogAssets_{t-1}$			0.4350***
			(0.055)
$EquityRatio_{t-1}$			2.4515***
			(0.923)
$NetIncome_{t-1}$			17.9108***
			(2.197)
$CashtoAssets_{t-1}$			0.2278
			(0.275)
Observations	22,531	22,531	18,409
Adjusted R-squared	0.877	0.884	0.894
Bank FE	YES	YES	YES
Size Decile X Year FE	NO	YES	NO

Table V: This Table reports reduced form and second stage results from the 2SLS specification in Eq. 5. $MuniHoldings$ are the instrumented (log) of bank-level municipal bonds and they are instrumented using $Z_i \, x \, Post_t$. Z_i measures the bank exposure to the regulatory shock as from Eq. 1. $Post$ takes value of one during the regulatory change (2009-2010), and zero otherwise (2005-2008). $Assets$ is the log of bank assets net of municipal holdings, lagged by one year. $NetIncome$ is scaled by asset and lagged by one year. $USGvtSecuritites$ are the sum of Treasuries and government agency obligations. Robust standard errors are clustered at the bank level and are reported in parenthesis. Significance follows: * 10 percent; ** 5 percent; *** 1 percent.

	Reduced Form		2SLS
	(1)	(2)	(3)
	US Gvt Securitites	US Gvt Securitites	US Gvt Securitites
Z_i* Post	-0.3141*	-0.3970**	
	(0.170)	(0.170)	
Muni Holdings			-0.6905*
			(0.389)
Post	-0.2452***	-0.1821***	-0.0297
	(0.016)	(0.018)	(0.094)
$LogAssets_{t-1}$		-0.1075*	0.1240
		(0.063)	(0.196)
$EquityRatio_{t-1}$		-3.4200***	-2.8284**
		(0.683)	(1.253)
$NetIncome_{t-1}$		8.5046***	20.3120***
		(2.455)	(7.255)
$CashtoAssets_{t-1}$		-0.0010	0.3303
		(0.232)	(0.357)
Bank FE	YES	YES	YES
Observations	24,705	19,965	17,304
Adjusted R-squared	0.794	0.788	-
F-Stat (1st stage)	-	-	9.14