

Financing the Response to Climate Change: The Pricing and Ownership of U.S. Green Bonds

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Climate Change

- ▶ Global mean temperatures are rising
 - ▶ 16 of last 17 years are warmest since records began in 1880, with new records three years in a row
 - ▶ **Consequences:** Rising sea levels, retreating glaciers, ocean acidification
- ▶ Economically damaging weather events are becoming more frequent
 - ▶ Flooding, droughts, and storms
- ▶ Estimates of \$12 trillion required to achieve 2015 Paris target
 - ▶ Temperature rise of <2 degrees C to prevent catastrophe
 - ▶ Need \$ for both mitigation and adaptation: New technology by private sector; new infrastructure by governments; worldwide

Financing the Response

- ▶ How can capital markets play a role? Green securities
- ▶ “Green Bonds”: Bonds whose proceeds exclusively support a specific environmental purpose
 - ▶ Growing market, with indexes, ETFs, etc.
 - ▶ First green bond issued by European Investment Bank in 2007
 - ▶ **Issuers:** Supranationals, corporations, sovereigns, U.S. municipalities, universities
 - ▶ May be an easier place to see the impact of investor tastes on expected returns
- ▶ Bond market version of sin stocks, ESG/SRI investing literature

Some History

- ▶ 2007: First labeled “green bond” issued by the European Investment Bank and World Bank
- ▶ 2010: U.S. QECB and “New” CREB municipal bond schemes introduced (dry up in 2014)
- ▶ 2013: First \$1bn green bond issued by the IFC
- ▶ 6/2013: First labeled “green municipal bond” issued by Massachusetts
- ▶ 11/2013: First labeled “green US corporate bonds” including Bank of America
- ▶ Early 2014: Establishment of Green Bond Principles by I-bankers
 - ▶ **Definition:** Use of proceeds needs to be described in legal docs; project evaluation process must be outlined; management of proceeds/transparently separated; annual reporting of uses
 - ▶ **Categories:** Climate change, natural resource depletion, biodiversity conservation, pollution control
- ▶ 2014 Q3: State of California issues its first “green municipal bond”
- ▶ 2015: Worldwide issuance of \$37bn
- ▶ 2016: Apple issues its first “green corporate bond” raising \$1.5 billion (largest thus far)
- ▶ 2016: Worldwide issuance of \$87bn
- ▶ 2017: Worldwide issuance of \$155bn, with 2017Q4 having most issuance on record



I. Overview of U.S. green bonds

II. Pricing

III. Ownership concentration

Identifying green bonds

- ▶ “Green bond” label is becoming widely used, but not standardized
 - ▶ Fuzzier than “S&P 500 stock” or “BBB+ rated bond” categories
 - ▶ Less fuzzy than “growth stock” or “value stock” categories
- ▶ We use Bloomberg green bond flag
 - ▶ “There are many shades of green ... In addition, terminology often varies, with issuers using different titles to promote the environmental benefits of their bonds. While the use of proceeds often varies by bond as well, all issuers must commit to deploying 100% of bond proceeds for environmental sustainability-oriented activities in order for their bond to be identified as a labeled green bond.”
- ▶ The sample includes three somewhat distinct types of green municipal bonds
 - ▶ CREB and QECP, self labeling, “certified” green

Issuance by year

Year	<i>Green</i>			<i>Ordinary</i>
	Unique Bonds	Unique Issuers	\$ (M)	\$ (M)
Panel A. Municipal				
2010	116	32	466	255,000
2011	97	34	137	180,000
2012	106	24	180	261,000
2013	78	15	261	224,000
2014	309	22	2,130	244,000
2015	593	38	2,940	309,000
2016	784	39	6,530	353,000
Total	2,083	204	12,644	1,826,000
Panel B. Corporate				
2014	2	2	700	1,270,000
2015	11	6	6,720	1,390,000
2016	6	5	4,080	1,330,000
Total	19	13	11,500	3,990,000

Use of proceeds

Use	Green		Ordinary	
	Unique Bonds	Unique Issuers	\$ (M)	\$ (M)
Panel A. Municipal				
Agriculture	0	0	0	93
Airlines	0	0	0	2,300
Airports	0	0	0	54,600
Bridges	0	0	0	6,830
Courts	0	0	0	2,170
Civic/Convention Centers	0	0	0	8,100
Correctional Facilities	10	2	6	7,080
Multiple Public Utilities	0	0	0	14,900
Economic Development	31	2	267	12,200
→ Public Power	246	40	1,080	64,600
Fire Station/Equipment	0	0	0	1,530
Flood Ctl/Storm Drain	0	0	0	2,430
Gas	0	0	0	5,600
General Purpose	515	41	2,380	591,000
Government/Public Buildings	2	2	9	8,650
→ Higher Education	194	20	1,010	161,000
Hospitals	3	3	101	86,900
Industrial Development	0	0	0	3,360
Irrigation	0	0	0	831
Library or Museums	0	0	0	3,560
Malls/Shopping Centers	0	0	0	22
→ Mass/Rapid Transit	83	4	1,480	27,100
Multi-Family Housing	0	0	0	14,900
New Public Housing	0	0	0	16
Nursing Homes	0	0	0	3,740
Office Bldg	0	0	0	864
Other Healthcare	5	1	53	29,400

Use of proceeds

Use	Green			Ordinary
	Unique Bonds	Unique Issuers	\$ (M)	\$ (M)
Panel A. Municipal				
Other Public Service	0	0	0	233
Other Recreation	0	0	0	1,840
Other Education	0	0	0	7,050
Other Housing	20	1	40	5,480
Other Transportation	43	2	492	45,900
Other Utilities	0	0	0	2,070
Parks/Zoos/Beaches	0	0	0	4,360
Pension Funding/Retirement	0	0	0	4,750
Parking Facilities	0	0	0	2,250
Police Station/Equip	1	1	7	648
Pollution Control	21	1	19	10,200
Land Preservation	0	0	0	505
Primary/Secondary Education	114	33	262	335,000
Redevelopment/Land Clearance	5	1	2	11,400
Retirement Centers	0	0	0	3,500
Sanitation	24	1	167	1,340
Seaports/Marine Terminals	0	0	0	10,800
Single Family Housing	0	0	0	23,400
Single/Multi-Family Housing	0	0	0	2,690
Stadiums/Sports Complex	0	0	0	5,460
Student Loans	0	0	0	4,170
Theaters	0	0	0	228
Toll Road and Highway	0	0	0	51,500
Tunnels	0	0	0	40
Veterans	0	0	0	1,510
Solid Waste	42	3	51	6,060
→ Water and Sewer	724	32	5,210	170,000
Total	2,083	190	12,637	1,826,160

Bond characteristics

Variable	<i>Green</i>				<i>Ordinary</i>				<i>Diff</i>	
	Mean	Median	Min	Max	Mean	Median	Min	Max	Mean	P-Value
Panel A. Municipal										
Rating (AAA=1)	2.78	2.00	1	14	3.40	3.00	1	21	-0.63	(0.005)
Maturity (Years)	11.94	11.22	1	30	10.70	9.82	1	30	1.25	(<0.001)
Insured (Yes=1)	0.060	0.00	0	1	0.170	0.00	0	1	-0.11	(<0.001)
Taxable (Yes=1)	0.280	0.00	0	1	0.069	0.00	0	1	0.21	(<0.001)
Taxable AMT (Yes=1)	0.000	0.00	0	0	0.011	0.00	0	1	-0.01	(<0.001)
Taxable State (Yes=1)	0.056	0.00	0	1	0.091	0.00	0	1	-0.03	(0.101)
Total Issue Size (\$M)	6.3	2.3	0.1	250	3.0	0.7	0.1	3500	3.27	(<0.001)
Bank Qualified (Yes=1)	0.016	0.00	0	1	0.383	0.00	0	1	-0.37	(<0.001)
New Money (Yes=1)	0.711	1.00	0	1	0.434	0.00	0	1	0.28	(<0.001)
General Obligation (Yes=1)	0.147	0.00	0	1	0.468	0.00	0	1	-0.32	(<0.001)
CBI Certified Green (Yes = 1)	0.066	0.00	0	1	0.000	0.00	0	0	0.07	(0.029)
Panel B. Corporate										
Rating (AAA=1)	9.26	8.00	2	14	9.10	9.00	1	21	0.17	(0.879)
Maturity (Years)	6.84	7.03	2	10	8.37	7.52	1	30	-1.52	(0.085)
Total Issue Size (\$M)	605	500	250	1,500	487	350	0.1	11,000	118.0	(0.129)

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Pricing

- ▶ “Sin securities” versus Green
 - ▶ **Sin securities:** Is cost of capital higher for unfavored securities?
 - ▶ **Green:** Is cost of capital **lower** for environmentally friendly securities?
- ▶ Stocks versus Bonds
 - ▶ Bonds: Easier to measure expected return at offering, control for risk
 - ▶ But -- New market with a short history, with limited secondary returns data, and few or no defaults

Yield statistics

Year	Green			Ordinary		
	N	Pre-Tax Yield (%)	After-Tax Yield (%)	N	Pre-Tax Yield (%)	After-Tax Yield (%)
2010	116	5.21	3.38	71,643	3.76	3.40
2011	97	4.69	3.00	64,485	3.38	3.30
2012	106	3.12	2.01	92,259	2.39	2.32
2013	78	3.51	2.04	80,666	2.67	2.57
2014	309	2.54	2.39	89,720	2.48	2.41
2015	593	2.52	2.31	116,377	2.37	2.29
2016	784	2.12	2.03	128,149	1.98	1.92
Total	2,083	2.69	2.28	643,299	2.61	2.50

22 basis points
(v 12 per Rating Notch)

Yield regressions

Variable	<i>After-Tax Yield</i>			
	1	2	3	4
Green	-7.4 [-8.91]	-7.0 [-9.60]	-5.4 [-6.73]	-7.2 [-10.93]
CBI Certified Green	-18.8 [-5.87]	-16.9 [-6.08]	-13.9 [-5.19]	-8.2 [-3.77]
R-Squared	0.88	0.91	0.93	0.96
Adjusted R-Squared	0.88	0.91	0.93	0.95
N	614,440	610,485	613,912	609,907
Fixed Effects				
Maturity	Yes		Yes	
Rating	Yes		Yes	
Month	Yes		Yes	
Maturity x Rating x Month	Yes		Yes	
Issuer Fixed Effects	No	No	Yes	Yes
Additional Fixed Effects (all specifications)	Rating, Size Category, Insured, Taxable, Taxable AMT, Taxable State, Bank Qualified, New Money, Code = GO, Use of Proceeds			



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Ownership (HHI) regressions

Variable	<i>Dependent variable: HHI</i>			
	Model 1	Model 2	Model 3	Model 4
Green	0.04 [2.81]	0.03 [2.10]	0.05 [2.78]	0.06 [2.88]
CBI Certified Green	0.20 [4.09]	0.23 [4.27]	0.09 [1.70]	0.06 [1.05]
R-Squared	0.24	0.34	0.42	0.51
Adjusted R-Squared	0.23	0.23	0.37	0.38
N	71,126	67,200	69,625	65,546
Fixed Effects				
Maturity	Yes		Yes	
Rating	Yes		Yes	
Month	Yes		Yes	
Maturity x Rating x Month		Yes		Yes
Issuer Fixed Effects	No	No	Yes	Yes
Additional Fixed Effects (all specifications)	Size Category, Insured, Taxable, Taxable AMT, Taxable State, Bank Qualified, New Money, Code = GO, Use of Proceeds			

Summary

- ▶ Overview of U.S. green bond market
 - ▶ Small but rapidly growing
- ▶ Pricing
 - ▶ Green bonds sell at a premium
- ▶ Ownership
 - ▶ Green bonds are more closely held