

THE EVIDENCE ON THE GREEN BOND PREMIUM IN ASIA-PACIFIC AND EUROPEAN MARKETS

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Disclaimer : This presentation is intended only for use in SEC Capital Market Symposium 2022

Agenda

- I. Introduction of Green Bond
- II. Approaching Green Bond Premium
- III. Result Summary
- IV. Conclusion & Implications

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I. Introduction of Green Bond

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I. Introduction of Green Bond

Four things to know about “Green Bond”

What are Green Bonds?

- **Green bonds** are fixed-income securities which dedicated only to projects with environmental advantages or climate and environment-related objectives.
- **Green Bonds** function the same way as any other bonds.
- **Green Bonds Issuers** are obligated to use the proceeds from the issuance for project deemed environmentally beneficial.

Who can issue Green Bonds?

- **Private Companies** - Non-financial corporations, particularly energy and utility companies
- **Financial Institutions** - Commercial banks, Investment Banks, and Development Banks
- **Municipalities and National Governments**

Green Bonds are part of the Sustainable Debt Market



Green Bond



Social Bond



Sustainability Bond



Sustainability-linked Bond



Transition Bond

- **Green bonds lead sustainable debt market** with more than \$1.6 Trillion in market size and 2,045 issuers in 80 countries.

Green Bond's Key Milestone

The 1st Green Bond issuance by European Investment Bank

2007

Poland becomes the 1st green sovereign issuance

2015 2016

The Paris Agreement accelerates green bond issuance

Green Bond Market hits \$1.6 Trillion

2019

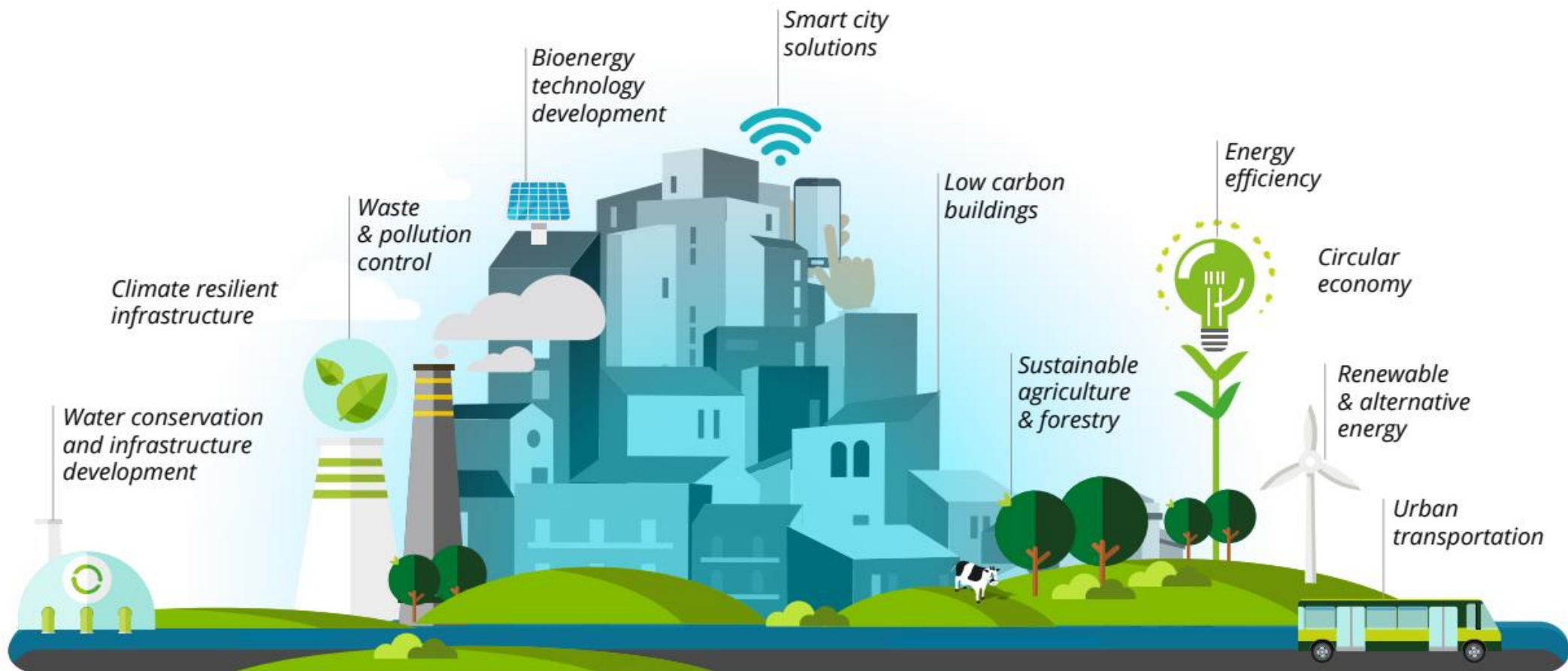
Green Bond Market hits \$783 Billion

2021

I. Introduction of Green Bond

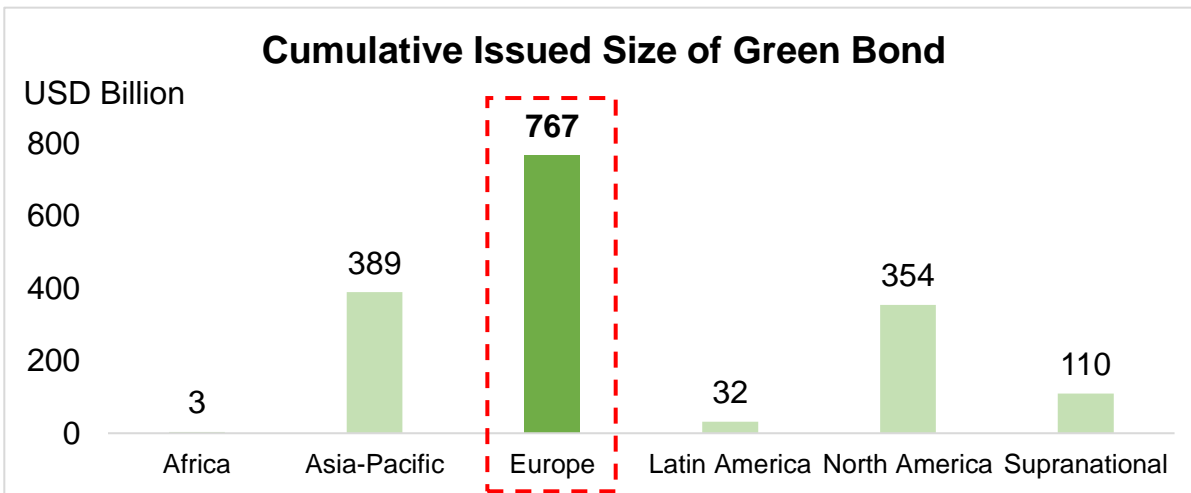
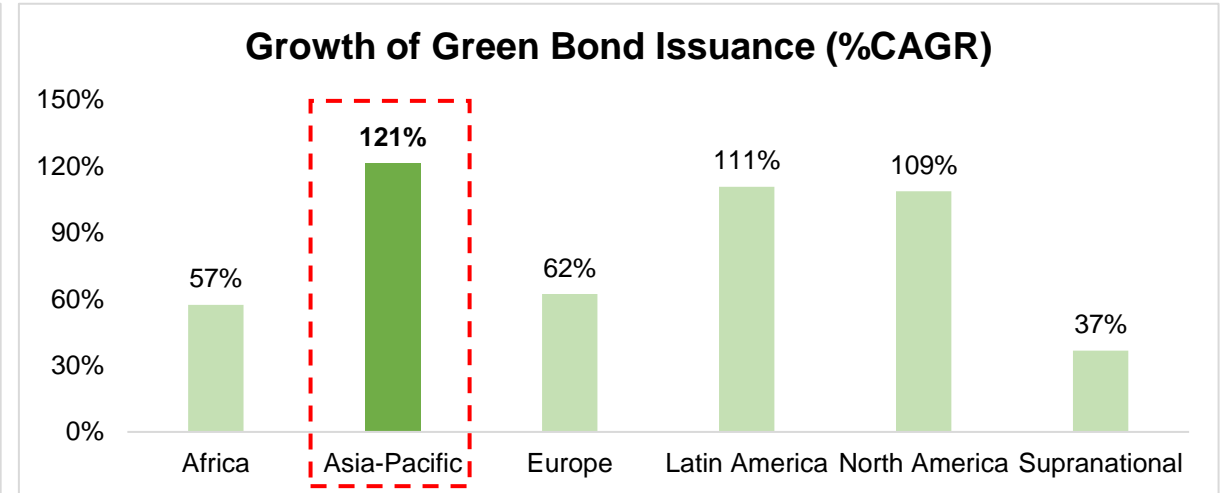
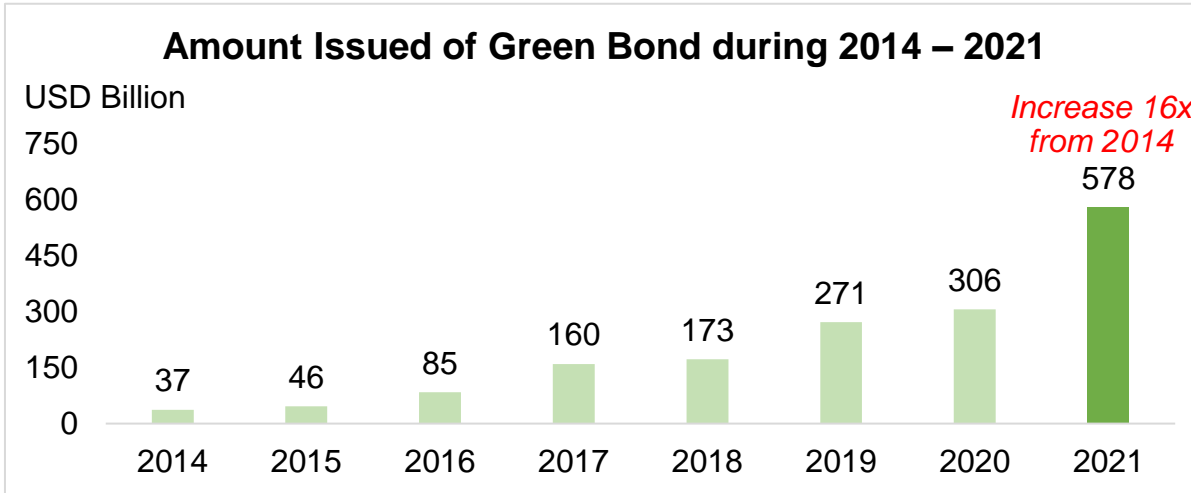
Use of proceeds of green bonds can be utilized to various environmental projects

- **Renewable Energy, Green Buildings, and Transportation** are the three largest use of proceeds, contributing 81% to the 2021 total.



I. Introduction of Green Bond

The demand for green investments by ESG investors is expanding at a rapid rate

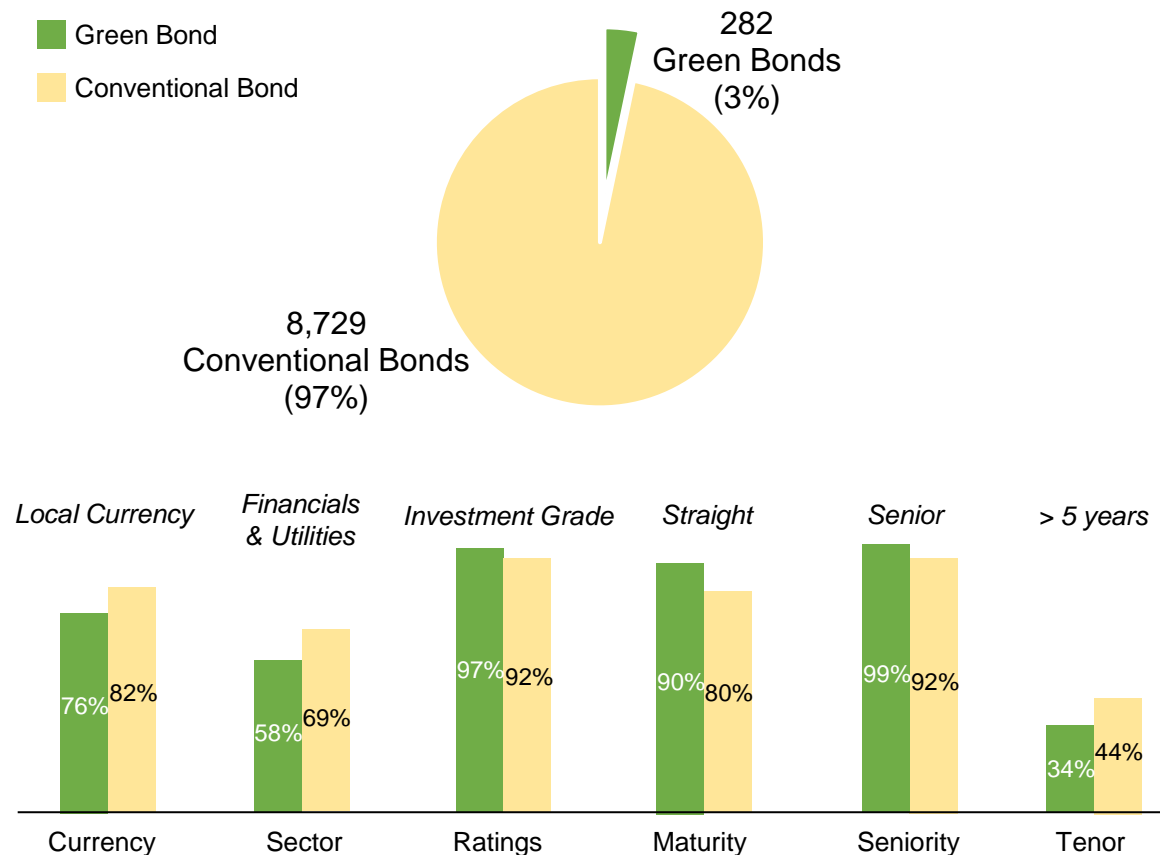


- After the first issuance in 2007, green bond market expansion has revealed **a strong shift toward pro-environmental preferences among both issuers and investors. The issuance of green bond are more than \$1.6 Trillion** in outstanding amount issued as of December 2021.
- **Asia-Pacific contributes the world's highest compound annual growth rate (CAGR) from 2014 – 2021 of 121%.**
- **Europe contributes the world's largest cumulative amount issued of \$767 Billion.**

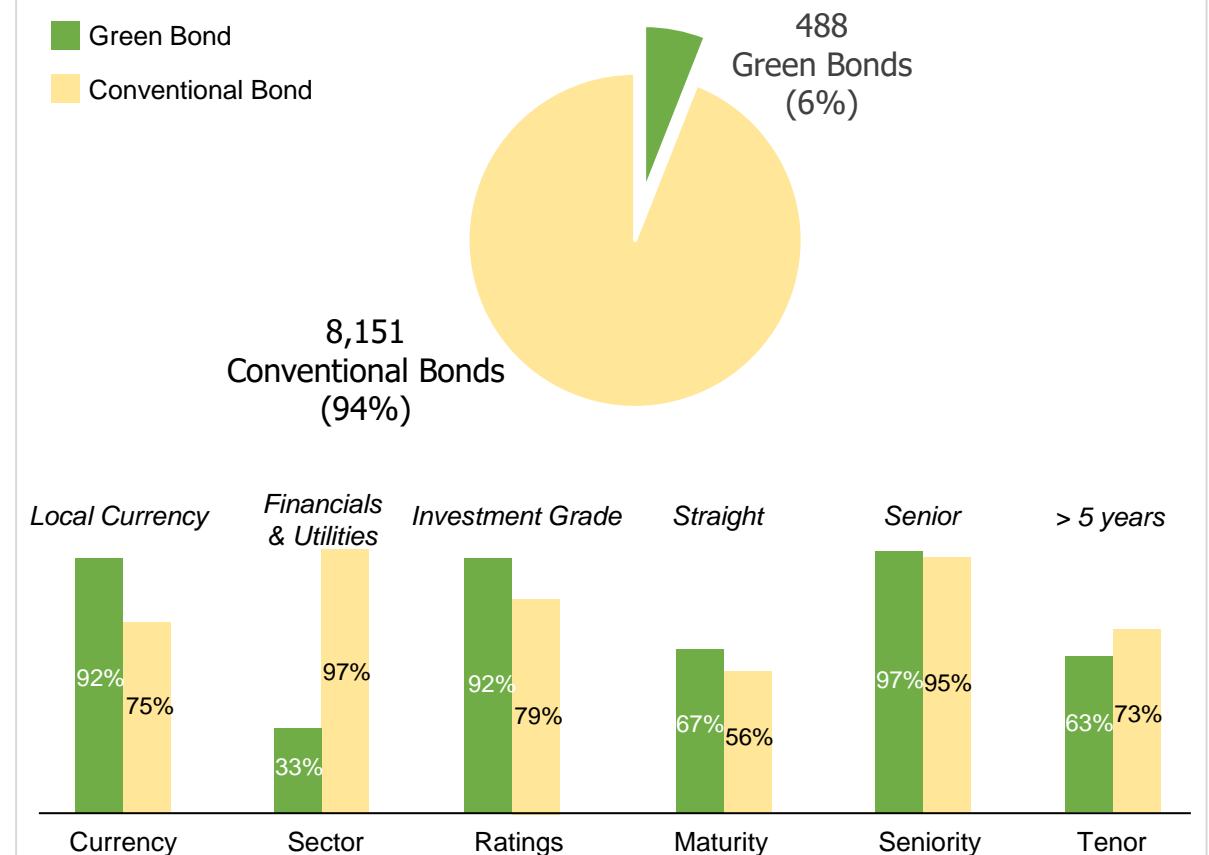
I. Introduction of Green Bond

Distribution of green and conventional bonds from January 2016 to December 2021

Asia-Pacific Markets



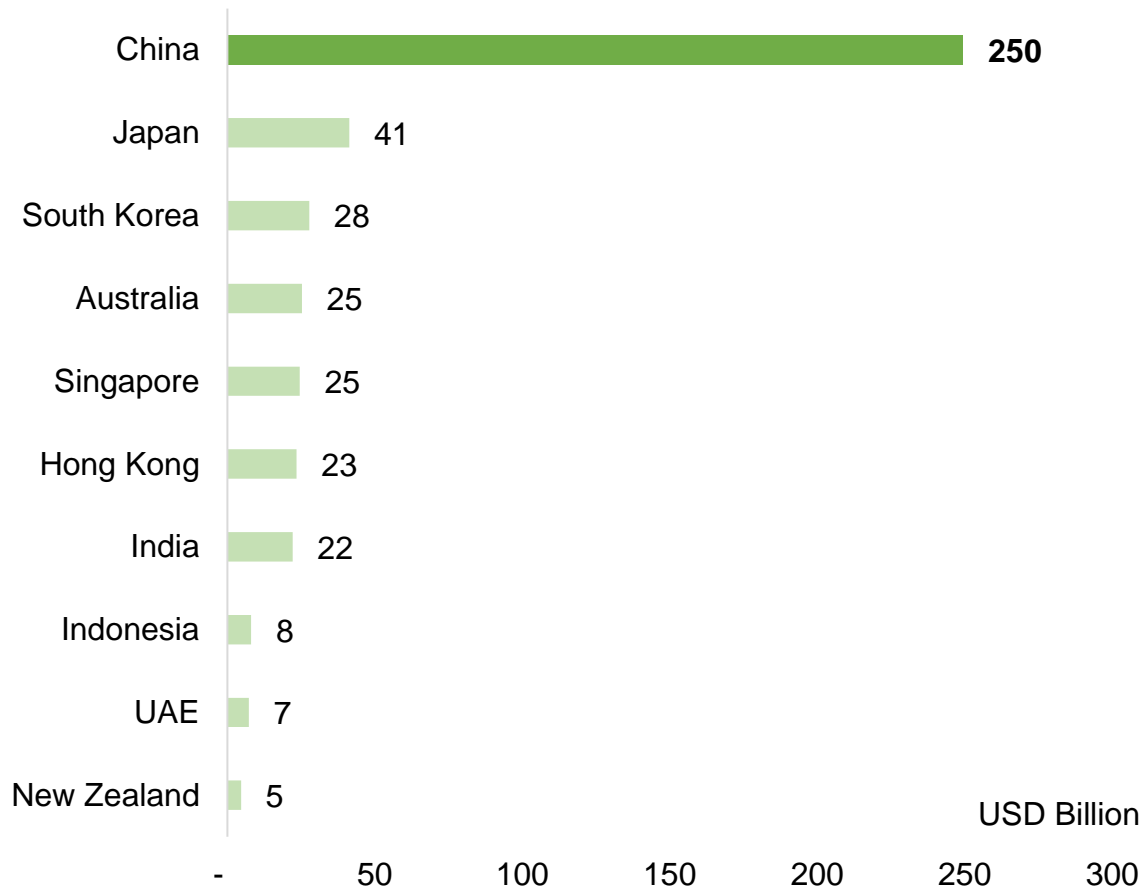
European Markets



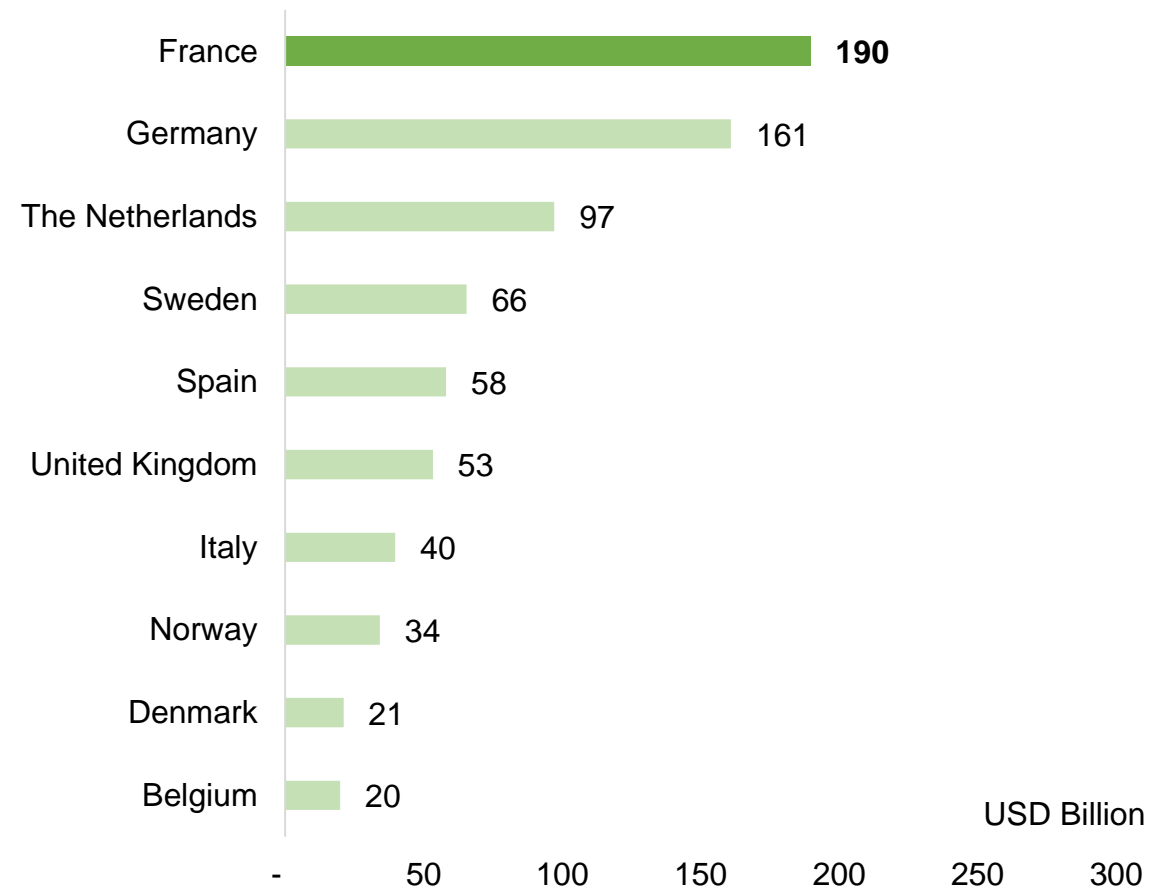
I. Introduction of Green Bond

Top 10 countries in Asia-Pacific and Europe that issued green bonds (Cumulative amount)

Asia-Pacific Markets



European Markets



Agenda

I. Introduction of Green Bond

II. Approaching Green Bond Premium

III. Result Summary

IV. Conclusion & Implications

II. Approaching Green Bond Premium

Defining Green Bond Premium and A concept of yield's comparison

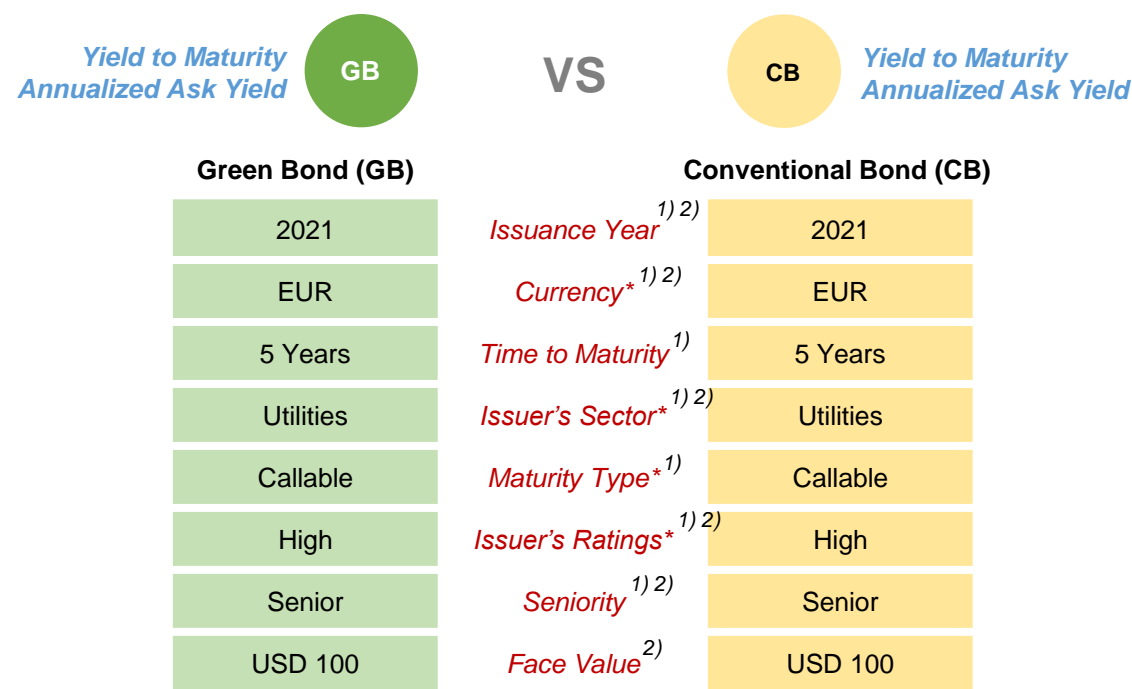
What is a “Green Bond Premium”?

- “Green Bond Premium” refers to the difference between green bond’s yield and conventional bond’s yield.
 - If green bond premium is **positive**, green bond’s yield is **higher** than conventional bond’s yield.
 - If green bond premium is **negative**, green bond’s yield is **lower** than conventional bond’s yield.
 - If green bond premium is **zero**, green bond’s yield is **equal** to conventional bond’s yield.

Bond Yield’s Representatives to approach the Green Bond Premium

- **Yield to Maturity**, as a bond’s yield in Primary market
- **Annualized Ask Yield**, as a bond’s yield in Secondary market

Concept of Yield’s Comparison between green bond and conventional bond



Selected features for green and conventional bond matching pairs

1) Variable used in Propensity Score Matching Approach

2) Variable used in Coarsened Exact Matching Approach

II. Approaching Green Bond Premium

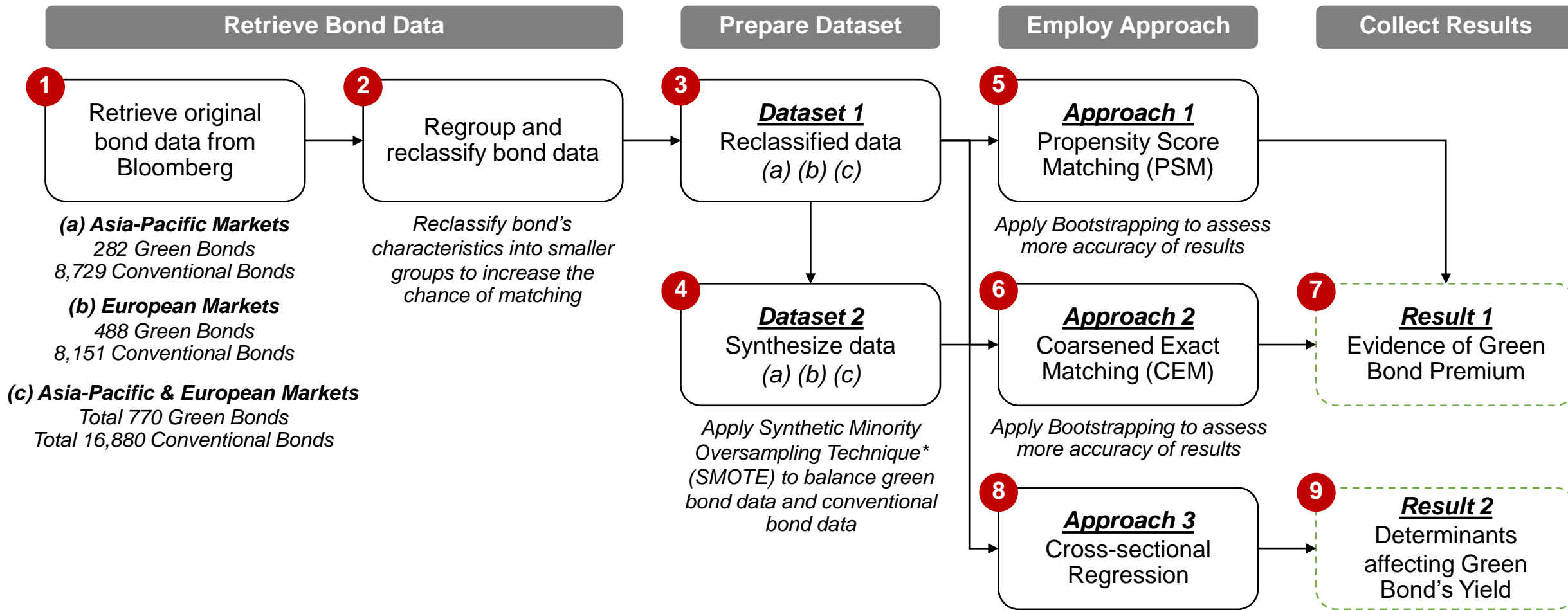
The evidences of Green Bond Premium from previous studies

- Previous studies reveal the evidence of the Green Bond Premium in many ways, making it difficult to draw any conclusions and motivating future research.

	Green Bond Premium (Basis Points)	Author(s)	Dataset
-	(20) – (15)	Löffler, K.U., et al., (2021)	Global 2,000 green bonds and 180,000 conventional bonds issued between 2007-2019
-	(9) – (1)	MacAskill, S., et al . (2020)	Journal articles and industry reports published between 2007-2019
-	(2)	Zerbib, O. (2019)	Global 1,065 green bonds and 2 synthetic conventional bonds for each green bond issued between 2013-2017
-	(18)	Kapraun, J. & Scheins, C. (2019)	408,997 ISINs of green bonds and conventional bonds
-	(19) – (15)	Gianfrate, G. & Peri, M. (2019)	121 European green bonds and 2,815 European conventional bonds issued between 2013-2017
-	(29) – (17)	Fatica et al. (2019)	1,397 green bonds and 271,312 conventional bonds issued between 2007-2018
+	2 – 6	Bachelet et al. (2019)	89 bond couples with selected crucial characteristics
+	63	Nanayakkara, M. and Colombage, S. (2019)	82 green bonds and 43 conventional bonds issued between 2016-2017
+	0 - 5	Partridge, C. & Medda, F.R. (2020)	Green municipal bonds and conventional municipal bonds in US issued in 2014, 2015, and the first half of 2016
●	-	Wensaas, E. & Wist, J.B. (2019)	All Nordic 77 green bonds and 154 conventional bonds issued between 2013-2016

II. Approaching Green Bond Premium

Summary of all employed methodologies to analyze Green Bond Premium



Note : *Synthetic Minority Oversampling Technique (SMOTE) synthesizes new sample in the minority class in the overall sample to fitting the model without providing any additional information (Chawla, N., et al., 2002)

Agenda

I. Introduction of Green Bond

II. Approaching Green Bond Premium

III. Result Summary

IV. Conclusion & Implications

III. Result Summary

Negative Green Bond Premiums exist in both Asia-Pacific Markets and European Markets

		Asia-Pacific Markets					
Unit : Basis Points		A. Propensity Score Matching				B. Coarsened Exact Matching	
Approach / GBP		Nearest Neighbor	Radius	Kernel	Stratification	Automated Coarsening	k2k
Reclassified Data	(1) GBP in Primary market	(13.42)	(7.58)*	(7.80)*	(4.31)	(16.28)	(20.99)
	(2) GBP in Secondary market	(26.22)*	(116.38)*	(119.45)*	(25.77)*	(36.68)*	(33.82)*
	(3) Yield Volatilities	(24.00)*	(79.24)*	(80.58)*	(11.26)	(47.19)*	(53.55)*
Synthetic Data	(4) GBP in Primary market	119.15*	(52.22)*	(52.52)*	(0.17)	(9.03)*	(10.15)
	(5) GBP in Secondary market	115.19*	(85.90)*	(87.10)*	(19.10)*	(37.58)*	(39.24)*
	(6) Yield Volatilities	125.72*	(40.12)*	(46.37)*	8.87	(25.81)*	(55.71)*

- **Negative Green Bond Premiums** exist in both primary market and secondary market.
- Green Bond Premiums are in the range between **(53)** and **(8)** basis points in the primary market.
- Green Bond Premiums are in the range between **(119)** and **(19)** basis points in the secondary market.
- Yield Volatilities of green bonds are considerably lower than conventional bonds ranging between **(81)** and **(24)** basis points.

Remark : GBP = Green Bond Premium

Note : * indicates significance at the 95% level / In all estimations, a common probability support of the treated and control units is required to ensure greater comparability of matched units / 100 replicates of bootstrapping

III. Result Summary

Negative Green Bond Premiums exist in both Asia-Pacific Markets and European Markets

Unit : Basis Points		European Markets					
		A. Propensity Score Matching				B. Coarsened Exact Matching	
		Approach / GBP	Nearest Neighbor	Radius	Kernel	Stratification	Automated Coarsening
Reclassified Data	(1) GBP in Primary market	(7.71)	(68.11)*	(68.93)*	(2.49)	(1.60)	(1.19)
	(2) GBP in Secondary market	18.85*	(28.10)*	(29.40)*	16.52	17.63*	23.95
	(3) Yield Volatilities	(13.50)	(76.45)*	(75.63)*	26.28	31.63	16.47
Synthetic Data	(4) GBP in Primary market	61.76*	(30.18)*	(54.91)*	(14.49)	(6.10)	5.27
	(5) GBP in Secondary market	51.29*	2.69	(14.82)*	13.29*	12.25*	2.37*
	(6) Yield Volatilities	149.94*	(29.19)*	(66.92)*	(10.77)	4.01	0.93

- **Negative Green Bond Premiums** exist mainly in primary market.
- Green Bond Premiums are in the range between **(69)** and **(30)** basis points in the primary market.
- Green Bond Premiums are in the range between **(29)** and **51** basis points in the secondary market.
- Yield Volatilities of green bonds are considerably lower than conventional bonds ranging between **(76)** and **(29)** basis points.

Remark : GBP = Green Bond Premium

Note : * indicates significance at the 95% level / In all estimations, a common probability support of the treated and control units is required to ensure greater comparability of matched units / 100 replicates of bootstrapping

III. Result Summary

Negative Green Bond Premiums exist in both Asia-Pacific Markets and European Markets

		Asia-Pacific & European Markets					
Unit : Basis Points		A. Propensity Score Matching				B. Coarsened Exact Matching	
Approach / GBP		Nearest Neighbor	Radius	Kernel	Stratification	Automated Coarsening	k2k
Reclassified Data	(1) GBP in Primary market	(8.19)	(84.10)*	(82.36)*	(11.52)	(3.06)	(2.48)
	(2) GBP in Secondary market	4.29	(86.38)*	(85.00)*	(6.57)	1.24	5.15
	(3) Yield Volatilities	(2.76)	(73.22)*	(70.39)*	(15.18)	(2.90)	(5.83)
Synthetic Data	(4) GBP in Primary market	41.61	(38.95)*	(55.60)*	(10.60)*	(8.85)*	7.36
	(5) GBP in Secondary market	71.02*	(33.17)*	(50.17)*	5.19*	0.66	14.19*
	(6) Yield Volatilities	143.01*	(38.27)*	(59.14)*	(24.68)*	(19.51)*	(13.19)

- **Negative Green Bond Premiums** exist mainly in primary market.
- Green Bond Premiums are in the range between **(84)** and **(9)** basis points in the primary market
- Green Bond Premiums are in the range between **(86)** and **71** basis points in the secondary market
- Yield Volatilities of green bonds are considerably lower than conventional bonds ranging between **(73)** and **(20)** basis points

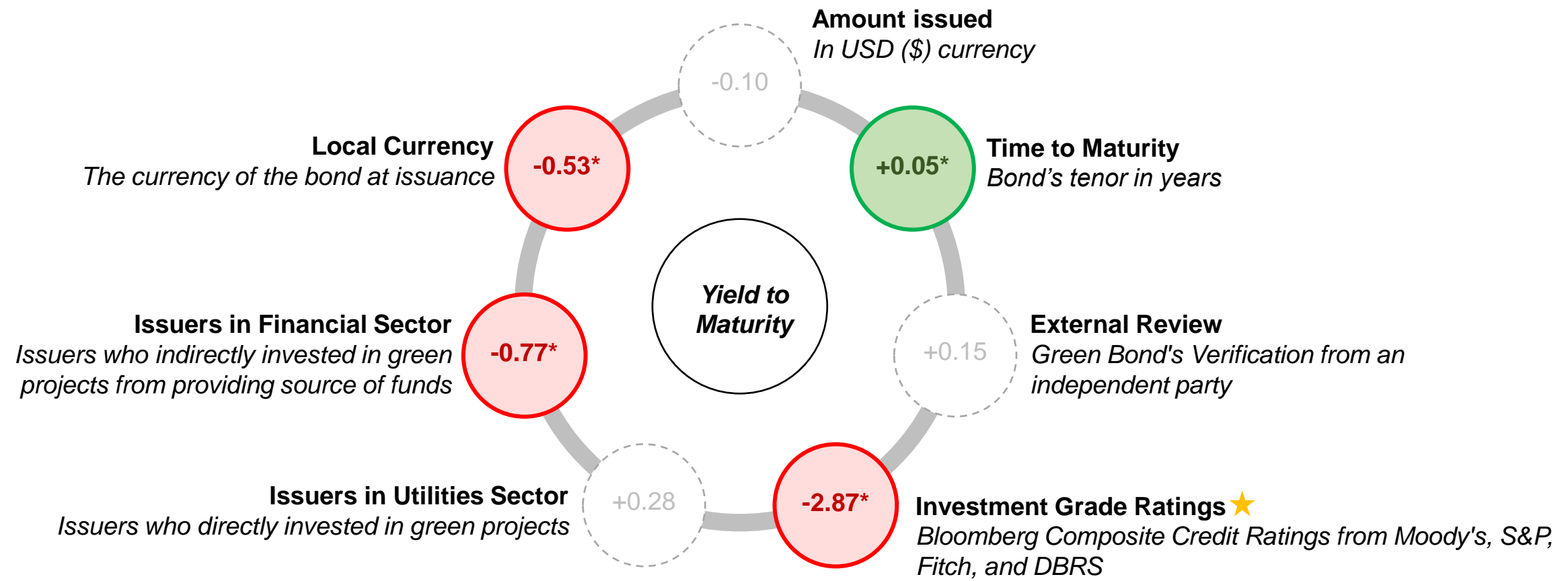
Remark : GBP = Green Bond Premium

Note : * indicates significance at the 95% level / In all estimations, a common probability support of the treated and control units is required to ensure greater comparability of matched units / 100 replicates of bootstrapping

III. Result Summary

Potential drivers of green bond's yield in Asia-Pacific markets

- In Asia-Pacific markets, the results show a statistically significant **negative relationship** to green bond yield from **investment grade ratings, issuers in financial sector, and local currency**.

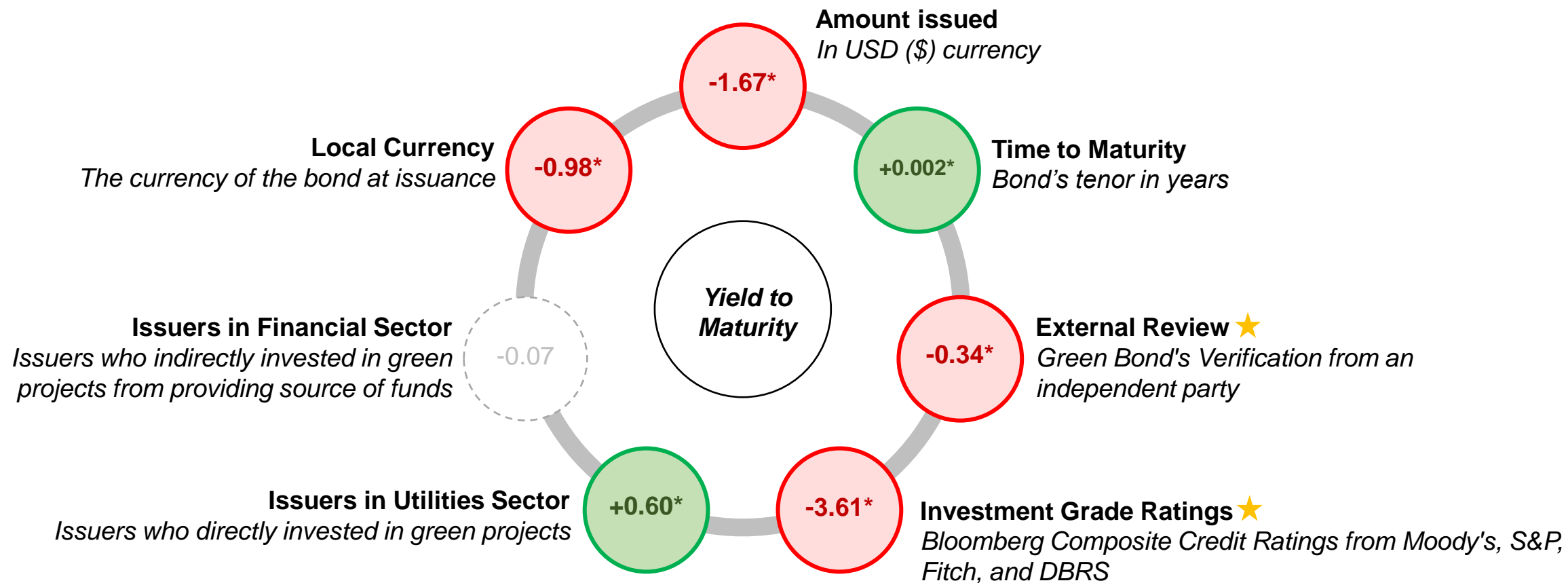


Note : Using Yield to Maturity (YTM) as a dependent variable in Cross-sectional regressions with robust standard errors

III. Result Summary

Potential drivers of green bond's yield in European markets

- In European markets, the results show a statistically significant **negative relationship** to green bond yield from **investment grade ratings, amount issued, local currency, and external review.**



Note : Using Yield to Maturity (YTM) as a dependent variable in Cross-sectional regressions with robust standard errors

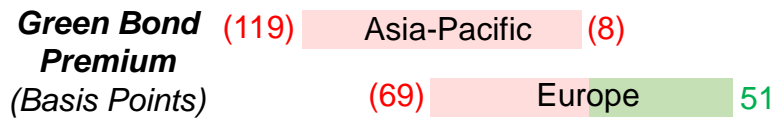
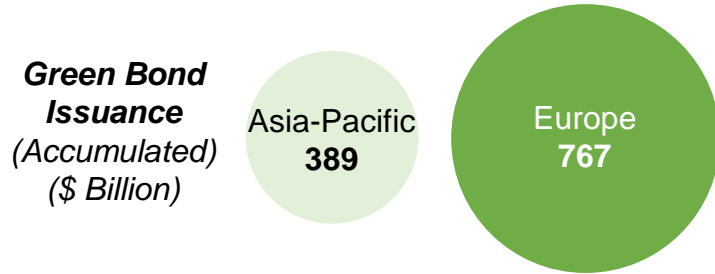
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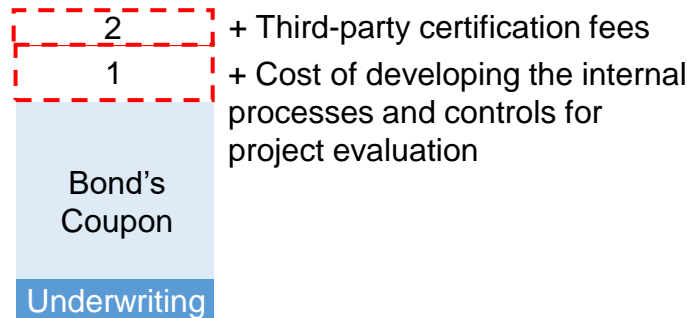
3 pillars of the implications on the evidence of the Green Bond Premium

1. Potential Mismatch Demand / Supply



- A potential mismatch between demand and supply **may raise the price while reducing the yield**, resulting in a negative green bond premium.
- With more limited supply, Asia-Pacific green bonds have larger negative green bond premium** than European markets.
- Asia-Pacific bond issuers can be the first-mover advantage for lower funding cost** by offering more green-labeled bonds before the market structure catches up to European markets.

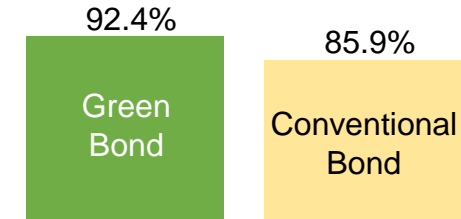
2. Additional Issuer's Cost of fund



Issuer's Cost of fund for Bond issuance

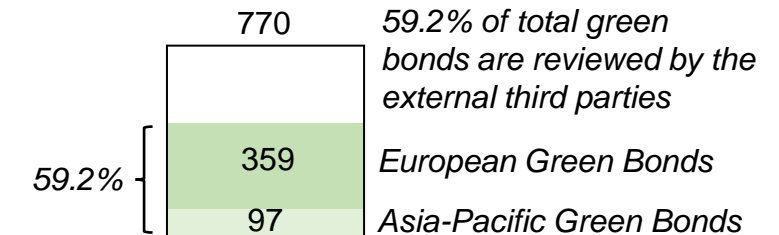
- Due to the need for issuers to pay to third-party opinion verification, **green bond issuers may seek financial compensation** to at least offset the additional cost of issuance.
- With more externally verified of green bond**, European green bond issuers have extra cost and should compensate themselves by lowering cost of fund and issuing more green bonds.
- However, if investors do not see any green label's benefits, green bond issuers may need to increase their yields **to persuade investors who are unwilling to accept lower returns.**

3. Lower Risk Profiles



Investment Grade Issuers*

- Most of green bonds are issued by issuer with a greater credit rating** than conventional bonds.



Green Bond Issuance with External Review

- External verification can eliminate information asymmetry** between issuers and investors.
- External verification may reduce the risks of greenwashing** and the risk from exposing investors to reputational risks beyond cashflow concerns.

THE EVIDENCE ON THE GREEN BOND PREMIUM IN ASIA-PACIFIC AND EUROPEAN MARKETS

The End of Presentation and Thank you for your kind attention