



Analysis of

Green Municipal Bonds in the Great Lakes Region

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Acknowledgments

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Summary

The objective was to understand changes in green bond offerings between 2019–20, to compare with offerings in the previous decade. To help understand the opportunity, we sought to analyze the municipal bond market in the Great Lakes Region by issuer and use of proceeds. We further needed to analyze the cost of credit rating over time, as measured by coupon payments and yield, to understand the spread relative to the benchmark. The data indicate a 25% increase in green bond issuance, a 3.3x in the amount outstanding (compared to vanilla bonds), with one additional state (Illinois) issuing green bonds. To date, only four Great Lakes states and one Province have issued green bonds, with uses of proceeds ranging from water/sewerage, green energy, industrial conversion (to recreation), public transit and housing.

Given the maturity of green bonds in the municipal markets, we explored whether there is an emergent green bond premium in the primary markets for the Region and compared this to the premium obtained from national issuances. A green bond premium may be an indicator of a willingness of investors to accept a lower interest payout for investing in and holding sustainable issues. The results from propensity score matching, a statistical inference technique that compares two populations (green/vanilla) for the green treatment effect, while accounting for relevant confounders that bias the analysis indicate a premium of 23.6 bps once the bias of water bonds is removed. This effect was similar to the national universe of bonds (28 bps), whereby water bonds appear to dilute the greenium effect, which is mainly driven by energy, transportation and housing bonds.

Project Scope and Background

This project set out to explore whether a greenium effect has emerged both nationally and for bonds issued in Great Lakes region. The greenium effect is derived not only from high demand (oversubscription) from investors, but also from a perception that over time green bonds are less risky. Standardization will become increasingly important as the green bond market grows. Currently, classification of projects that qualify for green bond financing depend on third party opinions and certification.

The investor's perspective. The 'green label' or certification is **attractive to investors and pension funds** seeking to (i) diversify their holdings towards social and environmental impact, (ii) to respond to their fiduciaries seeking increased opportunities to invest in sustainable infrastructure, and (iii) to diversify their risk exposures to market volatility.

The bond issuer's perspective. A greenium would be attractive for the **municipal issuer** because the cost of financing of its debt would be lower. A discount of as little as 1.2 basis points (bps) was considered attractive for the City of Toronto in their financing of a green new City Hall.

Academic research on the linkage between environmental and financial impacts has investigated the potential for a 'greenium', a price discount that will be accepted by

the markets as a reward for resiliency and anticipation of future climate and social risks (Hachenberg and Schiereck, 2018; Partridge and Medda, 2020ab; Larcker and Watts, 2020; Harrison et al. 2020). Baker et al. (2016) observed a green bond premium of about **6 bps** for the combined U.S. corporate and municipal green bonds market in 2015-16 on an after-tax basis. On the other hand, Karpf and Mandel (2017) found a green penalty (positive yield difference) of approximately **8 bps** (bps) in the U.S. municipal bond market. Larcker and Watts (2019) analyzed the green bond premium based on pair-matched green and non-green municipal bonds in the US market in 2017-18 and found the greenium to be negligible. Research by Gianfranco and Peri (2019) observed that green bonds exhibit an average discount of around **18 basis points**, based on 121 senior Euro-denominated green bonds issued between 2013 to 2017. Their work indicated that the greenium effect did not emerge until after 2016, and that confounder analysis (impact of various biases) is critical to see a market signal from the green label. The estimates in the literature for this “green bond premium” thus depend on:

- (1) The bond universe (US, Europe, muni, corporate) analyzed,
- (2) The analytical methods used,
- (3) Whether primary or secondary markets data are used,
- (4) Which time period of analysis.

Hence, we have to be careful in how we specify each of these dimensions.

Methodological Approach

Bond Universe

The Bloomberg and FactSet fixed income search tools were used to uncover municipal bonds issued between 2008 and 2018 (original; prior report) and from 2019-2021 (current report). To capture the broadest possible universe, all filters including ‘green’ (as designated under the American Recovery and Reinvestment Act of 2009), and use of proceeds/purpose such as water, energy, industrial improvements and similar were used (Figure 1). The search criteria further included time of issue, maturity (after 2019), and locality of registration.

SRCH Criteria			
Asset Classes: Municipals			
Sources: All Securities			
Security:			
AND	Security Status	Include	Municipals : Active
AND	Muni Is Derivative	---	No
__OR	A.R.R.A. Program	Include [Match Any]	Qualified Energy Conservation Bond Direct Pay or Clean Renewable Energy Bond Direct Pay
AND	Registered Location	Include [Match Any]	Ontario or Quebec or Illinois or Indiana or Michigan or Minnesota or New York or Ohio or Pennsylvania or Wisconsin
			Electric, Light & Power or Multiple Utility Improvements or Natural Gas Utility Improvements or Power Plants (non-nuclear) or Power Plants (Nuclear) or Sewer Improvements or Water Utility Improvements or Telecommunications or Industrial Improvements or Pollution Control or Resource Recovery or Green Purpose
AND	Muni Bond Purpose	Include [Match Any]	
AND	Issue Date	In the range	01/01/2019 to 12/31/2020
AND	Maturity	Greater than	01/31/2021

Figure 1. Search Criteria for Muni Bonds (Bloomberg)

Following the initial results, a deeper analysis was conducted within each area of use of proceeds purpose to gather data on the bond rating, performance and coupon. In addition to the performance data, data was gathered on the issuer of the bonds (e.g. water or transportation authority), but also on the financial underwriter of the bond (banks).

Bond Yield Spread

Since 2016, researchers have started to statistically explore the existence of a green bond premium in primary and secondary markets. One of the tools that has been used is called ‘propensity score matching (PSM)’, which evaluates a treatment effect (e.g. green-tagged) on bond yield spread (relative to the 10 yr Treasury note), and allows for correcting for the impact of more standard financial factors such as credit rating, bond use, tenor, and coupon. In a way, the tool allows us to explore the residual effect on bond yield after accounting for confounding factors. Propensity score matching involves a number of steps: (1) the populations to be compared (here: vanilla and green) should have a similar distribution in their yields such that there are sufficient pairs that can be matched (Figure 2); (2) extreme outliers need to be treated similarly; (3) a pair matching algorithm needs to be selected (e.g. k-nearest neighbor, where $k = 3$), and (4) balancing of the covariates (confounders) to have similar impacts on the matching technique).

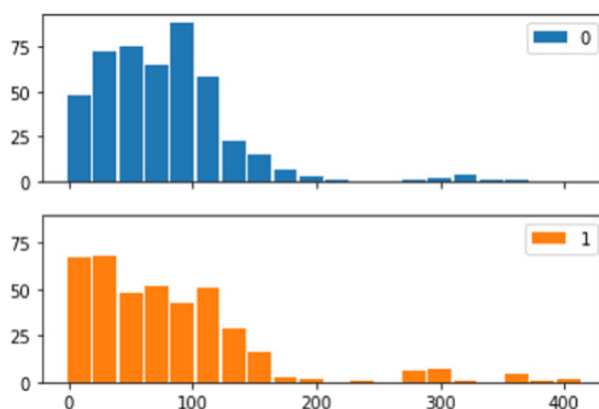


Figure 2. Histogram of yield spread for vanilla (top) and green (bottom) bonds in the Great Lakes region

RESULTS

Following the search criteria, 945 municipal bonds were identified across all states and use of proceeds areas, between 2019–20. Out of this universe, there were 465 (or \$8.7 bn) green-labeled bonds under ARRA, or other green bond designations. Over 500 managing firms (financial underwriters) were identified across the offerings in 7 states, with green bonds issued in 4 states (NY, PA, OH, IL).

Municipal Bond Distribution by State

Based on the criteria, the muni bonds were grouped by registered location and use for proceeds (Figure 3). Based on the figure, the dominant issuance is in water and sewerage,

followed by electric power, transportation and housing. Essentially, in two years there is a **25% increase** in number of green bond issues compared to 2008-18. The total green bonds amount is **40% higher** than the green bond amount issued over previous 10 years. The total value of green bonds issued is **3.3x** that of vanilla bonds. Aside from the number of bond issues, it is important to consider the amounts (\$MM.) underwritten for the bonds, as there is no correspondence to the number of registered securities. Ohio and New York sold the largest traded volume on the market, valued at \$7.5 bn across all securities.

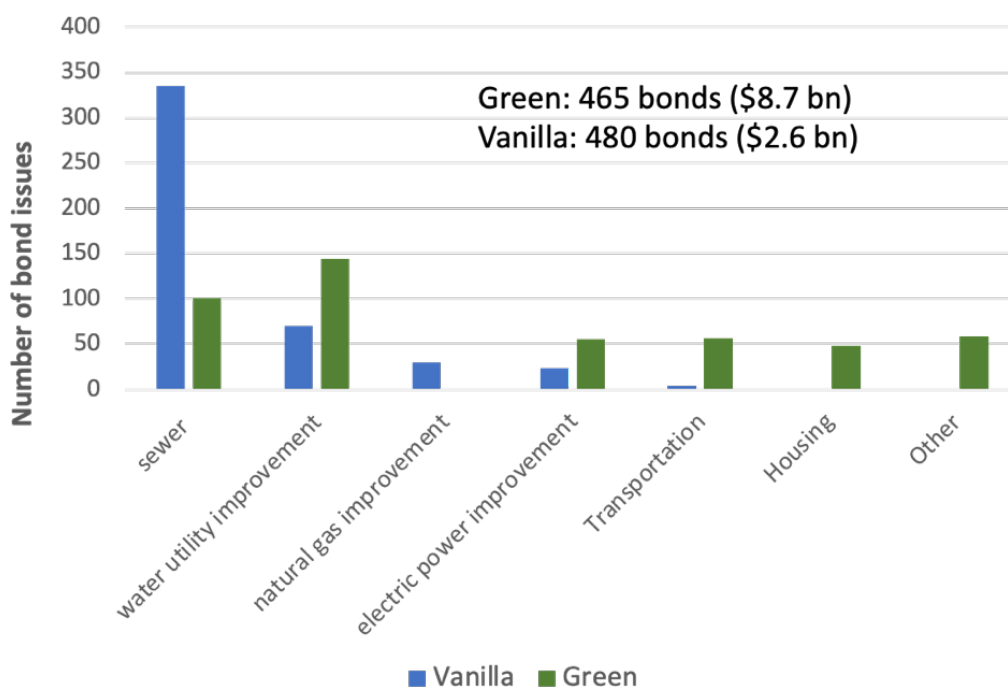


Figure 3. Issued Muni Bond Securities by Use of Proceeds

Distribution by Use of Proceeds

To capture the broadest universe of muni bonds, we included:

- Green bonds as defined under ARRA, which include renewable energy investments, energy efficiency improvements, and water infrastructure projects
- Various improvement bonds (water utility, sewer, resource recovery, transit, electric, natural gas, multi-utility, transit, telecommunications, and industry)
- Payouts of financial contracts such as interest swaps, refunding of notes or bonds

By just focusing on the green highlighted issues, we looked at the outstanding amount and distribution across these bonds. Green bonds (58 unique issues; 465 total securities) use of proceeds varied greatly by State. For example, the green bonds are all offered in New York, Ohio, Pennsylvania, and Illinois (Table 1). The use of proceeds focuses on mass transit and housing (NY), electric power upgrades and water utilities (Ohio), and water and sewerage utilities (PA). Illinois is a new state of green bond issuances as compared to the 2010-18 time period. No green bonds were issued in Minnesota, Wisconsin, Indiana, or Michigan; vanilla

muni bonds in the same use of proceeds were issued in all states but Michigan, indicating substantial opportunity for future growth in this area.

Table 1. Distribution of green bond issues and use of proceeds

State	# of Issues	Amount	Dominant use of proceeds
New York	125	\$ 6,672,950,000.00	Transportation & Housing
Ohio	106	\$ 877,935,000.00	Water & power
Illinois	68	\$ 767,065,000.00	Water
Pennsylvania	166	\$ 202,370,000.00	Water & Sewerage
Total	465	\$ 8,721,365,000.00	

Pricing of Bond Issues

Aside from the primary emphasis on green bonds, water utility bonds, sewer improvement bonds, recreational improvement and housing/transportation were key. A deeper dive in the bond issues was performed to assess the rating and coupon offered (Figure 4). The rationale for this assessment was to understand where the potential opportunity exists to ‘move the risk needle’ with positive impact on the Great Lakes basin. The argument is that higher environmental performance of the bond may lead to improvements in its risk ratings, and result in a lower coupon for the issuer. Green bonds appeared to skew towards higher interest rates. The lower interest rate bonds were dominated by water and sewerage bonds.

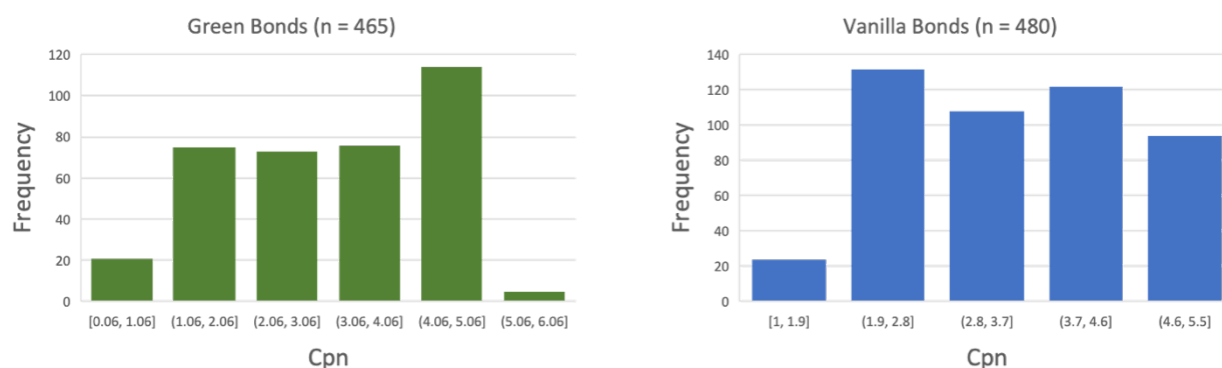


Figure 4. Frequency of coupon applied to green (left) and vanilla (right) bonds

Greenium Analysis

To apply the PSM method, all confounders need to be available for all bonds. This reduced the universe from 945 to 865 issues. The initial choice of confounders was coupon rate, issue date, maturity, amount outstanding, and state of origin. The result of this analysis indicated that there was essentially no greenium effect between the vanilla and green bonds in the primary market. In fact, there was a slight increase in yield spread of green over vanilla bonds of 0.6 bps. This was similar to the observations of Larcker and Watts (2019), who

observed no greenium effect in the national database of municipal bonds, albeit in 2017–2019.

We then looked at the impact of confounder selection on the greenium effect (Figure 5). Was it possible that for example use of proceeds of the bond impacts the discount, particularly since the coupon rate of water bonds is the lowest, both for vanilla and green bonds? It would be difficult to extract a market signal. Hence, we included water and sewerage bonds (246 issues) in the confounder analysis to reduce the bias from this type of bond (5). The impact was significant, as this resulted in a greenium of 23.6 bps, indicating that water bonds dilute the effect of the greenium which is driven by other uses of proceeds. Bond maturity had the second most significant effect, with a greenium of 8.9 bps (combination 4). This may be due to the general observation that green months are of shorter duration than vanilla bonds, and thus a pair-wise comparison may be misleading. The State of issuance was important as well (combination 3), with a greenium of 6.8 bps, which can possibly be explained by the type of bond issued. New York and Ohio are the only states that issue non-water bonds. Removal of the bias from amount outstanding (size of the bonds) increased the greenium to 4.6 bps, since on average vanilla bonds are still larger than green bonds which may impact the yield spread.

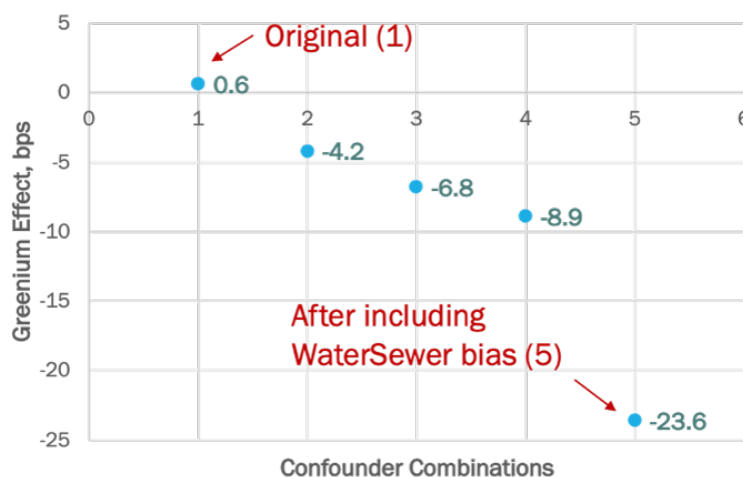


Figure 5. Impact of bias on greenium effect (Legend: 1–6 refer to confounder combinations, with water/sewer use of proceeds most significant)

When compared to the national universe of green and vanilla bonds issued in 2019–20 (6,529 issues), the greenium effect was 28 bps when the same set of confounders was used, and the bias of water/sewerage bonds removed. Hence, also in this universe did water bonds have a significant effect on the greenium effect.

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