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August 6th, 2025

PhD Student Workshop on Climate Finance
National Bureau of Economic Research
Cambridge, MA

Dear Professors Flammer and Giglio,

I am writing to apply for the PhD Student Workshop on Climate Finance, to be held on October 9, 2025, in Cambridge. I am a PhD candidate in Economics at the University of Pennsylvania, currently starting my fifth year, and expect to complete my degree by Spring 2027. My research focuses on topics at the intersection of financial markets, climate policy, and information frictions, with particular emphasis on public finance.

One of my current projects, co-authored with Daniel Garrett and Brian Gibbons, is titled "Muni Green Bonds: Who Labels and What's Priced?" In this study, we examine the supply and pricing dynamics of ESG labels in the $4 trillion municipal bond market, leveraging a novel and unexpected third-party assessment of environmental, social, and governance (ESG) characteristics covering over $1 trillion in bonds. We show that most eligible bonds are issued without ESG labels and that local beliefs and issuance terms discourage labeling. Using a difference-in-differences design, we provide within-bond evidence that reducing ESG-related uncertainty increases investors' willingness to pay. We estimate a 3-4 basis point premium for assessed bonds highlighting what we term an "assessment effect." The greenium for higher environmental or transparency scores is smaller but significant, and pricing effects are especially pronounced for revenue bonds with material credit risk. These results speak to the broader role of ESG information in assessing credit risk and underscore the mismatch between investor demand and information supply in climate-relevant capital markets.

I am excited about the opportunity to receive feedback from peers and leading researchers at the workshop, and to engage with ongoing work in climate finance. I am particularly interested in discussions around market-based mechanisms for climate adaptation and how institutional investors incorporate transition and physical climate risks into their portfolios.

Thank you for your consideration. Please find enclosed my CV and the working draft of my paper. Professor Daniel Garrett (danielgg@wharton.upenn.edu) is available as a reference.

Sincerely,
Mahdi Shahrabi

Mahdi Shahrabi — CV

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Education

Ph.D. in Economics
University of Pennsylvania *2021-Now*

M.Sc in Economics
Khatam University, TeIAS *2018-2020*

B.Sc. in Electrical Engineering with a Minor in Economics
Sharif University of Technology *2013-2018*

Experiences

Equity Investments Intern - PanAgora Asset Management, Boston *Jun 2022 - Aug 2022*
Developed a data-driven quantitative investment strategy using Python for global stock markets, leveraging time series modeling to predict stock performance and optimize portfolio allocation.

Research Assistant - Stanford University *Jul 2018 - May 2020*
Assisted in the research for the paper "Just a Few Seeds More: The Inflated Value of Network Data for Diffusion." Simulated cascade effects using the independent cascade model in *R* and *Python*, analyzing the impact of seeding strategies on diffusion in large random networks and real-world networks.

Research Assistant - Pompeu Fabra University *Jul 2020 - Jan 2021*
Developed and simulated a life-cycle model with job choice for heterogeneous agents in *MATLAB*, analyzing economic behavior over time under uncertainty. Conducted structural estimation of the model parameters using data from the UK Household Longitudinal Study, employing econometric techniques to ensure robustness and applicability to economic policy analysis.

Research Assistant - TeIAS Jan 2018 - Sep 2019
Analyzed daily ownership data in the Tehran Stock Exchange (TSE) using *Python* to study the impact of institutional investors as blockholders on market dynamics and stability. Replicated key findings from academic papers using TSE data in *Python* and *Stata*, validating financial models in an emerging market context.

Working Papers

Who Labels and What's Priced? Evidence from Third-Party ESG Assessments in the Municipal Bond Market
With Daniel G. Garrett and Brian Gibbons
We study the supply and pricing dynamics for ESG labels using a novel and unexpected third-party assessment of environmental, social, and governance (ESG) characteristics for over $1 trillion in municipal bonds. We show that most eligible bonds are issued without ESG labels and that local beliefs and issuance terms discourage labeling. Using a difference-in-differences design in combination with these assessments, we provide within-bond evidence that reducing ESG-related uncertainty increases investors' willingness to pay. We find a 3-4 basis point premium for assessed bonds, even those with average ESG scores (i.e., ineligible for ESG labels), which we call an assessment effect. The greenium for higher environmental or transparency scores is smaller but significant. These pricing effects are consistent across local characteristics, but are much larger for revenue bonds with material credit risk. Our evidence highlights the general relevance of ESG information in assessing credit risk and a mismatch between its supply and investor demand.

Bank Stocks and Deposits Flows: Partners in Banking Stress
With Pablo D'Erasmo and Guillermo L. Ordoñez.
Bank stability relies on the stability of deposit flows. When deposits are uninsured, these flows depend on the extent of information available, both about banks' health and about depositors' behavior. For banks listed in stock markets this information is revealed quickly and widely through prices. We exploit confidential high frequency data on deposit flows to show that deposits are less stable on banks that are listed and that hold more uninsured deposits. Further, we document a nonlinearity in this relation, which suggests the existence of a doom loop between bank stocks and withdrawals.

Technical Skills

Programming Languages: Proficient in PYTHON, SQL, R; Familiar with C++
Data Analysis and Modeling: Familiar with Machine Learning, Neural Networks, NLP
Tools and Software: MATLAB, LATEX
Finance: Empirical and Theoretical Asset Pricing, Corporate Finance

Honors & Awards

- **Fellowship for Ph.D. in Economics, University of Pennsylvania** ($350,000) 2020
Awarded to up to 10 first-year students annually by the Graduate Division of Arts and Sciences.
- **Haamee Institute Fellow (Accepted)** 2020
Accepted for a scholarship for Ph.D. in Economics ($35,000); declined funding due to alternate support from the University of Pennsylvania.
- **HAND Foundation Economics Fellow (Accepted)** 2020
Accepted for a scholarship for Ph.D. in Economics ($30,000); declined funding due to alternate support from the University of Pennsylvania.
- **National Elites Foundation** Scholarship 2013 - 2018
Awarded for B.Sc. studies at Sharif University of Technology.
- **Ranked 29th**, National University Entrance Exam (Konkoor) (Mathematics and Physics) 2013
Ranked among more than 210,000 participants. Received a fellowship from the Department of Electrical Engineering at Sharif University of Technology.

Who Labels and What's Priced? Evidence from Third-Party ESG Assessments in the Municipal Bond Market*

Daniel G. Garrett† Brian Gibbons ‡

Mahdi Shahrabi§

June 25, 2025

Abstract

We study the supply and pricing dynamics for ESG labels using a novel and unexpected third-party assessment of environmental, social, and governance (ESG) characteristics for over $1 trillion in municipal bonds. We show that most eligible bonds are issued without ESG labels and that local beliefs and issuance terms discourage labeling. Using a difference-in-differences design in combination with these assessments, we provide within-bond evidence that reducing ESG-related uncertainty increases investors' willingness to pay. We find a 3–4 basis point premium for assessed bonds, even those with average ESG scores (i.e., ineligible for ESG labels)—which we call an *assessment effect*. The *greenium* for higher environmental or transparency scores is smaller but significant. These pricing effects are consistent across local characteristics, but are much larger for revenue bonds with material credit risk. Our evidence highlights the general relevance of ESG information in assessing credit risk and a mismatch between its supply and investor demand.

Keywords: Environmental, Social, and Governance (ESG) Investing, Public Finance, Investments, Municipal Bonds, ESG Labels, Greenium

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1 Introduction

Investor demand for financial instruments addressing environmental and social impacts and risks has grown substantially over the past two decades. In response, borrowers increasingly issue bonds with specific green, social, and sustainability labels—collectively referred to as "ESG-labels." These labels are meant to certify that the proceeds of the issue finance projects with positive environmental or social impacts. However, labeling remains voluntary and issuers apply ESG labels inconsistently, even when projects clearly meet established criteria for a label. A primary reason for the lack of uptake of such labels is the disagreement among both practitioners and academics surrounding the financial benefits of labeling.

In this paper, we study both the selection into ESG labeling and the related pricing implications. We ask: (1) are investors willing to pay a premium for bonds with verified underlying ESG features? And (2) if such a premium exists, what frictions or incentives lead issuers to under-label eligible bonds? Our evidence shows that issuer characteristics limit the provision of ESG-related information while investor demand for this information is broad. This information friction has a tangible impact on municipal bond prices broadly—not just the "greenest" issues.

Our empirical setting is the quasi-exogenous and unexpected release of novel ESG assessments and label eligibility opinions for over $1 trillion of municipal bonds—almost all of which were not originally labeled by the issuer. These assessments come from Kestrel Sustainability Intelligence (Kestrel), which scores bonds on environmental, social, and transparency dimensions and evaluates eligibility for green, social, or sustainability labels under International Capital Market Association (ICMA) standards.[1] Kestrel began providing these ESG assessments to institutional investors in March 2022 and released them publicly via Bloomberg Terminals on March 6, 2023. The scores now appear on the same screens as basic information about the bond.[2] This new data source significantly reduces the costs of acquiring information about the ESG-related information for municipal bonds investors.

On the supply side, we begin by examining issuers' decisions to label bonds, using Kestrel's assessments as a proxy of true eligibility for a label. We document that 82% of bonds that are eligible for an environmental label (i.e. green, sustainabililty) and 94% of bonds eligible for a social label did not adopt one at issuance. Among bonds eligible for

[1] See ICMA (2021) and ICMA (2023). Note that these are the most recent versions of the ICMA publications and that the first version of these labeling guidelines were published in 2014.

[2] The two-staged information release process allows us to partially disentangle impact of large institutional investors with explicit ESG investing goals from the impact of the broader public. During the first 12 months, only select institutions had access, which we call the "institutional information period," while quantitative scores became available to all Bloomberg users on March 6, 2023, which we call the "public information period."

a ICMA green or sustainability label, the primary determinant of voluntary self-labeling is the "greenness" of the project, as measured by Kestrel's "E" score. We also find that social, political, and financial frictions that discourage issuers from using ESG labels. Specifically, conditional on eligibility and the underlying ESG characteristics of the project, higher shares of Hispanic or Nonwhite residents, Republican voters in 2020, or residents unconcerned about climate change substantially reduce the likelihood of ESG labeling and thus the provision of ESG-related information.

On the demand side, we assess the pricing impact of this information intervention using a within-bond identification strategy in a modified difference-in-differences design. We track the changes in bond spreads following the information release and find that investors are willing to pay a premium for newly assessed bonds. We decompose this premium into the premium received for a bond with average environmental, social, or transparency (i.e., the public analogue to governance) scores, which we call the *assessment effect*, and the marginal premium for receiving relatively higher or lower scores (i.e., a *greenium*—a premium paid for green assets). Our estimates show a 3 to 4 basis points (bps) assessment effect and a small *greenium* of 1 to 2bps for bonds receiving new information that have top environmental or transparency scores. There is no social premium, as the total effect of new ESG assessment is smaller for bonds with higher social scores. These results support the idea that reducing ESG-related uncertainty affects pricing, as in the model from Avramov, Cheng, Lioui and Tarelli (2022), and that uncertainty over ESG information itself—not just the underlying green or social characteristics of the asset—drives valuation. We do not find evidence that crossing the specific eligibility thresholds into ICMA label eligibility explain pricing effects.

To gain a deeper understanding of these pricing effects, particularly the surprisingly large average assessment effect and relatively small impact of marginal environmental and transparency measures, we test three potential mechanisms: (1) institutional investor demand, (2) local issuer characteristics, and (3) project-level risk that may interact with ESG verification and information. These tests help to distinguish whether pricing reflects coordination, values-based preferences, or credit-relevant information.

Most notably among these mechanisms, we find that the pricing impacts are largest for bonds with material credit risk. We separate bonds along three dimensions: credit risk (proxied by credit ratings), liquidity risk (proxied by spreads between customer sales and purchases), and source of funding (revenue vs. general obligation). The assessment effect is over four times larger for bonds without high-grade credit ratings (9.0bps) than for highly rated bonds (2.1bps), suggesting that ESG assessments provide information that complements traditional credit ratings. We find no meaningful differences by liquidity, implying the scores do not merely coordinate trading in an otherwise extremely illiquid market. Fi-

nally, a two-way sample split shows that high-grade bonds, regardless of funding source, experience small spread declines (1–2bps), while among lower-rated bonds, the assessment effect is driven by those bonds backed by project revenue—not general tax revenue. This pattern indicates that ESG information is most valuable when also evaluating project-specific credit risk.

The other two mechanisms play a more limited role. We find some evidence that green labeled mutual funds and ETFs purchase more of the newly assessed bonds in the institutional information period, in line with earlier findings including Baker, Bergstresser, Serafeim and Wurgler (2022) and Tomunen and Yi (2023). But this effect is economically small and disappears once the scores are made public. We also find that the pricing impacts of the information intervention are very similar across a variety of local characteristics, including those characteristics predictive of labeling decisions. We split bonds by local political and climate change beliefs[3] and environmental risk[4] and find that the assessment effect is uniformly present across all eight subsamples. The marginal greenium for high-scoring bonds is concentrated in areas with more belief in climate change but lower expected climate losses.

Together, these findings suggest that ESG assessments create pricing benefits even where labeling might not be politically favored, and that issuer decisions about labeling are misaligned with where ESG-related information is most valued. Additionally, we estimate that these assessments increased the value of scored bonds by over $1 billion, two-thirds which accrued to bonds ineligible for any ESG label—making them unlikely to have been assessed absent this broad scoring initiative. These findings align with theories suggesting that uncertainty over ESG characteristics raises required returns, as in Avramov, Cheng, Lioui and Tarelli (2022), but we find that, in the municipal bond market, these effects are particularly stark in the presence of credit risk.

A causal interpretation of our estimates of the value of ESG assessments and labeling requires that the parallel trends assumption holds. In this case, it requires that, absent the information intervention, spreads for bonds receiving Kestrel scores and eligibility opinions would have moved in parallel to similar bonds without such information. We provide several supports of this ultimately untestable assumption. First, in our dynamic difference-in-differences model, we find no differences in monthly spreads between treated and control bonds in the 14 months prior to the release of the Kestrel scores—either for the general assessment indicator or for the marginal score variables. Second, the information shock was

[3]We measure beliefs using climate worry from Howe, Mildenberger, Marlon and Leiserowitz (2015) and Republican vote shares from MIT Election Data and Science Lab (2017).

[4]We measure environmental risks using FEMA Expected Loss Scores and Climate Impact Lab direct climate damages from Hsiang, Kopp, Jina, Rising, Delgado, Mohan, Rasmussen, Muir-Wood, Wilson, Oppenheimer et al. (2017).

exogenous to issuer decisions. Issuers were unaware of Kestrel's data project or the scope of assessed issues, eliminating typical self-selection concerns that arise in comparisons of green and non-green securities. Third, issuers had no control over the timing of the public release. While Kestrel now evaluates bonds at issuance on an ongoing basis, its stock of scores publicly released in March 2023 was comprised almost entirely of already issued bonds. Fourth, we include a comprehensive set of fixed effects and other controls to eliminate potential confounding factors: CUSIP, month-by-state-by-taxability, month-by-credit rating, and month-by-average trade size tercile fixed effects, as well as duration, coupon rate, log of issue size, and a second-order polynomial in maturity all interacted with time fixed effects. We also include a separate time-varying control for ex ante labeled bonds—those that already had a green, social, or sustainability label according to Mergent or Bloomberg before the novel Kestrel scores were released.

Fifth, we implement two placebo tests. The first examines the pricing of bonds in a pre-sample period from 2017–2020 by issuers who are most likely to have bonds reviewed by Kestrel in our 2021–2023 sample. The second test examines bonds that Kestrel assesses later between 2024 and 2025, focusing on their trading behavior in the 2021–2023 sample relative to unassessed bonds. These tests help rule out that selection into treatment by Kestrel drives the pricing effects. Finally, a battery of additional tests demonstrates that our findings are robust and not a function of key features of bonds within the sample. We find that these results are not driven by the liquidity of the issue, call provisions that are often attached to longer maturity bonds, issuances in states that represent a large portion of the sample (particularly California, New York, and Texas), or the choice of control variables.

This paper provides novel insights for several strands of literature. First, we advance the understanding of investors' willingness to pay a greenium for fixed income securities by demonstrating that equilibrium pricing ***within bond*** is sensitive to the ESG information environment.[5] Recent literature—especially in the municipal bond market—debates the existence and size of the greenium. By studying observably similar bonds with and without green labels, Zerbib (2019) and Baker, Bergstresser, Serafeim and Wurgler (2022) both show evidence of a price premium for green assets. Conversely, Larcker and Watts (2020) find no difference in offering yields for green bonds using a twin-bond methodology, while Baker, Bergstresser, Serafeim and Wurgler (2022) observe a small greenium in secondary market

[5]In the equity market, many studies have looked at the release of information either on rankings (e.g., Hartzmark and Sussman, 2019) or ex post realized events that arise from the endogenous behavior of firms (e.g., Derrien, Krueger, Landier and Yao, 2022; He and Zhang, 2024) and find that prices are responsive. Others have characterized green factors using this information following Pástor, Stambaugh and Taylor (2022). Here, we focus on debt financing tied to specific projects, limiting the fungibility concern common in corporate equity or debt.

trading with the same method. Li, Wang and Yu (2023) shows that the original within issuer-day comparison results in a small greenium in more recent years, although it is still precisely zero for many observations. Similarly, Tomunen and Yi (2023) also provide evidence that there is not a large greenium using an intermediary relationship-driven instrument available to certain insured issues.[6] We contribute to this literature by documenting a statistically and economically meaningful greenium in the municipal market—but also show that most of this effect derives from a broader "assessment effect" rather than the marginal greenness of a bond. This distinction helps reconcile prior mixed findings.

Another related stream of literature explores why issuers adopt ESG-related commitments or labels. Beyond attempting to capture a potentially lower cost of capital, issuers may use ESG-labeled bonds to signal a firm's commitment to the environment (Flammer, 2021; Lu, 2025) or to signal general firm quality (Tang and Zhang, 2020). These signals are often credible, as some firms increase real investments in green projects after issuing green-labeled bonds (Devine, Kok, Özgür and Yönder, 2024), though the generalizability of such findings is debated (Lam and Wurgler, 2024). Issuer characteristics also matter. Board composition and capital structure influence corporate green bond issuance (Cicchiello, Cotugno, Monferrà and Perdichizzi, 2022), and some firms may adopt ESG labels to appeal to stakeholders or attract institutional investors (Baker, Larcker, McClure, Saraph and Watts, 2022). Chang, Hu and Shen (2024), a closely related study on the determinants of green bond labeling, shows that local political preferences shape the supply and demand for green bonds by pooling green and non-green labeled municipal bonds in selection and pricing models. The advantage of our setting is that Kestrel's scores allow us to compare the choice to label bonds conditional on the underlying ESG characteristics—greatly simplifying the structure of the selection problem and sharpening inference on why some eligible bonds remain unlabeled.[7] In doing so, we are able to offer new insights into how social, political, and financial factors shape the adoption of innovation in the municipal finance market while holding constant the relevant ESG characteristics of the underlying project.

[6]Papers focusing on corporate bonds show a similar pattern of results. Flammer (2021) does not find evidence of a greenium at issuance, while Aswani and Rajgopal (2022) documents a greenium in secondary market trading of approximately 8% concentrated in financial firms' bonds. This secondary market effect may be, in part, explained by liquidity. Amel-Zadeh, Lustermans, Pieterse-Bloem, Dekker and Christopoulos (2024) show that green bonds are more liquid, less volatile, and have better execution than conventional bonds.

[7]There is also a larger related literature on subnational public entities selecting into emerging financial contracts. Studies like Pérignon and Vallée (2017) and Ang, Bhansali and Xing (2010) demonstrate that selecting into new types of financial contracts can influence both cost and risk margins of their borrowing. While Tomunen and Yi (2023) suggest that green labeling specifically does not influence municipal behavior among insured borrowers, our estimates support the idea that pricing is influenced by the labeling decision, especially where existing credit risk is material.

This study also contributes to the understanding of the value of ESG disclosure and information intermediaries in the municipal bond market—an area less explored than corporate disclosures. In equity markets, disagreement among information intermediaries (i.e., ESG scoring agencies) contributes to risk and influences investors' reactions to ESG news (Avramov, Cheng, Lioui and Tarelli, 2022; Serafeim and Yoon, 2023). Conversely, improved transparency around firms' non-financial disclosures improves market efficiency (Krueger, Sautner, Tang and Zhong, 2021) and has real outcomes for institutional investment and firm financial policy (Gibbons, 2023). Our findings highlight the importance of standardized, third-party ESG assessments in resolving information frictions in fragmented markets like municipal bonds. Municipal bonds vary widely in purpose, issuer type, and documentation quality. Gathering project-level ESG information is costly, and unlike some corporate reporters, municipalities face no unified ESG reporting mandate. Kestrel's third-party assessments lower these information acquisition costs and help match capital to projects—even when borrowers lack particularly positive ESG characteristics or have no incentive to self-label. We show that investors value this information broadly, not just for obviously green or social projects. Third-party ESG verification increases the value of assessed securities and helps overcome the institutional and political frictions that have slowed the adoption of ESG labeling in the municipal sector.

Finally, we contribute to growing literature on how investors price environmental, social, and transparency-related risks in municipal finance. On the environmental side, there is evidence investors price sea level rise risk (Painter, 2020; Goldsmith-Pinkham, Gustafson, Lewis and Schwert, 2023), heat exposure (Acharya, Johnson, Sundaresan and Tomunen, 2022), wildfire pollution (Lopez, Murphy, Tzur-Ilan and Wilkoff, 2025), and access to renewable energy resources (Cornaggia and Iliev, 2024). On the social side, research shows that investors consider risks related to healthcare interventions (Gao, Lee and Murphy, 2022; Cornaggia, Li and Ye, 2024), opioid-exposure (Cornaggia, Hund, Nguyen and Ye, 2022), and racial animus when pricing bonds (Dougal, Gao, Mayew and Parsons, 2019).[8] Concerns over transparency also are priced, including recent newspaper closures leading to less oversight over local fiscal planning (Gao, Lee and Murphy, 2020). We extend this literature by showing that investors' willingness to pay increases with third-party verification of ESG characteristics and risks, particularly along environmental and transparency dimensions, providing further evidence of the broad-based impact of ESG factors on municipal bond pricing.

[8] Bruno and Henisz (2024) provide evidence that a broad variety of ESG-related outcomes have been priced in the municipal bond market going back to the beginning of the century and that this pricing impact is increasing over time.

2 Empirical Context

Public projects in the United States, including those with significant environmental impacts, have been financed through municipal bonds issuance since at least 1812, beginning with a canal project in New York City. In 2025, the municipal bond market encompasses over $4 trillion dollars in outstanding debt with average new issuance totaling $300-$600 billion annually. This borrowing funds investments in public assets like bridges, schools, water treatment plants, energy infrastructure, and hospitals. Future public investments in renewable energy infrastructure, transportation infrastructure, energy-efficient buildings, land conservation, stormwater and flood management, and infrastructure for the circular economy will also continue be funded by capital raised in this market.

When a municipal entity issues a bond, an underwriter or syndicate provides the issuer cash for the right to receive coupon payments and a principal repayment, which are then sold to investors. A substantial portion of this market is held by retail investors, either directly or via intermediaries such as mutual funds. These bonds are especially attractive to investors in high marginal tax brackets due to the federal income tax exemption on interest payments, reducing their required pre-tax returns relative to comparable taxable assets (Longstaff, 2011; Garrett, Ordin, Roberts and Suárez Serrato, 2023).

The cost of municipal borrowing is thus a central theoretical and policy concern: the marginal cost of public funds influences the efficient level of public good provision. Empirically, municipalities with lower financing costs borrow and invest more (Adelino, Cunha and Ferreira, 2017; Dagostino, 2025; Yi, 2021; St. Clair, 2024). To this end, both federal and states governments have developed regulatory frameworks aimed at reducing borrowing costs and curbing unnecessarily expensive issuance.[9] These frameworks also require disclosure and clear reporting on the use of proceeds, enhancing transparency for both investors and constituents.

Labels describing a bond's intended use of proceeds—sometimes referred to as "issue purpose" or "use of proceeds"—have been a feature of this market since its inception. These labels have pricing implications.[10] Such pricing differences may reflect variation in risk or

[9]For example, many states encourage or require the use of auction sales especially for small issuers to encourage underwriter competition (Cestau, Green, Hollifield and Schürhoff, 2019), provide additional bond insurance for certain borrowers (Yang, 2024), and engage in active fiscal monitoring (Nakhmurina, 2024). Meanwhile, federal interventions include real-time trade reporting requirements and support (Schultz, 2012), new guidelines through Dodd-Frank (Garrett, 2024), and innovation in subsidy design (Luby, 2012; Cestau, Green and Schürhoff, 2013; Liu and Denison, 2014).

[10]The earliest empirical exploration of the pricing impact of municipal bond purpose labeling, to our knowledge, is Heins (1962) who found that bonds carried different yields on average when issued for different purposes, with bond funding toll roads, bridges, and utilities being more expensive than bonds issued for other purposes. More recent studies such as Guzman and Moldogaziev (2012) confirms continued large

investor preferences.[11] Over time, new labels have emerged to include new categories that highlight the environmental or social benefits of a project, which we call *ESG-related labels*. The Commonwealth of Massachusetts issued the first large municipal bond labeled as a "green bond" in the US with their $100 million Series D issue in 2013.[12] The Series B and C bonds within the same issue were not labeled as such.

ESG labels in municipal finance are not automatically applied to eligible bonds; rather, issuers must opt into them, often at financial or administrative cost. As a result, labeling has been up to this point endogenous, and many issuers choose not to pursue labels—even when their bond use-of-proceeds would qualify under established frameworks. Figure 2 shows the patterns of ESG-related labeling among municipal bonds using Bloomberg's historical labels merged with Mergent primary market data. Although the 2013 Massachusetts issuance is widely viewed as the first green municipal bond, earlier bonds funded similar projects without being explicitly self-labeled as green. For instance, the purpose of Vicksburg, MI, Community Schools' 2007 *Energy Conservation Improvement Bonds* was "energy conservation improvements to school district facilities" but were not self-labeled as green. To this end, Bloomberg has identified some bonds with similar purposes as green without these bonds being self-labeled.[13, 14]

Despite growing salience for financing of sustainability projects, labeled municipal bonds remain a relatively small segment of the market, as Figure 2 shows. In 2019, only $13.5 billion of municipal borrowing in the US was self-labeled as green—just 2.9% of the annual issuance. Including social and sustainability labeled bonds brings the total to 3.7%. By 2022, ESG-labeled share increased to 11.5% of bond volume, comprising 5.5% green, 4.9% social, and 1.1% sustainability-labeled bonds.

Labeling only matters to the extent that investors find it informative—either as a signal of value or risk. To attempt to increase the value of their signals by coalescing around a single set of known definitions, issuers, investors, and third-party institutions have increasingly

differences in pricing by purpose.

[11] For example, Kidwell and Koch (1982) sort bonds with different issue purposes into categories of riskiness of the project, arguing that much of the relative difference in pricing by bond purpose is related to a risk premium instead of a preference.

[12] The bonds in this series were issued to finance a variety of projects including the reduction of water pollution, efficiency improvements in government buildings, Superfund cleanup, land protection, and habitat restoration. Within the bond indenture, the issuer explicitly states that the purpose of labeling this bonds as green "is to allow investors to invest directly in environmentally beneficial projects."

[13] Another example is the State of Florida's Department of Environmental Protection Series A and B 2010 issue of $349 million as a green bond, which included funds for waterway restoration and conservation. This bond self-labeled as a "Florida Forever Bond" instead of as a green bond.

[14] The definition given by Bloomberg for its application of Green/Sustainability/Social bond labels is if "the offering document states that the instrument finances projects or activities with social and/or environmental outcomes, transitional outcomes, and/or if the instrument includes organizational sustainability targets."

adopted Green, Social, and Sustainability bond labels and the related definitions established by the International Capital Markets Association (ICMA, 2021, 2023).[15] ICMA's guidelines provide standardized criteria for label eligibility based on four pillars: (1) use of proceeds, (2) process for project evaluation and selection, (3) management of proceeds, and (4) reporting. Eligible project categories are allowed include measurements of environmental impact, such as *pollution prevention and control*,[16] as well as measurements related to the mitigation of environmental risks such as *climate change adaption*.[17]

Initially, labeling relied on self-certification. Issuers interpreted ICMA or similar guidelines and asserted their bond's eligibility directly. Over time, as investor demand and standards evolved, third-party verification became more common. Firms such as Build America Mutual (Tomunen and Yi, 2023) and Kestrel Sustainability Intelligence—the focus of our study—began offering external evaluations to issuers in lieu of self-certification. Kestrel employs biologists, engineers, architects, and financial analysts to evaluate the underlying project's environmental, social, and governance characteristics for municipal bond issues. Its methodology produces "Sustainability Scores" for issues in the municipal bond market as well as opinions about labeling eligibility. The scores include an individual 1 (low) to 5 (high) score on the environmental, social, and transparency attributes for the use of proceeds for a bond, as well as an overall weighted ESG score.

The shock that we study comes from an institutional investor driven push to get ESG-related information, including label eligibility, for bonds that had never been assessed. Starting in March 2022, several institutional investors began obtaining scores and opinions on ICMA label eligibility from Kestrel. Then, on March 6, 2023, Bloomberg began displaying these Kestrel scores on its platform.[18] This presents an interesting quasi-experiment because we are able to observe how the same bond trades under different information environments. This information intervention has nothing to do with the decisions of the borrowers because the issuers behind these assessed bonds did not have any say in whether the scores are posted, nor did they pay anything to Kestrel. On behalf of their investor clients, Kestrel focused

[15] ICMA put out their first "Green Bond Principles" in 2014, but there were earlier incarnations of similar principles from the Climate Bonds Initiative. The World Bank issued their first bond specifically labeled as "green" in 2008 with many others following suit before the guidelines coalesced (See: 10 Years of Green Bonds).

[16] Page 4 of ICMA (2021): "[R]eduction of air emissions, greenhouse gas control, soil remediation, waste prevention, waste reduction, waste recycling and energy/emission-efficient waste to energy."

[17] Page 5 of ICMA (2021): "[E]fforts to make infrastructure more resilient to impacts of climate change, as well as information support systems, such as climate observation and early warning systems."

[18] These ESG scores appear on the "Impact" tab for all assessed municipal bonds. Even users without a Kestrel subscription can view these scores. Importantly for this analysis, Kestrel's scores and analysis allow investors to screen for bonds that meet internationally recognized standards for "green", "social", or "sustainability" bonds, even if those bonds were not labeled as such at the time of issuance. We provide more details about and examples of how this information is available to investors in Appendix B.

on assessing newer, larger bonds—particularly those issued since 2022 and with par values exceeding $20 million. We display the share of bonds that received Kestrel ESG assessments by size and issuance date in panel A of Figure 3.

3 Data

To facilitate our exploration of the uptake and importance of ESG information and labeling, we gather data from a variety of sources about the structure and trading of municipal bonds. This section documents our use of (1) data on municipal bond transactions from MSRB, (2) novel ESG scores and label eligibility opinions from Kestrel, (3) local characteristics from a variety of data sources, (4) bond structure characteristics from Mergent, and (5) mutual fund and ETF ownership from CRSP.

First, we gather information on the universe of municipal bond trades from January 1, 2017, through December 31, 2023, as reported through the Municipal Securities Rulemaking Board (MSRB). The MSRB's Historical Transaction Data contains information on all trades including the CUSIP of the traded bond, the date and time of the trade, the par value traded, the price of the trade, the yield to worst, whether the trade is a customer purchase, customer sale, or an interdealer trade, and whether there is any non-transaction based compensation to the dealer. We limit our analysis to the universe of customer purchase transactions that do not include any sort of non-transaction based compensation to understand the customer willingness to pay for municipal securities where the prices we observe are exactly the prices that customers pay. We aggregate the transaction data to the bond-month level by finding the weighted average customer purchase price for each bond within a given month. Following Green, Hollifield and Schürhoff (2007) and Schwert (2017), we also restrict the sample to transactions that take place at least 90 days after the issuance date and more than a year before maturity. We also include the distance between customer purchase prices and customer sale prices within a given bond and month, which is a proxy for inverse liquidity, as a control variable in a robustness check and for a heterogeneity split.

We obtain series-level scores on a project's environmental, social, and governance (i.e., transparency) attributes from Kestrel Sustainability Intelligence along with all of Kestrel's textual description of the project and its characteristics. Kestrel assigns a score for many outstanding and new municipal bond issuances regardless of existing ESG credentials. On the primary market since 2022, Kestrel has a goal to evaluate all new bonds with a par value above $20 million and a credit rating of "A" or better. However, coverage is not universal even among large bonds. Kestrel covers approximately a quarter of the notional value of all outstanding municipal bonds, and a much higher proportion of recently issued bonds as

shown in panel A of Figure 3.

The Kestrel scoring universe used in this study covers 125,509 individual bonds from 9,864 unique issues by 3,845 unique issuers. The dollar value of these scored bonds that we are able to match to the transaction data amounts to $1.8 trillion in financing for public investment. Kestrel uses the definitions put forward by ICMA (2021) and ICMA (2023) and provides an opinion on whether each bond meets the necessary criteria to be a "green," "sustainability," or "social" bond. In addition to these binary labeling opinions, Kestrel publishes analysis and quantitative scores on the margins of "environmental benefits," "social benefits," and "transparency benefits." Most of the bonds Kestrel assesses and scores are not formally labeled, either by the issuer or other third parties. While Bloomberg users without a Kestrel subscription cannot access opinions on ICMA eligibility or Kestrel's deeper analysis, they can observe the underlying scores, which are correlated with the label eligibility opinions.

We exploit the fact that Kestrel provides eligibility opinions and the continuous scores for both previously labeled and unlabeled bonds to study two distinct mechanisms: the effect of receiving any information about the ESG characteristics of the project (assessment effect), and the effect of underlying ESG quality of the project/qualification for a eligible label (greenium effect). This distinction is central to our identification strategy and allows us to assess whether investors respond to the ESG designation itself, the content behind it, or both. Panel B of Figure 3 displays the average scores by the year of issuance for all of the assessed bonds in our sample.[19]

We map these bonds to local characteristics using the counties associated with 6-digit CUSIP issuers from SDC Platinum. At the county level, we gather (1) income and tax characteristics from the 2021 IRS Statistics of Income series, (2) 2020 vote shares for president from MIT Election Data and Science Lab (2017), (3) demographic, educational, and employment shares from the 2021 ACS 5-year data, (4) climate change beliefs from the Yale survey (Howe, Mildenberger, Marlon and Leiserowitz, 2015), (5) local exposure to natural hazard risk from the FEMA National Risk Index, and (6) estimated damage from climate change from the Climate Impact Lab (Hsiang, Kopp, Jina, Rising, Delgado, Mohan, Rasmussen, Muir-Wood, Wilson, Oppenheimer et al., 2017).

In order to estimate a pricing model that assesses the impact of the information intervention we study, we also match bonds to the Mergent Municipal Database based on 9-digit CUSIP numbers. Mergent provides a large number of standardized bond- and issue-level

[19]Bonds issued before 2022 were selected to be scored while they were already outstanding based on Kestrel's client requests. Bonds issued in 2023 and beyond are scored by Kestrel at the time of issuance, which captures almost the whole universe. The average ESG score is the same regardless of the year of issuance, which is consistent with there not being important selection on underlying ESG characteristics in what bonds are assessed.

characteristics including security size, issue size, issuer name and state, maturity schedule, coupon type and amount, use of proceeds, credit rating (historical), tax exemption status, callability features, and issuer-designated ESG labels. In the results in the paper, we follow Schwert (2017) and drop all callable bonds and provide a robustness check to their inclusion in Appendix E. We also drop bonds with variable coupon rates, remarketings, bonds with missing par value or maturity dates, and putable bonds.

In order to calculate tax adjusted spreads and other outcomes, we augment our bond cross-section and our bond-transaction panel with additional data sources. We match each transaction of a municipal bond with the estimates of a zero-coupon treasury yield curve developed by Liu and Wu (2021). We use a linear interpolation of the yield curve at different monthly maturities to get as exact a correspondence as possible between the municipal bond transaction we observe and the yield an investor could have received if they had purchased a risk-free asset instead. We also use the NBER TAXSIM estimates of state and federal tax rates for high income individuals to calculate the after-tax spread that a municipal bond earns over a maturity matched treasury. Most municipal bond income is exempt from state and federal taxation and treasury bonds are exempt from state level taxation, with the exception of Tennessee. We calculate the tax adjusted spread of each bond i of maturity m transacted at time t as

$$\text{spread}_{imt} = \text{yield}_{imt}(1 - \mathbb{1}(\text{federal tax})\tau_t^{Fed} - \mathbb{1}(\text{state tax})\tau_t^{State}) - \text{treasury yield}_{mt}(1 - \tau_t^{Fed}),$$

where τ_t^{Fed} and τ_t^{State} are the marginal federal and state tax rates for an individual earning one additional dollar beyond an income of \$1.5 million. This measurement of after-tax spreads captures how much more an investor has to be compensated to purchase a municipal bond relative to a treasury of the same maturity.

In order to gauge the importance of large intermediaries driving pricing in our context, we also gather mutual fund and ETF holding data from the CRSP Mutual Fund Holdings database. We match these data to Mergent by CUSIP to measure holdings of all municipal bonds at the end of each quarter by all funds identified by CRSP as municipal bond funds and other funds that hold substantive amounts of municipal bonds (one percent or more of NAV). We total the holdings at the bond level each quarter to create a balanced panel of holdings with a structure similar to our main sample of price data. Ownership of bonds from Mergent that do not appear in the CRSP database are coded as zeros. There are many instances of bonds with no mutual fund/ETF ownership for the entire sample period. Such cases do not appear in the final sample. Additionally, following Baker, Bergstresser, Serafeim and Wurgler (2022), we total bond ownership by funds with explicit environmental or social

objectives. We identify these funds' holdings by searching for specific strings in the fund name that indicate that the fund has such objectives.[20]

4 Selection into Issuing ESG-Labeled Securities

We now examine the decisions of municipalities to label their bonds with ESG-related information. In our sample of bonds, Kestrel developed its scoring methodologies after the projects were initiated, so municipal entities had no ability to adjust their projects in order to meet the relevant scoring thresholds. This timing allows us to isolate the financial labeling decision from the project design decision. Assuming that Kestrel accurately measures the fundamentals of the projects and their eligibility for ESG-related labels according to ICMA standards, we can estimate how local demographics, project features, and bond characteristics impact the likelihood of seeking such a label. Understanding which municipalities choose to label helps isolate whether observed pricing effects stem from the label itself or from underlying issuer characteristics correlated with the label. The baseline rates of labeling among eligible bonds are low: of 2,763 eligible green and sustainability bond issues only 499 (18.1%) label as such, and of 4,540 eligible social bond issues only 283 (6.2%) label as such.[21]

We estimate a logistic regression to describe which characteristics are associated with the decision to use an ESG-related label, conditional on being eligible. To do this, we restrict the sample to bonds that Kestrel determines are eligible for an ICMA ESG-related label—either green, sustainability, or social. Let $Y_i = 1$ if an issuer chose to label their bond i in a given category at issuance. Then let $\pi_i = \Pr(Y_i = 1)$ be the probability that a given bond was issued with an ESG label. We then model the log odds of labeling as:

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right) = X_i\beta + \varepsilon_i, \tag{1}$$

where X_i is a vector of local, project, and bond characteristics. We include the Kestrel environmental and social scores for the relevant subsamples, as well as the size of the issue. Among local characteristics, we include variables for the local share of the population worried about climate change on average in 2018-2021, the share of the local population voting Republican in the 2020 presidential election, the FEMA expected annual loss score, the natural log of income per capita, the unemployment rate, the share of local taxpayers itemizing

[20] These strings include "CALVERT," "CATHOLIC," "CHURCH," "CLEAN," "DOMINI," "ENVIRON," "ESG," "FAITH," "GREEN," "IMPACT," "KLD," "PARNASSUS," "SOCIAL," "SRI," and "WALDEN." We add "SUSTAIN" to capture the VanEck HIP Sustainable Muni ETF, a large municipal bond fund with stated environmental objectives, and other funds using similar names.

[21] Note that these totals include bonds that Kestrel rates through May 2025, so the number of eligible bonds is larger than in our transaction sample in the following sections.

deductions, the share of non-white or Hispanic residents, the share of the population 65 years of age or older, and the share of local residents with a college degree or more education.

We present estimates of the marginal effects evaluated at sample averages from four specifications of this regression in Figure 4. The first includes all controls. The second excludes Kestrel's environmental or social scores. The final two specifications drop the climate concern and Republican vote share variables, respectively. These two preference variables are strongly negatively correlated ($\rho = -0.9$), so their joint inclusion inflates standard errors. Because bonds are only issued once, we do not have a time dimension, and we only cluster standard errors at the issuer level. We display the corresponding point estimates from all of these logistic regressions in Table D.1 for eligible green and sustainability bonds and in Table D.2 for eligible social bonds. We discuss selection into labeling green and sustainability bonds first.

Municipalities face several frictions in labeling eligible bonds. One likely concern is uncertainty about eligibility near the margin. Uncertainty over eligibility is a first order concern. While the ICMA guidelines aim to be precise and quantitative, issuers with projects near the margin of eligibility may be hesitant to label their bonds if there is uncertainty around the cutoff point and a cost associated with being rejected from a label. A simple test of this friction is whether higher environmental benefit scores predict labeling among eligible bonds. The first specification in panel A of Figure 4 shows that a standard deviation increase (0.93 on a 5 point scale, in sample) in the environmental benefits score, conditional on being eligible, raises the likelihood of labeling a bond as a green or sustainability bond by 13 percentage points, holding other factors constant.[22] This effect is consistent with a reluctance to label because of uncertainty, concerns regarding eligibility, or strategic caution.

Attitudes of local constituents may also shape labeling decisions. Just as investors may have preferences over the environmental or social impacts of their investments, local communities may have preferences over the use of ESG-related labeling. We find strong evidence that this is the case. However, multicollinearity complicates interpretation of political preference measures. When we exclude climate concern (specification 3), a one-standard-deviation increase in Republican vote share (15.7%) is associated with a 9 percentage point decline in labeling likelihood. This implies that if Republican vote share fell by 15.7 percentage points nationally, predicted green or sustainability labeling would rise to 27%. While economically significant, this would still leave the majority of eligible bonds unlabeled—suggesting that frictions other than voter ideology (e.g., fixed costs or institutional inertia) play a critical role.

[22]Table D.1 shows point estimates for the likelihood ratio that range between 0.936 and 0.980 that are all statistically significant at the 1% level.

In the fourth specification that omits Republican vote share in panel A of Figure 4, a one standard deviation increase in the share of local population that is worried about climate change increases labeling likelihood by 12 percentage points. Similarly, we find that an additional standard deviation of non-white or Hispanic residents is associated with a 7 to 12 percentage point decline in the likelihood of labeling across all four specifications. These three measures show economically and statistically significant declines in the likelihood of labeling a bond green. All of these effects are conditional on eligibility for such a label by inclusion in this sample and also hold constant Kestrel's environmental benefits score.

Financial frictions related to income or to the general costs and benefits of labeling a bond as green may also matter. First, labeling a bond as green usually requires the capacity and credibility to assess the underlying greenness of the bond in order to self-certify. Then, hiring an external verifier for a "second party opinion" is increasingly seen as best practice. While we do not have comprehensive pricing data for such services, anecdotally, we understand the costs of external verification to range from the low single-digit thousands to the low double-digit thousands. Other similar types of third party verification such as credit ratings and credit enhancements carry high fixed costs, which means the net benefit of verifying is bigger for larger issues (Joffe, 2017). We do find some evidence of the perceived fixed cost of providing an ESG assessment deterring some issuers from labeling their bonds: a one standard deviation increase in ln(par value) (1.17 log points), leads to a 0.206 increase in the log of the odds ratio of labeling the bond when eligible, according to the specification in column (1) of Table D.1, which is statistically significant at the 10% level. We do not find specific evidence that municipal issuers in richer or more economically prosperous locations are more likely to label their bonds through controls for income, unemployment rate, or share itemizing deductions. If anything, municipalities with more educated residents are less likely to label their eligible bonds. These findings suggest that ESG labeling is not merely a luxury good; the perception of up-front costs and local norms likely deter adoption.

For social bonds, similar patterns emerge with a few key differences. We display these results in Table D.2, with the marginal effects presented in panel B of Figure 4. Bonds with higher social benefits scores are not more likely to label. Municipalities in locations with more Republican votes in 2020 and less non-Hispanic white residents are less likely to select labels for bonds that are eligible. However, issue size does not predict labeling, implying that fixed costs are not the main constraint for social bond labeling. Much like the green and sustainability bond selection model, counties with relatively more college graduates are less likely to label their eligible issues as social bonds, though the relationship disappears in specification 4. Given that the baseline rate of social bond labeling is only 6.7%, decreasing the Republican vote share by one standard deviation is associated with social

labeling likelihood increasing by 10 percentage points, which is economically large but again leaves most of the lack of labeling decision unexplained by these observable characteristics.

In sum, municipalities make systematic labeling decisions. For green and sustainability bonds, labeling appears influenced by up-front costs, local beliefs, and demographics. For social bonds, fixed costs matter less, and political and demographic preferences play a larger role. We next examine the pricing implications of these labeling decisions and other ESG-related information using Kestrel's ESG assessments and their staggered release in 2022–2023.

5 Research Design to Identify Pricing Implications of Novel ESG Assessments and Labels

A fundamental problem with figuring out how much investors value the ESG-related assessment and labeling of fixed income securities is that issuers have the choice of whether or not to seek a label. This issuer-level selection limits the set of plausibly exogenous comparisons available among labeled bonds, such as the within issuer-date comparisons used by Larcker and Watts (2020) and Li, Wang and Yu (2023), or the use of financial intermediary relationships as instruments, as in Tomunen and Yi (2023). Our approach builds on this existing literature by using the exogenous and unexpected provision of external ESG assessments for bonds that already exist and are actively traded.

A second, related challenge is that the assessment of underlying ESG-related characteristics has historically been available only for bonds that seek a label. This bundling of verification and labeling creates identification difficulties: any observed premium could reflect the ESG characteristics themselves, the assessment process, or the interaction between the two. In the case of the Kestrel ESG scores—widely available via Bloomberg—most assessed bonds do not qualify for ESG-related labels, and the majority of bonds trading in the market are not assessed. This setting provides a unique opportunity to compare bonds with varying ESG scores, conditional on receiving an assessment. By focusing on this subset, we can isolate the market's valuation of specific ESG characteristics—often referred to as a *greenium*—from any general premium attributable to the act of ESG assessment itself—the *assessment effect*.

We employ a modified difference-in-differences method to compare outcomes for bonds that receive ESG-related information interventions to bonds that do not receive any new information. Within bond, we hold the selection of the project fixed and compare pricing behavior for bonds that receive Kestrel ESG scores with those that do not, leveraging the

fact that this ESG disclosure is externally provided and not self-selected. We estimate our main dynamic difference-in-differences model using the following regression equation:

$$Y_{ijt} = \alpha_i + \sum_{k=0}^{T} (\beta_k + \gamma_{Ek}\text{E Score}_i + \gamma_{Sk}\text{S Score}_i + \gamma_{Tk}\text{T Score}_i) \times \text{assessed}_i \times \mathbb{1}(t = k) + X_{ijt} + \varepsilon_{ijt} \quad (2)$$

where i denotes the CUSIP, j the issuer, and t the month, spanning from January 2021 to December 2023. Our outcome variable Y_{ijt} measures the monthly trade-size weighted average tax-adjusted spread over a maturity-matched treasury. The first independent variable of interest is $assessed_i$, which is an indicator equal to 1 for all bonds that Kestrel newly assessed, excluding any bonds that already had a green, social, or sustainability label according to Mergent or Bloomberg.[23] The $assessed_i$ indicator is then interacted with subscores that Kestrel assigned for environmental, social, and transparency characteristics of the bonds: E Score$_i$, S Score$_i$, and T Score$_i$, respectively. These component scores are normalized to have a mean of zero and a standard deviation of one, conditional on receiving a new ESG assessment.

X_{ijt} includes an extensive set of fixed effects to capture unrelated phenomena that impact spreads over the sample period. These controls include CUSIP, month-by-state-by-taxability, month-by-credit rating, and month-by-average trade size tercile fixed effects, as well as duration, coupon rate, log of issue size, and a second order polynomial in maturity all interacted with time fixed effects. We also include a separate time-varying control for ex ante labeled bonds—those that already had a green, social, or sustainability label according to Mergent or Bloomberg before the novel Kestrel scores were released. Each of these controls captures a known pricing determinant of municipal bonds that we allow to have flexible impacts over time. For example, the classic "muni puzzle" is that spreads for munis increase faster with increases in maturity than in other asset classes (Bergstresser, 2023). Our quadratic in maturity interacted with month fixed effects account for the existence of this potentially time varying and non-linear phenomenon.

The coefficients of interest are, first, the monthly β_k estimates, which measure the spread differential for an assessed bond with an average ESG score relative to unassessed bonds—the *assessment effect*. Second, we are interested in the γ_{Ek}, γ_{Sk}, and γ_{Tk} coefficients that capture the marginal required compensation for bonds with above- or below-average ESG characteristics along these respective dimensions. The omitted category consists of bonds

[23] Our exact measure of the scores comes from a snapshot of all Kestrel scores in February 2024. Some of these scores may not have been immediately available when we consider the assessment treatment starting in March of 2022 and March of 2023 for select institutional subscribers and general investors, respectively.

that were neither labeled ex ante nor assessed by Kestrel, enabling interpretation of the coefficients as treatment effects relative to a no-information baseline. This setup implicitly assumes that the average assessed bond's ESG characteristics are comparable to those of unassessed bonds. Supporting this assumption, we note that while Kestrel was only rating a small portion of bonds issued before 2021, while it was rating almost the universe of newly issued bonds with par value greater than $20 million by 2022 and 2023. In panel B of Figure 4, we show that the average ESG score is constant for bonds issued before and after 2021 despite the dramatically broader assessment coverage in later years.

The quantitative scores that Kestrel provides through their assessment are not, however, direct measures of labeling eligibility according to ICMA's published principles. Kestrel also provides a separate eligibility opinion—available only to subscribers—regarding whether a bond qualifies for green, social, or sustainability labeling under ICMA standards, along with a text description of the reasoning behind the labeling opinion. We estimate an alternative specification that further separates the pricing impact of assessment and component scores depending on whether the outcome of the assessment is eligibility for a label (either green, sustainability, or social). Formally:

$$\begin{aligned} Y_{ijt} &= \alpha_i \\ &+ \sum_{k=0}^{T} (\beta_{k,1} + \gamma_{Ek,1}\text{E Score}_i + \gamma_{Sk,1}\text{S Score}_i + \gamma_{Tk,1}\text{T Score}_i) \times \text{assessed ineligible}_i \times \mathbb{1}(t=k) \\ &+ \sum_{k=0}^{T} (\beta_{k,2} + \gamma_{Ek,2}\text{E Score}_i + \gamma_{Sk,2}\text{S Score}_i + \gamma_{Tk,2}\text{T Score}_i) \times \text{assessed eligible}_i \times \mathbb{1}(t=k) \\ &+ X_{ijt} + \varepsilon_{ijt} \quad (3) \end{aligned}$$

Here, the subscripts and controls are otherwise identical to Equation 2, with the exception of the coefficients of interest that are now allowed to vary based on whether the novel ESG assessment found that the bond is eligible for any sort of label by international standards. Insofar as there is a premium related to meeting specific labeling criteria (i.e., a willingness to receive a lower return for bonds in alignment with the ICMA principles), we expect these $\beta_{k,2}$ coefficients associated with being assessed and eligible to be more negative than the $\beta_{k,1}$ coefficients associated with being assessed an ineligible for labeling.

The primary assumption behind a causal interpretation of this dynamic difference-in-differences approach is parallel trends: in the absence of Kestrel's information release, spreads for bonds that were ultimately assessed would have evolved in parallel to those that were not. We provide evidence that this is likely to be the case through three complementary

approaches. First, we estimate dynamic effects beginning in January 2021 and show that pre-treatment trends for ultimately assessed and unassessed bonds appear to be parallel. Second, we create two placebo measures of assessment to test the ability of the model to correctly price bonds that Kestrel might have assessed in similar contexts. Third, we run a battery of robustness checks. We find strong support that pricing for bonds treated by the information intervention would have moved in parallel in absence of treatment. We discuss these tests in more detail in the following Section.

We double cluster standard errors in our main specification by issuer j and month t to account for serial and cross-sectional correlation in the residuals. Such factors might include local fiscal policy and economic conditions differentially affecting the risk of issuers across the sample, or broader macroeconomic shocks that affect the municipal bond market within a given month. We also report estimates with two-way clustering by issue and month. This choice would be more appropriate if the error structure is driven more by bond-specific features like liquidity or seniority than municipality-wide factors. We find, however, that confidence intervals are less conservative at this level. As a result, we use the more conservative issuer and time clustering for tables and display both clustering approaches on graphs.

6 Empirical Pricing Implications of Novel ESG Assessments

In this Section, we discuss the results of the dynamic difference-in-differences analysis of the information intervention due to the release of Kestrel's new ESG scores and labeling opinions. We begin by discussing the estimates of Equation 2 that decomposes the novel ESG assessment into an assessment effect and marginal effects for Kestrel's environmental, social, and transparency scores.

Assessment effect

Figure 5 displays estimates of β_k from equation 2 and the related 95% confidence intervals for the bonds that receive new assessments indicating that they were eligible for green or sustainability labels after February 2022. These estimates describe how much the spread for the average assessed bond changed since December 2021 relative to bonds that do not receive any ESG assessment from Kestrel. The outcome variable is the tax-adjusted spread relative to maturity matched treasuries and the regression includes all controls listed in Section 5.[24]

[24]CUSIP, month-by-state-by-taxability, month-by-credit rating, and month-by-average trade size tercile

The figure is divided into three time periods that correspond to the information environment. In the first period, prior to March 2022, the treated bonds did not have any available third party information about their potential for ESG labeling and were not self-labeled. During this initial 14-month period, we do not find any differential pricing trends for the newly assessed bonds.

Starting in March 2022 (marked by a dashed vertical line), Kestrel began providing information about these bonds to select institutional subscribers, including the quantitative scores that would later be published on Bloomberg and the associated ICMA eligibility opinions. During this *institutional information* period, we find a decline in spreads for the bonds receiving an ESG information intervention that evolves slowly over time.[25] By February of 2023, just before the ESG assessments are announced on Bloomberg, the assessed bonds are trading at spreads that are 2bps lower than comparable bonds that were not assessed, which is statistically significant at the 1% level.

The initial set of Kestrel scores were published on Bloomberg on March 6, 2023, and we shade this period a darker gray. During this period, the spread discount increases to 3.8 basis points for bonds that receive a new Kestrel assessment. Table 2 displays point estimates and standard errors for the pooled difference-in-differences estimates in column 4. In columns 1 through 3, we provide additional specifications with sequentially added controls building to the main specification. The premium that bonds assessed by Kestrel command after assessment doubles during the public information period relative to the institutional information period across all four specifications.

Marginal impact of new ESG-related scores

Next, we analyze the estimates of γ_k from equation 2, which capture how marginal differences in ESG scores affect bond pricing. The left column of panels of Figure 6—A, C, and E—plot the point estimates and 95% confidence intervals for a one-standard deviation increase in environmental, social, and transparency score, respectively. Point estimates and standard errors for a pooled difference-in-differences version of this same regression are displayed in column 4 of Table 2.

Before March 2022, none of the three scores has a measurable pricing effect on bonds that will receive new ESG assessments in the future, which is an extra test of the parallel trends assumption. In the institutional information period between March 2022 and February

fixed effects, as well as duration, coupon rate, log of issue size, and a second order polynomial in maturity all interacted with time fixed effects.

[25]The set of institutional subscribers as well as the set of assessed bonds was growing in this period. The increasing transition path of our estimates is consistent with growth in the which bonds are assessed as well as the share of investors in the market with this information.

2023, higher environmental or transparency scores still do not yield price premia, but bonds with higher social scores actually experience *smaller* declines in spreads than their lower-scoring counterparts as shown in panel C. After March 2023, when the scores become publicly available, we observe modest pricing effects: a 0.8bps spread reduction per standard deviation increase in environmental scores (significant at the 5% level) and a 0.4bps reduction per standard deviation increase in transparency scores (significant at the 10% level). Social impact scores continue to exhibit a discount, with bonds receiving higher scores experiencing smaller spread declines.[26]

The right column of panels—B, D, and F—puts these marginal effects into context by adding them to the average assessment effect, producing total predicted spread changes for bonds at 25th and 75th percentile ESG scores. In Panel B, for instance, a bond rated 3 (25th percentile, red) on environmental performance sees its spread decline by 3.2bps, while a bond rated 4 (75th percentile, blue) experiences a 4.2bps decline—a 1bp greenium. At a score of 5, the model predicts a 5.2bps drop, implying a 2bp greenium for moving from the 25th percentile to the maximum environmental score.

The effects are very similar for the transparency scores in panel F. However, the story in panel D of Figure 6 displaying the spread of outcomes for social scores is quite different. Bonds at the 25th percentile social score, which is 3 out of 5, have a slightly larger than average decline in spreads, dropping by 5.1bps between March and December of 2023. Newly assessed bonds at the 75th percentile social score (5/5), on the other hand, only see a 1.6bps decline in spreads after the Kestrel scores are released relative to December 2021. So, assessed bonds see spreads go down on average regardless of score, but there are small premia for bonds receiving high environmental and transparency scores and a relatively larger discount for bonds receiving high social scores.

Marginal impact of labeling eligibility

The quantitative subscores that Kestrel/Bloomberg publish are not, however, the same thing as using a specific label under the ICMA principles, although they are correlated. Maybe one reason we estimate relatively small (and one negative) ESG subscore premia

[26] We note there are at least two interpretations of this relative discount for bonds with high social scores. One reason could be that social scores are not subject to much uncertainty because of the existing disclosures made for municipal bonds. For example, official statements and related filings already describe the project's impacted population through socioeconomic information disclosures of the local populace (population, major employers, income, unemployment, common occupations, etc.). From an uncertainty standpoint as in Avramov, Cheng, Lioui and Tarelli (2022), it would be natural for high scoring social projects to have had relatively less of an information intervention because information was already present. Another explanation could be that bonds receiving high social scores may also be subject to discrimination as in the case of historically black colleges and universities documented by Dougal, Gao, Mayew and Parsons (2019).

is because what really matters to investors and their investment mandates is meeting the ICMA threshold of eligibility. We turn to Equation 3, which further interacts the assessment indicator with whether or not the assessment results in the opinion of label eligibility. We display estimates of this regression in Table 3 which uses the same controls as Table 2. Column 4, the primary specification, shows that bonds assessed by Kestrel but found ineligible for any label saw spreads fall by 2.8bps in the institutional period and 6.5bps in the public period at average E, S, and T scores. With assessed bonds eligible for any label separated out, the marginal pricing impact of new information about marginal environmental impacts still leads to lower spreads, although the result is statistically weak or insignificant depending on the specification. The marginal pricing of social impact scores and transparency scores are no longer significant among assessed bonds ineligible for any label.

The big difference from the primary estimates is that we observe the assessment effect separately for bonds that are eligible for some ESG label. Among the ex post eligible bonds, the assessment effect is much smaller, -1.8bps in the public information period. The pricing of marginal environmental impact is a similar magnitude as in the baseline combined sample, around -1.1bps per standard deviation environmental score, but the discount for marginal social score and premium for marginal transparency score do not show up in this version.[27] This set of results, in our opinion, is surprising—assessed bonds that are eligible for a specific ESG-related label do not experience larger declines in spreads than bonds that are not eligible, largely because of the different assessment effects.

These results may be due to investors' distaste for such labels. However, recall that these eligibility opinions are only available only to paying subscribers and the headline ESG scores are available to any Bloomberg user. There is no sharp cutoff in scores that delineates an eligible bond from an ineligible bond. Given the prior set of results showing marginal premia for high green and transparency scores, we view this as unlikely. We also note that there is still a premium paid for bonds with higher scoring environmental impacts, which is evidence that this is not a sort of negative greenium, but instead a smaller assessment effect. So, it is more likely the imperfect correlation between label eligibility and score and relative uncertainty over score that is driving this seemingly contradictory result.

Ex ante labeled bonds

We also include a separate time varying indicator for bonds that were self-labeled as green, social, or sustainability prior to the Kestrel intervention in the estimation of Equation

[27] We present another test of reaching bond labeling eligibility guidelines in Appendix F and Table F.2, which comes to the same conclusion: the bonds specifically meeting ICMA labeling guidelines are not the largest beneficiaries of the information intervention.

2.[28] Two considerations motivate their inclusion in the model. First, their pricing may reflect broader secular trends in pricing of ESG-related information, especially given the rise of anti-ESG sentiment and political actions across many U.S. states during 2022–2023. Second, if ESG investor capital is limited, these ex ante labeled bonds could be substitutes for newly assessed and label-eligible bonds. Each scenario has different implications for interpreting the treatment effects, but our empirical setting is not ideal to identify which scenario is correct so we interpret both and focus on the more conservative estimates when aggregating impact of the Kestrel/Bloomberg information intervention (i.e., we assume ex ante labeled green bonds are substitutes for newly assessed bonds).

If our regression is picking up a secular rotation out of ESG-labeled assets, one would want to subtract the coefficients of the Ex Ante Labeled bonds from the Novel ESG Assessment. This would be the same as treating ex ante labeled bonds as the control group instead of treating unassessed bonds as the control group. On the other hand, if limited capital moves from ex ante labeled to ex post label eligible bonds, then we need to consider the decline in ex ante bond labeled value when aggregating the value change in outstanding municipal bonds caused by the information intervention. Insofar as their could be substitution, we would think of this as a SUTVA violation, which is the reason we do not treat ex ante labeled bonds as the control group but do include their coefficients for completeness.

Figure 7 displays the dynamic difference-in-differences point estimates and 95% confidence intervals for the ex ante labeled bonds. Corresponding point estimates and standard errors for the pooled difference-in-differences regression are in column 4 of Table 2. Here, we have slightly larger standard errors because the effective sample of ex ante labeled bonds is relatively small. We find no pre-trend differences relative to unassessed bonds. However, during and after the institutional information period, spreads on these ex ante labeled bonds begin to rise. The pooled estimates indicate a 2.2bps and 3.0bps spread increase in the institutional and public periods, respectively, both statistically significant at the 10% level, in column 4 of Table 2. For the sake of contextualizing the overall magnitude of the pricing impact from this information intervention, we assume that these increases in spreads are due to the availability of newly assessed and label eligible bonds announced through our treatment to be conservative.

Magnitude of pricing impacts

So far, we have shown several estimates that the bonds that receive novel Kestrel ESG

[28] The time varying ex ante labeled control is also included in the estimation of Equation 4 and displayed in Table F.2. The estimates are identical out to the tenth of a basis point across these different versions of the model.

ratings and that did not have any other outstanding ESG-related label saw tax-adjusted spreads decline by around 3.8bps between March and December of 2023. Of bonds that have at least 1 transaction reported in the MSRB historical transaction database during this period, ESG assessments were applied to $867.7 billion in outstanding par value that did not have an existing label. Bonds with ex ante green, social or sustainability labels with at least 1 trade in the same period amount to $132.8 billion. In order to estimate the aggregate impact of these new assessments on average, we have to make an assumption about whether the increase in spreads for ex ante labeled bonds was related to the Kestrel ESG information or not. If we assume these phenomena are unrelated, then the newly published ESG scores led to investors being willing to pay $1.32 billion[29] more for newly assessed securities. If we instead assume that the increase in spreads for bonds with outstanding labels is entirely caused by the release of the new ESG scores and labeling opinions, then the aggregate affect is lowered to $1.16 billion,[30] which is still a sizable net increase in willingness to pay for securities with verified ESG characteristics.

We now consider the change in willingness to pay for securities with verified ESG characteristics under a different labeling counterfactual: what if all bonds Kestrel states were eligible for bond labels had instead labeled themselves?[31] Of the $867.7 billion in borrowing in our sample that Kestrel assessed, $372.3 billion is eligible for a label. These bonds have average E, S, and T scores of 3.55, 4.53, and 3.94, respectively, which correspond to 0.11, 0.69, and 0.18 standard deviations above the mean. Multiplying these scores by our estimates in column (4) of Table 2 suggests that average assessed bond that is ex post eligible for a green, social, or sustainability label has a spread decline of 3bps.[32] Our model estimates combined with the total par value and it's average duration suggest labeling all eligible bonds would have increased asset values for eligible bonds by $0.45 billion. This further implies that $0.87 billion in increased value ($1.32 billion minus $0.45 billion), or about two thirds, came from assessments on bonds specifically ineligible for any label.

Assessing identification

As mentioned, the primary identification assumption underlying our empirical design is

[29] $\approx \$867.7B \times 0.00038 \times 4$, where 4 is the average duration for municipal bonds in our sample assuming all bonds will be called at the first available call date.

[30] $\approx (\$867.7B \times 0.00038 \times 4) - (\$132.8B \times 0.00030 \times 4)$, where, again, 4 is the average duration for municipal bonds in our sample assuming all bonds will be called at the first available call date.

[31] We also assume that our model captures the pricing impact of the labeling decision, which rules out the possibility that the self-choice to label also has some sort of pricing implication that our setting is not well suited to pick up.

[32] This is made up of the -3.8bps average assessment affect, the -0.1bps environmental effect (-0.8×0.11), the 1.0bp social effect (1.4×0.69), and the -0.1bps transparency effect (-0.4×0.18).

that, absent the introduction of Kestrel's ESG scores, our assessed and unassessed bonds would have experienced similar trends in secondary market spreads. Three sets of evidence strongly support this assumption.

First, our dynamic DiD design shows clear evidence of parallel trends in the pre-treatment period. Spreads for treated and control bonds closely tracked one another from January 2021 until the staggered release of Kestrel assessments began in mid-2022. This visual and statistical evidence suggests that, absent treatment, spread trajectories would likely have remained parallel.

The absence of pre-treatment trends is, in part, due to the strength of our pricing model. We address potential time-varying confounders—such as real or perceived shifts in duration risk, credit risk, liquidity risk, or state-level fiscal policy—by including a rich set of controls. Specifically, we allow the pricing of credit risk to evolve flexibly via credit rating-by-time fixed effects. To rule out confounding changes to state policy, we also include a state-by-time-by-taxability status fixed effect that limits comparisons to bonds in the same state with the same tax treatment trading at the same time. Our primary specifications also directly control for a time-varying price of duration risk, and include time varying coupon and maturity controls to capture the various components of duration on their own. We test the robustness of our results to the exclusion of duration (Table 2, Column 1), and find similar point estimates.

In Appendix E, we incorporate a proxy following Jankowitsch, Nashikkar and Subrahmanyam (2011), measuring the gap between customer purchases and sales interacted with time fixed effects to address liquidity risk. While we lack CDS spreads like those used in Fleckenstein and Longstaff (2023), our controls capture age, maturity, trading size, and other liquidity-relevant bond characteristics, all interacted with time.[33]

Second, we conduct two separate placebo tests. The first placebo test uses issuers who eventually receive a Kestrel assessment prior to the treatment period. To identify such "future treated" issuers, we estimate a regression of the treatment indicator (whether the bond is ever assessed by Kestrel) on bond observables, including issuer fixed effects. These fixed effects capture unobserved issuer characteristics correlated with future assessments—such as investment in ESG-related projects—that are not captured by observable bond features.

We classify the top 25% of issuers by these fixed effects as "likely to be treated" and simulate a placebo treatment in the 2017–2020 period. This timeframe includes major macroeconomic events (e.g., monetary tightening, the COVID-19 shock) that could plau-

[33]In the Fleckenstein and Longstaff (2023) model, liquidity is a function of age, maturity, trading amounts and sizes, and credit risk, as measured by a CDS spread. Our sample of bonds almost uniformly do not have CDS spreads available. We do, however, include direct measures or proxies of all other liquidity premium impacting variables and interact all of these controls with time fixed effects.

sibly reveal latent differences in bond demand or pricing behavior across issuer types. Using the same specification as in our main regression, we estimate Equation 2 for this placebo sample. Figure 8, Panel A, shows no differential spread trends between "likely to be treated" and other bonds, suggesting no pre-existing price dynamics that would confound our main estimates.[34]

The second placebo test uses bonds that are assessed by Kestrel after our sample period—specifically, between February 2024 and May 2025—but not during the treatment window. This test allows us to assess whether the future assessed bonds exhibited any divergent pricing behavior during the sample period, potentially due to differences in investor demand, issuer quality, or project type. We find that spreads for these post-sample "future treated" bonds evolved in parallel with other unassessed bonds during the full treatment window, providing further support that our estimated treatment effects are not driven by latent selection by Kestrel.

Third, further robustness tests, detailed in Appendix E, continue to confirm our findings. These include: (i) dropping each of the three largest issuing states (California, New York, Texas); (ii) including callable bonds; (iii) redefining spreads using yield or pre-tax measures; and (iv) estimating models with issuer-by-time fixed effects. Though these granular fixed effects absorb most ESG score variation (due to limited within-issuer treatment heterogeneity), we continue to find similar effects of ESG assessments on pricing.[35]

Together, these three pieces of evidence—the combination of strong pre-trends, comprehensive robustness checks, and carefully constructed placebo tests—provide a strong basis to interpret the observed decline in spreads following the disclosure of Kestrel's ESG assessments as causal.

6.1 Potential mechanisms for observed patterns of response

In this section, we explore the potential mechanisms behind the pricing results we have documented. So far, we presented evidence that bonds receiving novel ESG assessments see spreads decline relative to bonds without any assessment or those with ex ante labels. Most of this effect is driven by the average assessment impact rather than differences across

[34]The lingering potential concern is that the types of projects and associated borrowing that eventually gets scored by Kestrel is unobservably different than other non-scored bonds in such a way that the volatile and changing market in 2022 and 2023 impacted the bonds differently for some reason other than the release of the Kestrel scores. One example of such a concern that is ruled out by this placebo test would be if the types of governments that invest in green projects have less elastic bond investors whose demand is relatively less responsive to monetary policy.

[35]In our sample, 86.4% of issuers (21,658 of 25,065) have bonds that are either all assessed or all unassessed. As a result, identification in issuer-by-time fixed effect specifications comes from a relatively small subset of issuer-months.

environmental, social, and transparency scores.

We first explore the importance of institutional demand and intermediation. Our findings suggest that institutional ownership accounts for only a small part of the observed pricing effect. We then analyze how the effects vary across different types of issuers. We find that the pricing patterns are similar across markets with varying constituent and investor beliefs about politics and climate change, as well as across markets with different levels of physical climate risk. Finally, we explore the heterogeneous effects of our results across different types of bonds by credit risk, liquidity spreads, and funding structure. Most of the assessment impact is concentrated among bonds with funding structures specific to the revenue of the project that also have material credit risk. Overall, these results indicate that a broad set of investors—not just institutional ones—value the novel ESG assessments provided by Kestrel, primarily due to how these assessments interact with existing credit risk, particularly for projects with idiosyncratic risk and limited taxing authority.

Institutional demand

One way in which the novel ESG scores could impact bond outcomes could be through changing demand from institutional investors. Baker, Bergstresser, Serafeim and Wurgler (2022) and Tomunen and Yi (2023) for example, find that labeled green bonds are held in higher concentrations by institutional investors.[36] Similarly, Gibbons (2023) finds an analogous result with ESG disclosure in the equity market. Thus, shifts in demand from mutual funds—the second-largest holders of municipal bonds behind retail investors—could contribute to the observed pricing trends for these bonds receiving new ESG assessments. Funds that label themselves with some ESG-related language frequently report portfolio statistics based on environmental and social characteristics.[37] Fund managers with and without internal ESG evaluation systems may change their willingness to purchase bonds with new ESG assessments if they value the information provided.

Using bond level holdings of mutual funds and ETFs in the CRSP Mutual Fund database matched to Mergent, we examine whether funds with "green" concerns (i.e., environmental or social), as defined by Baker, Bergstresser, Serafeim and Wurgler (2022), help explain the observed pricing patterns. We first describe the mutual fund and ETF ownership patterns for the market overall (i.e., holdings of all bonds, not just those in our sample) in Figure

[36]Note that the "norm-constrained" institutional investors that hold less sin-related assets in Hong and Kacperczyk (2009), like pension funds and university endowments, are historically tax exempt and only very small holders of municipal bonds.

[37]For instance, the Calvert Responsible Municipal Income Fund uses an internal 1-to-5 rating system to evaluate the environmental and social impact of bonds and states that it primarily targets investments rated 4 or 5 (Calvert Research and Management, 2025)

9. Panel A of Figure 9 shows that all funds collectively hold over $800 billion in municipal bonds. In contrast, panel C reveals that green funds account for less than 0.5% of this total ownership. Green funds holdings of ex ante labeled bonds are even smaller, totaling just over $1 billion prior to the information intervention period.

We separately describe "green-tilted" funds—those that held more than 5% of AUM in ex ante labeled municipal bonds in the pre-period—in Panel B of Figure 9. We find that these tilted funds as well as bond funds more broadly, hold substantially more of bonds with ex ante labels than green funds. Green-tilted funds hold approximately $15 billion of ex ante labeled debt, while all mutual funds and ETFs combined hold around $40 billion. Thus, non-green and non-green-tilted funds together hold more ex ante labeled bonds than those with explicit ESG mandates or tilts. Given that the funds in Panels A and B hold the majority of outstanding labeled green bonds, the observed pricing effects bonds are more likely to be driven by these funds' responses to new labeling information, despite their lack of formal green mandates.

Figure 10 describes in-sample bond holdings by Kestrel score without any controls. Across all three panels, holdings of assessed bonds remain relatively stable throughout the sample period.[38] Notably, green-tilted funds (panel B) increase their holdings of ex post ineligible bonds leading up to the information shock and add an additional $1 billion afterward—consistent with the yield changes observed. In contrast, green funds (panel C) hold an economically negligible share of these bonds, never exceeding $50 million during the sample period. The mean (median) share of ex post ineligible bonds held by green funds is only 0.02% (0.00%) .

We formally test these trends using Poisson pseudo-maximum likelihood regressions in Table 4, controlling for bond characteristics as in prior specifications. The sample in this table is significantly smaller than the universe of municipal bonds, including those in prior tables, as inclusion in the sample requires the bond to be owned by at least one mutual fund/ETF during the sample period. PPML is well suited for modeling changes in holdings, as it accommodates non-negative, skewed distributions with many zeros in the dependent variable (Correia, Guimarães and Zylkin, 2020).

Once controls are included, we find no change in ownership patterns for newly assessed bonds for all funds (column 1) or green-tilted funds (column 2). Among non-green funds, the only strong statistically significant effect we find is that green-tilted funds are selling off their ex ante labeled assets, with 43% lower holdings of these assets after March 2023.

[38] All panels show a pre-period increase followed by a decline in holdings of bonds not assessed by Kestrel, consistent with a broader sell-off during the rising interest rate environment of 2022. We argue that macro-driven changes in control group ownership are not a concern because macro changes are well captured by our pricing model (see Figure 8).

On the other hand, we do find that green funds (column 3) are net buyers of the bonds with new Kestrel assessments, but only during the institutional information period, and net sellers newly assessed bonds with high social scores. They do hold slightly more bonds with high transparency scores in the long run, but the average affect of assessment on mutual fund and ETF holding across all groups is zero once the novel ESG assessments are posted on Bloomberg suggesting that other groups of investors are more likely driving our observed pricing effects.

Heterogeneity by characteristics of place

We now turn to differences in local characteristics of constituents and of geography and climate risk. In Section 4, we documented that there are large differences in labeling decisions based on beliefs of local residents. In particular, we showed that counties with more Republican voters in 2020 and less residents who are worried about climate change are less likely to label their bonds with ESG-related labels *conditional on labeling eligibility*. In Table 5, we present estimates of the coefficients of interest from Equation 2 split into high and low climate worry and high and low Republican vote share. We identify very similar pricing implications of ESG assessment across space. The public information period assessment effect is -3.5bps in counties with below median climate worry, while it is -4.1bps in counties with above median climate worry. Similarly, the coefficients are -4.1bps and -3.6bps in counties with above and below median share of Republican voters in 2020, respectively. We do find differences in the marginal pricing of information contained in the ESG ratings, with higher pricing benefits for higher environmental and transparency score bonds in high climate worry and low Republican share counties.

In Table 6, we replicate the same exercise splitting the sample into counties with high vs. low FEMA expected loss scores and high vs. low Climate Impact Lab direct climate damage estimates (Hsiang, Kopp, Jina, Rising, Delgado, Mohan, Rasmussen, Muir-Wood, Wilson, Oppenheimer et al., 2017). This sample split speaks to whether investors are pricing these bonds because of concerns over physical climate risk. We find estimates of the assessment effect that are, again, similar across space regardless of physical climate risk: high FEMA expected loss score counties see bond spreads decline by 4.8bps with assessment relative to 3.7bps for low FEMA expected loss score counties. For Climate Impact Lab direct climate damage estimates, the pattern is similar but reversed with high expected damage counties having a -2.6bps assessment effect and low expected damage counties having a -5.2bps assessment effect.

Across these splits, we fail to find systematic differences in pricing implications of ESG information. This is particularly interesting in the municipal bond market because the in-

vestors in these markets largely live in the same geographic locations as the bond issuer, so the beliefs of many of the investors should be captured by these splits. The lack of large differences across the belief subsamples also suggests that the labeling selection being substantially influenced by local belief factors will lead to money being left on the table by municipalities who under-provide this information since the pricing impact of verified ESG information is very similar.

Heterogeneity by characteristics of bonds

We now explore whether our results are constant across different types of bonds. One potential theory is that the ESG-related information verified by Kestrel helps investors better understand default risk. To test whether the ESG-related information could be valuable because it is related to default risk, we split the sample of bonds into those with high grade credit ratings (Aa1 and above according to Moody's) and those with lower or no credit rating at issuance and re-estimate the regression described by Equation 2.

We display the results of this exercise in columns 1 and 2 of Table 7. We find that low credit risk bonds (column 1) still have a statistically significant assessment effect, but it is only a 2.1bps decline in spreads in the public information period. High credit risk bonds (column 2), on the other hand, experience a much larger assessment effect of 9bps. The marginal pricing effects of environmental and transparency scores are less precisely estimated in this specification but the point estimates are still negative. There is a statistically significant greenium on the environmental margin in the low credit risk subsample, but both subsamples still have attenuated pricing impacts for high social score bonds.

Digging further into the credit risks, we present additional splits of the assessment effect by funding source and their complete dynamic effects in Figure 11. Panel A presents the credit risk split only for bonds that have general obligation funding. We find no impact of the new ESG scores on high credit risk general obligation bonds. We continue finding a statistically significant 1-2bps assessment effect for general obligation bonds with high grade credit ratings after March 2023 when the ratings become available on Bloomberg.

In panel B, we restrict to bonds that are secured by the specific cashflows of the project instead of being backed by something like the full faith and credit of the municipal issuer. In this split, there is a striking difference in spread responses for high grade and lower or unrated bonds to the new ESG information. These so called "revenue" bonds with high grade credit ratings have a pricing response to the ESG information that looks a lot like the response for high grade general obligation bonds: spreads decline by 1-2bps starting in March 2023 but do not have any statistical response otherwise. The lower credit rated and unrated revenue bonds see spreads drop by 10bps when they receive new public assessments

of their ESG characteristics. This evidence suggests that investors really value verified ESG information for bonds where there is existing material default risk and where the profitability of the project is directly related to repayment.[39]

Another potential mechanism is that the ESG scoring information provided by Kestrel provides a coordinating mechanism to investors in an especially illiquid market. There are more than 1.2 million CUSIPs outstanding, and finding a counterparty to trade any given bond can be extremely costly in this market. It could be the case that the additional 125 thousand reviews available from Kestrel allows investors to focus on a narrower set of bonds and that these bonds become more liquid. If these non-eligible bond scores are mostly providing a coordination mechanism, we expect that most of the decline in spreads would happen among the most illiquid bonds. To test this hypothesis, we sort all bonds according to the gap between customer purchase and sale prices in the first 14 months of the sample and split at the median.[40] Bonds that generally have low liquidity should have higher spreads in the pre-period.

We display estimates from this sample split in columns 3 and 4 of Table 7. Bonds with both high and low liquidity spreads in the pre-period have similar assessment effects, albeit slightly larger where liquidity spreads are higher but neither can statistically reject the headline estimate of -3.8bps from Table 2. The marginal pricing for having a higher environmental score is only statistically significant in the low liquidity spread sample (i.e., bonds with more liquidity) and the marginal pricing for transparency is only statistically significant in the high liquidity spread sample (i.e., bonds with less liquidity), but the point estimates are similar across subsamples. The most notable difference is that the increase in spreads for bonds with existing green, social, or sustainability labels only shows up in the high liquidity spread sample. The evidence in these specifications suggests that coordinating liquidity is not the main driver of the impacts that we estimate due to the release of the novel Kestrel ESG scores.

[39] That the presence of ESG-related information verification through the new Kestrel scores and eligibility opinions carry the most impact for low-scored bonds is consistent with the idea that ESG-related information verification has default risk implications. Since Tomunen and Yi (2023) study the portion of the market where bonds are already receiving credit enhancement through bond insurance, this relationship with credit risk could explain part of why our context shows pricing impact of ESG information when they estimate null impacts on several margins for relationship-driven labeling.

[40] We include bonds that never trade in the first 14 months of the sample in the high liquidity spread sample.

7 Conclusion

In this paper, we present a novel exploration of environmental, social, and sustainability labeling decisions among municipal bonds and provide new evidence on the pricing implications of ESG uncertainty. We document a disconnect between where ESG labels are supplied and where ESG-related information is priced. While labeling decisions correlate with local political and climate-related beliefs, investor pricing responses to third-party ESG assessments do not follow the same geographic or ideological patterns. This asymmetry suggests that labeling decisions are not aligned with where the market values the new ESG information most.

We begin by studying the supply side of ESG labels using Kestrel's eligibility assessments. Among bonds that qualify for ESG labels according to international standards, the vast majority do not select into labeling. Our selection model finds that labeling a bond as green, sustainability, and social, conditional on conformity with international standards, is more likely when the project has relatively larger positive environmental impacts, is located in municipalities with more constituents worried about climate change, less Republican voters, or a larger share of white population, and when issuance size of the bond is larger.

Turning to demand and pricing, we then use the release of Kestrel's ESG scores and label eligibility opinions to assess how investors respond to a reduction in information frictions in this market. There has been mixed evidence of investors' willingness to pay a premium for specific ESG characteristics of financial instruments, especially in the municipal bond market—a setting where such a greenium could be very important. Using a modified difference-in-difference research design, we study how bond pricing responds for bonds receiving ESG assessments relative to those that do not, and we further decompose this effect for bonds that receive higher or lower scores conditional on assessment.

We find that investors are willing to pay a premium for bonds with verified ESG characteristics. Surprisingly, the largest pricing response occurs for bonds with average scores (i.e., those specifically ineligible for any ESG label), which we call the *assessment effect*. We also find marginal premia for bonds that receive relatively higher environmental impact and transparency scores (i.e., greenium), amounting to about 2bps for a movement from a score of 3 out of 5 to a score of 5 out of 5 on either margin. We find the opposite for bonds that have very high assessments of their social impact—bonds with maximum social scores and average environmental and transparency scores only see spreads drop by 1.6bps after the new Kestrel assessments are released. We fail to find evidence of an **incremental** premium for bonds deemed eligible for green, sustainability, or social labels under ICMA standards beyond that of similar bonds receiving similar ESG assessments.

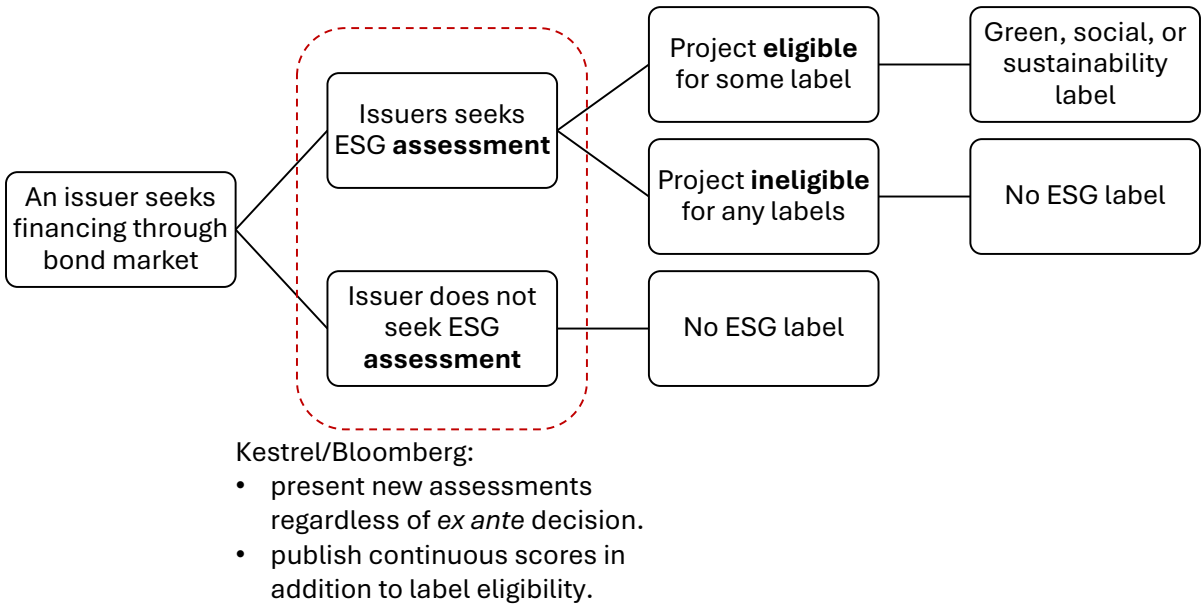
We find only limited evidence of differential pricing trends depending on the local beliefs that are related to selection into using bond labels. The marginal premium for high environmental and transparency scores is slightly larger in lower Republican-voting and more climate-concerned areas, but the assessment effect, and thus the overall pricing effect of the newly released ESG scores, is very similar across jurisdictions. The only substantial heterogeneity in pricing patterns arises from underlying risk: bonds with lower credit ratings, particularly those with limited taxing authority, experience much larger spread declines after assessment.

Together, these results highlight the role of information intermediaries and the value of credible and comparable disclosure in addressing ESG-related information frictions in the municipal bond market. They also uncover a mechanism for why prior studies have found mixed evidence of a greenium—reliance on issuer self-labeling limited both coverage and comparability, distorting investors' willingness to pay.

More broadly, our results suggest a disconnect between the supply of and demand for verified ESG-related information. While ESG labels have historically been applied selectively by issuers, investor pricing responds to verified ESG information across a much wider set of bonds. The transition from issuer-paid labeling to investor-paid labeling in this market has likely alleviated some of these issuer-specific frictions and lowered borrowing costs for a wider set of municipalities previously excluded from the labeled market.

Figures

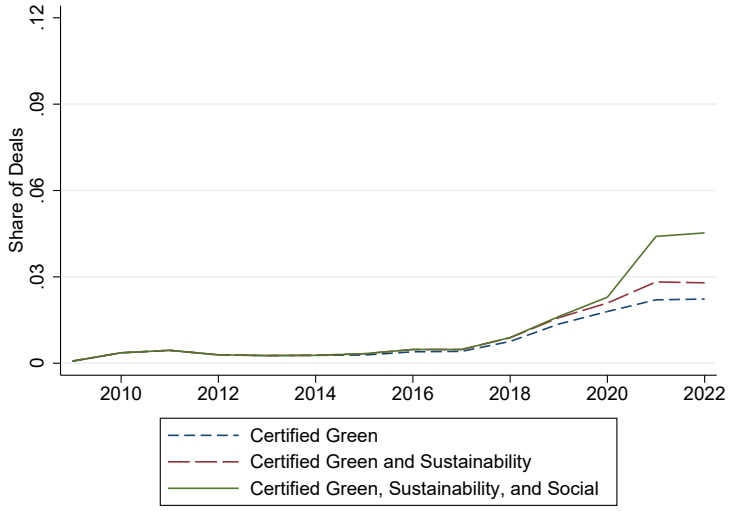
Figure 1: ESG-related Assessment, Eligibility, and Labeling Decision



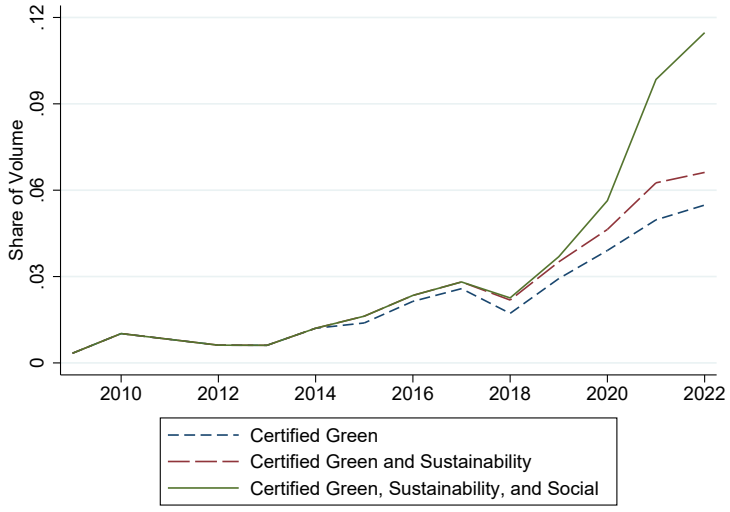
Note: Figure 1 displays the basic mechanics and terminology related to how municipal bond issuers obtain labels for ESG-related purposes as well as the quasi-experiment we explore in this paper. First, when issuing a bond, issuers have many choices of how to present that bond to the market and what information to disclose or highlight for investors. This paper focuses on the decision of whether to seek an ESG-related label, and the first step of acquiring such a label is either performing an internal assessment or hiring a third party to perform an assessment. If the issuer does not seek an assessment of their own accord, historically they would not receive any label. If they do seek assessment, the ESG impacts and risks of the project are measured against some standard, such as the ICMA (2021) *Green Bond Principles*. If the assessment finds that the project meets the standard, then the bond is eligible for a label and will receive a label. Most of the time, the assessment or third party opinion is included as an addendum to the official statement. Historically, if the assessment determines that the bond is ineligible for an ESG-related label, then that assessment would not be shared with investors.
On March 6, 2023, Bloomberg terminals began displaying quantitative scores from ESG assessments from Kestrel Sustainability Intelligence to investor on many bonds—about 1/4 of the municipal market—regardless of the original assessment and regardless of eligibility, which we display with a red dashed line. Subscribers to this information also receive eligibility opinions.

Figure 2: Historical Use of Ex Ante ESG-Related Bond Labels

A. Share of Deals with Labels



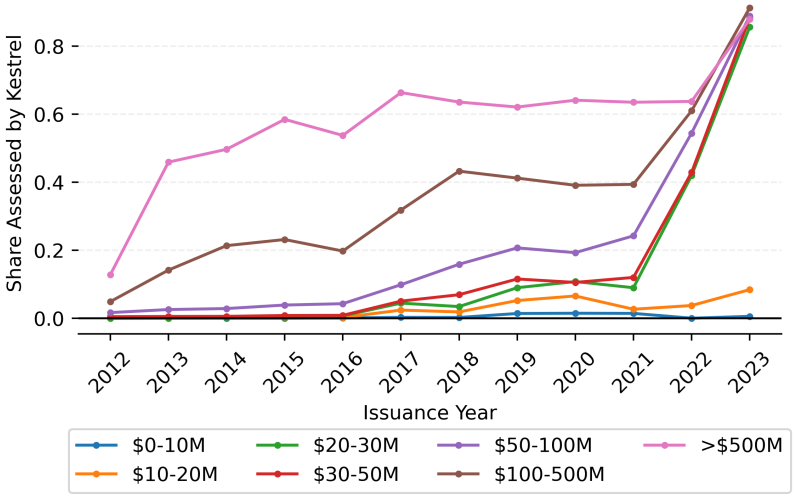
B. Volume of Deals with Labels



Note: This figure shows the count (panel A) and volume (panel B) of the primary municipal bond market issues that choose to use some sort of ESG-related label according to Bloomberg from 2009 through 2022. The labeled bonds before 2013 were not using "green" labels but were using related labels that noted funds were going to projects with environmental benefits or extra investment to avoid environmental risks. ICMA adopted the first *Green Bond Principles* in 2014, which to our knowledge is when participants started coalescing around the currently used labels. The grand majority of municipal bonds historically, by count and by volume, did not receive any such label.
Source: Mergent and Bloomberg

Figure 3: Characteristics of Kestrel Assessed Bonds by Original Issuance Year

A. Presence of Kestrel Score by Size and Issuance Year

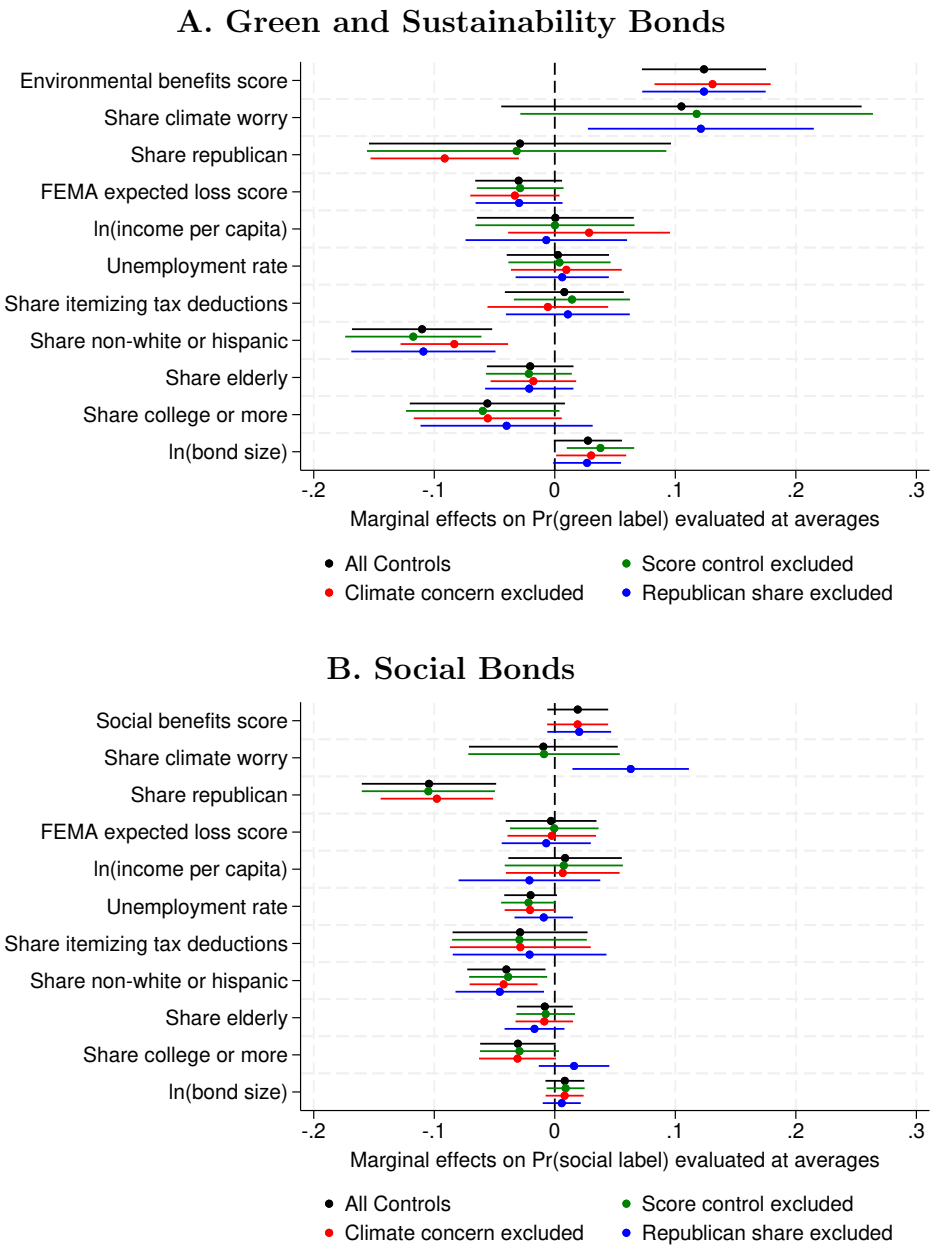


B. Average of Kestrel Scores by Category and Issuance Year



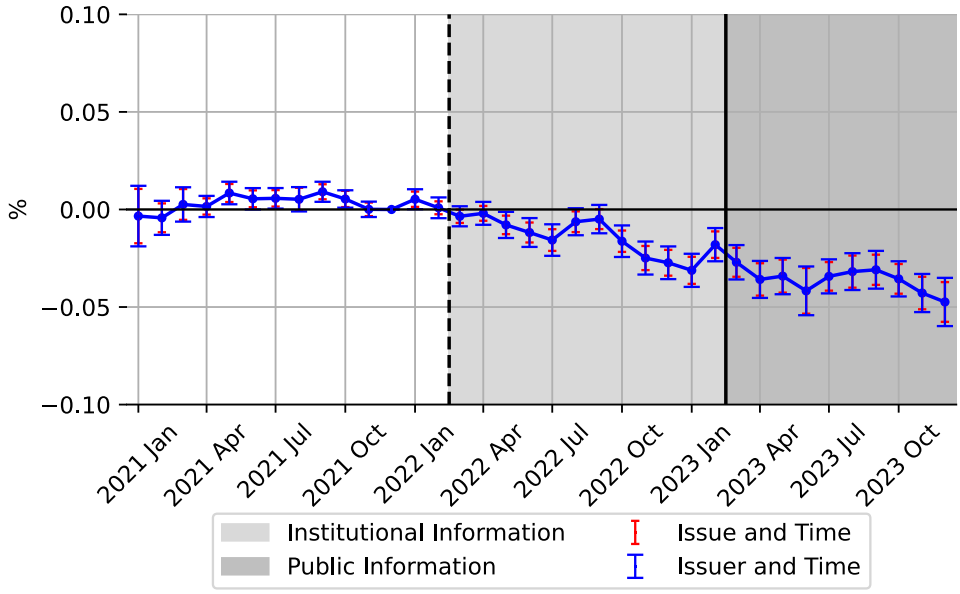
Note: This figure displays the relative assessment likelihood and the average scores conditional on assessment by bond issuance year. Panel A shows the share of bonds in our transaction sample, bonds that trade a least once in the years 2021 through 2023, that have ESG characteristics assessed by Kestrel and posted on Bloomberg terminals. There are two dimensions that drive most of the information intervention. The first is that larger bonds across all years are more likely to be scored. This makes our ability to control for time-varying size premia very important. Second, the market started getting much more complete Kestrel ESG-data compilation and verification in 2022 at the same time scores began being made available for institutional investors. This increase in scores in 2022 is almost entirely concentrated among bond issues where the par value is greater than $20 million. Panel B shows the average quantitative scores that Kestrel assigns to each assessed bond conditional on scoring.
Source: MSRB Transaction Data, Mergent, and Kestrel.

Figure 4: Marginal Impacts on Bond Label Selection Likelihood Conditional on Eligibility



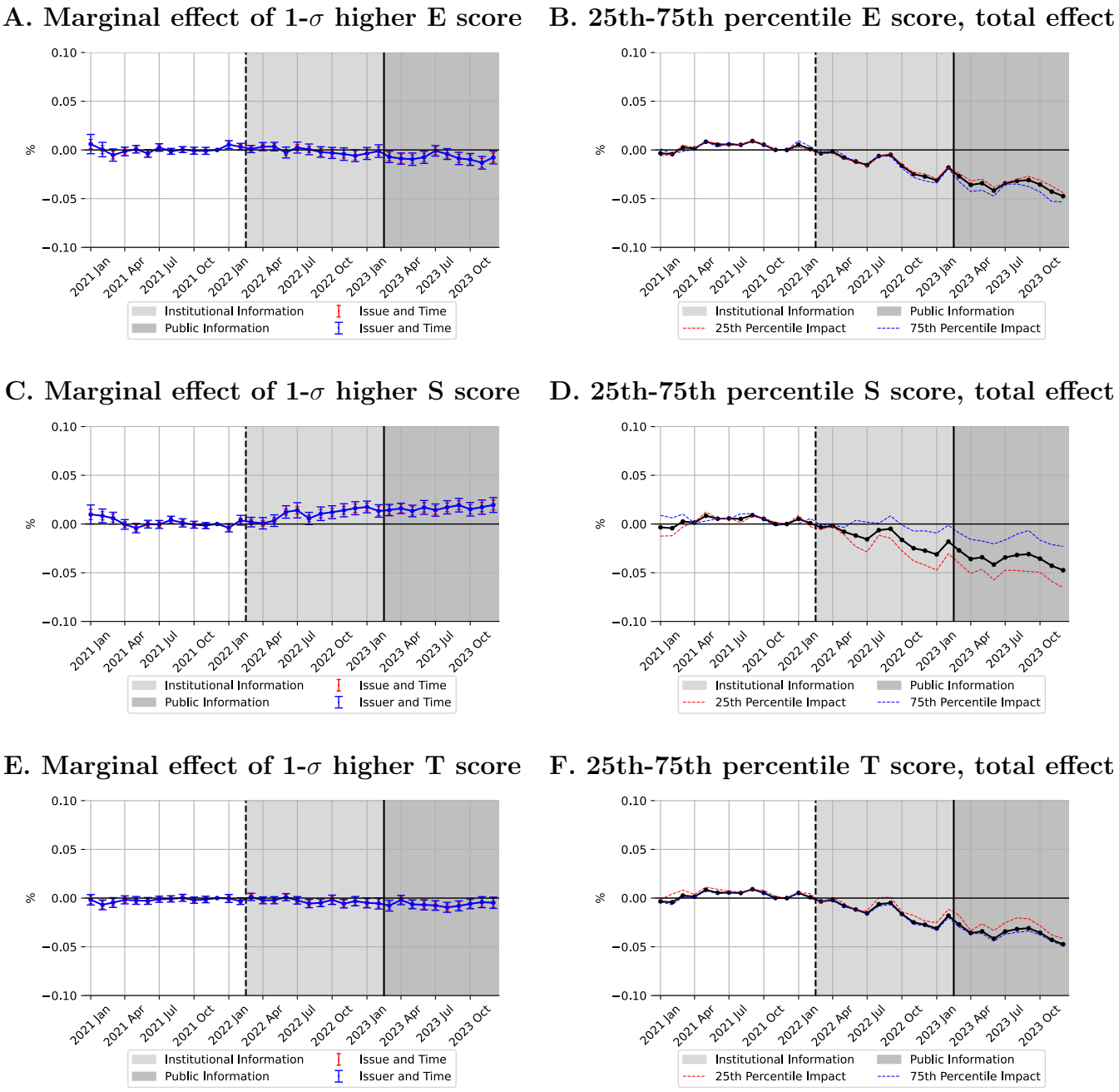
Note: This figure plots the the marginal effects on the likelihood of selecting a green, sustainability, or social bond label conditional on being eligible for such a label according to Kestrel's opinion. The estimates in each panel come from logistic regressions of an indicator equal to one for bonds that were issued with relevant labels while the sample is restricted to the set of bonds that Kestrel states are eligible for such a label. The demographic and economic control variables are measured at the local county level, or at the state level for state and state agency issuers as well as multi-county districts. Controls are normalized to standard deviations with mean zero. The unit of observation is a bond package level (i.e. a series of bonds). Marginal effect estimates include 95% confidence intervals for standard errors clustered at the issuer level. The associated logistic point estimates from which we derive marginal effects for panel A are displayed in Table D.1 and for panel B are displayed in Table D.2.

Figure 5: Spread response for bonds receiving novel Kestrel ESG assessment



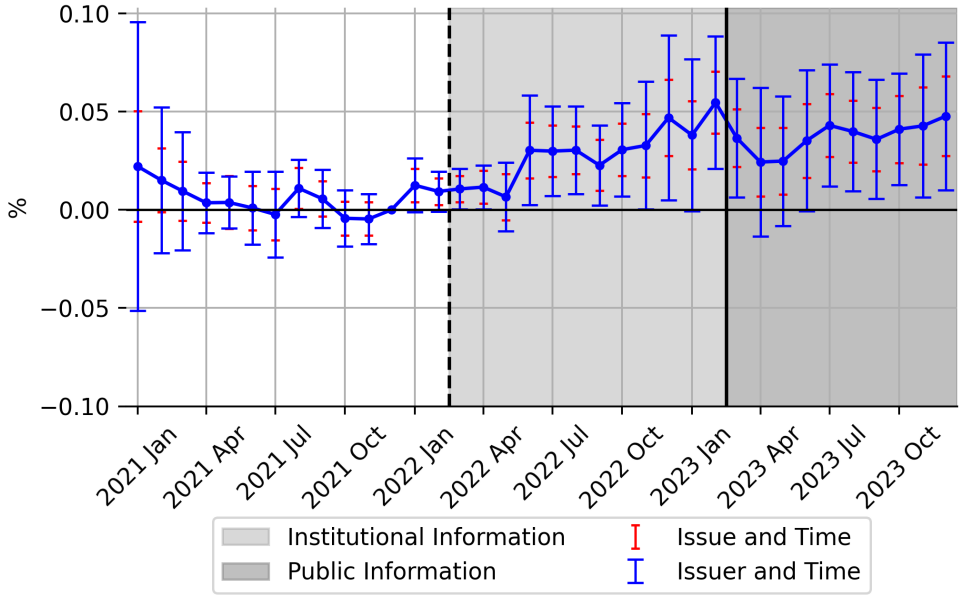
Note: This figure shows how the ESG-related information intervention impacts spreads for affected municipal bonds by plotting estimates of β_k, which is the assessment effect, from Equation 2. These coefficients describe how the pricing evolves for municipal bonds who receive an ESG-related information intervention–evaluated at average scores–relative to those bonds that did not. The light grey (middle) region denotes months when Kestrel scores were available to select institutional subscribers. The dark grey (right) region denotes months when Kestrel numerical scores were disseminated widely through Bloomberg Terminals. This regression includes the following controls: includes controls for month-by-state-by-taxability status, month-by-credit rating, month-by-average trade size tercile, month-by-placement style terciles (exact offering price trades and non-transaction based compensation trades), as well as coupon rate, log issue size, duration, and years to maturity (quadratic) interacted with month fixed effects. These controls match column 4 of Table 2, which displays pooled difference-in-differences estimates. Corresponding estimates for the marginal impact of the environmental, social, and transparency scores are displayed in Figure 6. 95% confidence intervals for standard errors two-way clustered on bond issuer and month (issue and month) are given by the blue (red) bars.

Figure 6: Marginal spread responses to scores included in Kestrel assessment



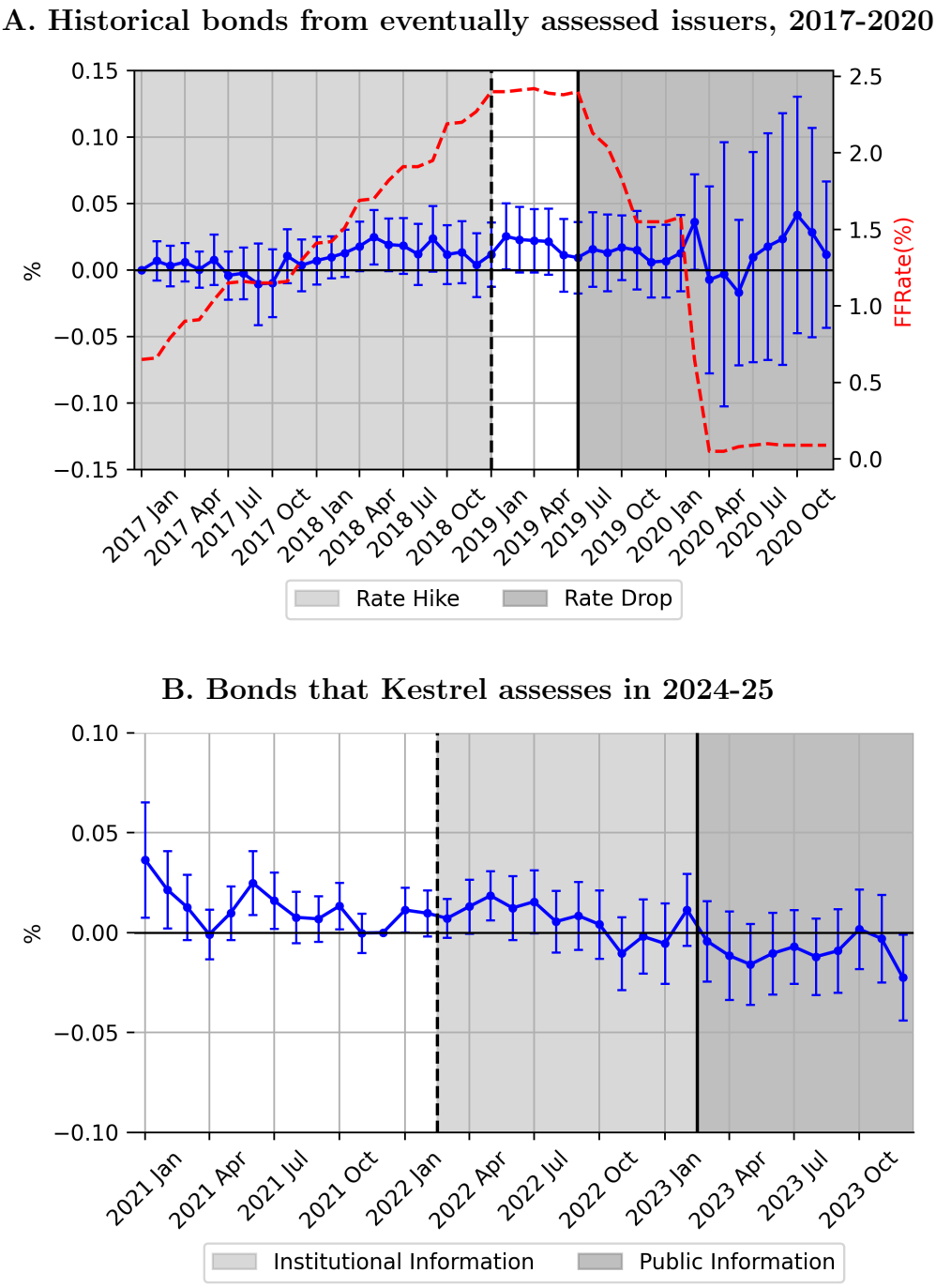
Note: This figure shows how the ESG-related information intervention impacts spreads for affected municipal bonds by plotting estimates of γ_k, which are the marginal impacts of ESG subscores conditional on assessment, from Equation 2. The coefficients in panels A, C, and E describe how the pricing evolves for municipal bonds who receive a more positive revelation of ESG-related information relative to bonds that were also assessed but received less positive subscore information. Panels B, D, and F show how these marginal coefficients translate into total effects when combined with the average assessment effect for the environment, social, and transparency scores respectively. Moving from the 25th to 75th percentile increases the magnitude of the spread impact on the environmental and transparency margins, but it shrinks the magnitude of the spread impact for the social measurement. The controls match column 4 of Table 2, which displays pooled difference-in-differences estimates. Corresponding estimates for the assessment effect are displayed in Figure 6. 95% confidence intervals for standard errors two-way clustered on bond issuer and month (issue and month) are given by the blue (red) bars.

Figure 7: Spread evolution for bonds that were labeled ex ante



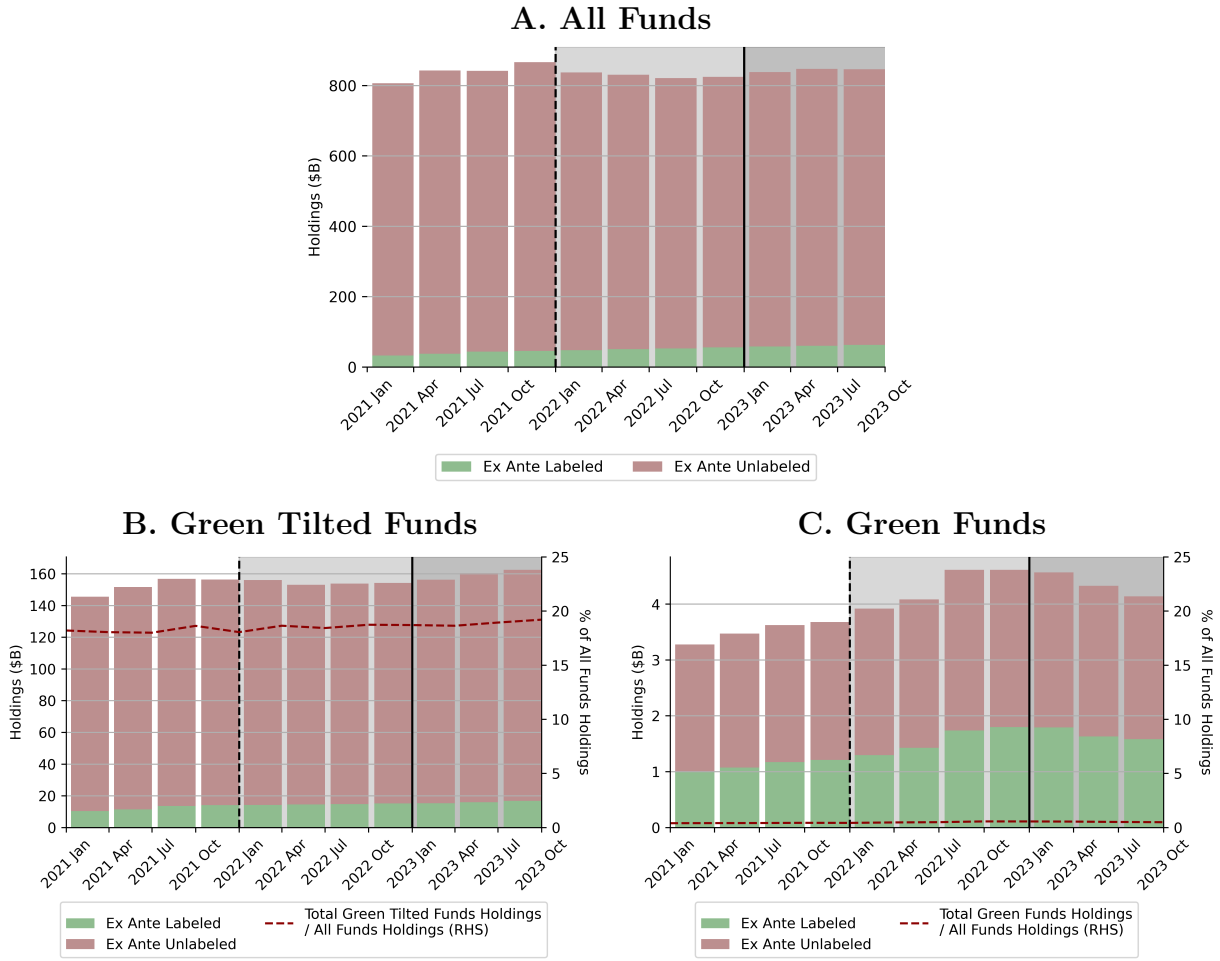
Note: This figure plots estimates of the pricing of ex ante labeled green, social, and sustainability bonds over the period of the ESG information intervention. These coefficients describe how the pricing evolves for municipal bonds with existing ESG labels evolve relative to bonds that are unlabeled and also did not receive any information intervention. The light grey (middle) region denotes months when Kestrel scores were available to select institutional subscribers. The dark grey (right) region denotes months when Kestrel numerical scores were disseminated widely through Bloomberg Terminals. This regression includes the following controls: includes controls for month-by-state-by-taxability status, month-by-credit rating, month-by-average trade size tercile, month-by-placement style terciles (exact offering price trades and non-transaction based compensation trades), as well as coupon rate, log issue size, duration, and years to maturity (quadratic) interacted with month fixed effects. These controls match column 4 of Table 2, which displays pooled difference-in-differences estimates. 95% confidence intervals for standard errors two-way clustered on bond issuer and month (issue and month) are given by the blue (red) bars.

Figure 8: Placebo Tests for the assessment effect



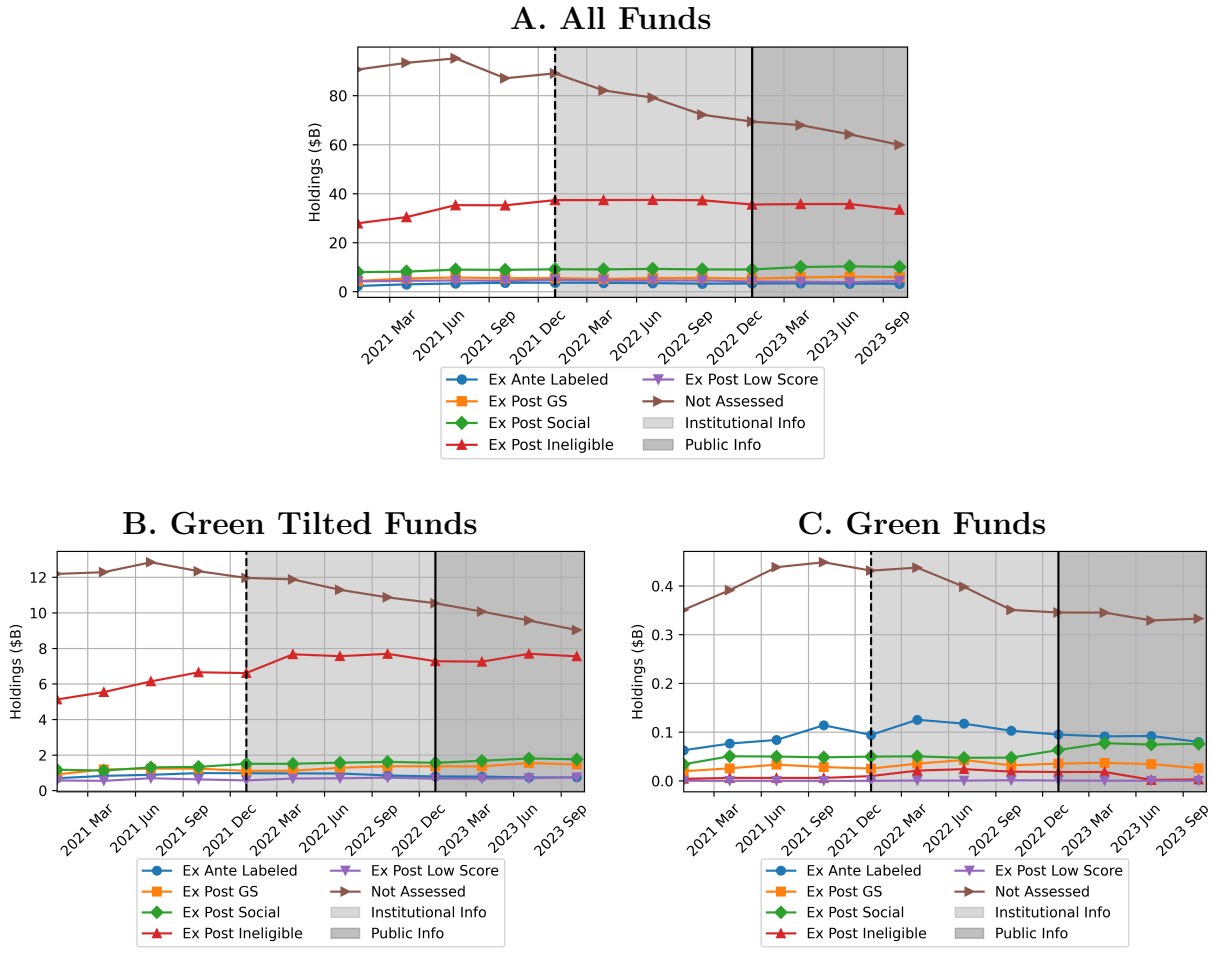
Note: This figure plots the results of the dynamic difference-in-differences regression specified in equation 2 for a two different ***placebo*** treatments. Panel A provides a placebo test with unassessed bonds that were trading during the years 2017 through 2020, including the COVID-19 period of extreme volatility. This first placebo treatment is defined as one for bonds issued by issuers that are most likely to have bonds scored by Kestrel starting in 2022, which is the 75th percentile residual issuer treatment likelihood to match the same treatment share as in the main sample, and zero otherwise. The federal funds rate is diplayed on the right axis to show how placebo bonds are not priced differently in an earlier period of monetary policy volatility. Panel B provides a placebo test using bonds that were not assessed by Kestrel during the sample period but were rated between February 2024 and May 2025. The bonds in this second placebo treatment are eventually selected in the same manner as earlier rated bonds but were untreated in 2022 and 2023. Controls for both panels are the same as in Figure 5. The figures both include 95% confidence intervals for standard errors two-way clustered by issuer and month.

Figure 9: Mutual Fund and ETF Ownership of Municipal Bonds



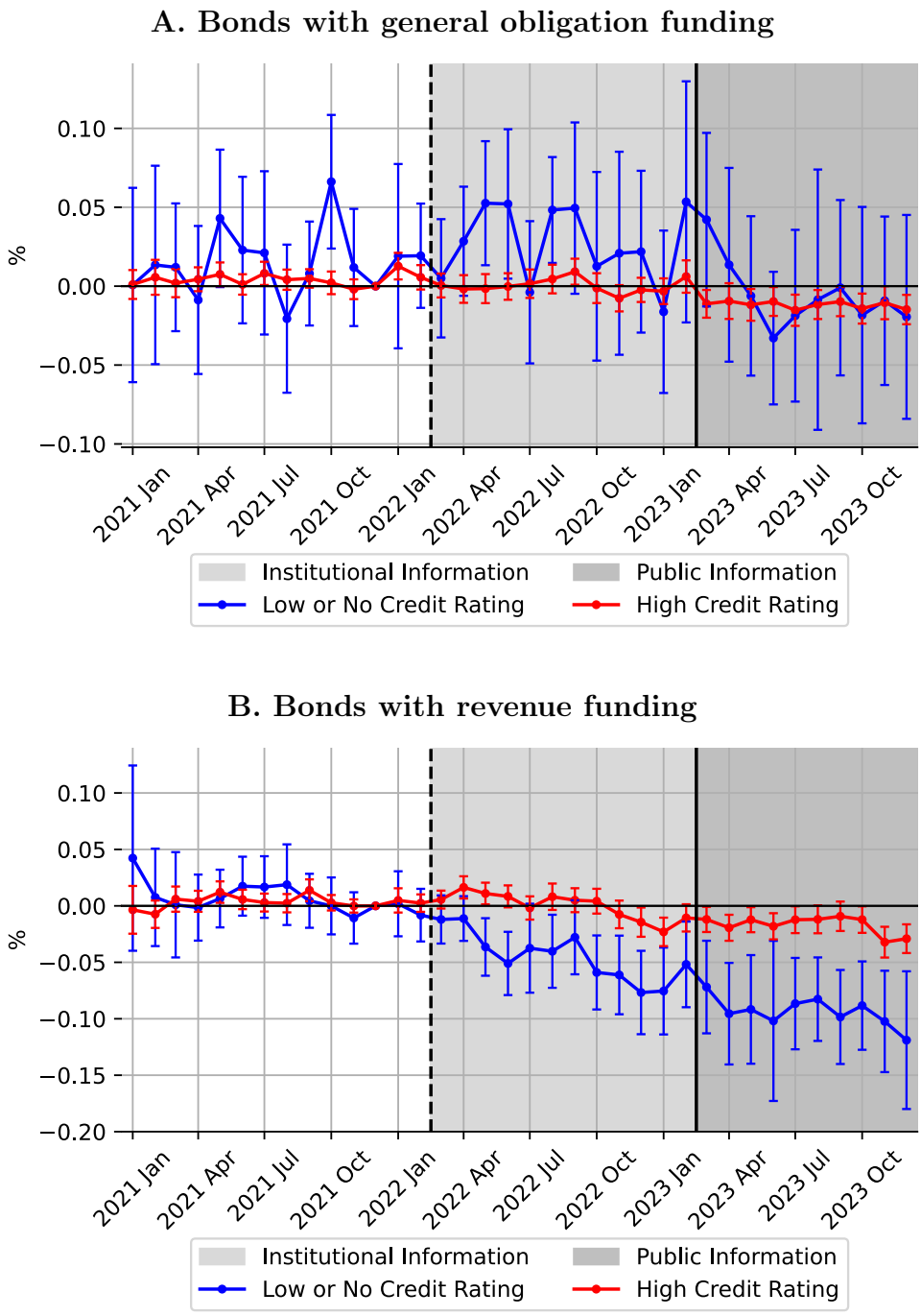
Note: This figure plots total quarterly ownership of municipal bonds by mutual funds and ETFs. The sample includes the holdings of all CUSIPs in Mergent that are owned by mutual funds and ETFs in the CRSP MF database. Panel A gives the total municipal bond holdings of all funds in the database. Panel B gives the total municipal bond holdings of all funds that have an average quarterly holding of *Ex Ante Labeled* municipal bonds of $> 5\%$ of fund AUM in the pre-period, *Green Tilted Funds*. Panel C gives the total municipal bond holdings of funds identified as "green" using the fund name dictionary from Baker, Bergstresser, Serafeim and Wurgler (2022), *Green Funds*. In each panel, the total holdings of *Ex Ante Labeled* municipal bonds are given in green and all other municipal bonds are in red. The stacked bars give the total combined holding amount. In Panels B and C, the dashed red line gives the total holdings of *Green Tilted Funds* and *Green Funds*, respectively, as a percentage of holdings all funds. The light grey (middle) region denotes months when Kestrel scores were available to select institutional subscribers. The dark grey (right) region denotes months when Kestrel numerical scores were disseminated widely through Bloomberg Terminals.

Figure 10: Mutual Fund and ETF Ownership of Municipal Bonds by Kestrel Score



Note: This figure plots total quarterly ownership of in-sample municipal bonds by mutual funds and ETFs, conditional on the available ESG information after the information intervention. Panel A gives the total municipal bond holdings of all funds in the database. Panel B gives the total municipal bond holdings of all funds that have an average quarterly holding of *Ex Ante Labeled* municipal bonds of $> 5\%$ of the fund's AUM in the pre-period, *Green Tilted Funds*. Panel C gives the total municipal bond holdings of funds identified as"green" using the fund name dictionary from Baker, Bergstresser, Serafeim and Wurgler (2022), *Green Funds*. *Ex Ante Labeled* bonds are those that had a green, sustainability, or social label when they were issued. *Ex Post GS* bonds are those that qualify as green or sustainability bonds but that did not label themselves as such. *Ex Post Social* bonds are those that qualify as social bonds but that did not label themselves as such. *Ex Post Ineligible* and *Ex Post Low Score* bonds are bonds that are ineligible for ICMA certifications in Kestrel's opinion but which have scores equal to 3 or above out of 5, or below 3, respectively. The *Not Assessed* bonds are those that never labeled themselves and that do not have any additional information provided by Kestrel or on Bloomberg regarding their ESG characteristics. The light grey (middle) region denotes months when Kestrel scores were available to select institutional subscribers. The dark grey (right) region denotes months when Kestrel numerical scores were disseminated widely through Bloomberg Terminals.

Figure 11: Heterogeneous spread response to new Kestrel ESG assessment by credit rating and bond funding



Note: This figure shows how the ESG-related information intervention impacts spreads for affected municipal bonds by plotting estimates of β_k, which is the assessment effect, from Equation 2 for 4 different subsamples. These coefficients describe how the pricing evolves for municipal bonds who receive an ESG-related information intervention–evaluated at average scores–relative to similar bonds that did not. The controls match column 4 of Table 2. Panel A limits the sample to bonds that are financed with "general obligation," which often means the bonds are backed by the full faith and credit of the municipal issuer. Panel B limits the sample to bonds that are financed with revenue from a specific project or source (security types B, C, G, H, I, J, M, N, O, P, Q, R, and S in Mergent). Each panel further splits the sample into bonds that have have *high credit ratings*, which means prime or high grade ratings from one of the three major credit rating adgencies, and bonds that have *low or no credit ratings*, which is everything else. 95% confidence intervals for standard errors two-way clustered on bond issuer and month (issue and month) are given by the blue (red) bars.

Tables

Table 1: Characteristics of the bond-month transaction sample

	Mean	SD	Obs	25^{th}	50^{th}	75^{th}
Yield	2.32	1.30	1,131,122	1.09	2.58	3.18
Labeled or assessed	2.36	1.17	305,456	1.43	2.61	3.14
Not labeled, not assessed	2.31	1.34	825,666	1.00	2.56	3.20
Tax adjusted spread	0.38	0.43	1,131,122	0.12	0.31	0.58
Labeled or assessed	0.33	0.37	305,456	0.08	0.27	0.54
Not labeled, not assessed	0.40	0.45	825,666	0.14	0.33	0.59
Years to maturity	4.01	2.17	1,131,122	2.17	3.64	5.50
Labeled or assessed	4.47	2.21	305,456	2.63	4.24	6.09
Not labeled, not assessed	3.84	2.13	825,666	2.05	3.42	5.25
Coupon	4.38	1.19	1,131,122	4.00	5.00	5.00
Labeled or assessed	4.63	0.99	305,456	5.00	5.00	5.00
Not labeled, not assessed	4.28	1.24	825,666	4.00	5.00	5.00
Issue Size (Par)	4.11	1.37	1,131,063	3.15	4.09	5.08
Labeled or assessed	5.06	1.14	305,436	4.37	5.09	5.84
Not labeled, not assessed	3.76	1.28	825,627	2.89	3.73	4.61
Monthly volume	293,024	1,526,800	1,131,122	20,000	50,000	150,000
Labeled or assessed	465,356	1,953,606	305,456	25,000	80,000	250,000
Not labeled, not assessed	229,270	1,329,106	825,666	20,000	50,000	120,000
Conditional on assessment						
Environmental Score	3.45	0.88	281,681	3.00	3.00	4.00
Social Score	3.90	0.91	281,681	3.00	4.00	5.00
Transparency Score	3.82	0.66	281,681	3.00	4.00	4.00

Note: This table shows the basic characteristics of the bond transactions that are included in our sample. This sample includes the universe of customer bond purchases reported in MSRB for bonds that have fixed coupons and that do not include call functions. We also restrict the sample to bond-months where bonds have been trading for at least 90 days and they have at least one year left before maturity. Yield is measured as yield to maturity for these bonds since they don't have call options. The tax adjusted spread compares after-tax returns on the muni transaction with a maturity matched treasury, assuming that the owner is a very high income individual in the state of issuance. This table, and our sample more broadly, does not include bond-months where we don't observe any trades.

Table 2: Pooled difference-in-differences estimates of information intervention on spreads

	Δ Spread (basis points)			
	(1)	(2)	(3)	(4)
Novel ESG Assessment				
× Institutional Ownership Period	-1.269***	-1.241***	-1.289***	-1.681***
	(0.384)	(0.406)	(0.406)	(0.409)
× Public Information Period	-3.256***	-3.293***	-3.412***	-3.826***
	(0.518)	(0.537)	(0.541)	(0.541)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.178	-0.186	-0.193	-0.146
	(0.245)	(0.255)	(0.254)	(0.254)
× Public Information Period	-0.804**	-0.813**	-0.839**	-0.814**
	(0.297)	(0.330)	(0.329)	(0.324)
× Social Score (σ)				
× Institutional Ownership Period	0.978***	0.974***	0.887**	0.859**
	(0.319)	(0.335)	(0.329)	(0.317)
× Public Information Period	1.547***	1.544***	1.442***	1.445***
	(0.322)	(0.373)	(0.372)	(0.336)
× Transparency Score (σ)				
× Institutional Ownership Period	-0.0322	0.0110	0.00574	-0.0880
	(0.191)	(0.193)	(0.192)	(0.191)
× Public Information Period	-0.338	-0.279	-0.288	-0.415*
	(0.241)	(0.259)	(0.259)	(0.243)
Ex Ante Labeled				
× Institutional Ownership Period	2.750**	2.785**	2.433**	2.225*
	(1.057)	(1.151)	(1.112)	(1.142)
× Public Information Period	3.737**	3.820**	3.339**	3.037*
	(1.555)	(1.639)	(1.589)	(1.566)
Observations	1,070,347	1,070,347	1,070,347	1,070,347
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Maturity, Coupon (linear) by Month FE	Y	Y	Y	Y
Duration (linear) by Month FE		Y	Y	Y
Placement Type Bins by Month FE			Y	Y
Maturity (quadratic) by Month FE				Y

Note: This table displays pooled difference-in-differences estimates from Equation 2 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. In the first column, the regression includes controls for month-by-state-by-taxability status, month-by-credit rating, and month-by-average trade size tercile, as well as coupon rate, log issue size, and years to maturity interacted with month fixed effects. Column 2 adds a linear duration control interacted with month fixed effects. Column 3 adds two proxies for institutional interest from the initial placement: terciles in the share of trades happening exactly at the reoffering price (following Green, Hollifield and Schürhoff, 2007) and terciles in the share of trades containing non-transaction based compensation. Column 4 adds a quadratic term in years to maturity interacted with month fixed effects. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Pooled difference-in-differences estimates of information intervention on spreads: Separate assessment interactions for label eligible and ineligible bonds

	Δ Spread (basis points)			
	(1)	(2)	(3)	(4)
Novel ESG Assessment: Label Ineligible				
× Institutional Ownership Period	-2.458***	-2.466***	-2.466***	-2.832***
	(0.673)	(0.702)	(0.704)	(0.685)
× Public Information Period	-5.988***	-6.078***	-6.154***	-6.478***
	(1.308)	(1.685)	(1.719)	(1.495)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.943	-0.875	-0.934	-1.089*
	(0.626)	(0.664)	(0.658)	(0.627)
× Public Information Period	-1.345	-1.314	-1.436	-1.702*
	(0.860)	(1.026)	(1.025)	(0.871)
× Social Score (σ)				
× Institutional Ownership Period	0.654	0.563	0.519	0.605
	(0.595)	(0.626)	(0.625)	(0.657)
× Public Information Period	-0.229	-0.322	-0.355	-0.144
	(1.137)	(1.515)	(1.534)	(1.293)
× Transparency Score (σ)				
× Institutional Ownership Period	0.115	0.172	0.196	0.0788
	(0.258)	(0.263)	(0.265)	(0.272)
× Public Information Period	-0.469	-0.382	-0.364	-0.510
	(0.324)	(0.351)	(0.353)	(0.342)
Novel ESG Assessment: Label Eligible				
× Institutional Ownership Period	0.279	0.280	0.131	-0.318
	(0.409)	(0.455)	(0.458)	(0.431)
× Public Information Period	-0.967	-1.034	-1.238*	-1.764***
	(0.572)	(0.616)	(0.622)	(0.577)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.424	-0.435	-0.409	-0.317
	(0.269)	(0.276)	(0.276)	(0.271)
× Public Information Period	-1.201***	-1.206***	-1.195***	-1.098***
	(0.305)	(0.318)	(0.317)	(0.319)
× Social Score (σ)				
× Institutional Ownership Period	-0.252	-0.220	-0.226	-0.219
	(0.334)	(0.375)	(0.379)	(0.360)
× Public Information Period	-0.0947	-0.0558	-0.0923	-0.0187
	(0.399)	(0.428)	(0.431)	(0.407)
× Transparency Score (σ)				
× Institutional Ownership Period	-0.169	-0.138	-0.176	-0.252
	(0.291)	(0.295)	(0.296)	(0.286)
× Public Information Period	-0.177	-0.146	-0.188	-0.304
	(0.336)	(0.346)	(0.346)	(0.327)
Ex Ante Labeled				
× Institutional Ownership Period	2.673**	2.710**	2.367**	2.161*
	(1.051)	(1.146)	(1.109)	(1.130)
× Public Information Period	3.614**	3.699**	3.230**	2.932*
	(1.549)	(1.633)	(1.584)	(1.559)
Observations	1,070,347	1,070,347	1,070,347	1,070,347
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Maturity, Coupon (linear) by Month FE	Y	Y	Y	Y
Duration (linear) by Month FE		Y	Y	Y
Placement Type Bins by Month FE			Y	Y
Maturity (quadratic) by Month FE				Y

Note: This table presents estimates of the main difference-in-differences model (Table 2) with a separate interaction term for bonds that receive the novel ESG assessment from Kestrel but which are not eligible for any ESG-related label. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. Table F.2 displays estimates from a complementary approach to measure the discrete impact of label eligibility without controling for marginal E, S, and T scores. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Pooled difference-in-differences estimates of information intervention on mutual fund and ETF ownership

$ Value of Holdings:	All Funds	Green-tilted	Green labeled
	(1)	(2)	(3)
Novel ESG Assessment			
× Institutional Ownership Period	0.00106	-0.0303	0.348**
	(0.0256)	(0.0328)	(0.173)
× Public Information Period	0.000488	-0.0930*	-0.0294
	(0.0393)	(0.0492)	(0.307)
× Environmental Score (σ)			
× Institutional Ownership Period	-0.00460	-0.0331	0.0888
	(0.0107)	(0.0213)	(0.103)
× Public Information Period	-0.00287	-0.0183	0.187
	(0.0185)	(0.0323)	(0.145)
× Social Score (σ)			
× Institutional Ownership Period	0.00256	0.00626	-0.326**
	(0.00980)	(0.0233)	(0.148)
× Public Information Period	0.00427	-0.0182	-0.143
	(0.0160)	(0.0371)	(0.209)
× Transparency Score (σ)			
× Institutional Ownership Period	-0.000369	-0.0206	0.185**
	(0.00633)	(0.0220)	(0.0849)
× Public Information Period	0.00401	-0.0128	0.247*
	(0.0108)	(0.0308)	(0.135)
Ex Ante Labeled			
× Institutional Ownership Period	-0.0401	-0.156	0.167
	(0.0582)	(0.0998)	(0.135)
× Public Information Period	-0.0609	-0.430***	0.0166
	(0.0991)	(0.162)	(0.185)
Observations	533,965	164,277	11,200
CUSIP Fixed Effects	Y	Y	Y
State by tax by Month FE	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y
ln(Size) and Coupon (linear) by Month FE	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y

Note: This table reports estimates from Poisson pseudo-maximum likelihood regressions (as suggested by Cohn, Liu and Wardlaw, 2022) of how the information intervention affected holdings of mutual funds and ETFs. The dependent variable is the dollar value of mutual fund and ETF holdings of each bond in a given quarter and the estimates are interpretable as percent changes. The non-linear estimator forces bonds with the same outcome (mostly zeros) in all quarters to be dropped. The institutional information period includes months from March 2022 through February 2023 and the public information is March through December of 2023. Column 1 includes the total amount of each bond held by all funds in the CRSP MF database. Column 2 restricts the sample to *Green Tilted Funds*, all funds that have an average quarterly holding of *Ex Ante Labeled* municipal bonds of $> 5\%$ of the fund's AUM in the pre-period. Column 3 restricts the sample to funds identified as "green" using the fund name dictionary from Baker, Bergstresser, Serafeim and Wurgler (2022). The controls include CUSIP fixed effects, state-by-taxability-by month fixed effects, credit rating-by-month fixed effects, and log size, coupon, and maturity (quadratic) controls interacted with month fixed effects. Note that the departure from column 4 of Table 2 is that we remove controls related to trading outcomes (trade size bins, duration, and placement type controls) so we can include bond-quarters even if there are not directly observed transactions. Standard errors are presented in parentheses and are double clustered at the issuer and time levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Pooled difference-in-differences estimates of information intervention on spreads: heterogeneity by ex ante local preference characteristics

	Share Climate Worry		Share Republican	
	Low	High	Low	High
Novel ESG Assessment				
× Institutional Ownership Period	-1.355**	-1.960***	-1.677***	-1.647**
	(0.600)	(0.512)	(0.494)	(0.645)
× Public Information Period	-3.501***	-4.053***	-3.613***	-4.149***
	(0.939)	(0.679)	(0.663)	(0.904)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.159	-0.164	-0.148	-0.160
	(0.367)	(0.351)	(0.353)	(0.372)
× Public Information Period	-0.482	-0.910**	-0.996**	-0.533
	(0.514)	(0.420)	(0.431)	(0.519)
× Social Score (σ)				
× Institutional Ownership Period	0.258	1.233***	1.156**	0.292
	(0.360)	(0.436)	(0.428)	(0.405)
× Public Information Period	1.312**	1.327**	1.395***	1.381**
	(0.597)	(0.509)	(0.508)	(0.610)
× Transparency Score (σ)				
× Institutional Ownership Period	0.100	-0.251	-0.180	0.0874
	(0.277)	(0.317)	(0.298)	(0.270)
× Public Information Period	-0.157	-0.766**	-0.590	-0.167
	(0.325)	(0.369)	(0.363)	(0.331)
Ex Ante Labeled				
× Institutional Ownership Period	1.222	2.514	2.146	1.526
	(1.048)	(1.615)	(1.495)	(1.342)
× Public Information Period	-0.302	4.143*	3.366	0.611
	(1.585)	(2.123)	(2.037)	(1.930)
Observations	507,321	518,106	518,459	507,020
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Coupon, Duration (linear) by Month FE	Y	Y	Y	Y
Placement Type Bins by Month FE	Y	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y	Y

Note: This table displays pooled difference-in-differences estimates from Equation 2 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. The controls match column 4 from Table 2. *High Share Climate Worry* bonds are those issued in counties with above median share of residents concerned about climate change according to Yale Climate Survey on average from 2018-21 (Howe, Mildenberger, Marlon and Leiserowitz, 2015). *High Share Republican* bonds are those issued in counties where more than 55% of the vote went to the Republican presidential ticket in 2020. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Pooled difference-in-differences estimates of information intervention on spreads: heterogeneity by ex ante local climate risk characteristics

	FEMA Expected Loss Score		CIL Direct Climate Damage	
	Low	High	Low	High
Novel ESG Assessment				
× Institutional Ownership Period	-1.558***	-2.729*	-2.233***	-1.079**
	(0.408)	(1.368)	(0.578)	(0.522)
× Public Information Period	-3.719***	-4.766**	-5.221***	-2.626***
	(0.571)	(1.933)	(0.891)	(0.628)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.271	0.778	-0.323	-0.0293
	(0.253)	(0.617)	(0.385)	(0.331)
× Public Information Period	-1.070***	0.134	-0.952*	-0.631*
	(0.339)	(0.790)	(0.526)	(0.364)
× Social Score (σ)				
× Institutional Ownership Period	0.756**	0.977	1.175**	0.484
	(0.314)	(0.744)	(0.467)	(0.350)
× Public Information Period	1.342***	1.600	1.440**	1.164***
	(0.374)	(1.071)	(0.603)	(0.413)
× Transparency Score (σ)				
× Institutional Ownership Period	0.0560	-1.129*	-0.0671	-0.110
	(0.217)	(0.631)	(0.294)	(0.258)
× Public Information Period	-0.335	-1.187*	-0.589	-0.314
	(0.277)	(0.640)	(0.406)	(0.300)
Ex Ante Labeled				
× Institutional Ownership Period	2.668**	-0.0180	2.385	1.188
	(1.281)	(1.627)	(1.688)	(0.990)
× Public Information Period	3.584**	-2.395	3.119	0.964
	(1.678)	(2.895)	(2.078)	(1.448)
Observations	925,886	99,620	504,782	520,674
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Coupon, Duration (linear) by Month FE	Y	Y	Y	Y
Placement Type Bins by Month FE	Y	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y	Y

Note: This table displays pooled difference-in-differences estimates from Equation 2 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. The controls match column 4 from Table 2. *High FEMA Expected Loss Score* bonds are those issued in counties with above median losses from the FEMA National Risk Index. *High CIL Direct Climate Damage* bonds are those issued in counties with above median estimated Direct Climate Damage from the Climate Impact Lab (Hsiang, Kopp, Jina, Rising, Delgado, Mohan, Rasmussen, Muir-Wood, Wilson, Oppenheimer et al., 2017). Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Pooled difference-in-differences estimates of information intervention on spreads: heterogeneity by ex ante bond characteristics

	Credit Risk		Liquidity Spread	
	Low	High	Low	High
Novel ESG Assessment				
× Institutional Ownership Period	-0.659**	-4.013***	-1.500***	-1.745***
	(0.308)	(1.323)	(0.499)	(0.523)
× Public Information Period	-2.100***	-9.023***	-2.914***	-4.274***
	(0.378)	(2.071)	(0.827)	(0.598)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.0376	-0.506	-0.0506	-0.155
	(0.217)	(0.935)	(0.295)	(0.316)
× Public Information Period	-0.634**	-1.367	-0.939**	-0.630
	(0.299)	(1.216)	(0.367)	(0.445)
× Social Score (σ)				
× Institutional Ownership Period	0.596**	2.148**	0.976***	0.664
	(0.274)	(0.874)	(0.348)	(0.398)
× Public Information Period	0.837***	3.896***	1.283***	1.385***
	(0.305)	(1.163)	(0.365)	(0.437)
× Transparency Score (σ)				
× Institutional Ownership Period	0.0174	-0.349	-0.0813	-0.133
	(0.188)	(0.788)	(0.212)	(0.262)
× Public Information Period	-0.211	-0.791	-0.235	-0.562*
	(0.221)	(0.939)	(0.285)	(0.319)
Ex Ante Labeled				
× Institutional Ownership Period	2.822**	2.891	0.111	4.181**
	(1.097)	(2.624)	(0.749)	(1.598)
× Public Information Period	3.801**	2.192	-0.199	5.489***
	(1.624)	(3.033)	(1.178)	(1.924)
Observations	867,478	202,611	316,559	753,502
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Coupon, Duration (linear) by Month FE	Y	Y	Y	Y
Placement Type Bins by Month FE	Y	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y	Y

Note: This table displays pooled difference-in-differences estimates from Equation 2 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. The controls match column 4 from Table 2. *High Credit Risk* bonds are those issued with an original credit rating below "High Grade" (e.g., A1 and below for Moody's) by any of the 3 major credit rating agencies and those bonds that are unrated. *High Liquidity Spread* bonds are those with above median spread between customer purchases and sales before February 2022 including bonds with no observed trades in that period. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Internet Appendix: Not For Publication

This appendix includes several sections of supplemental information. Appendix A contains definitions for all the variables used in the paper. Appendix B describes the Kestrel scores and the related projects with several examples. We present additional robustness checks to the main results in Appendix E.

A Variable Definitions

Variable Name	**Description**
CUSIP	The 9-digit identifier that identifies individual bonds in both the MSRB transaction data and Mergent.
Month	The month in which a given bond trades. *Source:* MSRB
Issue	This is a variable that identifies groups of bonds identified by CUSIP that are all issued at the same time for the same purpose. *Source:* Mergent
Issuer	This is the name of the municipal entity that issues a bond. We use the *issuer_long_name* and *state* variables in Mergent in order to identify the issuer. *Source:* Mergent
State	The state in which the issuer resides. We use *state_c* variable in Mergent. *Source:* Mergent
ICMA Eligibility	Kestrel scores each bond on a large number of margins and aggregates these scores into opinions on eligibility of a green, sustainability, or social claim according to International Capital Markets Association standards documented in ICMA (2021) or ICMA (2023). *Source:* Kestrel
Existing bond label	Kestrel and Mergent both report whether bonds have any sort of self-selected label either by their own claim or by external verification. *Source:* Kestrel and Mergent
Ex Ante Labeled	This is an indicator variable that is equal to one for bonds that have any label listed in either Kestrel or Mergent. This nests green, sustainability, and social bonds. *Source:* Kestrel and Mergent
Ex Post Green	This is an indicator equal to one if a bond is ICMA eligible as either a green or sustainability bond according to Kestrel's opinion and the bond is not ex ante labeled. These are bonds that receive new, positive information about their relative greenness with the initiation and availability of the Kestrel opinions to different types of investors and parts of the market. *Source:* Kestrel and Mergent

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Table A.1 – *Continued from previous page*

Variable	**Description**
Ex Post Social	This is an indicator equal to one if a bond is ICMA eligible as social bond according to Kestrel's opinion and the bond is not ex ante labeled. These are bonds that receive new, positive information about their relative social impact with the initiation and availability of the Kestrel opinions to different types of investors and parts of the market. *Source:* Kestrel and Mergent
Ex Post Ineligible	This is an indicator equal to one if a bond is not ICMA eligible as green, social, or sustainability bond according to Kestrel's opinion and the bond is not ex ante labeled. These are bonds that receive new information about their relative greenness and social impact with the initiation and availability of the Kestrel opinions to different types of investors and parts of the market, but that information is not sufficient to meet international guidelines. *Source:* Kestrel and Mergent
Ex Post Low Score	These bonds were not originally labeled as anything and receive a score from Kestrel. These bonds are not eligible for any ICMA labeling, and they also score below 3. This is a subset of *Ex Post Ineligible* that is separated out in some of the descriptive analysis. *Source:* Kestrel and Mergent
Not Assessed	These bonds were not originally labeled as anything and Kestrel did not provide new ESG scores for these bonds. *Source:* Kestrel and Mergent
Kestrel Environmental Benefits Score	This is the quantitative measure of environmental impact or risk that is provided by Kestrel and reported publicly by Bloomberg. This is not a direct measure of ICMA eligibility, although it is correlated. *Source:* Kestrel
Kestrel Social Benefits Score	This is the quantitative measure of social impact or risk that is provided by Kestrel and reported publicly by Bloomberg. This is not a direct measure of ICMA eligibility, although it is correlated. *Source:* Kestrel
Kestrel Transparency Score	This is the quantitative measure of transparency that is provided by Kestrel and reported publicly by Bloomberg. This is not a direct measure of ICMA eligibility, although it is correlated. *Source:* Kestrel

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Table A.1 – *Continued from previous page*

Variable	**Description**
Kestrel Total Weighted ESG Score	This is the aggregated quantitative measure of environmental, social, and transparency benefits that are calculated by Kestrel and published in the first column by Bloomberg. This is not a direct measure of ICMA eligibility, although it is correlated. We restrict the primary sample to bonds that at least score a 3 out of Kestrel's 5 point scale. The bonds with lower scores are discussed in Appendix **??**. *Source:* Kestrel
Yield	The return that an investor will receive for an observed transaction. This is stated in terms of yield to worst, but we restrict the sample to non-callable bonds in the baseline analysis, so this is also equivalent to the yield to maturity in sample. *Source:* MSRB
Tax-adjusted Yield Spread	Most municipal bonds are tax exempt at the federal and state level, while treasury bonds are only taxable at the federal level. For most bonds i with time to maturity m traded at time t that are exempt at the state and federal level, the $\text{Spread}_{imt} = \text{muni yield}_{imt} - (1 - \tau_t^{Fed}) \times \text{treasury yield}_{mt}$. If the muni bond is taxable at the state and/or federal level, the yield is lowered accordingly. For state and federal tax rates, we use marginal individual rates at the first dollar after \$1.5 million in earnings following Schwert (2017) and Garrett, Ordin, Roberts and Suárez Serrato (2023), which is the standard TAXSIM definition and which assumes that the individual is subject to the \$10,000 cap on state and local tax deductions during our sample. For treasury rates, we use the reconstructed yield curves developed by Liu and Wu (2021). *Source:* MSRB, Mergent, TAXSIM, and Liu and Wu (2021)
Maturity	From the trade month, how many years will a bond be outstanding before it matures. The primary regressions use the floor of years to maturity from the time time trade to put bonds into groups. *Source:* Mergent and MSRB
Credit Rating	This is the lowest credit rating reported by any of the 3 major credit rating agencies (Moody's, S&P, and Fitch) at issuance. *Source:* Mergent
Issuance Size	The total par value of each bond issue (i.e., related bonds issued in series). We use $total_offering_amount_f$. *Source:* Mergent

Continued on next page

Table A.1 – *Continued from previous page*

Variable	**Description**
Par Value	The total par value of each individual bond. We use $total_maturity_offering_amt_f$. *Source:* Mergent
Trade Size	Each transaction is reported with an amount of par value traded. The fixed effects in the primary specification average trade size for all transactions observed in each month and *Source:* MSRB
Liquidity	We define a proxy of liquidity as the spread between customer purchase prices and customer sale prices in each month. *Source:* MSRB
Coupon	Bonds pay a coupon rate that is reported in percentage points of par value. The measurement for the fixed effects in the primary specification puts transactions into deciles. *Source:* Mergent and MSRB
AGI per taxpayer	Total AGI at the county level divided by the number of returns filed. *Source:* 2021 IRS Statistics of Income
Share itemizers	Number of returns filed that itemize deductions divided by the total number of returns within a county. *Source:* 2021 IRS Statistics of Income
Share elderly	Number of tax returns filed with the primary filer who is 60 or older divided by the total number of returns within a county. *Source:* 2021 IRS Statistics of Income
Share Republican	The 2020 vote share for the Republican presidential candidate at the county level. The denominator includes all votes submitted regardless of party. *Source:* MIT Election Data and Science Lab (2017)
Share Hispanic or nonwhite	This is the share of individuals of any age within a county who do not identify as white and non-hispanic. $1 - (b01001h_001e/b01001_001e)$ *Source:* 2021 ACS 5-Year Data
Unemployment rate	The number of unemployed individuals divided by the size of the local labor force. $b23025_005e/b23025_002e$ *Source:* 2021 ACS 5-Year Data
Share college	Number of individuals with a college or higher education divided by the number of individuals estimated for any education group. $b16010_041e/(b16010_002e + b16010_015e + b16010_028e + b16010_041e)$ *Source:* 2021 ACS 5-Year Data

Continued on next page

Table A.1 – *Continued from previous page*

Variable	Description
Share climate worry	The estimated share of the county population that are worried about the risk of climate change averaged over 3 survey periods from 2018-2021. *Source:* Yale Climate Survey (Howe, Mildenberger, Marlon and Leiserowitz, 2015)
FEMA expected loss score	The composite score for expected annual losses on a scale of 0 - 100 across 18 natural hazards in a county/state the relative to other U.S. geographies in 2021. *Source:* FEMA National Risk Index 2021
Direct climate damage	The estimated direct economic damages of climate change across all sectors as a percent of county GDP for the median projected outcome during 2080-2099 for the RCP8.5 (business-as-usual) emissions trajectory. *Source:* Climate Impact Lab (Hsiang, Kopp, Jina, Rising, Delgado, Mohan, Rasmussen, Muir-Wood, Wilson, Oppenheimer et al., 2017)

B Examples of Bonds and Related Projects

Municipal bonds, which have more than 1.2 million CUSIPs outstanding issued by more than 30,000 municipal issuers, finance many different types of projects. Many of these projects are intended for the public good, but that doesn't necessarily mean that they meet ICMA guidelines to be labeled as green, social, or sustainability bonds.

In Figure B.1, we show what a small sample of the newly scored bonds look like on a Bloomberg Terminal. This screenshot of a random sample from the Kestrel ESG Universe, taken September 22, 2024, shows that investors can see the CUSIP, the state, issuers, purpose, BBG composite credit rating, total issue size, sale date, and the four categories of Kestrel scores. The very furthest left column is a marker for self-selected green labeling. The "Kestrel Tot ESG" column highlights scores in green that are 4 or higher, but this does not mean that Kestrel's opinion is that the bond meets a labeling requirement by ICMA standards.

Figure B.1: Kestrel ESG Universe as Viewed on a Bloomberg Terminal



C Additional Data Descriptives

In this Appendix, we discuss additional descriptive statistics from the sample of bonds that are included in this study.

First, for the sake of creating digestible samples for some of of our descriptive moments, we allocate bonds to one of six categories and display characteristics separately:

1. Ex ante labeled bonds. These bonds selected into receiving green, sustainability, or social labels when they were issued, which is defined by showing up as labeled by either Kestrel, Bloomberg, or Mergent.

2. Ex post green and sustainability bonds. These bonds were not originally labeled, but receive an opinion from Kestrel that they could have been labeled as green or sustainability bonds.

3. Ex post social bonds. These bonds were not originally labeled, but receive an opinion from Kestrel that they could have been labeled as social bonds.

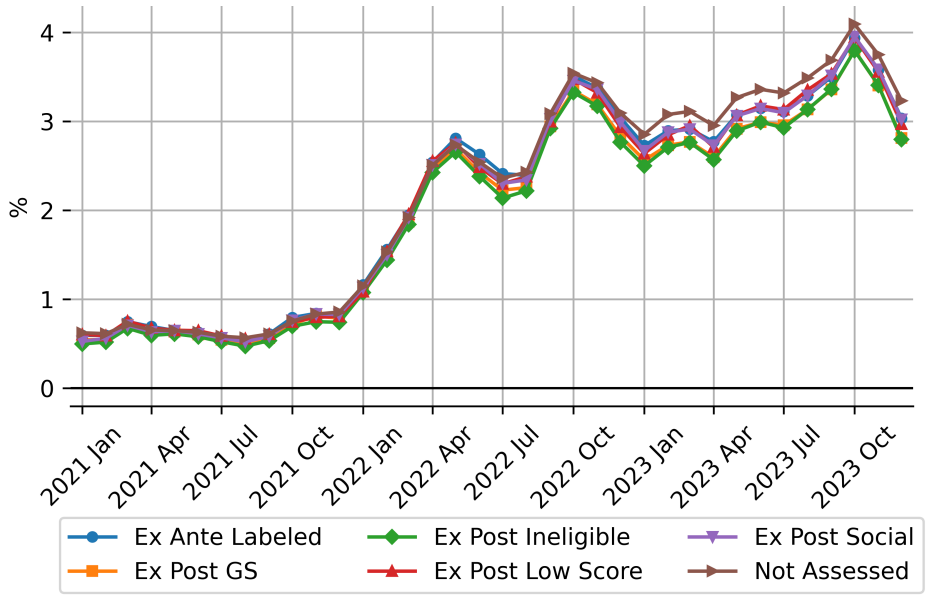
4. Ex post ineligible. These bonds were not originally labeled and receive a score from Kestrel indicating that these bonds are not eligible for any ICMA label.

5. Ex post low score. These bonds were not originally labeled as anything and receive a score from Kestrel. These bonds are not eligible for any ICMA labeling, and they also score below 3.

6. Not assessed. These bonds were not originally labeled as anything and Kestrel did not provide new scores for these bonds.

Figure C.1 displays the average yields to maturity for all of the bonds in our final sample aggregated into the Kestrel rating groups. This figure does not include any controls and only includes non-callable securities so there is no variation around the yield definition.

Figure C.1: Average Yield to Maturity of Municipal Bonds with Differently Evolving ESG Information



Note: This figure shows the average yield of transactions in the MSRB data conditional on the available ESG information after the information intervention. *Ex Ante Labeled* bonds are those that had a green, sustainability, or social label when they were issued. *Ex Post GS* bonds are those that qualify as green or sustainability bonds but that did not label themselves as such. *Ex Post Social* bonds are those that qualify as social bonds but that did not label themselves as such. *Ex Post Ineligible* and *Ex Post Low Score* bonds are bonds that are ineligible for ICMA certifications in Kestrel's opinion but which have scores equal to 3 or above out of 5, or below 3, respectively. The *Not Assessed* bonds are those that never labeled themselves and that do not have any additional information provided by Kestrel or on Bloomberg regarding their ESG characteristics. All of these categories follow the same broad trends over time, with yields increasing dramatically in the first few months of 2022, matching the secular trends in interest rates in other markets. This sample is restricted to bonds without call options.

D Labeling Selection Model Additional Results

This Appendix presents additional results related to the selection model.

Table D.1 displays point estimates from the logistic regression of ex ante green or sustainability labels on local and bond characteristics conditional on bonds being eligible for such a rating. The first column includes all controls. The second column omits the control for specific environmental scores from Kestrel's new ESG ratings. The third column omits the share of local population that is worried about climate change on average from 2018-2021 according to Howe, Mildenberger, Marlon and Leiserowitz (2015). The fourth column omits the control for the share of the local population that voted for the Republican presidential ticket in 2020 according to MIT Election Data and Science Lab (2017). Note that the share of residents with climate worry and the share of residents voting for the Republican presidential ticket in 2020 have a correlation coefficient of -0.9, so their joint inclusion causes large standard errors.

Table D.2 displays point estimates from the logistic regression of ex ante social labels on local and bond characteristics conditional on bonds being eligible for such a rating. The first column includes all controls. The second column omits the control for specific social scores from Kestrel's new ESG ratings. The third column omits the share of local population that is worried about climate change on average from 2018-2021 according to Howe, Mildenberger, Marlon and Leiserowitz (2015). The fourth column omits the control for the share of the local population that voted for the Republican presidential ticket in 2020 according to MIT Election Data and Science Lab (2017). Note that the share of residents with climate worry and the share of residents voting for the Republican presidential ticket in 2020 have a correlation coefficient of -0.9, so their joint inclusion causes large standard errors.

Table D.1: Logistic Model Estimates Describing Selection of Green and Sustainability Bond Labels
Among Eligible Bonds

	(1)	(2)	(3)	(4)
Environmental Score	0.937***		0.980***	0.936***
	(0.214)		(0.203)	(0.212)
	0.000		0.000	0.000
Share Climate Concerned	0.795	0.873		0.917***
	(0.561)	(0.538)		(0.342)
	0.156	0.105		0.007
Share Republican	-0.219	-0.235	-0.684***	
	(0.486)	(0.472)	(0.237)	
	0.653	0.619	0.004	
FEMA Risk Score	-0.227*	-0.213	-0.248*	-0.224
	(0.137)	(0.135)	(0.137)	(0.137)
	0.098	0.113	0.071	0.102
ln(AGI per capita)	0.004	0.001	0.213	-0.053
	(0.251)	(0.250)	(0.251)	(0.259)
	0.989	0.997	0.396	0.837
Unemployment Rate	0.019	0.029	0.072	0.047
	(0.164)	(0.160)	(0.174)	(0.149)
	0.906	0.857	0.679	0.754
Share Itemizing	0.060	0.106	-0.043	0.082
	(0.191)	(0.184)	(0.190)	(0.199)
	0.754	0.564	0.821	0.681
Share Hispanic or Nonwhite	-0.833***	-0.871***	-0.624***	-0.825***
	(0.209)	(0.201)	(0.168)	(0.217)
	0.000	0.000	0.000	0.000
Share Elderly	-0.154	-0.160	-0.133	-0.160
	(0.139)	(0.136)	(0.137)	(0.142)
	0.268	0.239	0.333	0.260
Share College	-0.423*	-0.443*	-0.416*	-0.302*
	(0.244)	(0.238)	(0.230)	(0.271)
	0.083	0.063	0.070	0.264
ln(Par Value)	0.206*	0.279***	0.224**	0.201*
	(0.106)	(0.102)	(0.106)	(0.106)
	0.052	0.006	0.035	0.057
Observations	2,660	2,660	2,660	2,660

Note: This table displays logistic regression estimates explaining the likelihood of labeling a bond issue as either green or sustainability conditional on being eligible for such a label in Kestrel's opinion. The unit of observation is a bond issue (i.e., a package of bonds issued in series). The demographic and economic control variables are measured at the local county level, or at the state level for state, state agency, and other multi-county issuers. All control variables are normalized to standard deviations with mean zero. We display a version of these estimates that are rescaled to be interpreted as marginal effects at population average measurements in panel A of Figure 4. Standard errors are presented in parentheses and are clustered at the issuer level. p-values are presented below. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.2: Logistic Model Estimates Describing Selection of Social Bond Labels Among Eligible Bonds

	(1)	(2)	(3)	(4)
Social score	0.365		0.363	0.375
	(0.245)		(0.247)	(0.250)
	0.137		0.141	0.133
Share Climate Concerned	-0.182	-0.170		1.165***
	(0.602)	(0.611)		(0.427)
	0.763	0.781		0.006
Share Republican	-1.998***	-2.001***	-1.873***	
	(0.438)	(0.431)	(0.351)	
	0.000	0.000	0.000	
FEMA Risk Score	-0.059	-0.008	-0.048	-0.131
	(0.368)	(0.358)	(0.359)	(0.347)
	0.873	0.981	0.893	0.707
ln(AGI per capita)	0.163	0.142	0.126	-0.389
	(0.461)	(0.478)	(0.462)	(0.544)
	0.723	0.766	0.784	0.474
Unemployment Rate	-0.384*	-0.415*	-0.393**	-0.169
	(0.207)	(0.212)	(0.199)	(0.230)
	0.063	0.050	0.048	0.462
Share Itemizing	-0.551	-0.559	-0.547	-0.387
	(0.537)	(0.532)	(0.561)	(0.602)
	0.304	0.293	0.330	0.520
Share Hispanic or Nonwhite	-0.769**	-0.738**	-0.812***	-0.845**
	(0.317)	(0.315)	(0.271)	(0.345)
	0.015	0.019	0.003	0.014
Share Elderly	-0.159	-0.144	-0.167	-0.311
	(0.230)	(0.241)	(0.236)	(0.236)
	0.491	0.549	0.481	0.186
Share College	-0.586*	-0.558*	-0.592*	0.296
	(0.307)	(0.322)	(0.311)	(0.262)
	0.056	0.083	0.057	0.259
ln(Par Value)	0.159	0.171	0.156	0.107
	(0.157)	(0.155)	(0.154)	(0.150)
	0.310	0.268	0.311	0.476
Observations	4,336	4,336	4,336	4,337

Note: This table displays logistic regression estimates explaining the likelihood of labeling a bond issue as a social bond conditional on being eligible for such a label in Kestrel's opinion. The unit of observation is a bond issue (i.e., a package of bonds issued in series). The demographic and economic control variables are measured at the local county level, or at the state level for state, state agency, and other multi-county issuers. All control variables are normalized to standard deviations with mean zero. We display a version of these estimates that are rescaled to be interpreted as marginal effects at population average measurements in panel B of Figure 4. Standard errors are presented in parentheses and are clustered at the issuer level. p-values are presented below. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E Information Intervention Robustness Tests

In this appendix, we describe a series of robustness checks to the primary result that ex post green and sustainability bonds experience a decline in spreads relative to maturity matched treasuries after information is shared about their relative ESG-related characteristics and that the same pattern does not show up for social bonds. We separate robustness tests into categories: (1) robustness to variable construction and inclusion and (2) robustness to sample inclusion.

Robustness to variable construction and inclusion

We display pooled difference-in-differences estimates from additional specifications with new controls and differently defined outcomes in Table E.1.

Column 1 of Table E.1 presents estimates of our primary specification of Equation 2 with an additional control for the observed spread between customer purchase prices and customer sale prices between January 2021 and February 2022, which is a proxy of liquidity. These spreads are interacted with monthly fixed effects to allow for a time varying liquidity premium. The results of this specification are very similar to the primary results in column 4 of Table 2 except that the marginal pricing impact of the transparency score is no longer statistically significant at the 10% level and the point estimate is slightly smaller in this version with a control for a time varying liquidity premium.

Our baseline model uses an after-tax spread of the municipal bond relative to a maturity matched treasury as the outcome of interest. This baseline measurement captures the after tax return that an investor requires to hold a muni over a risk-free asset. However, existing papers in the literature use different measures of the cost of borrowing including the pre-tax spread over maturity matched treasuries (muni yield minus treasury yield) or simply use the yield to maturity on the municipal bond. While the after-tax spread is the economically appropriate measure, we show robustness of our results to these other measurement approaches in columns 2 and 3 of Table E.1. Column 2 uses pre-tax spreads (i.e., spreads of muni yield over maturity matched treasury yield without any tax adjustment) and column 3 uses yields without any adjustment for the current risk-free rate. The pre-tax spreads version is quantitatively and statistically the same at the the primary results in column 4 of Table 2. The use of yields instead of spreads in column 3 does lead to the point estimate of the assessment effect in the institutional period to be statistically insignificant and to attenuate the point estimate toward zero. However, the rest of the point estimates and levels of statistical significance are either the same or larger as in the primary results in column 4 of Table 2.

Finally, column 4 of Table E.1 includes issuer by time fixed effects, so identification comes from issuers who have multiple bonds outstanding and trading that receive different levels of the Kestrel information intervention. This only applies to 13.6% of issuers since 86.4% of issuers (21,658 of 25,065) have bonds that are either all assessed or all unassessed in our sample. To identify the marginal pricing impact of differences in the E, S, and T scores, we need to observe multiple bonds from the same issuer that all have Kestrel assessments but that lead to different scores, which is even more rare in our sample. The estimates of the assessment effect in this specification are still positive and significant, but the rest of

the marginal effects are insignificant within issuer, which is unsurprising given the lack of variation.

Robustness to sample construction and large state exclusion

We display pooled difference-in-differences estimates from additional specifications with different sample selection criteria in Table E.2.

First, our baseline same excludes all bonds with call functions, following the existing literature such as Schwert (2017) and Green, Hollifield and Schürhoff (2007). We do not include these bonds in the primary sample because they include options that are not trivial to price and that may be subject to other issues including exercise at negative NPV (Ang, Green, Longstaff and Xing, 2017) or failure to exercise when value is maximized (Chen, Cohen and Liu, 2024). In column 1 of Table E.2, we include callable bonds in the sample as well. For these bonds, we measure spreads as after-tax "yield to first par call" minus the yield on a treasury that matures on the date at which the bond is first callable at par, which is generally the worst yield that an investor can receive. Our spread measure for callable bonds is intended to approximate this yield to worst, which we then adjust for any relevant taxes and from which we subtract the after-tax yield on a treasury that matures at the same time. A shortcoming of such an approach is that the option value may be changing over time and across bonds in a way that we are not able to capture well with available data. Therefore, it is most appropriate to drop these bonds in the primary analysis and show robustness to their inclusion in column 1 of Table E.2. When we include callable bonds the patterns are broadly similar except (1) the assessment effect is slightly larger, (2) the premia associated with higher environmental and transparency scores lose statistical significance at traditional levels, and (3) the estimated pricing trends for ex ante labeled bonds also become statistically insignificant. We do note that standard errors in this specification are much larger, probably because there are valuable options that we are not able to fully characterize with available data on the universe of bonds we are pricing.

Next, we test whether the inclusion of certain very large states as part of our estimation sample is driving our results. We particularly focus on the 3 states with the most bond-months with trade data in our analysis sample. In column 2, we drop California, the largest liberal-leaning state in the US by bond issuance transaction volume and by economic output. We drop New York from column 3, which is also a large liberal-leaning state but has a very different distribution of bonds outstanding than California. In column 4, we drop Texas, which is the largest conservative leaning state in our sample by bond issuance and economic output. Texas also engaged in novel restrictions on municipal bond issuance insofar as it relates to local ESG outcomes and the related disclosure during the sample period in 2021 and 2022 (Garrett and Ivanov, 2024), which we do not want to contaminate our estimates of the market response to the information intervention from Kestrel and Bloomberg. In all three specifications, we find that the omission of the most economically important states, regardless of political lean, does not impact our spread estimates. In all cases, we continue to find a long-run decrease in spreads for assessed bonds and a statistically significant premium for bonds with higher environmental scores. The premium for bonds with higher transparency scores and the increasing spreads for ex ante labeled bonds are both similar magnitudes across specifications, move in and out of statistical significance depending on the sample.

Table E.1: Pooled difference-in-differences estimates of information intervention on spreads: Robustness to measurement decisions

	Δ Spread	Δ Spread (pre-tax)	Δ Yield	Δ Spread
	(1)	(2)	(3)	(4)
Novel ESG Assessment				
× Institutional Ownership Period	-1.632***	-1.768***	-0.779	-0.824**
	(0.401)	(0.427)	(0.522)	(0.372)
× Public Information Period	-3.725***	-3.594***	-2.814***	-2.417***
	(0.540)	(0.580)	(0.567)	(0.395)
× Environmental Score (σ)				
× Institutional Ownership Period	-0.122	-0.106	-0.154	0.152
	(0.250)	(0.255)	(0.275)	(0.219)
× Public Information Period	-0.752**	-0.823**	-0.799**	-0.0577
	(0.323)	(0.335)	(0.365)	(0.295)
× Social Score (σ)				
× Institutional Ownership Period	0.839**	0.915**	0.936**	0.196
	(0.314)	(0.339)	(0.350)	(0.296)
× Public Information Period	1.406***	1.569***	1.507***	0.223
	(0.335)	(0.389)	(0.366)	(0.335)
× Transparency Score (σ)				
× Institutional Ownership Period	-0.0695	-0.149	-0.315	0.00415
	(0.191)	(0.234)	(0.203)	(0.282)
× Public Information Period	-0.394	-0.507*	-0.601**	-0.267
	(0.242)	(0.281)	(0.271)	(0.281)
Ex Ante Labeled				
× Institutional Ownership Period	2.278*	2.156**	2.374**	2.534**
	(1.125)	(1.050)	(0.999)	(1.064)
× Public Information Period	3.051*	3.078**	3.700**	-0.232
	(1.542)	(1.420)	(1.431)	(1.331)
Observations	1,070,347	1,070,347	1,070,347	936,061
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Coupon, Duration (linear) by Month FE	Y	Y	Y	Y
Placement Type Bins by Month FE	Y	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y	Y
Liquidity Control by Month FE	Y			
Issuer by Month FE				Y

Note: This table displays pooled difference-in-differences estimates from Equation 2 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table E.2: Pooled difference-in-differences estimates of information intervention on spreads: Robustness to sample construction decisions

	Δ Spread			
	(1)	(2)	(3)	(4)
Novel ESG Assessment				
× Institutional Ownership Period	-3.456***	-1.754***	-1.513***	-1.694***
	(0.704)	(0.438)	(0.403)	(0.418)
× Public Information Period	-4.952***	-3.882***	-3.684***	-3.940***
	(0.699)	(0.597)	(0.566)	(0.570)
× Environmental Score (σ)				
× Institutional Ownership Period	0.00941	-0.210	-0.113	-0.267
	(0.571)	(0.267)	(0.261)	(0.272)
× Public Information Period	-0.860	-0.921**	-0.789**	-0.950***
	(0.546)	(0.385)	(0.332)	(0.346)
× Social Score (σ)				
× Institutional Ownership Period	1.493**	0.719**	0.838**	1.023***
	(0.575)	(0.329)	(0.317)	(0.356)
× Public Information Period	2.269***	1.519***	1.552***	1.461***
	(0.525)	(0.399)	(0.336)	(0.373)
× Transparency Score (σ)				
× Institutional Ownership Period	0.558	0.0163	-0.251	-0.00583
	(0.443)	(0.199)	(0.194)	(0.205)
× Public Information Period	-0.112	-0.340	-0.570**	-0.459
	(0.481)	(0.270)	(0.245)	(0.275)
Ex Ante Labeled				
× Institutional Ownership Period	0.437	2.531*	0.982	2.298*
	(1.340)	(1.358)	(0.629)	(1.193)
× Public Information Period	1.600	3.260*	1.203	3.096*
	(1.335)	(1.854)	(0.964)	(1.602)
Observations	2,782,708	936,334	986,555	939,973
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Coupon, Duration (linear) by Month FE	Y	Y	Y	Y
Placement Type Bins by Month FE	Y	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y	Y
Callable Bonds	Y			
Dropped State		CA	NY	TX

Note: This table displays pooled difference-in-differences estimates from Equation 2 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. The controls match column 4 from Table 2. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

F Extended analysis and additional results

In this appendix, we present additional results from the difference-in-differences research design exploring how the information intervention affects muni bond spreads.

We present estimates of column 4 of Table 2, the baseline pooled difference-in-differences regression, separately for bonds that are funding different sorts of projects in Table F.1. Column 1 only includes general purposes bonds, most of which have middling ESG scores without much variation and general obligation security. We fail to reject the null hypothesis of no impact of the information intervention in this subsample. Column 2 only includes bonds issued to fund education, and we find estimates that are largely in line with our average estimates in the complete sample in column 4 of Table 2—there is a material assessment affect and a small premium for higher environmental impact scores. However, the small transparency effect does flip signs in this subsample.

In column 3, we restrict the sample to bonds issued to finance investment in utilities (water, sewer, public power, gas, solid waste, and sanitation), and here we find no assessment effect but a very large pricing effect for marginal environmental impact. In column 4, we restrict to the remainder of these 4 categories, which includes lots of healthcare, transportation, housing, and other revenue-based bonds that are not categorized elsewhere. We find effects that are in the realm of double the baseline effects. There is an 8.4bps assessment effect and the pricing of an additional standard deviation of environmental or transparency score leads to 2bps lower spreads. There is a discount for high scoring social bonds that amounts to half of the assessment effect.

We now present a variation of Table 2 where the marginal score terms are replaced with discrete eligibility opinions:

$$Y_{ijt} = \alpha_i + \sum_{k=0}^{T} (\beta_k + \delta_{Ek}\text{E Eligible}_i + \delta_{Sk}\text{S Eligible}_i + \delta_{SUSk}\text{Sus Eligible}_i) \times \text{assessed}_i \times \mathbb{1}(t = k) + X_{ijt} + \varepsilon_{ijt}. \quad (4)$$

Here, the subscripts and controls are otherwise identical to Equation 2, with the exception of the labeling eligibility coefficients. E Eligible$_i$, S Eligible$_i$, and Sus Eligible$_i$ are indicator variables equal to one for bonds that Kestrel asserts are eligible for green, social, or sustainability labels, respectively. The δ_{Ek}, δ_{Sk}, and δ_{SUSk} estimates in this setup reflect the marginal pricing effect of label eligibility conditional on assessment. Insofar as there is a greenium related to meeting specific labeling criteria (i.e., a willingness to receive a lower return for bonds in alignment with the ICMA principles), we expect these coefficients to be negative.

We display estimates of this regression in Table F.2 which uses the same controls as Table 2. Column 4, the primary specification, shows that bonds assessed by Kestrel but found ineligible for any label saw spreads fall by 2.9bps in the institutional period and 5.7bps in the public period. The big difference in this specification is that the estimates of δ_k, the marginal pricing impacts of actually being eligible for an ICMA label, are all positive and at least marginally significant but smaller in magnitude than the assessment effect. These results suggest that the bonds that receive an information intervention that they

are eligible for green labels see spreads drop by 3.2bps, bonds receiving positive information about social label eligibility only see spreads drop by 1.5bps, and bonds receiving information about sustainability label eligibility see spreads drop by 3.3bps.

Table F.1: Pooled difference-in-differences estimates of information intervention on spreads: Heterogeneity by Use of Proceeds

	General Purpose	Education	Utilities	Other
	(1)	(2)	(3)	(4)
Novel ESG Assessment				
× Institutional Ownership Period	-0.118	-0.202	1.538	-3.195***
	(0.806)	(0.423)	(1.384)	(0.995)
× Public Information Period	-0.741	-2.186***	1.195	-8.359***
	(0.825)	(0.498)	(1.688)	(1.543)
× Environmental Score (σ)				
× Institutional Ownership Period	0.270	-0.371*	-2.543***	-0.525
	(0.616)	(0.212)	(0.889)	(0.546)
× Public Information Period	0.176	-0.462*	-3.286***	-2.203**
	(0.666)	(0.251)	(1.075)	(0.813)
× Social Score (σ)				
× Institutional Ownership Period	0.560	-0.281	-0.851	1.315**
	(0.872)	(0.343)	(0.946)	(0.638)
× Public Information Period	0.313	0.674	-0.889	3.601***
	(0.930)	(0.406)	(1.037)	(0.821)
× Transparency Score (σ)				
× Institutional Ownership Period	0.0541	0.486**	0.660	-1.297**
	(0.240)	(0.235)	(0.471)	(0.575)
× Public Information Period	-0.625**	0.514**	0.421	-1.829**
	(0.290)	(0.250)	(0.560)	(0.728)
Ex Ante Labeled				
× Institutional Ownership Period	2.077**	0.724	-0.325	4.054*
	(0.993)	(1.112)	(0.887)	(2.173)
× Public Information Period	1.056	-1.100	-0.0332	5.398*
	(1.543)	(1.374)	(1.006)	(2.954)
Observations	324,122	355,824	139,331	250,053
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Coupon, Duration (linear) by Month FE	Y	Y	Y	Y
Placement Type Bins by Month FE	Y	Y	Y	Y
Maturity (quadratic) by Month FE	Y	Y	Y	Y

Note: This table presents estimates of the main difference-in-differences model (column 4 of Table 2) separately for differently categories of municipal spending. Categories of spending are assigned based on Mergent's "use_of_proceeds" variable. *General Purpose* includes bonds with a listed use of proceeds of general purposes public improvement (GPPI), which is the most common use code by a wide margin. Education includes primary and secondary education (PSED), higher education (HIED), and other education (OTED). Utilities includes water and sewer (WTR), public power (ELEC), gas (GAS), solid waste (WAST), and sanitation (SANI). Other spending is made up of the remaining 49 categories in Mergent, which includes many public projects with the largest remaining categories including hospitals (HOSP), toll roads (TOLL), seaports and marine terminals (SEAP), other transportation (OTRN), other healthcare (OHCA), airports (AIR), government and public buildings (GVPB), mass and rapid transit (MASS), and single- and multi-family housing (SMHG) among others. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table F.2: Pooled difference-in-differences estimates of information intervention on spreads: discrete treatment based on ICMA label eligibility opinions

	Δ Spread (basis points)			
	(1)	(2)	(3)	(4)
Novel ESG Assessment				
× Institutional Ownership Period	-2.595***	-2.560***	-2.507***	-2.877***
	(0.621)	(0.640)	(0.634)	(0.641)
× Public Information Period	-5.241***	-5.275***	-5.279***	-5.663***
	(0.703)	(0.732)	(0.747)	(0.749)
× Green Label Eligible				
× Institutional Ownership Period	1.874	1.929	1.822	2.152
	(1.219)	(1.281)	(1.263)	(1.299)
× Public Information Period	1.860*	2.014*	1.968	2.357*
	(1.098)	(1.174)	(1.176)	(1.198)
× Social Label Eligible				
× Institutional Ownership Period	2.857***	2.819***	2.607***	2.502***
	(0.691)	(0.709)	(0.694)	(0.658)
× Public Information Period	4.530***	4.490***	4.261***	4.153***
	(0.679)	(0.752)	(0.768)	(0.729)
× Sustainability Label Eligible				
× Institutional Ownership Period	1.903**	1.898**	1.709**	1.678**
	(0.738)	(0.767)	(0.771)	(0.718)
× Public Information Period	2.687***	2.678***	2.397**	2.288**
	(0.867)	(0.939)	(0.967)	(0.899)
Ex Ante Labeled				
× Institutional Ownership Period	2.697**	2.735**	2.390**	2.179*
	(1.049)	(1.138)	(1.099)	(1.124)
× Public Information Period	3.671**	3.758**	3.289**	2.983*
	(1.548)	(1.631)	(1.582)	(1.557)
Observations	1,070,347	1,070,347	1,070,347	1,070,347
CUSIP Fixed Effects	Y	Y	Y	Y
State by tax by Month FE	Y	Y	Y	Y
Credit Rating by Month FE	Y	Y	Y	Y
Trade Size Bins by Month FE	Y	Y	Y	Y
ln(Size), Maturity, Coupon (linear) by Month FE	Y	Y	Y	Y
Duration (linear) by Month FE		Y	Y	Y
Placement Type Bins by Month FE			Y	Y
Maturity (quadratic) by Month FE				Y

Note: This table displays pooled difference-in-differences estimates from Equation 4 describing how the observed spread of municipal bonds receiving a novel ESG assessment change relative to other municipal bonds after the information intervention. The institutional information period includes months from March 2022 through February 2023 and the public information period begins in March 2023. The outcome variable is the tax-adjusted spread relative to a maturity matched treasury weighted according to total par value traded. The unit of observation is a bond-month. In the first column, the regression includes controls for month-by-state-by-taxability status, month-by-credit rating, and month-by-average trade size tercile, as well as coupon rate, log issue size, and years to maturity interacted with month fixed effects. Column 2 adds a linear duration control interacted with month fixed effects. Column 3 adds two proxies for institutional interest from the initial placement: terciles in the share of trades happening exactly at the reoffering price (following Green, Hollifield and Schürhoff, 2007) and terciles in the share of trades containing non-transaction based compensation. Column 4 adds a quadratic term in years to maturity interacted with month fixed effects. Standard errors double clustered at the issuer and time levels are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.