Green Labeling

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We use a natural experiment in U.S. municipal bond markets to study why issuers choose green-labeled bonds and whether the label adds value beyond regular capital markets. Labels attract more (fewer) ESG (non-ESG) funds but have limited effects on yields and issuance sizes. Labeled governments are more inclined to make subsequent sustainability pledges, indicating social signaling rather than financial benefits as primary motivation. While labeled issuers improve environmental performance after issuance, there is no differential improvement compared to unlabeled issuers. Our findings suggest that, historically, financing green projects through green bonds has had no incremental environmental impact beyond regular markets.

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1 Introduction

Over the past decade, investor interest in socially responsible investments has surged. Among these, green bonds have emerged as a major instrument for directing capital towards environmentally friendly projects, with the total amount outstanding surpassing $3 trillion in 2024. Unlike regular bonds, the funds raised through green bonds are earmarked for sustainable projects and are considered an important instrument for financing the green transition to achieve the United Nations' Sustainable Development Goals.

However, a broad literature has found that green bonds have no or little effect on issuers' cost of capital.[1] In light of these findings, two critical questions arise: first, what motivates issuers to use such a label, when it offers limited financial benefits? Second, do green bonds create environmental value *beyond* what could have been achieved through regular capital markets?

In this paper, we address these questions by examining the U.S. municipal bond market through a novel natural experiment. In our setting, a green label is offered to a subset of issuers in a plausibly exogenous manner, which allows us to trace the responses of the issuers and investors, and ultimately study the economic and political factors motivating the use of a green bond over a regular one, and whether incremental environmental benefits exist. We also link the adoption of such labels to investor demand and pricing.

The natural experiment leverages the introduction of BAM GreenStar, a green bond verification program launched in 2018 by Build America Mutual (BAM), one of the major municipal bond insurance companies. Under this program, BAM automatically screens *every* issuance as part of its regular underwriting process, and assigns a green label to bonds that fund eco-friendly projects. This screening comes at no additional cost and with no ongoing reporting requirements for issuers. At present, BAM is the largest green bond certifier in the U.S. municipal bond markets. Furthermore, GreenStar-designated bonds are automatically labeled as green on widely used financial platforms such as Bloomberg, making it an economically significant and salient source of green bond labels.

Our empirical strategy compares changes in outcomes before and after the program's implementation among issuers with strong pre-existing relationships with BAM and those with similar ties to Assured Guaranty Municipal Corp. (AGM), another major municipal bond insurer.[2] Rather than directly comparing

[1] See, e.g. Zerbib (2019), Larcker and Watts (2020), Tang and Zhang (2020), Flammer (2021), Pástor, Stambaugh, and Taylor (2022), Baker, Bergstresser, Serafeim, and Wurgler (2022), Wang and Wu (2023), D'Amico, Klausmann, and Pancost (2024).

[2] BAM and AGM together cover around 97% of the insured municipal bond market during our sample.

issuers insured by BAM and AGM, we use historical relationship measures to alleviate concerns over the potential selection into BAM insurance in the post-program periods as a result of the GreenStar program. We show that relationships between issuers and insurance companies tend to be persistent, likely due to insurance companies' accumulated private information on their clients' creditworthiness. In particular, issuers who have exclusively relied on BAM for bond insurance in the pre-treatment period have a 32-33 percentage point higher probability of obtaining BAM insurance after the program, a 60% effect compared to the 54% unconditional probability of obtaining BAM insurance in our sample. This strategy does not require prior relationships to be random. Instead, taking the relationships as given, it assumes that the GreenStar program's initiation is uncorrelated with variations in these relationships. As such, our strategy, which relies on the persistence of these relationships, is similar to those commonly employed in the banking literature (e.g. Chodorow-Reich, 2014). We also find that issuers with pre-existing BAM and AGM relationships are economically indistinguishable across a number of dimensions, such as bond yields and issuance amount.

We focus on bonds financing water and sewer infrastructure, for two reasons. First, water projects are the most common use of proceeds category for green bonds, accounting for around 45% of U.S. municipal green bonds and 33% of global green bonds, making them an important sample to study. Second, the environmental impact of water projects is directly and systematically measurable, manifested in the quality of local drinking water and wastewater that are recorded in administrative water quality databases maintained by the U.S. Environmental Protection Agency (EPA). While drinking water on its face value may seem like a homogeneous commodity with little room for discretion on quality, there in fact exist numerous technologies with different cost and quality characteristics.[3] Thus, water bonds are both empirically and economically relevant for studying our research question.

Our first finding is that the BAM GreenStar program has a significant impact on the green municipal bond markets. Issuers with stronger pre-existing relationships with BAM, measured as the fraction of BAM-insured bonds from 2012 to 2018, experience an 18-19 percentage point increase in the likelihood of issuing a green-labeled water bond after the introduction of the program. This represents a six-fold increase compared

[3]For example, the Water Infrastructure Improvements for the Nation Act requires EPA to provide information on the cost-effectiveness of alternative technologies for drinking water delivery systems. As a result, EPA maintains Drinking Water Treatability Database (TDB) that contains information on 35 distinct treatment processes. Furthermore, EPA has developed Drinking Water Treatment Technology Unit Cost models "that can help public water systems assess the cost effectiveness of these technologies". These bottom-up engineering models estimate costs for a particular treatment process as a function of user-defined inputs such as target contaminant and raw water quality, among others. These cost estimates do not only include equipment acquisition costs, but annual operation and maintenance costs as well. These databases and models demonstrate that there are significant tradeoffs between costs and water quality when making a decision among different production technologies and how specific technology is operated after acquisition.

to the sample average probability of 3%. Our dynamic difference-in-differences estimators indicate that there is a large and immediate jump in the likelihood of issuing green-labeled water bonds for the treated group in 2019, despite similar pre-trends between the treated and control groups.

Next, we show that ESG-oriented investors value a green label. More specifically, ESG-focused mutual funds increase their ownership in treated sample by 13.3 percentage points (pp) compared to control sample. However, we also document a crowding-out effect: non-ESG funds decrease their ownership by 18.2pp, so that the total mutual fund holdings is statistically insignificant at -4.9pp. As a result, we find little evidence that the green label has a material effect on primary or secondary market bond yields, consistent with the findings of the earlier literature. Furthermore, we find no evidence of issuers deciding to upsize their green labeled issuances so that the issuance size remains unchanged. Taken together, the large increase in ESG-oriented investor demand, coupled with a drop in demand from non-ESG-oriented investors and a limited overall price impact, can potentially be explained by a high degree of substitutability between green and regular bonds resulting in demand-driven price pressure being small. This rationale is in line with Chaudhary, Fu, and Li (2023), who find that corporate bonds with similar risk characteristics are close substitutes.

Having found only weak evidence for financial incentives for green bond issuance, we ask what else might motivate issuers to choose a green bond. BAM states that one potential benefit of having a BAM GreenStar designation is to highlight the issuer's leadership role in sustainability to local stakeholders and voters. Thus, we next turn our attention to political motives and ask whether a green bond issuance motivates issuers to advertise their environmental commitments more broadly. A common way for a governmental organization to promote its green commitments is to formulate a sustainability policy, environmental pledge, climate action plan, or other similar document, and communicate them to stakeholders. As such, we parse issuers' Comprehensive Annual Financial Reports (CAFRs) and search for mentions of such plans or policies. We find a significant increase in mentionings of sustainability commitments after green bond issuance for treated issuers, consistent with green bond issuances serving as a social signaling mechanism for issuers to communicate their environmental commitments to the public. Even if stakeholders do not read CAFRs directly, they likely encounter them via media. Moreover, the effects we observe with CAFRs likely reflect broader local government communication trends.

In addition, we find evidence of political incentives for issuers to participate in the GreenStar program. The probability of issuing a green bond is 12-13pp higher for a standard deviation increase in the fraction of local votes for Democratic candidates in the most recent governor or presidential election. Combined with previous research showing that partisanship affects preferences for ESG investments (e.g., Hong and Kostovetsky 2012), our results suggest that local governments are more willing to accept the GreenStar designation in areas where voter preferences for sustainable investments are likely to be stronger.

Last but not least, we assess whether the green label leads to an improvement in treated issuers' environmental performance. It is possible that even in the absence of financial motive, green labeling results in a public commitment to environmental principles that motivate local governments to increase their green expenditures and efforts, ultimately leading to improved environmental performance. To measure environmental performance, we analyze two distinct databases maintained by the EPA. We test the impact of green labeling on environmental performance by analyzing the probability of active drinking water and wastewater quality violations, respectively, in the three years before and after a water bond issuance. We find that while the likelihood of both types of violations tends to decrease significantly three years after a water bond issuance, there is no differential decrease for treated issuers, who are more likely to issue a green bond, compared with control issuers, who are more likely to issue a regular bond (if anything, the point estimates suggest a statistically insignificant smaller improvement for treated issuers compared with control issuers). In other words, using green bonds does not result in an incremental improvement in environmental outcomes compared with what could have been achieved through regular capital markets.

Taken together, this evidence suggests that social signaling rather than financial motives are a major reason why many issuers have historically chosen to label their bonds green. However, this does not imply that the issuing local governments engage in "greenwashing" (claiming to be greener than they are, see e.g. Duchin, Gao, and Xu, 2024; Giannetti, Jasova, Loumioti, and Mendicino, 2023). On the contrary, issuers improve environmental performance after raising capital, suggesting genuine effort. That said, such improvements would have been obtained regardless of the existence of the green bond markets, suggesting that green labels mainly help make existing green investments more salient.

For participating ESG funds, a green label adds value as demonstrated by their increased willingness to participate in labeled offerings. The potential benefits include, among others, reduced screening costs and enhanced ability to demonstrate to their own clients that their capital is invested in an environmentally sustainable fashion. Since the financial performance of the investment was not affected by the label, this improved transparency is presumably a positive outcome for them. Furthermore, since the invested capital directly improved the environmental performance of the issuer, we find no evidence that the funds engaged in so-called "impact washing" (providing money for already green issuers without making any further impact, see e.g. Heath, Macciocchi, Michaely, and Ringgenberg, 2023).

Yet, our results hint at a subtler challenge in achieving environmental impact with sustainable investments: socially responsible capital may help issuers improve environmental performance, but not necessarily *beyond* what regular capital would have achieved in their absence. As such, while our setting is not designed to test the full implications of the theoretical model of Oehmke and Opp (2024), our findings are fully consistent with its predictions: for socially responsible funds to affect capital allocation, capital needs to be deployed in green projects that would *not* have been financially viable otherwise at comparable cost of capital. In our context, socially responsible capital impacts environmental performance without compromising financial performance, but this comes at the cost of crowding out regular capital, resulting in no *incremental* environmental benefit.

Our sample is large for a natural experiment (see Figure 1), making it an interesting setting to study in its own right. That said, it consists of insured bonds financing water infrastructure, and therefore, we must carefully consider the external validity of our results. Given that the literature has consistently found an absence of a substantial price response in municipal (Larcker and Watts, 2020; Baker et al., 2022), corporate (Flammer, 2021), and sovereign bond markets (Pástor, Stambaugh, and Taylor, 2022, D'Amico, Klausmann, and Pancost, 2024)[4], it seems that a typical green bond finances a project that would also financially viable at a similar cost of capital through regular capital markets. Thus, our main finding—green bonds help with transparency and social signaling but lack discernible price or environmental impact beyond those of regular bonds—is likely to apply broadly to a large number of issuances. Hence, if there exists a large number of environmentally friendly and financially viable projects globally, the $3 trillion green bond issuance to date may not necessarily imply significant incremental environmental benefits.

Our paper contributes to several strands of literature. The first studies the real impact of socially responsible investors. In theory, socially responsible capital can reduce the cost of capital of green firms relative to brown ones, resulting in more capital being allocated towards green investments (Heinkel, Kraus, and Zechner, 2001, Pedersen, Fitzgibbons, and Pomorski, 2021, Pástor, Stambaugh, and Taylor, 2021,

[4]The Finance Agency of the Federal Republic of Germany, one of the largest green bond issuers globally, notes the following in its 2024 Green Bond Investor Presentation: "Green Federal securities are part of Germany's sustainability strategy. They strengthen green financial markets and increase the *transparency for selected green budget items*.", suggesting that instead of financial benefits, Germany's main motivation for green bond issuance is to be able to communicate its green values to its stakeholders more transparently.

Oehmke and Opp, 2024).[5] In practice, several issues may limit the real impact of socially responsible capital. First, the cost of capital effect can be small if green and brown investments are close substitutes for financially motivated investors (Berk and Van Binsbergen, 2024). Second, funds may choose to engage in "impact washing" by investing in already socially responsible firms without making subsequent impact (Heath et al., 2023). Third, additional capital is unlikely to make already green firms greener in an absolute sense (Hartzmark and Shue, 2023). We contribute to this literature by showing a related but distinct challenge to achieving real impact with socially responsible capital: when a green project is financially viable through regular capital markets, the involvement of socially responsible capital may help issuers achieve environmental improvements, but not more so than the involvement of regular capital. Our results bear implications for measuring the success of impact investments: it is insufficient for socially responsible capital to merely demonstrate impact; this impact should surpass what would have been achieved without its involvement.

Second, several papers study the motivations behind socially responsible investing, with Riedl and Smeets (2017), Hartzmark and Sussman (2019), Bauer, Ruof, and Smeets (2021), and Giglio, Maggiori, Stroebel, Tan, Utkus, and Xu (2023) finding that social preferences instead of financial considerations being the main driver, although Giglio et al. (2023) find significant heterogeneity among retail investors in terms of their motivations. Heeb, Kölbel, Paetzold, and Zeisberger (2023) find in a field experiment that while many investors value sustainability, their willingness to pay for incremental impact is low. Our evidence suggests that many ESG funds are behaving consistently with this view: they value verifiably green investments, but do not increase their demand aggressively enough to impact prices.

Third, a few papers study the environmental benefits of green bonds and motivations for their issuance. Lam and Wurgler (2024) examine the descriptions of the projects the first-time green bond issuers finance, finding that most are used to refinance existing bonds or fund projects lacking novel green aspects. We take a different approach: instead of analyzing ex ante project selection, we examine an ex post, tangible real outcome—–issuers' environmental performance. Our conclusion aligns with theirs that green bonds offer no additionality beyond regular bonds. Furthermore, we investigate the motivations driving issuer participation in green bond markets beyond financial incentives, providing the first direct evidence of social signaling as a key factor behind green labeling. These results complement Flammer (2021), who investigates corporate

[5] In addition to affecting cost of capital, socially responsible investors can alternatively have an environmental impact through activism campaigns (e.g. Akey and Appel, 2020, Naaraayanan, Sachdeva, and Sharma, 2021).

green bonds and finds that their issuance is associated with improved environmental performance. While we observe similar improvements, our results highlight that they would likely have occurred without using dedicated green instruments.

2 Institutional Background

2.1 Green Bonds

In the U.S. municipal bond markets, the first green bond was issued by the State of Massachusetts in September 2013 to finance clean and drinking water projects, energy efficiency in state buildings, and open space and land remediation. More generally, typical green-eligible project categories include renewable energy, energy efficiency, pollution control, clean transportation, water, and wastewater management, and climate change adaptation.

Initially, green bonds were mainly just a self-designated label by the issuer, but more recently the majority of green bonds are reviewed by third-party verifiers. While no official definition for a green bond exists, the most widely used global standards are “Green Bond Principles” (GBP) by International Capital Market Association and “Climate Bond Initiative” (CBI) by a non-profit organization with the same name. Both standards certify third-party reviewers to assess eligibility based on the use of proceeds, transparency, and commitments to follow-up reporting. Furthermore, several data providers—most prominently Bloomberg—have established their own processes to identify green bonds, typically based on the aforementioned Green Bond Principles.

2.2 BAM GreenStar

Build America Mutual Assurance Company (BAM) is a mutual monoline municipal bond insurer that was founded in 2012. They insure bonds issued by various U.S. municipal issuers against default, focusing only on investment-grade issuers in various public infrastructure categories. The other major municipal bond insurance company, Assured Guaranty Municipal Corp. (AGM), began its operations as a monoline municipal bond insurer in 2013, having previously operated under its parent company Assured Guaranty Ltd. for several decades. Similar to BAM, AGM only focuses on insuring select categories of U.S. municipal bonds with investment-grade credit ratings.

In October 2018, BAM launched a green bond verification program called BAM GreenStar, which is certified both by GBP and CBI. A major value proposition of the program was that because BAM needs to obtain detailed information on the issuers and their underlying projects for insurance purposes anyhow, it is comparatively easy for them to start screening bonds for a green verification as a part of their regular underwriting process. As a result, BAM screens every bond it issues for such verification, and then contacts the issuer if the criteria are met. Eligible issuers are not required to accept the GreenStar designation, but it will be provided to them at no additional cost if they choose to do so. Furthermore, because BAM will also continuously monitor issuers after the issuance for insurance purposes, issuers are not required to commit to additional ongoing reporting when being assigned a GreenStar, which is in contrast to most other green bond verification programs. The existence of the insurance business also implies that the additional cost of the GreenStar program for BAM is low, providing them an inexpensive opportunity to establish a leading verification program in case the green bond market continues to expand and mature. GreenStar designation is generally displayed in the cover page of the official statement using a BAM GreenStar logo. Furthermore, BAM informs Bloomberg about each designation, and virtually all GreenStar-designated bonds appear as green bonds in Bloomberg's systems, which is a widely used green bond identifier both among practitioners and academics.

Currently, BAM is the largest provider of third-party green bond verifications in the U.S. municipal bond markets. As seen in Figure 2, the introduction of GreenStar had an immediate and large impact on the number of green bonds insured by BAM, with the number increasing from 89 in 2018 to 853 in 2019 and peaking at 1,733 in 2021. To date, AGM does not provide a similar verification program, so the number of green bonds it has underwritten over the years has been trending up much more slowly as the overall popularity of green bonds has been increasing. Despite the different roles they play in underwriting green bonds, BAM and AGM's overall market share remained stable and their total number of bonds underwritten are similar over time (see Appendix Figure A4).

Furthermore, along many other important dimensions, the businesses of BAM and AGM seem to be quite comparable. Figure 3 plots the market shares of BAM and AGM across different rating categories for water bonds. Virtually no issuers in the highest rating categories (AAA and AA+) choose to buy bond insurance during our sample period, given that such insurance would provide little credit enhancement for their bonds. This is especially true because both insurance companies are AA-rated themselves, meaning that the credit enhancement they provide cannot improve the insured rating of a bond above said category. Moreover, highly rated municipal issuers tend to be large governments such as states, for which credit default swap markets exist as an alternative way for investors to manage their credit risk. Instead, issuers in lower investment grade categories (A+ to BBB-) are more likely to benefit from credit enhancement provided by bond insurance, , as evident from significantly higher market shares for both AGM and BAM in these categories. Overall, despite significant variation in insurance market penetration across credit ratings, both companies seem to have comparable market shares across these categories.

Figure 4 plots the market shares of BAM and AGM across states. Again, there is significant variation in insurance market penetration across states, with issuers in some states such as Alabama and Pennsylvania being much more likely to buy insurance compared to issuers in many other states. Overall though, we don't see large differences in geographical footprints between the two companies except in a few states such as West Virginia and New Mexico where BAM has a significantly higher market share than AGM, and states such as North Dakota and New Jersey where AGM has a significantly larger market share than BAM. To account for these differences in geographical footprints, we use state-by-year fixed effects in all our specifications.

3 Hypothesis Development

The introduction of green bond markets can have four potential effects compared to a case where only regular bond markets existed:

1. **Contractual commitment.** Green bond allows issuer to contractually commit to a green project over a brown one.

2. **Costly signaling.** Green bond allows issuers to commit to sustainabilty even in the presence of contracting frictions. For example, issuing a green bond is an observable signal about the green values of the issuer, which may prompt it to increase environmental efforts to avoid reputational damages.

3. **Information asymmetries.** Green bond reduces informational asymmetries about project greenness between the issuer and other stakeholders such as investors. In the presence of delegated portfolio management (mutual funds in our case), a slight variation of this mechanism is that while the fund manager is fully informed about the greenness of the project, a dedicated label allows end-investors to verify that their capital is indeed deployed in an environmentally sustainable fashion.

4. **No effect.** Green bonds do not significantly affect incentives or information sets of any relevant agents.

Note that the first three channels are potentially non-mutually exclusive. Also, while the first channel is potentially important, our setting essentially holds the underlying contract fixed, as we will describe in

Section 5 more in detail. As a result, our study focuses on the informational and ex-post incentive channels of green labeling, which differentiates from earlier studies that focus on the combined effect of all three channels. With these considerations, our first hypothesis is:

Hypothesis 1: The effect of green label on investor demand

H_0: Holding the underlying contract fixed, a green label has no informational or incentive effects and hence no effect on investor demand.

H_1: Holding the underlying contract fixed, a green label increases issuers' commitment to environmental outcomes or reduces informational asymmetries between issuer and investors, increasing the demand from environmentally conscious investors.

Next, if a green label increases the demand from environmentally conscious investors, we ask whether this has a significant impact on bond price or quantity. An increase in investor demand may lower bond yields, and/or may prompt the issuer to upsize the issuance, allowing it to raise more capital at a similar cost. Alternatively, an increase in environmentally conscious investors' demand may not have significant impact on prices or quantities, if other investors are able to easily substitute between green and regular bonds.

Hypothesis 2: The effect of green label on bond price and quantity

H_0: An increase in environmentally conscious investor demand has no significant effect on bond price and/or quantity.

H_{1a}: An increase in environmentally conscious investor demand lowers bond yields.

H_{1b}: An increase in environmentally conscious investor demand increases issuance amount.

Next, we ask what motivates investors to choose a green bond over a regular one. The first motivation is the direct pecuniary benefits by being able to obtain cheaper financing from investors (Hypothesis 2). The other possibility is that the issuer gets non-pecuniary benefits from a green label by being able to communicate its environmental commitments to other stakeholders.

Hypothesis 3: The non-pecuniary benefits of a green label

H_0: A green label has no informational or incentive effects and hence does not affect issuer's incentive to promote its environmental commitments.

H_1: A green label provides a credible signal about issuer's environmental commitments, increasing its willingness to promote its environmental commitments.

Note that up to this point, none of the alternative hypotheses distinguish between commitment and information channels of green labeling. For that, we need to study real environmental outcomes. If the green label allows issuer to credibly commit to environmental sustainability, we should see its environmental efforts and performance to improve after the bond is issued. If, on the other hand, the effects of the label are purely informational (and do not affect issuer's cost of capital), we shouldn't expect environmental improvement compared to a case where the same project was financed through a regular bond. This leads us to our last hypothesis:

Hypothesis 4: The environmental effects of a green label

H_0: A green label does not improve issuer's environmental performance.

H_1: A green label improves issuer's environmental performance.

4 Data and Sample

4.1 Primary Market Data

We obtain municipal bond primary market issuance data from Mergent Municipal Bond Database. We collect variables such as issuer name, issuance date, and bond characteristics such as yield, amount of issuance, time to maturity, credit ratings, tax codes, call option flag, bond insurance indicator, name of the bond insurer, and more. We convert credit ratings into numerical values with smaller numbers indicating higher ratings (1=AAA/Aaa, 19=D/C) and take the average across available ratings issued by the three different agencies rounded to the nearest integer. Unlike for other bonds, the amount of issuance for zero coupon bonds is expressed as face value in Mergent database. We use the offering price to adjust the amount to correspond to the actual amount of money raised.

If a bond is taxable at federal and/or state-level, we first adjust their yields using maximum federal and state tax rates (τ_t^{fed} and $\tau_{s,t}^{state}$, respectively) from NBER TAXSIM:

$$y_{s,t}^{posttax} = (1 - \tau_{s,t}^{tot}) y_{s,t}^{pretax}, \tag{1}$$

where

$$(1-\tau^{tot}_{s,t}) = \begin{cases} (1-\tau^{fed}_{t})(1-\tau^{state}_{s,t}),\ t < 2018 \\ 1-(\tau^{fed}_{t}+\tau^{state}_{s,t}),\ t \geq 2018 \end{cases} \tag{2}$$

This transformation takes into account the fact that state taxes can be deducted from federal taxes until the Tax Cuts and Jobs Act in 2018 but not afterwards. Similarly to e.g. Schwert (2017), this assumes that the marginal investor lives in-state and is in the highest tax bracket.

Following Goldsmith-Pinkham, Gustafson, Lewis, and Schwert (2023), we use maturity-matched Municipal Market Advisors' AAA-rated yield as a tax-exempt benchmark rate to convert post-tax yields to credit spreads. We supplement these data with information on green bond status from Bloomberg.[6]

4.2 Secondary Market Data

We also use secondary market trading data from MSRB's Municipal Securities Transaction Database to measure secondary market yields. This database contains information about the date of the bond transaction, the amount and price transacted, and transaction type (inter-dealer, customer buy, or customer sell). We use the first available transaction yield after one month up to six months to measure secondary market prices.

4.3 Mutual Fund Ownership

We use CRSP Survivor-Bias-Free US Mutual Fund Database to measure mutual funds' participation in municipal bond offerings. For each bond in our sample, we search the entire CRSP database for mentions of bond ownership at 9-digit CUSIP level, and use the first available ownership report that mentions bond ownership between 90 days before and 180 after the dated date of the bond to measure primary market participation. Next, we split funds into ESG funds and non-ESG funds based on two alternative approaches. First, using the data from Cohen, Gurun, and Nguyen (2020), we classify a fund as green if it has "ESG" or "green" in its name, or if it is listed as an ESG fund either by USSIF (The Forum of Sustainable and Responsible Investment) or by Charles Schwab. We update this measure to include data from the 2023 snapshot of fund classifications. Second, following Baker et al. (2022), we split funds by fund name, using

[6]Because Bloomberg's green bond indicator can also be added after the bond issuance, we also create another, stricter definition of a green bond: in addition to bond being classified as green by Bloomberg, we require that its prospectus mentions words "green bond" or "green star" at least once to better ensure that the green bond status was observable to primary market investors. Both words are counted regardless of whether there is space between the two words or not. We also count "green revenue bond", "green general obligation bond", and "green pension obligation bond". This refinement does not significantly affect our results, as shown in Appendix Table A1.

a set of substrings to identify funds with an orientation toward responsible investing.[7]

4.4 Text-Based Measures of Sustainability Policies

To measure issuers' sustainability commitments over time, we use MSRB's Continuing Disclosure Database. Based on SEC Rule 15c2-12, most municipal bond issuers are required to submit Comprehensive Annual Financial Reports (CAFRs) to MSRB after each fiscal year. We obtain these documents for the majority of issuers, and search them for indications of whether the issuer has a formal environmental sustainability policy in place. Such sustainability policies generally outline government's commitment to practices and standards designed to promote environmentally and socially responsible operations. Such policies and pledges have quite diverse names, however, with different governments calling them 'Climate Action Plan', 'Sustainability Pledge', or 'Environmental Sustainability Statement', for example.

To capture these different permutations, we proceed as follows. First, we use a thesaurus to identify close synonyms to words 'strategy', 'commitment', and 'statement'.[8] Then, we use the following words to capture words related to sustainability: 'climate', 'sustainability', 'sustainable', 'environment', 'environmental'. In an alternative, wider specification we also include the words 'green', 'eco', 'carbon', 'energy efficient', 'energy efficiency', 'renewable energy' into this set. Using these two sets of words, we count the occurrences in the prospectus where one word from each set occurs no more than two words apart from each other. Lu and Nakhmurina (2022) use a somewhat similar approach to measure cities' climate adaptation.

4.5 Issuer Environmental Performance

We use two alternative measures of environmental performance of local governments. First, we obtain drinking water violation data on and prior to June 2022 from U.S. Environmental Protection Agency (EPA). The EPA sets legal limits on over ninety contaminants in drinking water. We obtain data on drinking water violations from the EPA's Safe Drinking Water Information System (SDWIS). SDWIS contains information on public water systems from the Public Water System Supervision Program, including monitoring, enforcement, and violation data related to requirements established by the Safe Drinking Water Act. For each calendar day,

[7]'calvert', 'catholic', 'church', 'clean', 'domini', 'environment', 'environmental', 'esg', 'faith', 'green', 'impact', 'kld', 'parnassus', 'social', 'sri', 'walden'.

[8]Resulting set of words: 'strategy', 'action', 'approach', 'blueprint', 'design', 'method', 'plan', 'planning', 'policy', 'procedure', 'program', 'project', 'scenario', 'scheme', 'system', 'commitment','engagement', 'guarantee', 'need', 'pledge', 'promise', 'responsibility', 'statement', 'proclamation', 'report'.

we calculate the number of active water quality violations for a given water district.[9] Based on this variable, we then calculate the probability of having a drinking water violation in a given year for a given county. We then merge these data with bond issuance data using the date of the issuance and county FIPS codes, which we manually categorize for all Mergent issuances. Since EPA's definition of a water system is very broad (ranging from single a drinking water well operated e.g. by a highway rest stop to a major municipal water supply network serving hundreds of thousands of inhabitants), we use various filters to remove systems that are unlikely to be operated by municipal bond issuers. In particular, we only include community water systems owned by local governments or public/private partnerships that have more than 10,000 customers. These water systems are more likely to be large enough and to have the authority to issue municipal bonds.

Second, we obtain wastewater violation data from EPA's Integrated Compliance Information System (ICIS) for National Pollutant Discharge Elimination System (NPDES) Dataset that is mandated by the Clean Water Act. Note that while both drinking water violation (SDWIS) and wastewater violation (NPDES) databases are maintained by the EPA, they are distinct databases with different structures. Perhaps the most notable difference between these two databases is that for SDWIS, violations are reported at the water system level (e.g. NEW YORK CITY SYSTEM), whereas wastewater violations in NPDES are reported at facility-level (e.g. NORTH RIVER WATER POLLUTION CONTROL PLANT).

We download all facilities where the ownership type code indicates local government ownership,[10] and calculate the number of active effluent violations (E90) per facility. Then, we aggregate the number of violations to county FIPS-level before merging with our municipal bond sample.

4.6 Election Data

Finally, we use data from Election Atlas to measure governor and presidential election voting outcomes at the state level during the sample period. We use the most recent election and survey results when matching these outcomes to other panel data sets.

4.7 Sample and Summary Statistics

Our sample includes BAM- and AGM-insured municipal bonds issued with the use of proceed category "WTR" (water) in Mergent from 2015 to 2021. We focus on water bonds for three reasons. First, this

[9] In addition to actual water quality violations (Maximum Contaminant Level Violation, Treatment Technique Violation, Maximum Residual Disinfectant Level Violation), SDWIS contains information on various monitoring and reporting violations. We exclude these categories as they are not directly related to the water quality and environmental performance of the water system.

[10] Municipal or Water District (MWD), Municipality (CTG), Mixed Ownership (Mixed Ownership (e.g., Public/Private) (MXO), County Government (CNG), School District (SDT), District (DIS), GOCO (Gov Owned/Contractor Operated) (GOC).

category provides the cleanest match between GreenStar eligible project categories and project categories in the Mergent Municipal Bond Database which helps reduce noise. Second, water bonds constitute the largest green bond category in the U.S. municipal bond markets, with approximately 45% of all green bonds being in this category. Third, the environmental outcomes of these projects can be uniformly measured using EPA's drinking water quality data.

Green municipal bonds are extremely rare prior to 2015. Because the BAM GreenStar program was introduced in October 2018, throughout the paper, we measure years ending in September (i.e. the year 2019 includes calendar months from October 2018 to September 2019, the year 2020 includes calendar months from October 2019 and September 2020, and so forth). This way, our sample period includes four full pre-treatment years (2015-2018) and three post-treatment years (2019-2021). Because we examine changes in water violations three full years after bond issuances, and violations data are only available through July 2022, our water quality tests have a shorter bond issuance sample period (2015-2020).

We present summary statistics in Table 1. In our full sample, 3% of bonds are green-certified. This statistic is much higher—around 21%—in the subsample of BAM-insured water bonds in the post-treatment period, consistent with the GreenStar program having a large influence in the market. An average bond in our sample has a yield of 2.33%, a spread of 52 basis points, and a numerical credit rating of 5.56 which corresponds to a rating between A+ and A (or A1 and A2). BAM and AGM have similar market shares in our sample—54% of bonds are insured by BAM, and 46% by AGM. At the issuance level (Panel B), an average issuer has a 13% probability of having at least one active drinking water pollution code violation, and a 56% probability of having at least one active wastewater pollution code violation.

5 Empirical Approach

To identify the causal effects of green labeling on bond and issuer outcomes, we use a difference-in-differences approach around the BAM GreenStar program. We compare changes in outcomes, such as bond yields and issuer environmental outcomes, before and after the introduction of the program between issuers with strong pre-existing relationships with BAM and those with strong pre-existing relationships with AGM.[11] We focus our analysis on water bonds for the reasons described in Section 4.7. We estimate models

[11]We further validate all of our results by adding a third difference using bonds in GreenStar-eligible categories and those in ineligible categories, with a focus on water (eligible) and education (virtually always ineligible) bonds. This triple difference empirical design is restrictive—a competing alternative hypothesis must relate to BAM-insured issuers only, to the post-GreenStar program period only, and to water bonds only. This rules out, among other things, time-varying differences in economic fundamentals between issuers who historically chose BAM instead of AGM as their insurer.

of the following form:

$$Y_{ijt} = \beta_1 Post_t \times Treat_j + \beta_2 Treat_j + \theta X_{ijt} + \gamma_{rating\times t} + \eta_{state\times t} + \varepsilon_{ijt}, \tag{3}$$

where i denotes issuer, j denotes bond, and t denotes year. $Post_t$ is an indicator variable that takes the value of one in years after 2018. X_{ijt} is a vector of bond level control variables, including time to maturity, indicator variables for bank qualification, state and federal tax exemption, General Obligation, whether it is issued to raise new money or to refund an existing issuance, and whether the bond has call and put options embedded, respectively. We also include rating-by-year fixed effects, denoted by $\gamma_{rating\times t}$, to absorb time-varying differences in outcomes (such as yields and spreads) across bonds in different rating categories. We further condition on state-by-year fixed effects, denoted by $\eta_{state\times t}$, to absorb time-varying state-level fiscal institutions and financial conditions that may affect outcomes. We cluster standard errors at the issuer level.

$Treat_j$ is a continuous variable that measures an issuer's historical relationship with BAM. It is defined as:

$$Treat_j = \frac{N\,BAM_j^{12-18}}{N\,BAM_j^{12-18} + N\,AGM_j^{12-18}}, \tag{4}$$

where $N\,BAM_j^{12-18}$ is the number of bond issuances insured by BAM from 2012 to 2018, and $N\,AGM_j^{12-18}$ is the number of bond issuances insured by AGM from 2012 to 2018. The idea behind this treatment variable is that issuers with stronger pre-existing relationships with BAM should be more likely to use BAM going forward, and thus more likely to receive the treatment (the GreenStar designation). We formally test this assumption in Section 5.1. The *Treat* variable has a mean of 0.5, a standard deviation of 0.36, a 25^{th} percentile value of 0.02, and a 75^{th} percentile value of 0.77. These statistics suggest that there are significant variations across issuers in terms of their ex ante reliance on BAM insurance.

5.1 Identification Assumption

Our empirical approach compares outcomes before and after the BAM GreenStar program among issuers with prior relationships with BAM and AGM. This approach relies on the assumption that changes in outcomes, such as municipal bond yields and issuer environmental performance, would have evolved similarly across the two groups of issuers in the absence of the GreenStar program. To substantiate this assumption, a natural question to ask is whether the issuers who have strong pre-existing relationships with

BAM have similar economic characteristics to those who do not. In Table 2, we perform a covariate balance test. We split the sample based on whether *Treat* is above the median, and compare bond characteristics between issuers in the above- and below-median groups. As expected, the two groups of issuers differ in their tendency to get BAM and AGM insurance. They are similar in other dimensions such as yield, amount of issuance, and other bond characteristics. The only statistically significant difference is with the average maturity of their bond issuance, but the difference is economically small (about 0.38 years). Still, we make sure to carefully control for time to maturity in our regressions.

Our treatment variable measures pre-existing relationships between the issuer and BAM. By using this treatment variable, our first-stage result will be stronger when issuer-insurer relationships are more persistent, i.e., issuers with stronger pre-existing relationships with BAM are more likely to continue using BAM in the future, and thus more likely to receive the treatment (the GreenStar designation). Frequent switching between issuers and insurers will weaken the "first-stage" result on green bond issuance. However, we formally test this in Section 6.1 and find that the first-stage effects on the issuance of green-labeled bonds are substantial.

To further validate this treatment variable, we also show that insurer relationships are indeed persistent in municipal bond markets.[12] Specifically, we test whether the *Treat* variable, measured in the pre-treatment periods, predicts BAM insurance in the post-treatment periods. The results are reported in Table 3. In Column (1), we examine this relationship at the issuance level, and in Column (2), we analyze it at the bond level. In both cases, we find that issuers who have exclusively relied on BAM for bond insurance in the pre-treatment period have a 32-33 percentage point higher probability of obtaining BAM insurance after the program. These estimates are statistically significant at the 1% level. Furthermore, the magnitude of these findings is economically meaningful when compared to the 54% unconditional probability of obtaining BAM insurance in our sample.

6 Results

6.1 Effect on Green Bond Issuance

In this section, we establish strong first stage effects of the GreenStar program on certified green bond issuances. Using the difference-in-differences approach described in Equation 3, we find that the program had a major impact on the prevalence of green bonds in the municipal bond markets. Table 4 Panel A

[12] See Amornsiripanitch (2022) and Agrawal and Kim (2022) for prior work that also employs empirical strategies based on sticky relationships between municipal bond insurers and issuers.

shows that issuers with strong relationships with BAM experienced an 18-19 percentage point increase in the probability of issuing a green water bond after the introduction of the GreenStar program. The coefficient on *Treat* is small and statistically insignificant, which suggests that prior to the introduction of the GreenStar program, BAM and AGM customers do not have a meaningful difference in their propensity to issue a green bond.

We also estimate dynamic difference-in-differences models and plot the coefficient estimates on the interaction term in Figure 5. The figure shows a large and immediate jump in the probability of issuing green water bonds for treated groups in 2019, despite parallel pre-trends between treated and control groups.

6.2 Effect on Socially Responsible Capital

When asked about the benefits of having a BAM GreenStar designation, BAM states that one of the benefits is that "The GreenStar designation may widen and deepen an issuer's investor base to include the rapidly expanding group of investors pursuing ESG strategies." Motivated by this statement, and prior evidence in Baker et al. (2022) and Flammer (2021) that green bonds are associated with higher ownership concentration and ownership by green funds, we investigate whether there is a causal link between a green label and the flows of socially responsible and other capital.

We study this question through the lens of mutual fund ownership of municipal bonds, because data do not allow us to observe the ownership of municipal bonds by every individual investor. Focusing on mutual fund investors allows us to analyze separately the behaviors of ESG-oriented and non-ESG-oriented investors after the implementation of the green labeling program. For this test, we exclude bonds that do not have any mutual fund ownership throughout the sample period. As described in detail in Section 4.3, we use two methods to classify ESG- and non-ESG-oriented funds: we follow the definition of Cohen, Gurun, and Nguyen (2020) in Table 5 Panel A and the definition of Baker et al. (2022) in Panel B.

Table 5 Panel A Column (1) shows that there is a 13.3 percentage point increase in the proportion of bonds held by ESG funds. The magnitude amounts to a thirteen-fold increase on the unconditional mean of 1%. In contrast, non-ESG fund ownership shows a statistically significant decrease, as shown in Column (2). As a result, Column (3) suggests that there is no statistically significant change in the total proportion of mutual fund ownership. We further examine the number of ESG-oriented and non-ESG-oriented funds holding of the bond issuance in Columns (4) through (6) and reach similar conclusions. In Panel B, we classify ESG funds based on the methodology in Baker et al. (2022), and find quantitatively similar results.

While the increase in ESG fund ownership is easy to understand through their green preferences and investment mandate, the reason why non-ESG funds decrease their ownership is less clear. To us, there are two possibilities: first, despite the absence of a statistically significant effect on bond yields, we cannot dismiss the possibility that green bonds may lead to a small decrease in yields by a few basis points. If this was the case and non-ESG funds were extremely price sensitive, this small decrease in yields may motivate substitutions to other, comparable assets. This would be in line with Chaudhary, Fu, and Li (2023), who find that corporate bonds with similar risk characteristics are close substitutes. The other possibility is that these investors have explicit "anti-ESG" preferences or beliefs, causing their demand to drop as a result of the green label. This would be consistent, for instance, with Garrett and Ivanov (2022), who study the effects of anti-ESG laws and policies in Texas.

6.3 Bond Yields, Spreads, and Amount of Issuance

After establishing that the green verification program led to a large and statistically significant increase in the number of green-certified bonds and changes in the composition of the investor base, we then ask if these issuers experience a lower cost of capital as a result, and whether issuers take the opportunity to increase their overall issuance amount.

Despite the strong treatment effects on green bond issuance, we find limited evidence that the green label affects bond yields and spreads, in both the primary and secondary markets. In Table 6, we present regression results of Equation 3, using bond yields and spreads as outcome variables. Columns (1) and (2) show that on average, treated issuers experience a statistically insignificant 1.1 and 0.6 basis points decrease in bond yield and credit spreads, respectively, in primary markets. Similarly, we find statistically insignificant results when looking at secondary market yields and spreads.[13] We control for bond rating-by-year and state-by-year fixed effects, and a vector of bond characteristics including maturity, state tax exemption flag, federal tax exemption flag, General Obligation flag, bank qualification flag, call option flag, put option flag, and whether the bond is used to raise new capital or refund an existing bond.

Additionally, we test whether treated issuers raise more capital after the green verification program. To conduct this analysis, we sum up the amount of issuance at the issuer-year level. We report the results in Table 7. Again, we find little evidence that issuers raise more capital as a result of the program.

Taken together, the limited price effect suggests a high degree of substitutability between green and

[13] Columns (3) and (4) have lower numbers of observations because municipal bonds are relatively thinly traded in the secondary markets.

regular bonds and a relatively high price elasticity of demand. The muted quantity effects are consistent with investor substitution rather than a net increase in aggregate investor demand.

6.4 Political Incentives

Having found limited evidence for financial incentives for green bond issuance, we ask what else might motivate issuers to choose a green bond. BAM states that another potential benefit is that "Green Bond issuance highlights the issuer's leadership role to its local stakeholders, mayors, councils, and voters." Motivated by this statement, we explore whether there are non-financial incentives for issuers to participate in green verification programs.

First, we investigate whether issuers who participate in green bond issuances are more likely to advertise and promote their green values through policies such as sustainability plans, environmental pledges, and climate action plans. The idea is that if issuers perceive local voters and investors to be ESG-friendly, then there would be political motivations for them to make their green commitments more salient to local people. To this end, we analyze issuers' Comprehensive Annual Financial Reports (CAFRs) for mentions of such policies and test whether treated issuers are more likely to signal their commitment to sustainability actions following the GreenStar program. We study CAFRs because they are mandatory and standardized, providing a consistent lens through which we can assess and compare local government communications with stakeholders. Even if many stakeholders may not directly peruse the CAFRs, they likely receive indirect exposure through local media coverage and other popular outlets. Furthermore, any observed effect on communications via CAFR is likely to indicate a more broad effect on local governments communications.

As shown in Table 8, we find a statistically significant increase in the frequency of mentionings of such pledges in issuer annual reports. Treated issuers have a 27 percentage points increase in the frequency of such mentioning, regardless of whether we use a narrower set of phrases in Column (1) (excluding terms such as "green bond", and focusing on terms such as "climate action plan"), or a wider set of phrases in Column (2). We take this as evidence that the green label may act as a credible signal that motivates issuers to convey their green commitments.

Additionally, we examine whether local political partisanship affects the tendency of issuers to adopt green labeling. Numerous pieces of evidence suggest that partisanship affects the preferences for ESG investments (e.g. Hong and Kostovetsky 2012). Therefore, we hypothesize that local governments are more likely to accept green verification in areas where voter preferences for sustainable investments are stronger.

In Panel B of Table 4, we find that a one standard deviation (around 8%) increase in the fraction of state residents voting for Democratic leaders in the most recent gubernatorial elections is associated with a 12-13 percentage point increase in the probability of issuing a certified green bond.

6.5 Real Outcomes: Drinking Water and Wastewater Quality

Next, we study the environmental effects of green-labeled bond issuances. We examine not only whether these bonds lead to environmental improvements, but also whether these improvements surpass those achievable with unlabeled, regular bonds. Given that we find little evidence that local governments have lower bond costs or higher issuance amounts due to green labeling, it is likely that local environmental performance does not change as a result of green labeling. However, if green labeling represents a form of public commitment to green principles, local governments may increase green expenditures and efforts even in the absence of a change in bond issuance costs for reputation reasons. This might result in improved environmental performance.

We measure issuers' environmental performance using comprehensive drinking water and wastewater monitoring and violations data obtained from the EPA. Because these outcomes vary over time both in the years before and after a bond issuance, we conduct event studies around green-labeled and unlabeled water bond issuance using a panel-data structure, and measure the subsequent changes in water quality.[14] Specifically, we measure the level of drinking water and wastewater pollution code violations three years before and after a water bond issuance in the county where the issuer is located. Effectively, we ask: after the GreenStar program, did treated and control issuers experience differential improvements in their water quality?

Our empirical specification takes the following form:

$$\begin{aligned} Y_{jt} = &\sum_{t=-3}^{+2} \alpha_t I(\text{Event Year} = t) \times Treat_j + \sum_{t=-3}^{+2} \beta_t I(\text{Event Year} = t) \\ &+ \beta_3 Treat_j + \gamma_{rating \times t} + \eta_{state \times t} + \delta_j + \varepsilon_{jt}, \end{aligned} \tag{5}$$

where j denotes bond issuance and t denotes event year. Because our pollution violation dataset only extends until 2022, we limit our sample to bonds issued after the program's implementation but on or before 2020, allowing us to measure violations over the full three years after a bond issuance. The set of coefficients β_t

[14] The results are similar if we use cross-sectional issuance level specification as in Eq. (3) and change in water quality 2-years after the issuance as y-variable.

measures the average impact on pollution after any water bond issuance. The set of coefficients α_t measures whether such impact varies across the level of treatment (and thus likelihood of receiving a green label). We condition on the set of control variables and fixed effects discussed before, and additionally control for bond-fixed effects (δ_j) given the new panel data structure to study evolutions of water quality within a bond issuance.

The regression results are reported in Table 9. In both columns, the coefficient loadings on the event year indicators (β_t in Equation 5) show that after a water bond issuance, the probability of pollution violations decreases on average. This reduction is larger and more statistically significant over time, which is expected because water investments may take time to influence water quality.

While water quality improves, on average, after a water bond issuance, the coefficient loadings on the interaction terms (α_t in Equation 5) are all statistically insignificant, suggesting no *differential* improvement for issuers who have stronger relationships with BAM and thus are more likely to issue green-labeled bonds. Moreover, we separately plot the event-time estimates for issuers with $Treat$ above and below the median. The coefficient estimates are plotted in Figure 6 and tabulated in Appendix Table A2. Both groups experience a reduction in the likelihood of water pollution violations and the effects build up over time. However, there are no statistically different reductions across the two groups of issuers.

To summarize, when investigating the environmental performance of issuers, we find that despite the observed increasing water quality after a water bond issuance, there is no differential improvement attributable to the issuance of green-labeled bonds.

7 Implications and External Validity

Having presented all our results, we will now discuss their implications in light of the hypotheses we developed in Section 3. First, even when holding the underlying contract fixed, we find strong demand effects from environmentally conscious investors and promotion of environmental values from issues. Hence, we can rule out the null hypothesis that the label did not affect any agents' incentives or information sets. However, since we don't find any effect on bond prices and quantities, or incremental effects on environmental performance, it seems that the effect of the label was mainly informational without an effect on financial and environmental incentives. This implies that the introduction of green bond markets has shifted financing for many financially viable, environmentally sustainable projects from regular bonds to green instruments, contributing to the growth of green finance without an associated contribution to environmental sustainability.

Next, we will discuss to what extent we expect this mechanism to generalize to other settings beyond our immediate sample. As with any natural experiment, this is an important question to ask, but perhaps even more so in our setting given that the global green bond markets are highly heterogeneous in terms of the underlying green projects and the type of issuers.

First, given the similar nature of the underlying project, we expect our results to generalize to other water and sewer infrastructure projects beyond our specific sample. As demonstrated by Figure 1, this is by far the most frequent project category that green bonds are used for in the U.S. municipal bond markets, with dedicated water and sewer bonds accounting for around 45% of all green bonds during our sample period. Water and sewer projects are also an important component of the global green bond landscape—they are the most frequent category of green projects internationally with a 33% deal share, according to Climate Bonds Interactive's global Green Bond database covering not only municipal, but corporate and sovereign bond issuers.[15]

Second, for other types of green projects, it is not a priori obvious whether we should expect results similar to ours. On the one hand, for projects such as energy and buildings, there may be more scope for issuers to choose between alternative technologies with different levels of environmental impact. Furthermore, the incentive structures for corporate issuers may be different than those in our setting, in which case investors may value the commitment benefits of a green bond more. On the other hand, prior literature has largely found only small or no greenium in not only municipal bond markets (e.g. Larcker and Watts, 2020, Baker et al., 2022), but also corporate (Flammer, 2021) and sovereign bond markets (Pástor, Stambaugh, and Taylor, 2022, D'Amico, Klausmann, and Pancost, 2024). The limited yield effects suggest that these projects are also largely financially viable at a similar cost of capital via the regular capital markets, and that green investors do not subsidize green alternatives with significantly lower yields. Thus, similar projects would have likely been financed in their absence. Thus, we also have reasons to expect that a nontrivial amount of issuances in these other settings as well. To the extent that the stock of financially viable, green label-eligible projects was globally large at the offset of green bond markets, its incremental environmental benefits may have been significantly more modest than what the multi-trillion dollar issuance amounts to date might otherwise suggest.

To conclude, our results suggest that despite the recent growth of green bond markets, a significant fraction of these issuances may not have yielded incremental environmental benefits. Furthermore, the

[15] Since water and sewer infrastructure projects tend to be local, their share of the global issuance amount is smaller at around 8%.

study demonstrates an important that is likely to be applicable for most green investments: when assessing investor's environmental impact, it is not sufficient to demonstrate that the green project yielded tangible environmental improvements. Instead, one must demonstrate that the impact was larger that would have been obtained in the absence of the investment.

8 Conclusion

In this paper, we use a natural experiment in the U.S. municipal bond markets to study the impact of green bond labels on financial and environmental outcomes. Green labels attract ESG-oriented capital and push away non-ESG oriented capital. Additionally, issuing governments are more likely to make formal sustainability pledges after the issuance of a green bond, and issuers in Democratic states are more likely to accept the green label, indicating the political role of green labeling.

However, despite the widespread use of green bonds as a tool for financing sustainable projects, we find little evidence that adding a green label brings additional economic value to issuers. Specifically, we find little evidence that the green label affected bond yields, the amount of capital raised, or issuers' environmental performance. Our findings suggest that in many cases, financing green projects through green bonds has had no incremental environmental impact compared to what could have been achieved through regular capital markets, and green bonds are primarily used for social signaling purposes rather than achieving tangible economic and environmental benefits.

Overall, these findings suggest that when evaluating whether to deploy environmentally conscious capital, it is critical to assess whether the investment project would have been financially viable in the absence of such capital. These findings have significant implications for policymakers, socially responsible investors, and issuers seeking to finance sustainable projects using green instruments.

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Figure 1: U.S. Municipal Green Bonds by Use of Proceeds

This figure displays the number of green bonds by Mergent Use of Proceeds categories during our sample period of 2015 to 2021 (year ending in September).

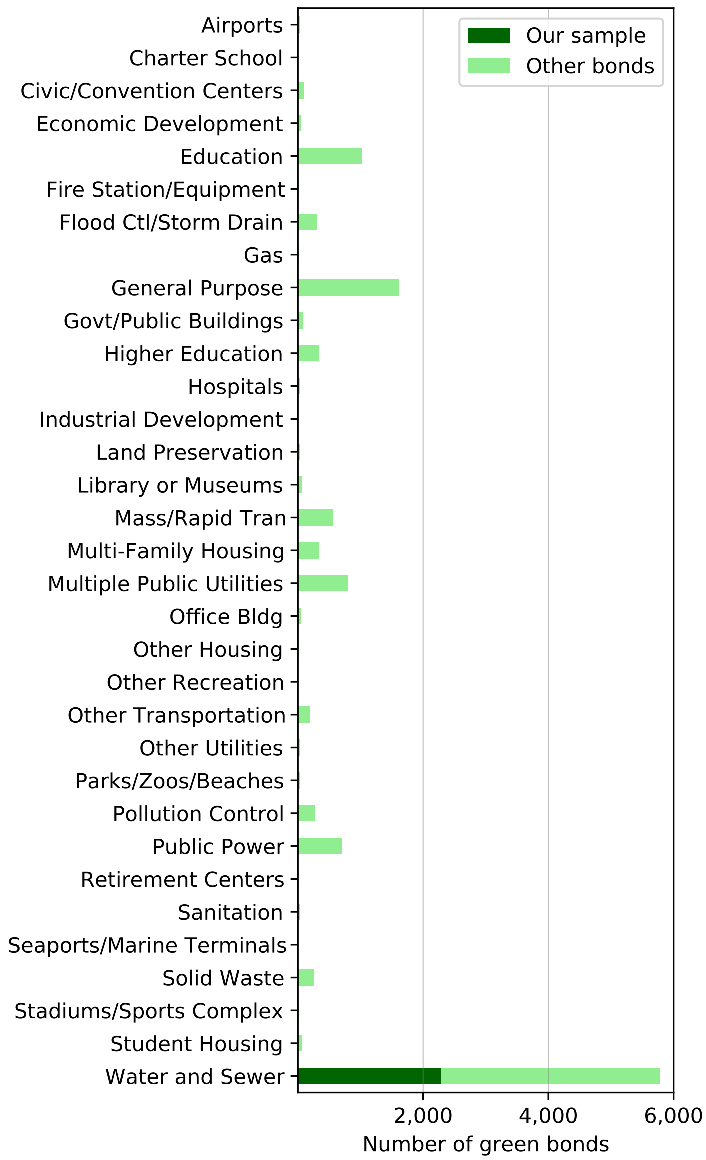


Figure 2: The Impact of BAM GreenStar on the U.S. Green Municipal Bond Markets

This figure displays the number of Bloomberg-designated green bonds underwritten by BAM and AGM from 2013 to 2022 (year ending in September). The data for the year 2022 are incomplete and include bonds issued between October 2021 and August 2022.

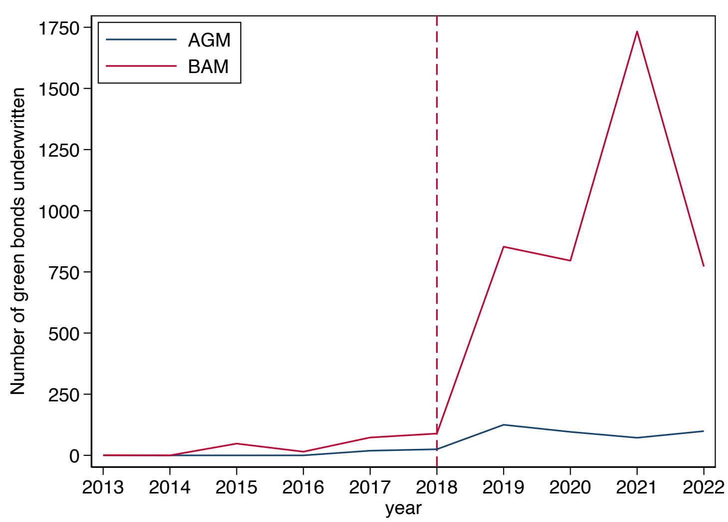


Figure 3: Market Share of AGM and BAM by Credit Rating Categories

This figure displays the market share of BAM and AGM across different rating categories. The sample includes all water bonds (insured and uninsured) from 2015 to 2021.

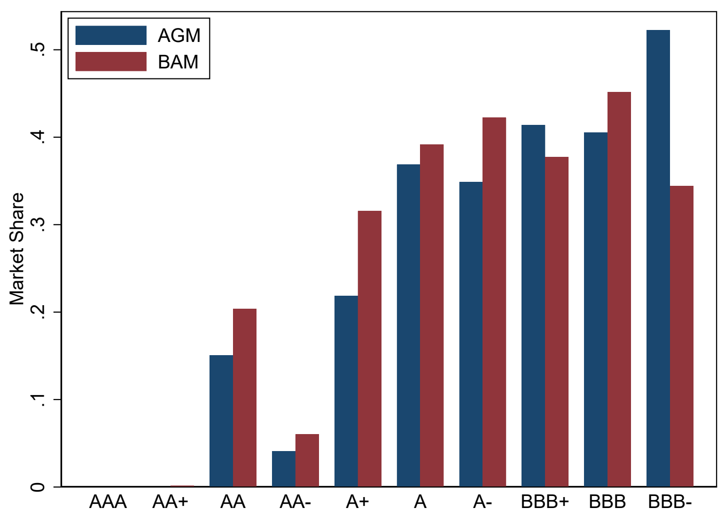
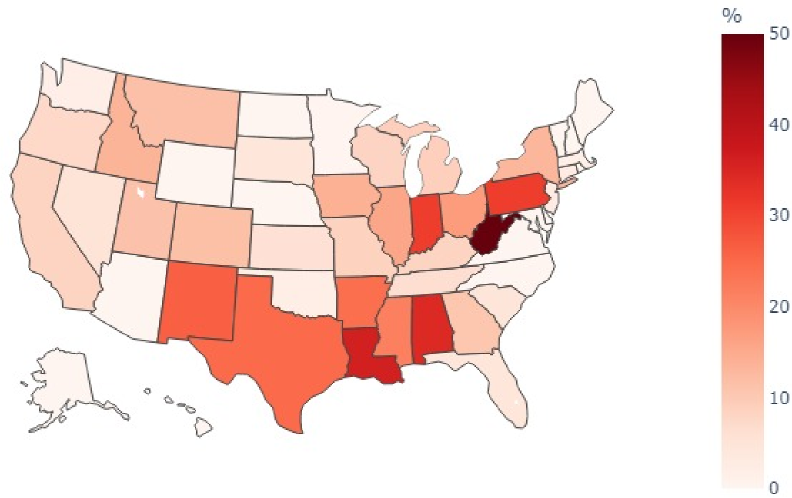


Figure 4: Market Share of AGM and BAM by Geography

These figures display the heatmaps of BAM and AGM market shares across states. The sample includes all water bonds (insured and uninsured) from 2015 to 2021.

Panel A: BAM Market Share



Panel B: AGM Market Share

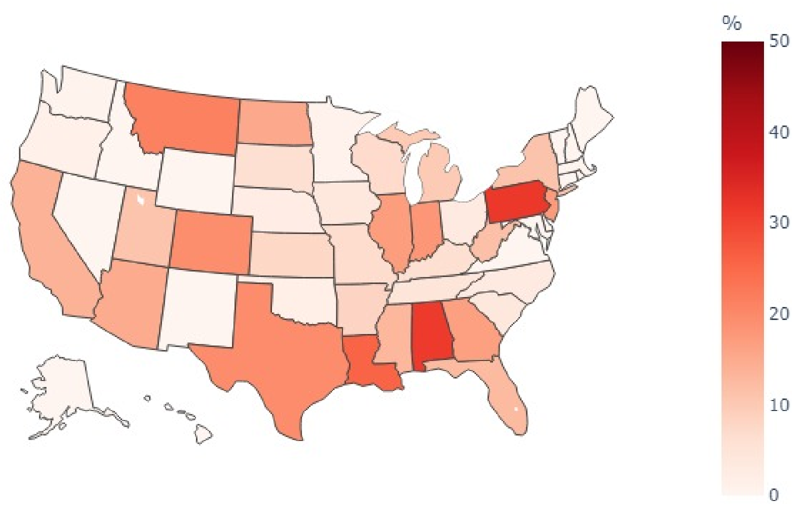


Figure 5: Effect of BAM GreenStar Program on Green Bond Issuance

This figure displays the coefficient estimates from the dynamic difference-in-differences regression models and two-tailed 95% confidence intervals based on standard errors clustered at the issuer level. The outcome variable is an indicator variable for whether the bond is labeled as green.

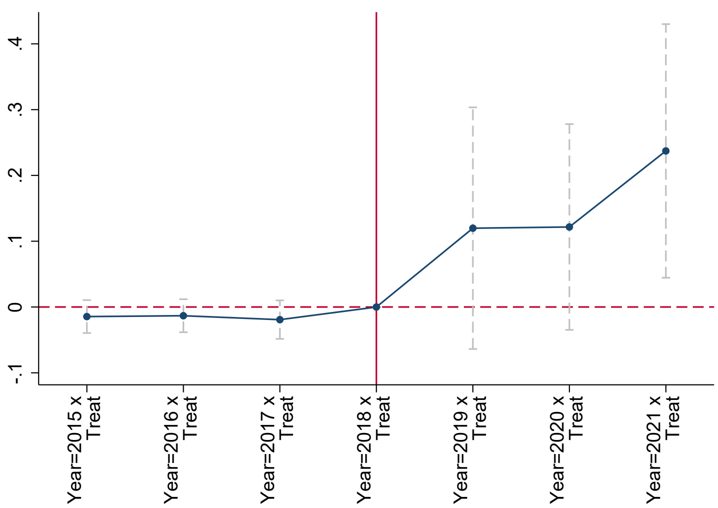
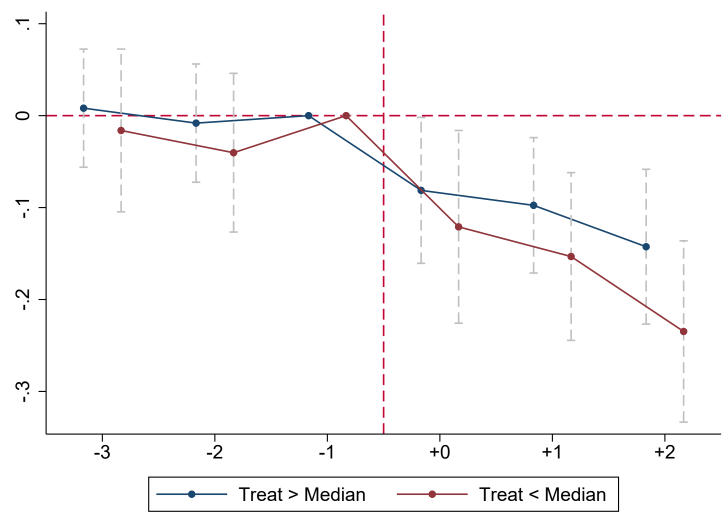


Figure 6: Effect of BAM GreenStar Program on Issuer Drinking Water Quality

This figure displays the coefficient estimates in the dynamic difference-in-differences regression models and two-tailed 95% confidence intervals based on standard errors clustered at the issuer level. The outcome variable in Panel A (Panel B) is an indicator variable for active drinking water (wastewater) pollution violations. The tabular versions of the estimates are presented in Appendix Table A2.

Panel A: Drinking Water Pollution Violations



Panel B: Wastewater Pollution Violation

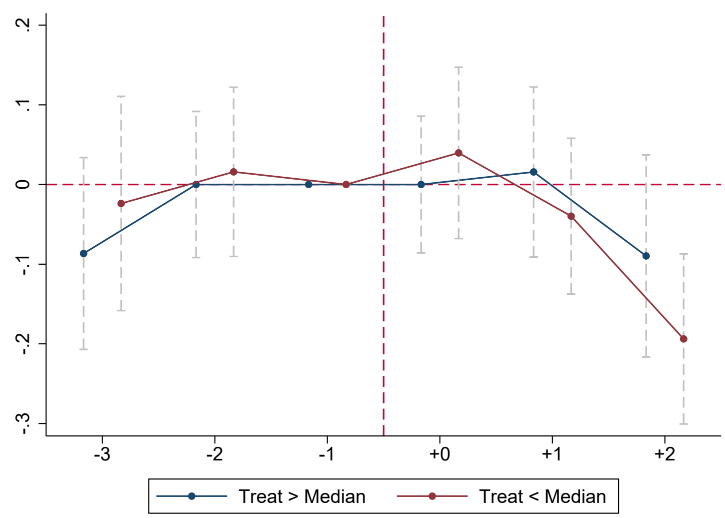


Table 1: Summary Statistics

The sample includes BAM- and AGM-insured water bonds issued between 2015 and 2021. In order to construct the treatment variable, we restrict the sample to issuers who issued at least one insured bond between 2012 and 2018. Panel A reports summary statistics for variables at the bond level. *I (Green)* is an indicator variable that takes a value of one if a bond issuance is labeled green by Bloomberg. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *I(BAM Insured)* and *I(AGM Insured)* are indicator variables that take a value of one if a bond is insured by BAM and AGM, respectively. *Yield* is the post-tax issuance yield on the municipal bond. *Yield (Secondary)* is the post-tax secondary market yield on the municipal bond between 2 and 6 months after the issuance. *Spread* and *Spread (Secondary)* are the differences between issuance and secondary market yields and the maturity-matched Municipal Market Advisors' AAA-rated yield, respectively. *Issue Amount* is the size of the bond issuance. *Rating* is the credit rating of the bond issuance. We convert credit ratings into numerical values with smaller numbers indicating higher ratings (1=AAA/Aaa, 19=D/C) and take the average across available ratings issued by the three different agencies rounded to the nearest integer. *I (New)* is an indicator variable that takes a value of one if the bond is issued to raise new money, rather than to refund an existing bond. *Bank Qualified* is an indicator variable that takes a value of one if the bond is qualified for tax-advantaged status when purchased by commercial banks. *Taxable (Federal)* and *Taxable (State)* are indicators that take a value of one if the bond is not tax-exempt from federal and state income taxes, respectively. *General Obligation* is an indicator variable that takes a value of one if the bond is a General Obligation bond. *Callable* and *Putable* are indicator variables that take a value of one if a bond has call and put options embedded, respectively. *Years to Maturity* is the number of years after which the bond matures. *% Vote Democrat* measures the proportion of the state population who voted for Democratic leaders in the most recent gubernatorial election. *Mutual Fund Owners* measure the number of mutual funds holding the bond (conditional on having any mutual fund owners). *% Held by Mutual Funds* measures the percentage amount of the bond held by mutual funds (conditional on having any mutual fund owners). *ESG (Non-ESG) Fund Owners* measures the number of ESG (non-ESG) mutual funds holding the bond. Note that the variables ending with *"(CGN)"* are constructed following Cohen, Gurun, and Nguyen (2020) and the variables ending with *"(BBSW)"* are constructed following Baker et al. (2022). *% Held by ESG (Non-ESG) Funds* measures the percentage amount of the bond held by ESG (Non-ESG) mutual funds. Note that all mutual fund-related variables are measured on the sample of bonds having non-zero mutual fund owners. Panel B reports summary statistics for variables at the issuance level. *I (Drinking Water Violations)* is an indicator variable that takes the value of one if the number of active drinking water contaminant violations in the county where the issuer is located is above zero. *I (Wastewater Violations)* is an indicator variable that takes the value of one if the number of active wastewater contaminant violations in the county where the issuer is located is above zero. ΔSustainability Policy$_{t\rightarrow t+1}$ and ΔSustainability Policy (Wide)$_{t\rightarrow t+1}$ are text-based measures that capture the changes in the frequency of appearances of phrases that are related to sustainability policies, planning, and pledges. ΔSustainability Policy$_{t\rightarrow t+1}$ includes a narrower set of phrases and ΔSustainability Policy (Wide)$_{t\rightarrow t+1}$ includes a wider set of phrases (see Section 4.4).

Panel A: Bond Level

	Mean	SD	P25	Median	P75	N
I (Green)	0.03	0.18	0.00	0.00	0.00	23,254.00
Treat	0.50	0.36	0.02	0.52	0.77	23,254.00
I (BAM Insured)	0.54	0.50	0.00	1.00	1.00	23,254.00
I (AGM Insured)	0.46	0.50	0.00	0.00	1.00	23,254.00
Yield	2.33	0.90	1.65	2.35	3.10	23,253.00
Spread	0.52	0.24	0.34	0.52	0.69	23,253.00
Yield (Secondary)	2.51	0.88	1.81	2.56	3.24	4,764.00
Spread (Secondary)	0.51	0.29	0.30	0.53	0.73	4,764.00
Issue Amount (M)	0.69	1.10	0.19	0.34	0.69	23,254.00
Rating	5.56	2.08	3.00	6.00	7.00	23,254.00
I (New)	0.44	0.50	0.00	0.00	1.00	23,254.00
Bank Qualified	0.60	0.49	0.00	1.00	1.00	23,254.00
Taxable (Federal)	0.04	0.20	0.00	0.00	0.00	23,254.00
General Obligation	0.45	0.50	0.00	0.00	1.00	23,254.00
Taxable (State)	0.03	0.17	0.00	0.00	0.00	23,254.00
Callable	0.57	0.49	0.00	1.00	1.00	23,254.00
Putable	0.00	0.00	0.00	0.00	0.00	23,254.00
Years to Maturity	10.55	6.50	5.20	9.74	15.18	23,254.00
% Vote Democrat	0.45	0.08	0.40	0.43	0.48	23,254.00

Panel A: Bond Level (Continued)

	Mean	SD	P25	Median	P75	N
Mutual Fund Owners	1.55	1.32	1.00	1.00	2.00	1,149.00
% Held by Mutual Funds	0.55	0.31	0.29	0.50	0.84	1,149.00
ESG Fund Owners (CGN)	0.04	0.20	0.00	0.00	0.00	1,149.00
ESG Fund Owners (BBSW)	0.03	0.17	0.00	0.00	0.00	1,149.00
% Held by ESG Funds (CGN)	0.01	0.08	0.00	0.00	0.00	1,149.00
% Held by ESG Funds (BBSW)	0.01	0.07	0.00	0.00	0.00	1,149.00
Non-ESG Fund Owners (CGN)	1.51	1.29	1.00	1.00	2.00	1,149.00
Non-ESG Fund Owners (BBSW)	1.52	1.29	1.00	1.00	2.00	1,149.00
% Held by Non-ESG Funds (CGN)	0.54	0.31	0.29	0.50	0.83	1,149.00
% Held by Non-ESG Funds (BBSW)	0.54	0.31	0.29	0.50	0.83	1,149.00

Panel B: Issuance Level

	Mean	SD	P25	Median	P75	N
I (Drinking Water Violation)	0.13	0.34	0.00	0.00	0.00	1,440.00
I (Wastewater Violation)	0.56	0.50	0.00	1.00	1.00	1,474.00
ΔSustainability Policy$_{t\rightarrow t+1}$	-0.02	0.49	0.00	0.00	0.00	1,163.00
ΔSustainability Policy (Wide)$_{t\rightarrow t+1}$	-0.02	0.57	0.00	0.00	0.00	1,163.00

Table 2: Characteristics of Bonds issued by Treated and Control Issuers

This table reports the means and standard deviations of water bond characteristics issued by issuers with *Treat* ≥ Median and *Treat* ¡ Median from 2015 to 2018, the period before BAM GreenStar program. The last two columns report the P-values of the differences in means and the standardized differences in these variables between the two groups of counties. Standard errors are clustered at the issuer level. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018. For variable definitions, see Table 1 legend.

	Treat < Median		Treat ≥ Median			
	Mean	SD	Mean	SD	P-value	Std. Diff.
I (BAM Insured)	0.29	(0.45)	0.83	(0.37)	(0.00)***	0.93
I (AGM Insured)	0.71	(0.45)	0.17	(0.37)	(0.00)***	-0.93
Log Issue Amount	12.72	(1.09)	12.75	(1.07)	(0.63)	0.02
Yield	2.51	(0.85)	2.47	(0.86)	(0.25)	-0.03
Rating	5.83	(2.17)	5.42	(2.09)	(0.10)	-0.14
Gross Spread	1.33	(0.86)	1.27	(0.80)	(0.53)	-0.05
Bank Qualified	0.62	(0.48)	0.64	(0.48)	(0.70)	0.02
Taxable (Federal)	0.02	(0.12)	0.02	(0.13)	(0.86)	0.01
General Obligation	0.49	(0.50)	0.51	(0.50)	(0.88)	0.02
Taxable (State)	0.03	(0.16)	0.04	(0.19)	(0.38)	0.04
Callable	0.58	(0.49)	0.57	(0.50)	(0.69)	-0.01
Years to Maturity	10.73	(6.48)	10.35	(6.38)	(0.03)**	-0.04
I (New)	0.43	(0.49)	0.45	(0.50)	(0.55)	0.03

Table 3: Effect of Historical BAM Relationship on BAM Insurance

This table tests whether historical relationship with BAM predicts whether the issue purchases bond insurance from BAM in the post-GreenStar program years. The sample includes BAM- and AGM-insured water bonds issued in the post-treatment period (between 2019 and 2021). *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *I (BAM Insured)* is an indicator variable that takes a value of one if a bond is insured by BAM. Column (1) reports results at the issue level, and Column (2) reports results at the bond level. Standard errors are clustered at the issuer level.

	I (BAM Insured)	
	Issuance Level	Bond Level
	(1)	(2)
Treat	0.326***	0.331***
	(0.070)	(0.064)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	390	5,429
R^2	0.33	0.39

Table 4: Effect of BAM GreenStar Program on Green Bond Issuance

This table displays coefficient estimates and their standard errors from Equation 3. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *Post* is an indicator variable that takes a value of one for years after 2018. I (Green) is an indicator variable that takes the value of one if the bond is labeled green. Column (1) reports results at the issue level, and Column (2) reports results at the bond level. Panel B studies heterogeneous treatment effects for regions with different political attitudes. *% Vote Democrat* measures the proportion of the state population who voted for democratic leaders in the most recent gubernatorial election. *% Vote Democrat* is standardized to have a mean of zero and a standard deviation of one. Lower order terms are controlled for. Standard errors are clustered at the issuer level.

Panel A: Effect on Green Bond Issuance

	I (Green)	
	Issuance Level	Bond Level
	(1)	(2)
Post × Treat	0.191***	0.179***
	(0.062)	(0.056)
Treat	0.007	0.002
	(0.005)	(0.003)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	1,658	23,254
R^2	0.32	0.34

Panel B: Heterogeneity across % Vote Democrat

	I (Green)	
	Issuance Level	Bond Level
	(1)	(2)
Post × Treat	0.182***	0.167***
	(0.060)	(0.054)
Post × Treat × % Vote Democrat (std)	0.132*	0.120*
	(0.068)	(0.061)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	1,658	23,254
R^2	0.34	0.35

Table 5: Effect of BAM GreenStar Program on ESG and Non-ESG Fund Ownership

This table displays coefficient estimates and their standard errors from Equation 3. In Panel A, we classify ESG funds based on the measure used in Cohen, Gurun, and Nguyen (2020), and update this measure to include data from the 2023 snapshot. In Panel B, we classify ESG funds based on the measure used in Baker et al. (2022). *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *Post* is an indicator variable that takes a value of one for years after 2018. In Columns (1) through (3), the outcome variables are the percentage amount of the bond held by ESG-oriented mutual funds, non-ESG-oriented mutual funds, and any mutual fund, respectively. In Columns (4) through (6), the outcome variables are the number of ESG-oriented mutual funds, the number of non-ESG-oriented mutual funds, and the total number of mutual funds holding a bond, respectively. We exclude bonds that don't have any mutual fund ownership throughout the sample. Bond Controls include time-to-maturity, state tax exemption flag, federal tax exemption flag, General Obligation flag, bank qualification flag, call option flag, put option flag, bond size, and whether the bond is used to raise new capital or refund an existing bond. Standard errors are clustered at the issuer level.

Panel A: CGN ESG Fund Measure

	Ownership (%)			Number of Funds		
	ESG	Non-ESG	All	ESG	Non-ESG	All
	(1)	(2)	(3)	(4)	(5)	(6)
Post × Treat	0.133***	-0.182**	-0.049	0.277***	-0.974**	-0.697
	(0.051)	(0.077)	(0.071)	(0.078)	(0.450)	(0.451)
Treat	-0.029	0.086**	0.056	-0.057	0.224	0.167
	(0.021)	(0.043)	(0.046)	(0.037)	(0.178)	(0.189)
Rating-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bond Controls	Yes	Yes	Yes	Yes	Yes	Yes
Std. Err. Cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
Number of Obs.	1,149	1,149	1,149	1,149	1,149	1,149
R^2	0.21	0.45	0.43	0.23	0.48	0.46
Mean (Dep. Var.)	0.01	0.54	0.55	0.04	1.51	1.55

Panel B: BBSW ESG Fund Measure

	Ownership (%)			Number of Funds		
	ESG	Non-ESG	All	ESG	Non-ESG	All
	(1)	(2)	(3)	(4)	(5)	(6)
Post × Treat	0.136***	-0.185**	-0.049	0.240***	-0.937**	-0.697
	(0.045)	(0.076)	(0.071)	(0.079)	(0.463)	(0.451)
Treat	-0.029	0.085**	0.056	-0.049	0.216	0.167
	(0.021)	(0.043)	(0.046)	(0.038)	(0.179)	(0.189)
Rating-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bond Controls	Yes	Yes	Yes	Yes	Yes	Yes
Std. Err. Cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
Number of Obs.	1,149	1,149	1,149	1,149	1,149	1,149
R^2	0.25	0.45	0.43	0.21	0.47	0.46
Mean (Dep. Var.)	0.01	0.54	0.55	0.03	1.52	1.55

Table 6: Effect of BAM GreenStar Program on Bond Yields

This table displays coefficient estimates and their standard errors from Equation 3. Column (1) and (2) studies primary market yields and spreads, and Columns (3) and (4) studies secondary market yields and spreads. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *Post* is an indicator variable that takes a value of one for years after 2018. In Columns (1) and (3), the outcomes are post-tax bond yields in the primary and secondary markets, respectively. In Columns (2) and (4), the outcomes are the credit spreads in the primary and secondary markets, respectively. Bond Controls include time-to-maturity, state tax exemption flag, federal tax exemption flag, General Obligation flag, bank qualification flag, call option flag, put option flag, and whether the bond is used to raise new capital or refund an existing bond. Standard errors are clustered at the issuer level.

	Primary Market		Secondary Market	
	(1)	(2)	(3)	(4)
	Yield	Spread	Yield	Spread
Post × Treat	-0.011	-0.006	0.067	0.020
	(0.049)	(0.022)	(0.066)	(0.036)
Treat	0.026	-0.006	-0.040	-0.006
	(0.021)	(0.011)	(0.031)	(0.019)
Rating-by-Year FE	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes
Bond Controls	Yes	Yes	Yes	Yes
Std. Err. Cluster	Issuer	Issuer	Issuer	Issuer
Number of Obs.	23,253	23,253	4,752	4,752
R^2	0.87	0.57	0.83	0.44

Table 7: Effect of BAM GreenStar Program on Issuance Amount

This table displays coefficient estimates and their standard errors from difference-in-differences regressions at the issuer-year level. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *Post* is an indicator variable that takes a value of one for years after 2018. *Log Issuance Amount* is the total amount of the bond issuance by a given issuer in a given year. Column (1) includes refunding bonds and Column (2) excludes refunding bonds. Standard errors are clustered at the issuer level.

	Log Issuance Amount	
	All	Exclude Refunding Bonds
	(1)	(2)
Post × Treat	0.069	0.023
	(0.169)	(0.267)
Treat	-0.266**	-0.340**
	(0.105)	(0.168)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	1,099	469
R^2	0.29	0.33

Table 8: Effect of BAM GreenStar Program on Sustainability Policy

This table displays coefficient estimates and their standard errors from difference-in-differences regressions at the bond issuance level. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). *Post* is an indicator variable that takes a value of one for years after 2018. The outcome variables are text-based measures that capture the annual changes in the frequency of appearances of phrases that are related to sustainability policies, planning, and pledges. In Column (1), we consider a narrower set of phrases. In Column (2), we consider a wider set of phrases. The details of variable constructions are described in Section 4.4. Bond Controls include time-to-maturity, state tax exemption flag, federal tax exemption flag, General Obligation flag, bank qualification flag, call option flag, put option flag, and whether the bond is used to raise new capital or refund an existing bond. Standard errors are clustered at the issuer level.

	ΔSustainability Policy$_{t\to t+1}$	ΔSustainability Policy (Wide)$_{t\to t+1}$
	(1)	(2)
Post × Treat	0.270**	0.272**
	(0.107)	(0.118)
Treat	-0.091	-0.075
	(0.079)	(0.086)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Bond Controls	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	1,163	1,163
R^2	0.27	0.23

Table 9: Effect of BAM GreenStar Program on Issuer Environmental Performance

This table displays coefficient estimates and their standard errors from difference-in-differences regressions of Equation 5. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). Event Year indicators measure the number of years since a bond issuance. The base year for the estimation is the year prior to the bond issuance. *I (Drinking Water Violations)* is an indicator variable that takes the value of one if the number of active drinking water contaminant violations in the county where the issuer is located is above zero. *I (Wastewater Violations)* is an indicator variable that takes the value of one if the number of active wastewater contaminant violations in the county where the issuer is located is above zero. Standard errors are clustered at the issuer level.

	I (Drinking Water Violation)	I (Wastewater Violation)
	(1)	(2)
Event Year -3	-0.017	-0.002
	(0.051)	(0.080)
Event Year -2	-0.066	0.015
	(0.048)	(0.063)
Event Year -1	Base	Base
Event Year 0	-0.132**	0.050
	(0.059)	(0.065)
Event Year 1	-0.160***	-0.057
	(0.053)	(0.059)
Event Year 2	-0.231***	-0.179***
	(0.060)	(0.062)
Event Year -3 × Treat	0.026	-0.109
	(0.074)	(0.120)
Event Year -2 × Treat	0.086	-0.015
	(0.066)	(0.097)
Event Year -1 × Treat	Base	Base
Event Year 0 × Treat	0.064	-0.061
	(0.084)	(0.098)
Event Year 1 × Treat	0.071	0.092
	(0.077)	(0.107)
Event Year 2 × Treat	0.087	0.077
	(0.090)	(0.115)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Issuer FE	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	1,440	1,474
R^2	0.38	0.54

Internet Appendix

A Dynamic difference-in-differences estimates

In this section, we estimate dynamic difference-in-differences models for our bond-level outcome variables using the following specification:

$$Y_{ijt} = \sum_{t=2015}^{2021} \beta_{1t} 1(year = t) \times Treat_j + \beta_2 Treat_j + \theta X_{ijt} + \gamma_{rating \times t} + \eta_{state \times t} + \varepsilon_{ijt}, \tag{6}$$

where $1(year = t)$ represent indicator variables that take the value of one each year from 2015 to 2021. The rest of the variables are defined in Section 5. We use the year 2018 as the baseline year for our estimation and drop the year 2018 indicator's interaction term from the regressions.

A caveat with this exercise is that because our data for bond-level outcomes are structured as different cross-sections of bond issuances in years spanning 2015-2021, we lose much statistical power when estimating dynamic coefficients using a slice of the cross sections in a particular year, compared to our main specifications.

With this caveat in mind, we first study the dynamic effect of the green label on ESG and non-ESG mutual fund ownership. Results are shown in Figure A1. We find that the effects on ESG fund demand are largely driven by an initial increase followed by a potential partial reversal, whereas the non-ESG fund demand effects follow a nearly symmetric pattern. Thus, it is possible that the investor compositional shift mostly occurs in the first year after the program. However, we cannot reject a permanent effect either.

Next, we study the dynamic effects on bond yields (Figure A2) and issuance amounts (Figure A3), and find little evidence for such effects, consistent with our main results.

Figure A1: Effect of BAM GreenStar Program on ESG vs. Non-ESG Mutual Fund Ownership

This figure displays the coefficient estimates from the dynamic difference-in-differences regression models (Equation 6) and two-tailed 95% confidence intervals based on standard errors clustered at the issuer level. The outcome variables are the number and share of ESG (non-ESG) mutual fund ownership in Panel A (Panel B), described in detail in Section 4.

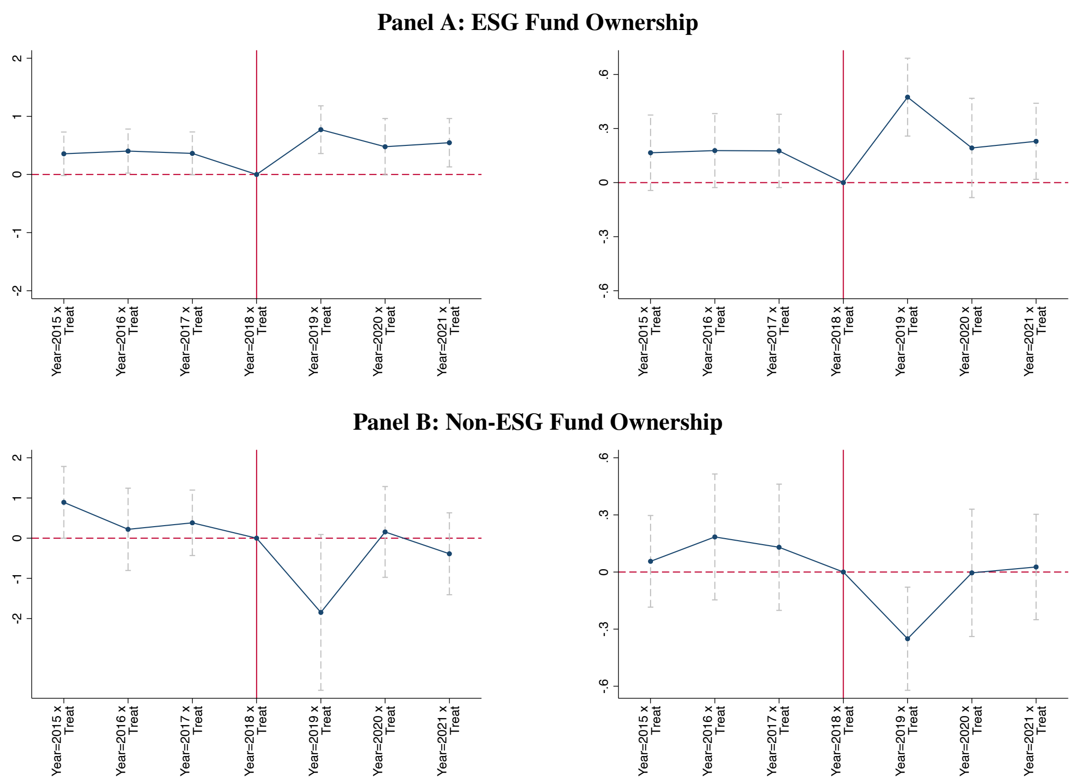
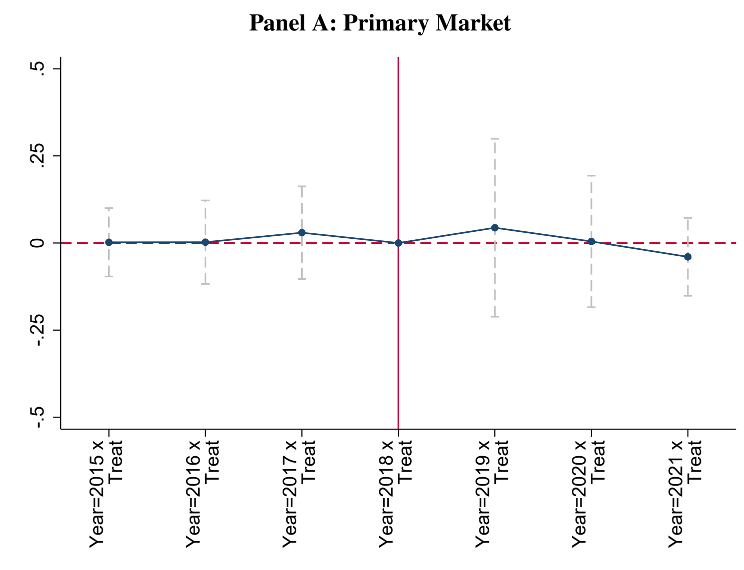


Figure A2: Effect of BAM GreenStar Program on Bond Yields

This figure displays the coefficient estimates from the dynamic difference-in-differences regression models (Equation 6) and two-tailed 95% confidence intervals based on standard errors clustered at the issuer level. The outcome variable is the post-tax bond yield in the primary market (Panel A) and secondary market (Panel B).



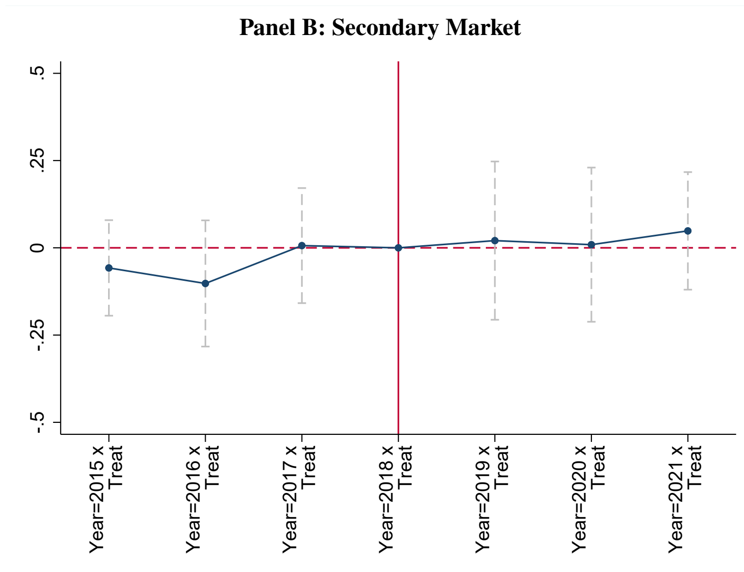
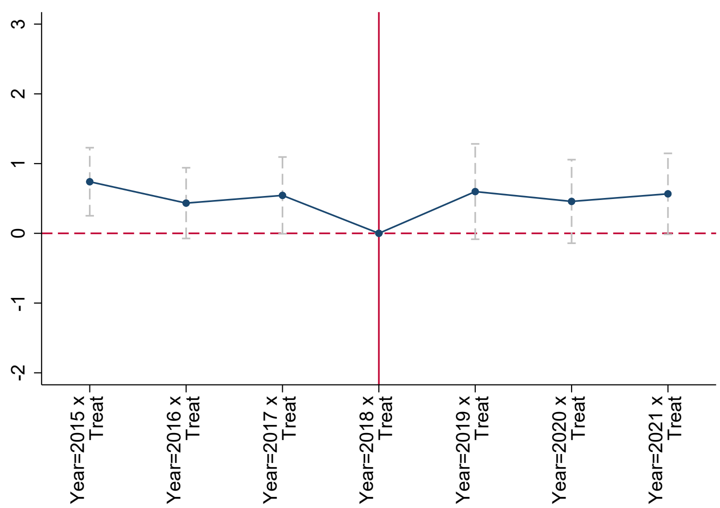


Figure A3: Effect of BAM GreenStar Program on Bond Issuance Amounts

This figure displays the coefficient estimates from the dynamic difference-in-differences regressions and two-tailed 95% confidence intervals based on standard errors clustered at the issuer level. The outcome variable is the natural logarithm of the total amount of bond issuance by an issuer in a given year.

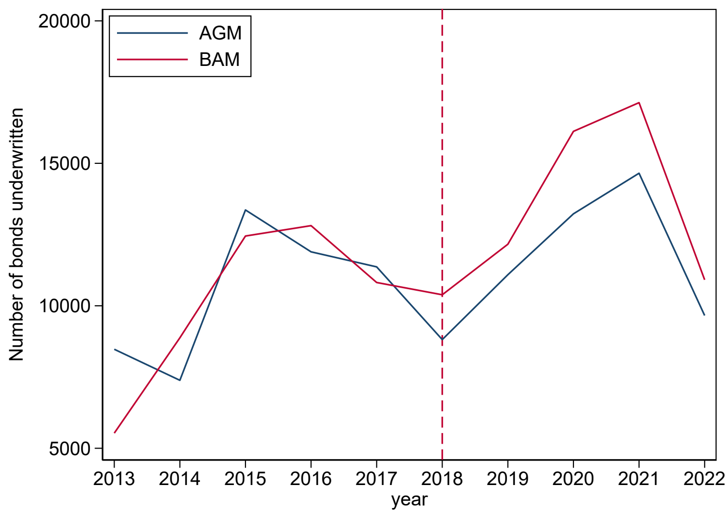


B Additional results

Figure A4: Number of Bonds Underwritten by BAM and AGM Over Time

These figures display the number of municipal bonds underwritten by BAM and AGM over time. In Panel A (Panel B), the sample includes all bonds (all water bonds) insured by either BAM or AGM from 2013 to 2022.

Panel A: All Municipal Bonds



Panel B: Water Bonds

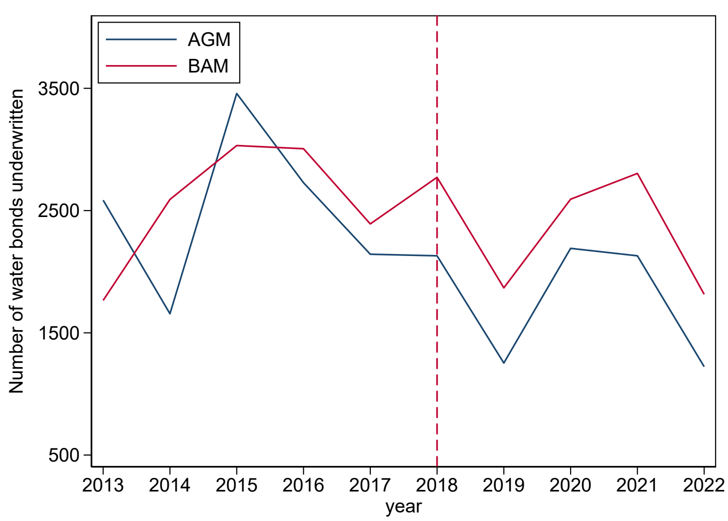


Table A1: Alternative Green Bond Classification Method

This table displays coefficient estimates and their standard errors from Equation 3. We classify a bond as a green bond if the bond is classified as green by Bloomberg and that its prospectus mentions words "green bond", "green revenue bond", "green general obligation bond", "green pension obligation bond", or "green star" at least once. Words are counted with or without spaces in between. *Treat* is a continuous variable that measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see equation 4 for details). *Post* is an indicator variable that takes a value of one for years after 2018. I (Green) is an indicator variable that takes the value of one if the bond is labeled green. Column (1) reports results at the issue level, and Column (2) reports results at the bond level. Standard errors are clustered at the issuer level.

	I (Green)	
	Issuance Level	Bond Level
	(1)	(2)
Post × Treat	0.161***	0.167***
	(0.061)	(0.056)
Treat	0.003	0.000
	(0.003)	(0.001)
Rating-by-Year FE	Yes	Yes
State-by-Year FE	Yes	Yes
Std. Err. Cluster	Issuer	Issuer
Number of Obs.	1,658	23,254
R^2	0.33	0.36

Table A2: Effect of BAM GreenStar Program on Issuer Environmental Performance

This table displays coefficient estimates and their standard errors from regressing water quality outcome variables on event time indicators, separately for issuers with an above and below median *Treat*, which measures the fraction of a municipality's bond issuances insured by BAM between 2012 and 2018 (see Equation 4 for details). Event Year indicators measure the number of years since a bond issuance. The base year for the estimations is the year prior to the bond issuance. *I (Drinking Water Violations)* is an indicator variable that takes the value of one if the number of active drinking water contaminant violations in the county where the issuer is located is above zero. *I (Wastewater Violations)* is an indicator variable that takes the value of one if the number of active wastewater contaminant violations in the county where the issuer is located is above zero. Standard errors are clustered at the issuer level.

	I (Drinking Water Violation)		I (Wastewater Violation)	
	Treat > Median	*Treat* ≤ Median	*Treat* > Median	*Treat* ≤ Median
	(1)	(2)	(3)	(4)
Event Year -3	0.008	-0.016	-0.087	-0.024
	(0.032)	(0.045)	(0.060)	(0.068)
Event Year -2	-0.008	-0.040	-0.000	0.016
	(0.032)	(0.043)	(0.046)	(0.053)
Event Year -1	Base	Base	Base	Base
Event Year 0	-0.081**	-0.121**	-0.000	0.040
	(0.040)	(0.053)	(0.043)	(0.054)
Event Year 1	-0.098**	-0.153***	0.016	-0.040
	(0.037)	(0.046)	(0.054)	(0.049)
Event Year 2	-0.143***	-0.235***	-0.090	-0.194***
	(0.042)	(0.050)	(0.064)	(0.054)
Rating-by-Year FE	Yes	Yes	Yes	Yes
State-by-Year FE	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes
Std. Err. Cluster	Issuer	Issuer	Issuer	Issuer
Number of Obs.	718	722	741	733
R^2	0.32	0.41	0.54	0.55