Case studies' evidence of greenium in green bond sovereign issuances during the pandemic selloff of March 2020.

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Contents

Executive Summary

Achieving the SDG goals will require enormous financing efforts from governments and the private sector. The advent of COVID19 has not only increased the challenge but added its own historical crisis.

Thematic bonds, in particular, green bonds have been emerging as a useful tool to help finance the gap for SDGs. The characteristic of these instruments is that unlike the case of regular bonds, the proceeds of green bonds are explicitly used to finance new or existing green projects. Such projects address climate change or have a positive environmental impact. To ensure this is the case, they are certified by third parties.

As instruments whose purpose is to finance activities that are not only financially sustainable but societally desirable, these securities have been expected to deliver some financial advantages for their issuers. For example, that investors require lower interest rates from green bonds as compared to their non-green comparables. Nevertheless, up to now, there has not been evidence that there are financial advantages for issuers. In fact, some question if issuing green bonds is more expensive than "plain vanilla" ones because of the cost of their green certification process, reporting requirements and more constrained use of resources.

This document finds some initial evidence of a possible financial advantage for issuers. It analyzes green sovereign-guaranteed bonds from Nigeria, BNDES (Brazil) and Chile and their comparables to assess their reactions during the COVID19 selloff that started in March 2020. During this period, the prices of green bonds behaved differently than their comparables.

The document examines one case where these differences could have meant lower funding costs for countries issuing green bonds (or rolling debt over) instead of issuing non-green comparables during the selloff. An example calculation amounts to savings of USD86 million in just 49 days during the selloff. That is, almost two million dollars per day in net present value savings for a country rolling debt over.

There could be several explanations for the difference in green bond's behavior. For example, a more diversified investor base, investor's preference for holding green instruments longer, less liquidity in green bond markets and central bank interventions targeting more liquid assets, among other. Due to data availability this document only explores the investor base composition.

Further research could include changing the risk-profile of green bonds (backing green bonds with green assets versus general issuers' assets), their behavior in the presence of other shocks (e.g. war and monetary policy normalization) their liquidity, and holders' composition and behavior vis-à-vis their plain vanilla equivalents. Additional statistical techniques could be used to better classify and differentiate bond's behaviors and features.

1. Introduction

Achieving the SDG goals will require enormous financing efforts from governments and the private sector. With COVID19 threatening to erase years of progress, calls for a green and resilient recovery and one that includes the participation of the private sector.

Thematic bonds have been the subject of debate because there was limited evidence of financial advantages for issuers up until the COVID19 emerging market selloff. Green bonds have been studied more since they have a larger market size than other thematic bonds. Before 2020, some issuers mentioned that green issuances had more diversified investor bases and that this could be an advantage in case of selloffs.

This paper presents case studies that evidence a more tamed reaction of green bonds when compared to their equivalents during the COVID19 selloff. The document focuses on green bonds because of their data availability, the relatively higher standardization vis-à-vis other thematic bonds, and deeper markets.

Although this is early evidence, the lessons learned can inform multilateral players, policy makers, issuers, and investors in the development of green and other thematic bond issuances and markets. Multilateral Development Banks can explore increasing their impact by helping their country clients develop their financial markets, increase the private financing available to them and potentially achieving more stable markets. Options for fostering mechanisms include supporting issuances and standardization, partially anchoring primary issuances and providing credit enhancements. Issuers can look into differentiating their issuances profiles with the usage of green proceeds and green collateral.

Sections 2-4 focus in the background of green bonds, what they are, what is theoretically expected as financial advantages from green bonds and evidence before the COVID19 selloff. Sections 5 and 6 focus on what happened after the shock for mainly three issuances from Chile, Nigeria and BNDES which have comparables. They also point at potential explanations for the observed yield behavior. Sections 7 outlines potential benefits for countries if the observed behavior during selloffs prevail and potential areas the ecosystem can add value to the development of green bonds. Section 8 presents conclusions and further research.

2. What are green bonds?

Green bonds are fixed income securities whose proceeds are used to finance new or existing green projects that address climate change or have a positive environmental impact. Although there are different types of green bonds, proceeds are either asset-linked or destined to a series of actions with an environmental impact. According to the Climate Bond Initiative green bonds can be classified into the categories outlined in Table 1.

Table 1. Types of green bonds

Type	*Proceeds raised by bond sale are*	*Debt recourse*	*Example*
"Use of Proceeds" Bond	Earmarked for green projects	Recourse to the issuer: same credit rating applies as issuer's other bonds	EIB "Climate Awareness Bond" (backed by EIB); Barclays Green Bond
"Use of Proceeds" Revenue Bond or ABS	Earmarked for or refinances green projects	Revenue streams from the issuers though fees, taxes etc. are collateral for the debt	Hawaii State (backed by fee on electricity bills of the state utilities)
Project Bond	Ring-fenced for the specific underlying green project(s)	Recourse is only to the project's assets and balance sheet	Invenergy Wind Farm (backed by Invenergy Campo Palomas wind farm)
Securitization (ABS) Bond	Refinance portfolios of green projects or proceeds are earmarked for green projects	Recourse is to a group of projects that have been grouped together (*e.g.*, solar leases or green mortgages)	Tesla Energy (backed by residential solar leases); Obvion (backed by green mortgages)
Covered Bond	Earmarked for eligible projects included in the covered pool	Recourse to the issuer and, if the issuer is unable to repay the bond, to the covered pool	Berlin Hyp green Pfandbrief; Sparebank 1 Bolligkredit green covered bond
Loan	Earmarked for eligible projects or secured on eligible assets	Full recourse to the borrower(s) in the case of unsecured loans. Recourse to the collateral in the case of secured loans but may also feature limited recourse to the borrower(s).	MEP Werke, Ivanhoe Cambridge, and Natixis Assurances (DUO), OVG
Other debt instruments	Earmarked for eligible projects		Convertible Bonds or Notes, Schuldschein, Commercial Paper, Sukuk, Debentures

Source: Climate Bond Initiative

The collateral used for these green bonds are not the green asset per se but the issuer's general assets/revenue streams. An analogy with a house mortgage can be useful to understand this. In most house mortgages, if the buyer of the house who requested the credit defaults on the loan, the lending bank will take possession of the house. That is, the bank will seek to recover its funds by claiming the collateral for which the credit was issued, in this case the house. This is a typical arrangement. Nevertheless, there could be other ways of structuring the recovery of funds in case of default. For example, the bank could request the buyer to pledge other assets or sources of income as collateral. These could be shares in a company, bond holdings, claims against future income streams, claims against retirement funds etc. In the case of green bonds, if the issuer of the bond defaults on the bond, the collateral may or may not be what was built or, bought, with the borrowed resources. Instead, there is a claim on the general assets of the borrower. This distinction is important. In more technical terms, if a green bond issuer does not collateralize its green bonds with a green asset but rather backs them up with its general creditworthiness, the risk of the green bond will be the same as any non-green bond issued by the same organization. That is, the probability of default of any bond and the loss given default will be the same for any green or non-green bond. In the case of green bonds, only a few issuances have been backed by a green asset.

In general terms a bond is formally categorized as green when it receives third-party certification on its "green" use of proceeds. The Climate Bonds Standard and Certification Scheme is a labelling scheme for bonds, loans, and other debt instruments. Rigorous scientific criteria ensure that it is consistent with the goals of the Paris Climate Agreement to limit warming to under 2 degrees.

3. **Are there expected financial advantages for issuers?**

On the supply side, policymakers and other players have been fostering the issuance of green bonds. The European Investement Bank and the World Bank issued the first green bond in 2008. The Inter-American Development Bank recently launched the Green Bond Transparency Platform, devoting important financial resources to its development. Nevertheless, without the proof that there are financial advantages for issuers (governments and companies) further fostering the development of these types of instruments is challenging.

There are several theoretical arguments that point to potential financial advantages for issuers.

On the demand side, some argue that investors -especially "impact investors"- (who choose assets not based purely on financial return but on the environmental impact of green bonds) see green or thematic bonds differently. This could give rise to price differences, perhaps a willingness to give up part of the return. For example, Fama (2007) argues that assumptions from standard asset pricing models underpinning that investments do not behave like consumption goods, meaning -no preferences of tastes are involved- are unrealistic.

Also, it could be argued that even non-impact investors at some point could simply punish dirty (or non-green) issuances and deliver a price differentiation. Hong and Kacperczyk (2009) provide evidence for the effects of social norms on markets by studying "sin" stocks—publicly traded companies involved in producing alcohol, tobacco, and gaming. They found that sin stocks are less held by norm-constrained institutions such as pension plans as compared to mutual or hedge funds and receive less coverage from analysts than do stocks of otherwise comparable characteristics. Sin stocks also have higher expected returns than otherwise comparable stocks, consistent with them being neglected by norm-constrained investors and facing greater litigation risk heightened by social norms. These characteristics of "sin" stocks or assets could be likened now to non-green or "dirty" assets.

Green bonds and in general thematic bonds are still a small percentage of the total outstanding fixed income securities. As of August 7, 2020, Green Bonds Outstanding reached USD682 billion, compared **to the** USD1 **trillion in** the total debt securities in total markets.

The demand factors combined with a still relatively small percentage of green bonds in the market could make it possible that prices for green issuances are driven higher with consequently lower yields.

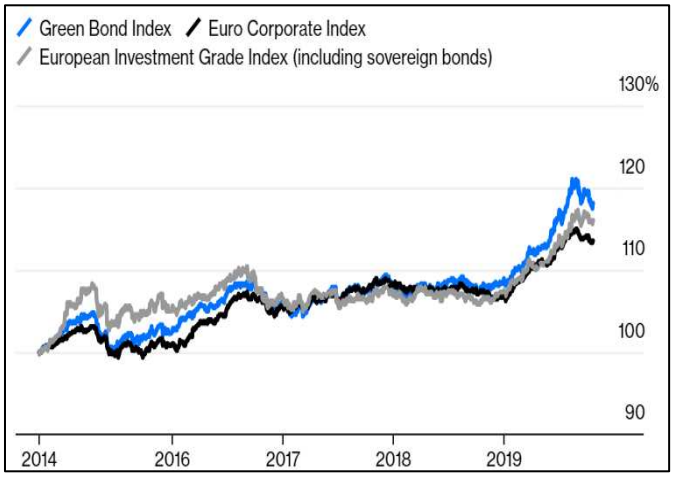
4. **What does the evidence before COVID19 say on yields about financial advantages for issuers?**

Despite the theoretical considerations expressed above, almost no financial advantage yield differentiation had been found before the COVID19 selloff. This section focuses on the markets

pre-COVID19. It uses several approaches to gauge whether green bonds pay lower yields in the secondary market.

General Bond indexes. An initial approach to test whether green bonds offer smaller yields is to look at Bond Indexes across time and compare them with their equivalents ("plain vanilla" bond indexes). Figure 1 shows the relationship between the Green Bond Index (GBI), the Euro Corporate Index (ECI), and the European Investment Grade Index (EIGI).

Figure 1. Green Bond Index vs Euro Corporate Index and European Investment Grade Index



Source: Bloomberg "Exploding demand for green bonds does not come with a premium"

One shortcoming of the comparison is the presence of corporate and government bonds in the same index which have different risk levels.

Nevertheless, despite the inclusion of different types of bonds in the indexes, there does not seem to be a clear difference for green issuances across the sample years. From 2014 to 2017 the GBI showed levels between the ECI and the EIGI. After 2017, this relationship seemed to have changed, but the EIGI and the ECI also switched positions relative to each other for some of the sample period.

To correct for biases generated by using corporate issuances in the indexes, it is useful to look at individual sovereign issuances alone even though this comes with increased challenges. Sovereign issuances have a more limited universe. In addition, comparisons among issuances ought to be as similar as possible in terms of maturity, payment schedule and financial structure.

This note examines four cases of issuances with sovereign guarantee. That is, backed by a national government. The cases were chosen based on data availability and availability of a comparable vanilla bond. The bonds compared are the green issuances by Chile, Nigeria, France, and the Brazilian development bank BNDES. As the sovereign green/thematic bond market develops more cases can be analyzed. Doing a pair comparison avoids any biases caused by issuer factors such as credit rating, country risk perception and issuance currency. Table 2 present the four bonds and their main characteristics.

Table 2. Sovereign bond pairs for comparison

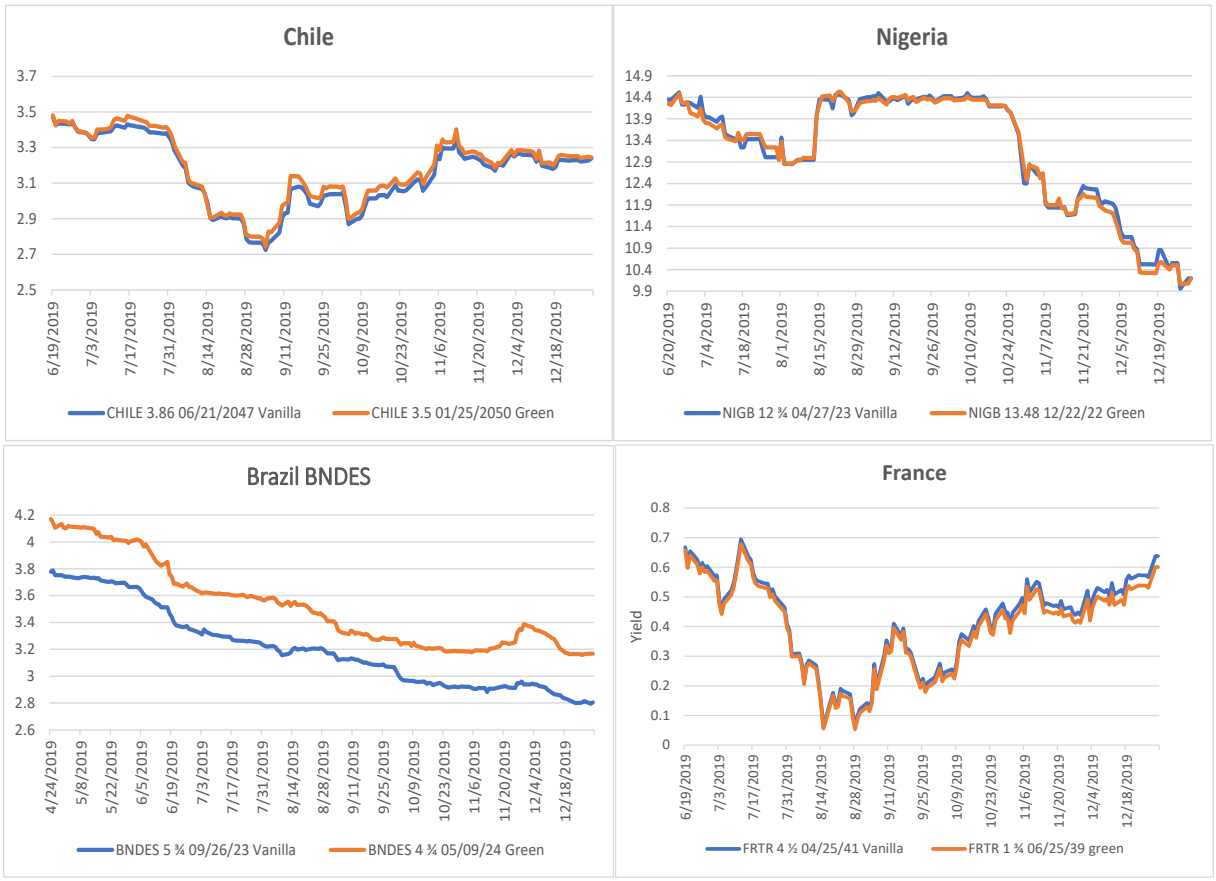
Issuing Country	Bond type	Moody's	S&P	Fitch	Currency	Amount outstanding in millions	Issuance	Maturity	Coupon
Chile	Green	A1	A+	A-	USD	2,318	6/17/2019	1/25/2050	3.50
Chile	Vanilla	N/A	A+	A-	USD	1,284	6/13/2017	6/21/2047	3.86
France	Vanilla	Aa2u	AAu	AAu	EUR	36,152	6/23/2009	4/25/2041	4.50
France	Green	Aa2u	N/A	AAu	EUR	27,375	1/24/2017	6/25/2039	1.75
Nigeria	Vanilla	N/A	N/A	N/A	NGN	834,080	4/25/2018	4/27/2023	12.75
Nigeria	Green	N/A	N/A	N/A	NGN	10,690	12/20/2017	12/22/2022	13.48
Brazil	Green	Ba2	BB-	N/A	USD	497	5/2/2017	5/9/2024	4.75
Brazil	Vanilla	Ba2	BB-	BB-u	USD	1,094	9/19/2013	9/26/2023	5.75

Source: Bloomberg

One of the most difficult tasks in choosing comparable bonds is finding instruments with similar maturities. The ideal comparison would involve two bonds issued simultaneously by the same issuer and for the same maturity. In this case, the chosen paired bonds in Table 2 all have maturities that are less than 3 years apart and are issued in the same currency. Although the issuances are not simultaneous, and in the Nigerian case there are larger differences in the outstanding amounts, the yield to maturity (YTM) can be used for comparison. As the graphics below show, the yields move in tandem. The YTM is provided by Bloomberg and brings together the price of the bond, the coupon rate and reflects the true underlying interest rate of return for the investor. The sample includes France that issues in Euros, Brazil and Chile which issue in USD dollars and Nigeria in local currency. France is included in the analysis for comparison purposes, but it did not suffer a selloff like the emerging markets.

Figure 2 shows the yield to maturity and the almost identical trends in the yield series from 2019.

Figure 2. Green Sovereign Bond yields from Chile, Nigeria, and Brazil
(Yield basis points in the vertical axis)



Source: Bloomberg

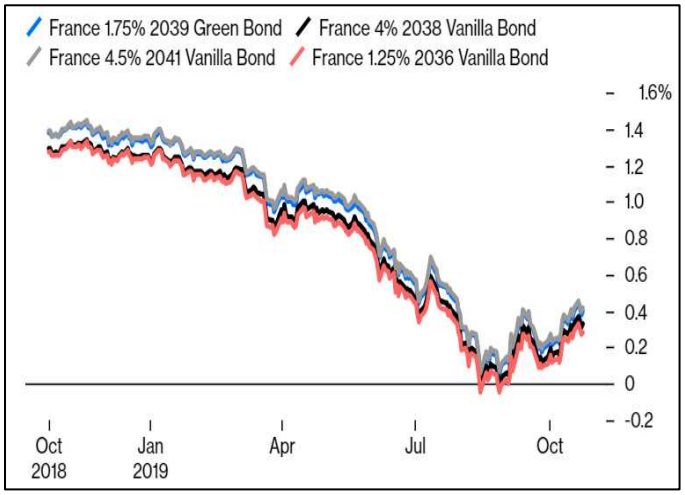
A closer analysis of the trends reveals that small differences correspond to the term premia. In the case of Chile, the vanilla bond has a shorter maturity (matures in 2047 vs the green in 2050) and thus one can expect a slightly lower yield. For Nigeria, the Vanilla bond matures in 2023, roughly 5 months after the green one and the yield can be expected to be slightly above. On the BNDES case, the green one has a longer maturity (2024 vs 2023), and its yield is correspondingly higher. Finally, for France the green bond has a maturity almost two years shorter and this premium is shows, especially in the last part of the 2019.

One evident conclusion is that there is no yield advantage for issuers of green bonds, at least in the secondary market. As mentioned above, if green issuances are not backed by a green asset but rather by the issuer's general assets of flows, the risk between green issuances and plain vanilla will be the same. On the contrary if green bonds were backed by green assets, their risk profile (less subject to regulatory risk for example) could be different.

To go beyond these conclusions, we can zoom in on the French case study (with higher liquidity) for more formal comparisons. As mentioned above, the green bond compared matures

in 2039 with 1.75% coupons. There are three other bonds potential comparables those maturing in 2036, 2038 and 2041 at coupons of 1.25%, 4% and 4.5% respectively. Figure 3 shows the comparisons. Ex-ante, the yield of the green bond could be expected to be above the 2036 and 2038 vanilla bonds given its longer maturity (2039). Similarly, it can be expected to be below the plain vanilla bond maturing in 2041. Figure 3 shows similar trends for all four bonds, which would be expected for the same issuer. With respect to the levels, the term premia seem to account for the differences.

Figure 3.



Source: Bloomberg "Exploding demand for green bonds does not come with a premium"

Further analysis of the distribution moments, the mean, standard deviation, kurtosis, and skewedness confirms the lack of yield financial advantage for the green bond. Table 3 presents different metrics using the 2039 green bond and the 2041 vanilla bond yields.

Table 3. Comparison between the green vanilla 2039 and the 2041 vanilla bond

Measure	GREEN2039	VANILLA2041	Difference
Mean	0.74	0.76	0.02
Median	0.63	0.65	0.02
Maximum	1.39	1.40	0.01
Minimum	0.05	0.06	0.01
Std. Dev.	0.40	0.40	0.00
Skewness	0.07	0.06	-0.02
Kurtosis	1.57	1.57	0.01
Jarque-Bera	22.67	22.31	-0.35
Probability	0.00	0.00	0.00
Observations	262.00	262	0.00

Test for Equality of Means Between Series
Sample: 12/20/2018 12/18/2019
Included observations: 260

Method	df	Value	Probability
t-test	518	-0.465311	0.6419
Satterthwaite-Welch t-test*	517.9913	-0.465311	0.6419
Anova F-test	(1, 518)	0.216514	0.6419
Welch F-test*	(1, 517.991)	0.216514	0.6419

*Test allows for unequal cell variances

The behavior of the distribution between both series appears to be almost the same. The differences in standard deviation, skewness, and kurtosis between the green 2039 bond and the 2041 vanilla are almost negligible. In terms of the mean levels, the term premium of the vanilla bond should render a greater mean for the 2041 issuance and that is what we observe. This means that the vanilla bond had yielded .76% for holders while the green one has yielded .74% (a .02% extra for the extra 2 years in maturity). The bottom of Table 3 also shows that the mean difference is not statistically significant. This means that aside from the premium for a longer maturity the green bond does not seem to offer a different yield than its comparable.

A deeper analysis of the trends further confirms the almost identical behavior among the French green yield and its equivalents. It is important to notice that the series' means are not constant across time, but they may have a cointegrating relationship. To assess cointegration table 4 first shows the results of the Augmented Dickey-Fuller (ADF) test for unit roots of each series. Both, are integrated of order one, I(1). That is, the series do not have a stable mean and only taking their first differences provides a stable value. Table 5 shows the ADF unit root test of the errors from the cointegrating equation of the two-yield series with a deterministic trend. The test shows that the error series is stationary. This further reinforces the findings above that the yields from the green bond and its comparable are not distinct beyond the expected term premium.

Table 4. Unit-root tests for the yield variables

Variable	ADF test statistic[2]	t-Statistic at @5% level	Probability
GREEN2039	-1.303043	-2.872499	0.6287
VANILLA2041	-1.320712	-2.872499	0.6204
D(VANILLA2041)	-16.90343	-2.872542	0.0000
D(GREEN2039)	-16.95297	-2.872542	0.0000

Table 5. ADF test on the cointegrating equation green2039 and vanilla2041

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.490684	0.0090
Test critical values:	1% level	-3.455289	
	5% level	-2.872413	
	10% level	-2.572638	

*MacKinnon (1996) one-sided p-values.

What about causality? Figure 4 shows the it cannot be rejected that both series cause each other.

Figure 4.

Null Hypothesis:	Obs	F-Statistic	Prob.
VANILLA2041 does not Granger Cause GREEN2039	255	0.61815	0.6861
GREEN2039 does not Granger Cause VANILLA2041		0.61008	0.6923

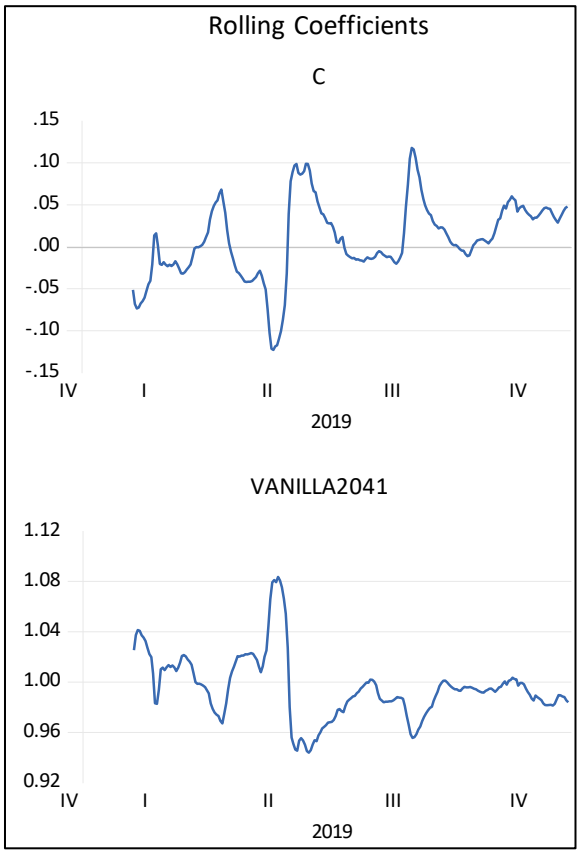
Although error correction mechanisms techniques can be used, one simple way to analyze the stability of the relationship between the yields consists of running a regression with varying sample sizes across time and observing the relative stability of the coefficient. Figure 4a presents the result of the simple OLS linear regression for the yields in levels as well as the rolling coefficients. The 2039 yield is the dependent variable since it was issued on January 24th, 2017 and the one maturing in 2041 was issued in June 2009. The coefficient that links the two bonds fluctuates around 1 and within a range of .96 and 1.08 during the entire sample. The results do not support the view that there is a financial advantage.

[2] The ADF test was conducted including an intercept.

Figure 4a. Simple regression and rolling coefficients across time for Green Bond Yields[3]

Constant (C)	0.0153***
	(.0008)
Vanilla2041 yield	.9813***
	(.0009)
Trend	.0001***
	(6.68E-06)
R-squared	.999
No. observations	260

Standard errors are reported in parentheses. *, **, *** indicates significance at the 90%, 95%, and 99% level, respectively.



All in all, and as suspected, there is no formal evidence of financial advantage in the secondary market for the French green emission.

This is consistent with other studies that reach the same conclusions. Larcker (2019) studied whether investors were willing to trade-off wealth for societal benefits in US municipal securities markets and found no evidence of "greenium". The research compared green securities to nearly identical securities issued for non-green purposes by the same issuers on the same day. With this, many

[3] This simple OLS includes T, a deterministic linearly increasing trend variable. The errors were tested for unit roots and are stationary on levels.

sources of potential variations among green and non-green assets such as term-premia, risk-premia, issuance timing, etc. are eliminated. The research found economically identical pricing for green and non-green issues. The paper goes on to argue that "in contrast to a number of recent theoretical and experimental studies, we find that in real market settings investors appear entirely unwilling to forgo wealth to invest in environmentally sustainable projects. When risk and payoffs are held constant, municipal investors view green and non-green securities by the same issuer as almost exact substitutes. Thus, the "greenium" is essentially zero."

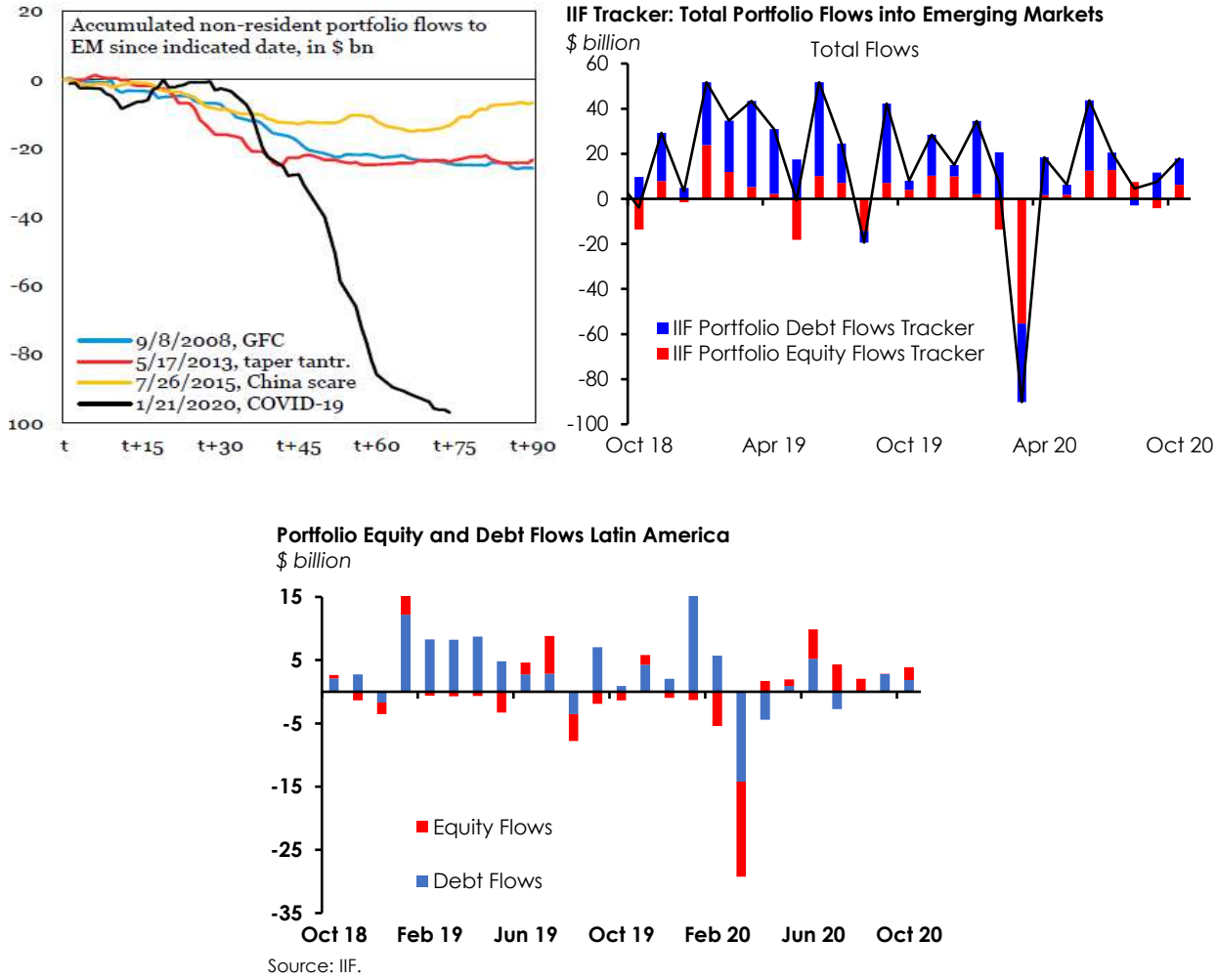
The is also consistent with anecdotal evidence from issuers. Conversations with the issuers of green bonds by NAFIN and FIRA in Mexico as well as investors from Bank of America, Trend Capital Management and Mellon Investment Corporation point not only to little initial knowledge about green issuances from traditional investors but an aggressive search for yield. NAFIN noted traditional investors initially expected higher returns from green issuances given that it was a new type of asset.

5. What was the effect of the COVID-19 shock?

The COVID-19 shock resulted in a pronounced sudden stop in capital flows to emerging markets (EMs). EMs experienced record portfolio outflows that dwarfed any other crises. Figure 5 shows the cumulative nonresident portfolio investment outflows from emerging markets (left panel) and the monthly portfolio flows broken down by equity and debt (right panel)[4]. A substantial drop in oil prices at the onset of the pandemic resulted in an additional outflow of ~USD83 bn in March alone.

[4] The data source is the IFF portfolio tracker. The historical Tracker estimates are based on country-level portfolio flows data covering 12 countries for debt flows and 14 countries for equity flows. These are the countries that provide timely data on portfolio flows on at least a monthly frequency. Together, these countries typically account for 71% of all portfolio debt flows and 64% of all portfolio equity flows for the IIF EM 25 countries.

Figure 5. Portfolio outflows from emerging markets



Source: IIF.

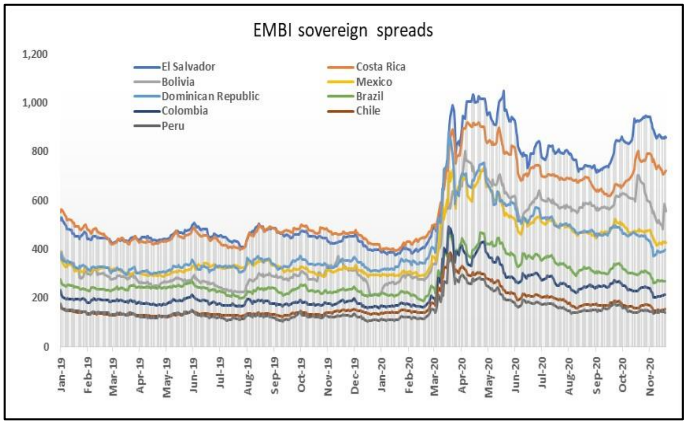
As the right panel graph shows, equity flows are an important part of monthly total flows, nevertheless the selloff in debt instruments was larger in March and accounted for around USD60bn. For Latin America (lower panel) the six-month trend of positive flows in debt instruments suddenly reversed and strong outflows took place in March and April[5].

Outflows from debt instruments are associated with price drops in the bond prices and corresponding increases in bond yields, which is what was observed in the emerging markets. For example, Figure 6 shows the sovereign spreads of nine Latin American countries during the pandemic. Argentina and Ecuador are excluded given their heightened risk profiles.

Even though in some cases the changes in spreads seem to be more short-term than others all countries felt the effect.

[5] The data source is the IFF Portfolio debe tracker.

Figure 6. Sovereign spreads in LAC countries

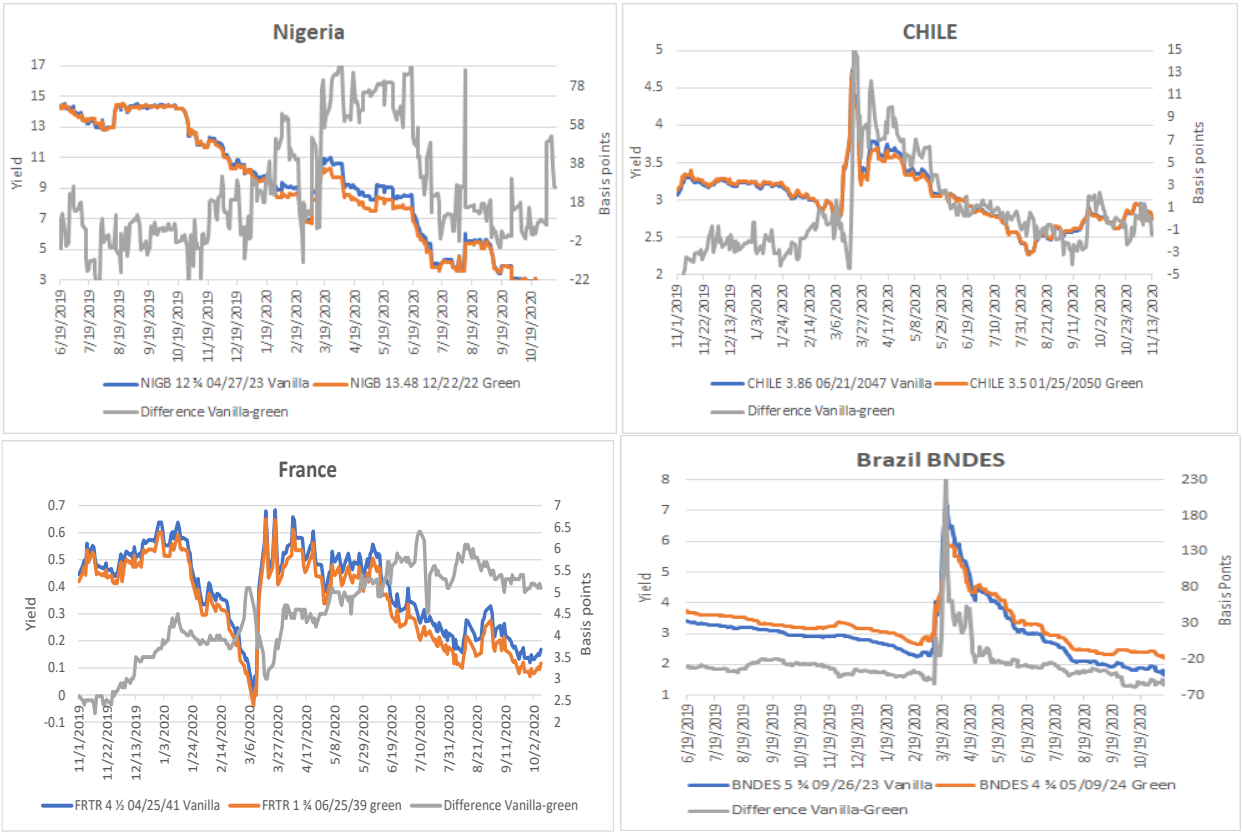


Data source: JP Morgan EMBIG index at Bloomberg.

The large magnitude of outflows was observed across fixed-debt instruments. Although data by instrument (green vs vanilla) was not available, data seem to indicate that the impact of the selloff -and perhaps the flow- was less evident for green bonds.

A look at the issuances from Chile, Nigeria and Brazil shows a differentiated behavior among the spreads of green versus plain vanilla issuances before and after the COVID19 March selloff. In the case of Chile, the basis points (bps) difference between the vanilla 2047 and the green 2050 was around -2.6 bps. With the selloff, starting the second week of March, the spread inverted and reached 15 bps. For Nigeria, the spread between the vanilla 2023 and the green 2022 was around 20 bps and during the selloff it increased to 89 bps. For BNDES, the differences reached the highest levels (6.5 bps and 230 bps) in June and November 2019, respectively. The graph below includes France because there were some effects detected although it is not an EME. It is important to notice that even though the effect in bps seems small, the yields are also very small. Figure 7 below shows the yield trajectories and differences in bps.

Figure 7. YTM and BPS differences between green and vanilla pairs.



Source: Bloomberg

For EMEs the effect of the selloff seemed to last approximately four to five months. The largest impact took place in March after the WHO declared COVID19 a pandemic on the 11th. It is important to keep in mind the changes in bps are also relative to the initial yield levels. The higher the initial YTM the higher the jumps in bps[6].

Given that lower yields imply smaller changes in bps a look at prices can provide insight into portfolio impacts. To do so, we can take the price averages of each bond pair before the selloff and compare them to their averages after the selloff. From the yield analysis we can expect that the percentage price drops would be higher for vanilla bonds. It is important to keep in mind that differences in bond duration and convexity can play a role in price responsiveness. That is why the right analysis should be carried out with yields. However, the price analysis helps us gauge portfolio impacts.

The analysis shows that even while prices, yields and bps for the sample bonds are different, green bonds dropped 1% less on average than the vanilla equivalents. Table 6 shows these results.

[6] Structural break econometric tests (e.g. CUSUM or Chow) could be used to formally assess the changes in the relationships between green and non-green yields.

Table 6. Differentiated price impacts between green and vanilla pairs.

	Vanilla			Greeen			
	Pre-shock average price (a)*	March-May average price (b)	% average price drop c = (b)/(a)-1	Pre-shock average price (d)*	March-May average price (e)	% average price drop f = (e)/(d)-1	difference vanilla-green (c)-(f)
Chile	113.5	105.1	-7.4%	106.7	100.0	-6.3%	-1.1%
France	184.2	179.0	-2.8%	126.0	123.3	-2.2%	-0.7%
Nigeria*	111.6	108.5	-2.8%	113.2	111.2	-1.8%	-1.0%
Brazil	110.2	102.9	-6.6%	106.2	100.3	-5.5%	-1.1%

*Averages from 06/19 to 03/20, except for Nigeria from 01/20 to 03/20 due to a strong trend in the series

The first row shows that the average price of green bonds for Chile dropped 1.1% less than the prices for green bonds after the selloff. Column (a) shows that the average vanilla bond price was USD113.5 from June 2019 to March 2020, the "pre-shock" average price. For the period of March to May 2020 that average price level dropped to USD105.1, which is shown in column (b). This implies a drop of 7.4%, shown in column (c). For the green bond, the equivalent drop was 6.3% (column f). That is, a drop from an average pre-shock price of USD106.7 (column d) to USD100.

The same larger drop is observed for the rest of the vanilla equivalents. The green bonds from Nigeria and BNDES dropped 1% and 1.1% respectively less than their vanilla equivalents. In the case of Nigeria, the series presents a marked downward trend (and corresponding upward trend in prices) from June 2019 to January 2020. Therefore, the pre-shock average only considers the period from January to March.

It is important to note that while initial prices and yields were at different levels for each pair, green bond prices dropped 1% less on average.

Some context is required to determine how meaningful a 1% smaller price shock is. There are several ways to analyzing this. Since the primary purpose of green bonds is to fund green projects, the first is to consider the impact on issuers. The second is the impact on investors whose portfolio drops in value.

One of the first impacts that a price drop has for issuers is a higher cost of funding and corresponding dollar (or currency) figures. Considering that green issuers are sovereign in nature, it is reasonable to assume that debt is constantly being issued and rolled over. This is especially the case during selloff times. Countries facing liquidity constraints during selloffs unlikely to repay debt. The corresponding higher yields are bad news for countries faced with higher liquidity needs. As noted in Figure 6 above, the effect of the March 2019 selloff lasted around 4-5 months for most countries. For some, the effect lasted longer. Nevertheless, we can estimate what it could mean for a country to fund itself issuing debt with vanilla versus green bonds.

One way to calculate the implied dollar savings of issuing green bond during the selloff is the summation of the differences in debt present value (PV) from theoretical simultaneous daily issuances of both types of bonds. This means calculating first the PV of debt issued at the higher vanilla yields for a given date (*e.g.,* March 20) and maturity (*e.g.,* 30 years). Next, calculating the same PV issued the same day at the lower green yields. In practical terms, these yields would be reflected in the bonds' coupons. Once this is estimated for a given date, we could expect that the PV of the debt with the higher yield (and hence a higher coupon) is greater. In this case, the vanilla debt is expected

to have a greater PV since it would be paying higher coupons for the entire maturity of the issuance. The difference in the PV between the vanilla and the green issuances (with lower coupons) would be the savings from issuing green. The next step is to calculate the same difference for the next day and so on. The summation of the differences during the selloff would be one approach to the estimated savings for an issuer in case it had issued and/or rolled green bonds vs vanilla ones.

The equations below illustrate the calculation described above. The present value of the vanilla bond debt can be calculated as:

$$1)\ PVv = \sum_{d=1}^{d=D} \sum_{t=1}^{t=T} \frac{CFV_{td}}{(1+r_d)^t}$$

Where:

$PVv = present\ value\ of\ vanilla\ debt$

$CFV_{td} = cash\ flow\ at\ time\ t\ from\ issuance\ date\ d$

$r_d = relevant\ discount\ rate\ on\ the\ date\ of\ issuance\ d$

To simplify the analysis, we can assume that the bonds pay an annual coupon. It is important to point out that the cashflows are equal to:

$$CFV_{td} = (1 + y_{td}) * FaceValue$$

That is, CFV_{td} is equal to the yield rate observed on the selloff date times the bond's face value. For example, if the yield observed in the market is 5% and the face value is USD100 then the coupon payments for all t will be USD5. For the last period, the cashflow includes the principal repayment of USD100 plus the final US5 coupon. The double summation is needed because during the selloff the yields y changed every day and it is assumed that debt from past issuances could be rolled out every day at the observed yields. How often the rolling takes place is important because the debt could be rolled once a month or once a week, depending on the specific country's financial programming. Similarly, the size of the debt can vary according to the financing needs.

After the described first step, the same present value is calculated for the green bond debt (the sub index g stands for green).

$$2)\ PVg = \sum_{d=D}^{d=D} \sum_{t=1}^{t=T} \frac{CFG_{td}}{(1+r_d)^t}$$

Finally, the savings is the difference in both total PVs[7].

[7] The calculation above is a rough approximation to the area between the present value curves for the selloff period. Put differently, it would be the difference in the areas under each PV curve.

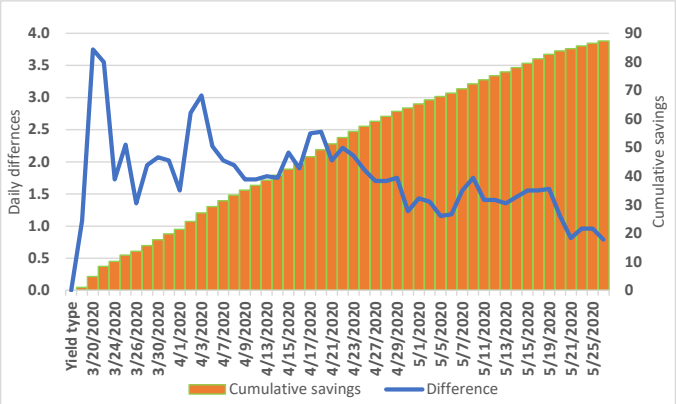
$$Savings = \int_{t=1}^{t} PVg(t) - \int_{t=1}^{t} PVv(t)$$

$$3)\ Savings = \sum_{d=D}^{d=D} \sum_{t=1}^{t=T} \frac{CFV_{td}}{(1+r_d)^t} - \sum_{d=D}^{d=D} \sum_{t=1}^{t=T} \frac{CFG_{td}}{(1+r_d)^t}$$

The choice of r_d is also important since it is the cash flow's discount rate. A relevant rate should be chosen, that is, for example a rate in the same currency as the bond issued and with the same maturity. The same discount rate on date *d* applies for both bonds.

In the case of Chile, this calculation yields a savings of USD86 million in 49 days, from March 19 to May 26. This considers the same period as the post-shock dates of Table 6. Figure 8 presents the aggregate numbers in USD million as well as the daily figures. It assumes debt rollovers of USD300 million per day and uses the US treasury constant 30-year bond rate as a discount.

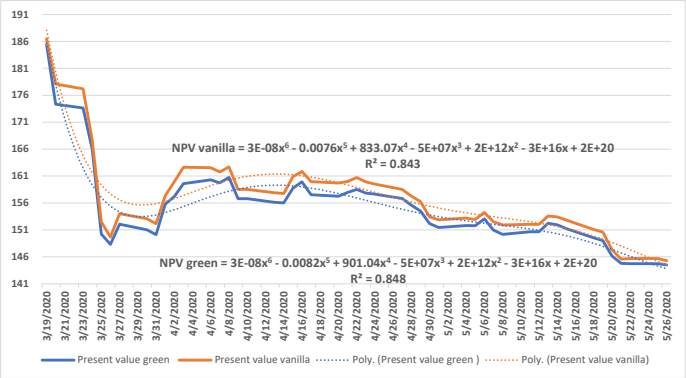
Figure 8. Daily illustrative differences and cumulative savings from USD300 million rollover in USD Million



The 1.1% difference in yields implies NPV savings of USD86 million in a short period of time, yet the magnitude of the savings depends on the length of the shock and the financing needs of the country. Figure 9 presents the NPV curves of the same exercise of USD300milllion daily debt rollover at 30 years with coupons equal to the observed yields[8].

[8] A more precise approximation to the area under the curve can be calculated by carrying out a polynomial approximation to each curve. By being continuous functions, the polynomials can be integrated to estimate the difference in areas under the curve. The graph shows a simple polynomial approximation of degree six. Nevertheless, further exploration by OLS yields equations of degree 10 for both curves. The corresponding equations are: $PVg = 184.2 - 6.50 * t^2 + 1.89889649617 * t^3 - 0.24 * t^4 + 0.01 * t^5 - 0.0007 * t^6 + 2.1e-05 * t^7 - 3.5e-07 * t^8 + 3.2e-09 * t^9 - 1.2e-11 * t^{10}$ and $PVv = 87. - 6.7 * t^2 + 1.9 * t^3 - 0.2 * t^4 + 0.01 * t^2 - 0.0008 * t^2 + 2.2e-05 * t^2 - 3.7e-07 * T\text{^}8 + 3.4e-09 * t^9 - 1.3e-11 * t^{10}$ respectively.

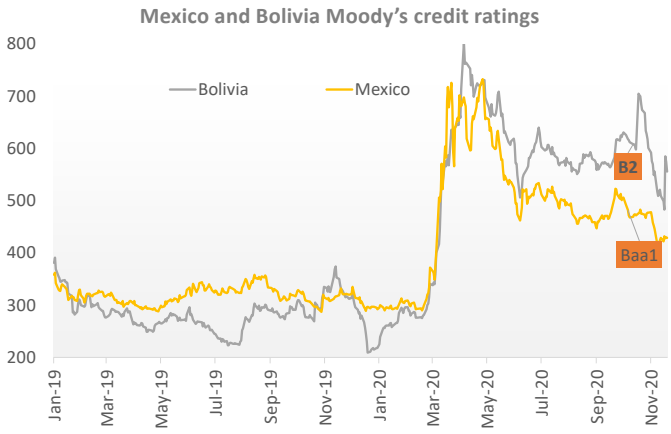
Figure 9. Illustrative example of Chilean NPV green vs vanilla debt
Daily rollover of USD300M in USD Million



Another way of assessing the relative magnitude of the difference between green and vanilla bonds is to compare basis-point changes to credit ratings. From Figure 6 above, it is clear that yield changes as measured by the EMBIG are not uniform. For example, the highest jump in yields corresponds to El Salvador, the country with the lowest credit rating in the sample. Similarly, Chile and Peru, the countries with the highest ratings experienced the smallest yield changes. Even though credit ratings are not the only factors in a selloff, they have an important impact.

Despite Mexico and Bolivia having different credit ratings (a seven-notch difference) in pre-pandemic times their yields were not too far apart. In fact, as Figure 10 shows, even though in February the EMBIG index from Bolivia was around the same level as Mexico, Bolivia had a lower spread during most of 2019. This was despite the important difference in credit ratings.

Figure 10. Impact comparison and credit ratings



Moody's		S&P		Fitch		Remarks
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term	
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime
Aa1		AA+		AA+		High grade
Aa2		AA		AA		
Aa3		AA-		AA-		
A1		A+	A-1	A+	F1	Upper medium grade
A2		A		A		
A3	P-2	A-	A-2	A-	F2	
Baa1		BBB+		BBB+		
Baa2	P-3	BBB	A-3	BBB	F3	Lower medium grade
Baa3		BBB-		BBB-		
Ba1	Not prime	BB+	B	BB+	B	Non-investment grade speculative
Ba2		BB		BB		
Ba3		BB-		BB-		
B1		B+		B+		
B2		B		B		Highly speculative
B3		B-		B-		
Caa1		CCC+	C	CCC	C	Substantial risks
Caa2		CCC				Extremely speculative
Caa3		CCC-				In default with little prospect for recovery
Ca		CC				
		C				

However, when the COVID-19 shock hit, the increase in yields was higher for Bolivia, widening by around 119bps, suggesting the market had differentiated between risk ratings.

Although it is not possible to map a certain rating level to a basis points response (at least in the scope of this document), we could divide the 119 basis points by the number of notches (119/7)=17. That is, for every credit rating difference, the response in bps was 17 basis points.

If we draw an analogy, the smaller yield responses from higher-rated countries (vs lower-rated ones) could be compared to the lesser yield responses from green bonds (vs vanilla ones). *That is, green bonds seem to react as if they were rated higher, even though they are not.* As mentioned before, with the selloff the green-vanilla spread difference reached 15 bps for Chile (from -2.6). If it could be directly comparable, a 15bps difference could mean in this case a one-notch difference in rating. For Nigeria, the spread between the vanilla 2023 and the green 2022 was around 20 bps and during the selloff it increased to 89 bps. The simple extrapolation again would mean something around four credit rating notches. For BNDES, the differences reached the highest levels (6.5 bps and 230 bps) seen in the November 2019 and June 2019, respectively. The 230 bps in the simple extrapolation would correspond to more than a 10-notch difference. Follow-up research is needed to calculate the relationship between credit ratings and yield responses in bps and other factors.

6. Potential explanations why green bonds are more resilient.

There are several potential reasons as to why the yields of green bonds behaved differently. Green bonds in general are still a small percentage of the bond market. Therefore, when large institutional investors face a selloff, it is possible that they liquidate large sections of their vanilla portfolio first. Similarly, the deeper vanilla bond markets may result in more liquidity ratios for vanilla vs green bonds. Vanilla bonds are also usually the target of Central Banks' main interventions[9] as opposed to smaller market instruments. Finally, green bonds may have wider and more stable investor bases composed of more specialized institutions with impact mandates. This could result in green investors holding their instruments longer than those investors with no green mandates. The differences in green yield behavior could also be the consequence of a combination of several of these factors. For example, green holders may be less inclined to trade their positions if they are constrained by a mandate to hold green instruments in a small and less liquid market. Simply put, in addition to having longer-term inclinations they may have less instruments to choose from.

The reasons cited above are all worthy of their own research, nevertheless the following paragraphs will only focus on the investor base due to data availability. Future research can tackle more question as data becomes available and markets widen.

Data on bond holder composition are not widely available. Bloomberg databases cover some of the issuances and provide useful breakdowns, but they are often incomplete, not reaching more than 20-30% of the issuances' amount. One of the reasons for this is that there is no centralized reporting database for bonds that are exchanged in different platforms and countries.

[9] Green bonds can also be the direct or indirect target of investment regulations. For example, on November 2020 the US Department of Labor ruled that starting January 12, 2021, plan investments for employee benefits could only take into account financial and not ESG considerations.

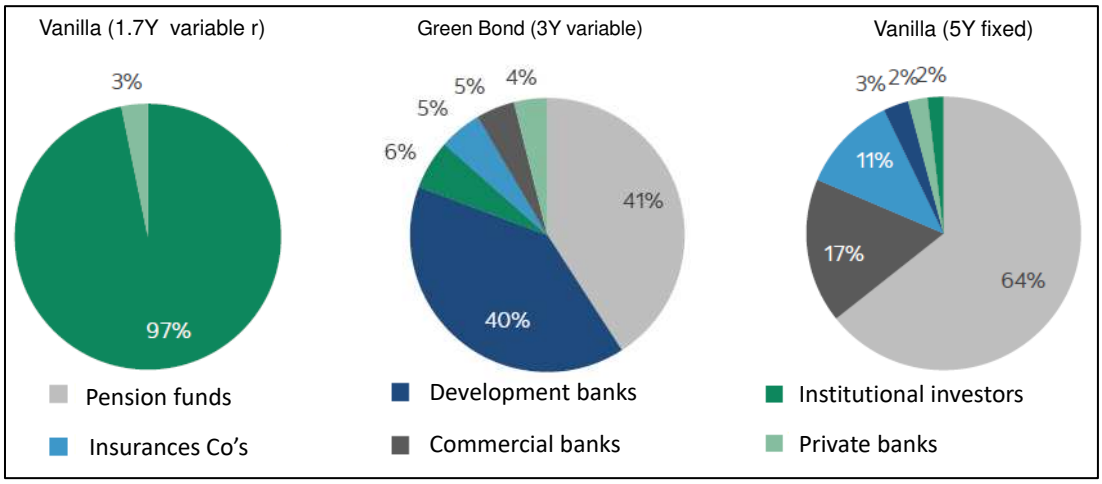
Nevertheless, testimonies from issuers and data from FIRA[10] in Mexico point to a larger green investor base for their issuances as compared to those of vanilla issuances. Considering that the Mexican domestic market size is relatively small, having access to a wider investor base can make an important difference. In fact, Andritzky (2012) found a strong and robust association between lower yields and larger shares of non-resident holdings.

It is useful to think about the extreme case of just one large holder to assess the potential risk implications for an issuance. If only one holder owned the entire issuance (or a large proportion) a decision to trade the position would have disproportionate large effects on the price of that security. In the case of a selloff, large swings in price and yield would be observed. The one holder effect would also impact the liquidity of the instrument. If the holder decided to keep the issuance for a long time, the trading volume of the issue and its liquidity would be low. It is not far-fetched then to think that in the opposite case -when there are multiple holders and especially with different mandates- the contrary would happen. A panic selloff would be less likely as the difference in mandates widens with respect to holding decisions. This could well be the case with green bonds. If all investors have profitability mandates but some also have impact mandates, we can expect dissimilar behaviors.

The issuance of FIRA in June 2019 is illustrative; it simultaneously issued one green bond and two plain vanillas and faced wide differences in their holders' composition. Figure 11 presents the holding shares of its green bond in the center and the vanillas on the sides. These bonds were issued in the local market in Mexican pesos. The combined size of the issuances was MXN10,000M (~USD434M). The 1.7Y issuance was for MXN1,500M (~USD75M). The 3Y green for MNX3,000M (~USD150M) and the 5Y for MXN5,500 M (~USD225M). The issuance was 2.41X oversubscribed. As the figure shows, one type of holder owned 97% of the 1.7Y vanilla issuance. For the 5-year bond, another type of holder had 64% share. The green bond, while still facing large concentrations had the widest investor base and more diversified ownership. These concentrations matter more the smaller the market (since this issuance was carried out locally, the market was constrained to fewer participants).

[10] Trust Funds for Rural Development (FIRA) is a second-tier development bank that offers credit and guarantees, training, technical assistance and technology-transfer support to the agriculture, livestock, fishing, forestry, and agribusiness sectors in Mexico.

Figure 11. Holders' share in the June 2019 issuances.



Source: FIRA.

Note: Development banks refer to domestic institutions, do not consider any Multilateral Development Bank.

The Herfindahl-Hirschman Index (HHI) is a commonly accepted measure of market concentration and a useful metric to assess it in this case. The index is calculated as the sum of the shares squared. It ranges from zero (when there are many firms with similar share sizes) to 10,000 points if there is only one firm. The index increases both as the number of firms decreases and as the disparity in size between them also does it. For context, the HHI is used for antitrust cases. The US department of justice establishes thresholds and takes actions based on changes to the index[11]:

"The agencies generally consider markets in which the HHI is between 1,500 and 2,500 points to be moderately concentrated and consider markets in which the HHI is in excess of 2,500 points to be highly concentrated. See U.S. Department of Justice & FTC, Horizontal Merger Guidelines § 5.3 (2010). Transactions that increase the HHI by more than 200 points in highly concentrated markets are presumed likely to enhance market power under the Horizontal Merger Guidelines issued by the Department of Justice and the Federal Trade Commission."

The HHI is calculated as follows:

$$HHI = \sum_{i=1}^{N} S_i^2$$

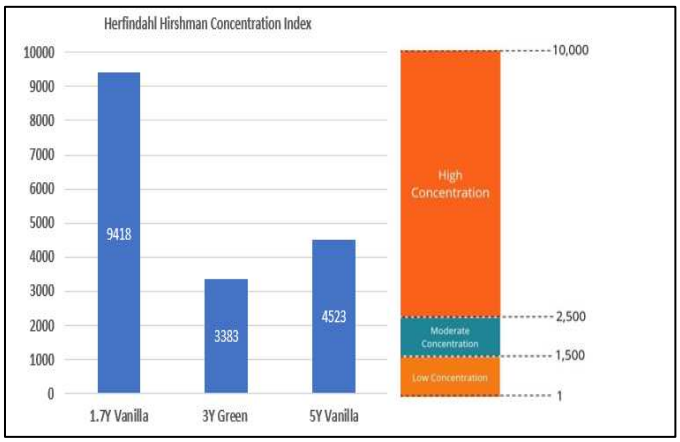
where S_i^2 is the square of the market share of firm i in the market, and N is the number of firms. Thus, for example, in a market with two firms each having 50 percent market share, the HHI equals $50^2 + 50^2 = 5000$. This number is indicative of a highly concentrated duopoly.

When we estimate the HHI using the concentration by type of institution the result is high concentration for all bonds but especially higher for the vanilla issuances. There is a caveat, the thresholds mentioned above apply for companies but may be different for bond holding concentrations. Figure 12 shows the concentration for the three bonds by FIRA ante the illustrative

[11] See: https://www.justice.gov/atr/herfindahl-hirschman-index

USD department thresholds[12]. It stands out that the bond with the highest, almost maximum concentration level is the 1.7-year vanilla bond. For the 5-year issuance, the concentration is almost half of the 1.7-year vanilla bond but still well above the 3-year green bond. That means that even if we only compared the 5-year vanilla to the green one, the concentration differences would still be way higher for the 5-year vanilla. It is nevertheless important to consider the holding incentives for each institution (*e.g.* why local development banks hold a large portion of the green bond).

Figure 12. HHI Index for FIRA issuances.



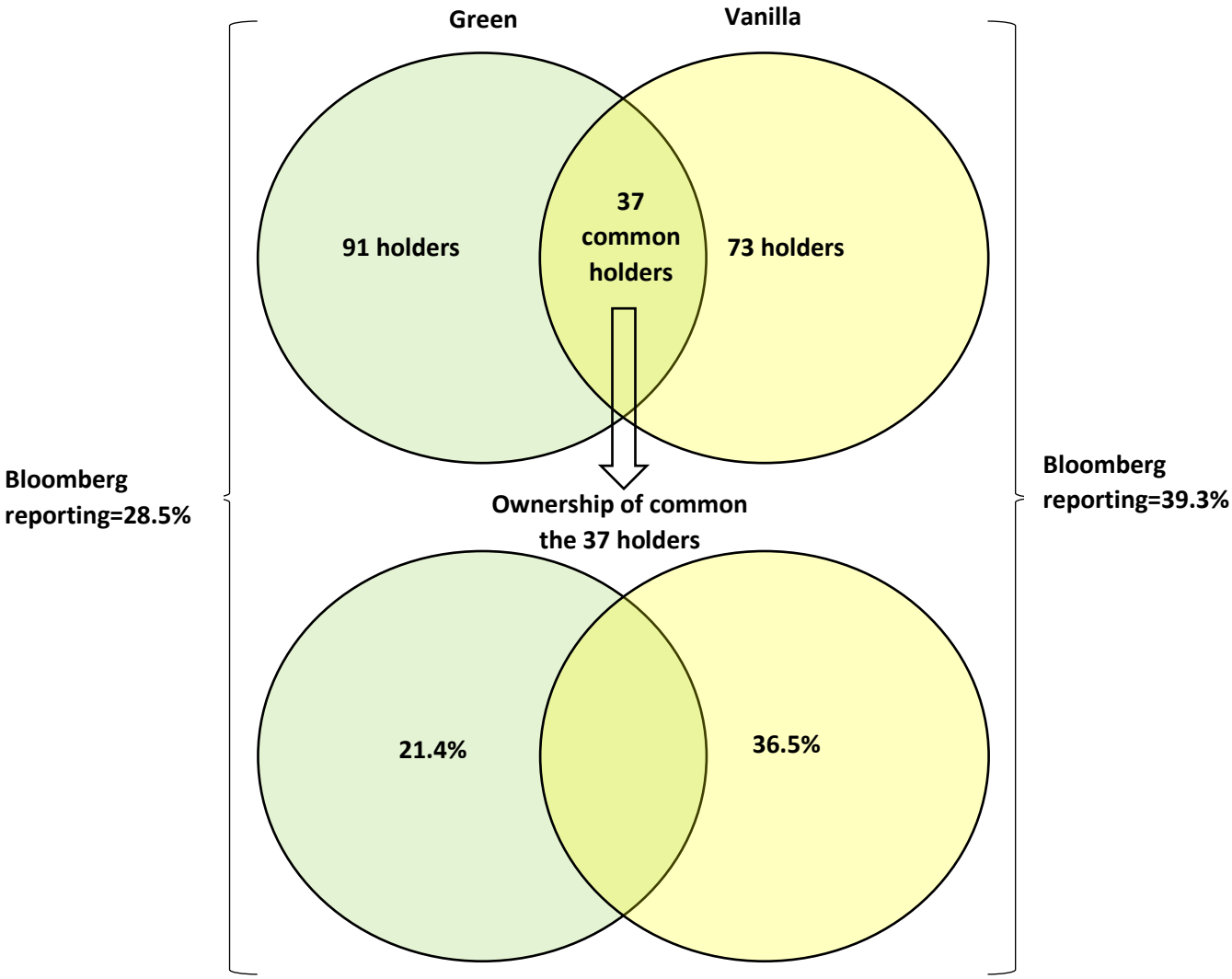
Limited data on the Chilean Bond ownership also points at a similar higher concentration case for vanilla bonds. As mentioned above, the Bloomberg databases provide some information on bond ownership. For the issuances analyzed in this document -the Chilean USD Vanilla Bond and its green comparable- data from July 23, 2020 reveals a list of owner institutions that reach almost 40% and 29% respectively. Even though there is a large share reporting gaps, an analysis of the existing information shows information about important stakeholders. For example, BlackRock Inc appears in the existing list for both issuances as one of the top holders. It owned 5.3% of the vanilla and 5.6% of the green. The Vanguard Group is also on the list. It owned 2.6% of the vanilla issuance and 2.4% of the green one.

Even though data on holders' share is incomplete, the available numbers show that a larger number of institutions hold a smaller percentage of the green bond -less concentration-. Figure 13 shows a summary of the holding data. A random sample from July 23, 2020 shows that 28.5% of the ownership of the Chilean 2050 green bond was reported on Bloomberg and belonged to 91 institutions. As for the Vanilla bond, 39.3% was reported and belonged to 73 holders. That is, at least from the available information, the vanilla bond had less investors holding a larger amount of the outstanding issuance. Although these results are not entirely conclusive because there are still large shares unaccounted for, it can be indicative. Investing institutions incorporate risk considerations when holding issuances. Many investors have restricting limitations as to how much of an issuance they can hold. Some institutions limit themselves to 20% of the issuance to limit issue and counterparty

[12] Future avenues of research can investigate typical issuance concentrations vs green bonds. A green yield curve could also be estimated to compare yields and concentrations across terms.

exposure. This fact becomes more relevant in a foreign currency issuance such as the one from Chile. A local currency issuance may face fewer potential buyers whereas a foreign currency one can face a larger addressable holder market with more specific limits. Further research could assess how the holding behavior evolved during the entire pandemic shock and how different holders behave (domestic vs foreign).

Figure 13. Holders and shares of the Chilean Vanilla 2047 and Green 2050 bond as reported on Bloomberg for July 23, 2020.



7. Issues for discussion and further research

There is strong global interest for a green recovery. Institutions and governments across the world have for some time shown strong interest in building back "better". Interest spans from investors to Central Banks. The last quarter of 2020, the European Central Bank (ECB) President Christine

Lagarde suggested that the ECB was going to consider favoring green corporate bonds in its asset purchase operations. This entails moving away from its current "market neutrality" principle. It could also help to offset the underpricing of climate risk by financial markets. Interventions by the ECB could provide higher liquidity not only in green bonds but on ESG ones despite their early stages of development, in particular for government bonds. Lagarde mentioned that climate change should be "mission critical" and this was included in the ECB strategic review agenda for 2021. Similarly, at the United Nations General Assembly on September 22, 2020, the president of China, Xi Jinping announced that China would aim at becoming "carbon neutral" by 2060. On the western side, the US re-enter the Paris Agreement and has been working on a plan "centered around a goal of setting the U.S. on the path to be a net-zero emitter by 2050.[13]".

Green and thematic bonds can be seen as practical government commitments toward green goals and as behavior-changing instruments. Even though the issuance cost of green bonds is not substantially greater that a plain vanilla one, it is still more expensive. It involves the certification process and the costs associated. These costs tend to be less than USD50,000 dollars[14] which are almost negligible as a percent of issuance amounts. Nevertheless, the real cost of a green bond does not lie in the certification process. The cost of governance, follow-up activities and reporting involve operational changes. These costs may or may not be quantified properly but the involve administrative processes, supervision, monitoring, reporting etc.

Nevertheless, the development of sovereign guaranteed green bonds is still in its infancy. As of the end of 2020 Chile had been the only sovereign in Latin America that had carried out a green bond issuance. Colombia issued the second sovereign green bond in LAC in September 2021. Despite interest from Emerging Market economies in Latin America and elsewhere, issuances are yet to take off. In a context of increased need for financing from green needs, COVID19 recovery and shrinking fiscal space new instruments are called for. Central Banks (CBs), Ministries of Finance (MOFs) and Multilateral Development Banks (MDBs) could follow the thematic bonds market closely and foster their development. MDBs actions prove crucial. In fact, it was two MDBs, the World Bank and the ECB that created the green bond market by issuing the first one 2008.

If broader investor bases and smaller reactivity in green bond persist as the market develops issuing Emerging Economies can benefit significantly. It is not possible to know now if the lower impacts in green bonds will be a temporary or a constant phenomenon. That is, it is possible that as the green bond market becomes closer to the vanilla one in size, the differentiated selloff behavior disappears. Nevertheless, it is also possible that even if both markets were the same size, investors would differentiate between green and vanilla. In fact, Cevik and Jalles 2020 found that climate change increased sovereign risk in government bond yields and spreads. That is, climate vulnerability has a highly significant effect on the cost of government borrowing, even after controlling for conventional macroeconomic and institutional determinants of sovereign risk. In the latter case, green bonds could either be held for longer, or start showing a greenium. In either case, the current evidence points at least at a temporary advantage for issuers. This may last a few years, but the development impact brought about by green bonds could last for longer. Similarly, if green bonds are

[13] See: https://www.etftrends.com/tactical-allocation-channel/what-does-a-biden-administration-mean-for-u-s-green-bonds/

[14] Source: Cicero.

collateralized by green government assets, their risk profile can certainly change. Although the risk of a bond with green vis-à-vis general collateral would have to be assessed, green assets such as solar and wind power will be less exposed to regulatory risk.

A) Potential benefits for issuers:

I. Attraction of new types of investors

To attract investors for their issuances, countries must compete with other issuers. To do so, they can offer either better yields, lower risk, or some sort of differentiation. Nevertheless, for a country that is considered riskier than others, attracting capital based only on higher yields may be neither feasible nor desirable. Most countries in LAC, -in particular in the years to come- will face higher levels of indebtedness in the aftermath of the COVID crisis. Higher yields on top of existing debt means higher balance sheet risks and insolvency potential. Therefore, on the differentiation front, countries can offer geographical diversification. Nevertheless, as globalization increases, higher economic and financial integration decreases the positive effects of such diversification. A second means of differentiation is via offering green or other thematic bonds. For example, issuing green bonds caters to investors with climate mandates that would not otherwise set their eyes on certain countries, in particular smaller ones. Interviews with green issuers in Mexico and Chile can attest to this differentiation. Despite being countries with important market access, both issuers encountered new types of investors when they issued green bonds. Green differentiation attraction can open the doors for new and longer-lasting relationships with first-time foreign investors for certain locations. Even within the same types of institutions studies reveal that as new generations of investors come to age, they care more about the social responsibility of their investments. Millennial investors (52%) care more about these as investment criteria compared with less than 30 percent of WWII-era investors and 42 percent of Gen X investors[15].

II. Greater access to capital/tenor -market development-

If a greater pool of new types of investors is available, countries can also face a wider selection of tastes and choices. This allows issuers, in particular small ones to develop their markets by lengthening the curves of their issuances and helping the private sector in following suit. As government yield curves materialize, they become benchmarks to price new green private issuances.

III. Catalytic Mobilization of private capital

Sovereign green issuances can trigger further investment by the private sector, not only from investment participation as co-financiers but with new investments. Depending on the levels of country development, green investments may heavily involve new technologies, networks and systems. For example, solar, wind, electric vehicles (EV), EV charging stations, low-emission buses and other. Private sector investments in energy provision with these types of technologies have become commonplace. Therefore, it is possible to encounter co-financing arrangements for utilities. Similarly, as technology develops further, it is expected that smaller systems become available for electricity production, shifting the burden from public sector provisioning of these services to the

[15] See Millennial and Generation X Investors: Attracting the Next Generations of Wealth (2018) by Spectrem Group.

private sector. In these cases, small network investments financed with sovereign green bonds can trigger larger investments in new technology from the private sector and private users.

IV. Smaller need for central bank forex intervention

Most central banks monitor exchange rates and intervene to restore liquidity or prevent excessive swings in cases of serious capital flights and sudden stops. This happens continuously for countries with fixed exchange rates but also for those with flexible regimes and international reserves. If green issuances prove to be even slightly more stable than vanilla ones during selloff times, countries could experience smaller selloffs and consequently a reduced need for central bank interventions. This can bring with it smaller needs for international reserves and their associated carrying costs.

V. Tempering of sudden stops and capital flights

If indeed green bonds prove to be more resilient to shocks overtime, countries could possibly face more tempered outflows and lower yields if they issue green bonds instead of vanilla ones. Besides the potential effect of a diversified investor base yielding smaller reactions during selloffs, there are other ways countries may benefit. The first is that as climate change materializes, its true costs can incrementally reveal themselves and be born more heavily by those with less climate resilience. That is, the debt (and underlying assets) of countries with less adaptation and mitigation financing could eventually be considered fundamentally riskier than others. At an asset level, Bernstein, Gustafson, and Lewis (2019) found that real estate exposed to the physical risk of sea level rise sell at a discount relative to otherwise similar unexposed properties. At a macro level, as mentioned Cevik and Tovar Jalles (2020) found that vulnerability and resilience to climate change have a significant impact on the cost government borrowing, after controlling for conventional determinants of sovereign risk. The magnitude and statistical significance of these effects are much greater in developing countries with weaker capacity to adapt to and mitigate the consequences of climate change. Kling et al. (2018) showed that countries particularly vulnerable to climate change incur a risk premium on their sovereign debt. These findings are even more relevant against the backdrop of adaptation representing only 20 per cent of climate finance as of December 2020[16]. The second is that strong fundamentals matter to prevent sudden stops in light of tightening external borrowing constraints as shown by Cavallo, Izquierdo, and León-Díaz (2019). If these fundamentals incrementally include sound adaptation, mitigation, and green policies, they will matter too, to prevent sudden stops.

VI. Less severe depreciation-induced demand contraction

If less severe capital flights from green bonds materialized sudden stops from issuing countries could attenuate demand contractions from depreciations. Episodes of sudden stops and capital flights can have non-evident negative effects for an economy. They generate exchange rate depreciations which are typically associated with increases in net exports and subsequent aggregate demand changes that spur growth. Nevertheless, aggregate demand increases may not ensue. The effect of a depreciation on the aggregate demand -especially one triggered by negative outflows- will depend on the relative response of the exports and imports. If exports do not grow and import volumes remain the same or grow but they have higher prices a depreciation effect can be negative.

[16] UN Secretary-General's remarks to the Bundestag, December 18, 2020.

For a depreciation to generate an increase in net exports, the so-called Marshall-Lerner[17] conditions must be met. For the case of Mexico, Cermeño (2010) researched the effects of volatility of the fundamental determinants of trade flows during the period 1991-2008. He found that exchange rate volatility had negative effects on growth. Similarly, by using the recently developed asymmetric Granger causality tests, Yoke-Kee, Wong, Chin-Yoong (2016) found evidence across nine selected Asian countries in support of an asymmetric effect of capital flows on economic growth. They found that cumulative capital inflows are irrelevant to growth, whereas cumulative capital outflows are destructive to growth. This means that if negative effects are present in the long run, then tempering outflows by issuing green bonds instead of vanilla ones could help if proven more stable. Some could argue that negative swings in exchange rates could be reversed in the short run, but even if this is the case, it is still possible that a country experiences asymmetric effects in the exchange rate. That is, capital flows that cause proportionally greater depreciations when they enter a country than when they leave it.

VII. Lower cost of funding during selloffs

If green portfolios continue to show smaller yield adjustments with selloffs, new primary issuances and debt rollovers can benefit from smaller costs. As thematic bond markets develop and climate change is incorporated in standard risk assessments, primary green issuances could deliver a greenium. In the meantime, selloff behavior seems to favor those who issue green bonds. Table 7 summarizes the benefits and the type of countries that could gain more from them.

Table 7

	High market access		**Low market access**	
	Local Currency	**Foreign Currency**	**Local Currency**	**Foreign Currency**
New types of investors	✓	✓		✓
↑ access to capital/tenor-mkt development-			✓	✓
Catalytic Mobilization of private capital			✓	
Smaller need for central bank forex intervention	✓		✓	
Tempering of sudden stops and capital flights	✓	✓	✓	✓
Less depreciation-induced demand contraction	✓		✓	
Lower cost of funding	✓	✓	✓	✓

B) Potential interventions for MDBs to consider and research.

[17] That is, if the absolute sum of a country's export and import demand elasticities is greater than one then a country with a balanced trade of deficit would experience an improved balance if there were a depreciation. In simple terms, import and export amounts should be reactive enough for a depreciation to positively affect the trade balance. Otherwise, the country ends up with worse conditions: more expensive exports and smaller receipts from exports because of their relative cheaper price following a depreciation.

Potential interventions from MDBs can stem from the existing instruments but also from innovations such as the anchoring[18] of SG bonds or reaching to new clients (subnationals). Roughly speaking, MDBs provide 1) financing in the form of equity, loans, and credit lines, 2) support via technical assistance (TA) and grants and 3) insurance in the form of 4) guarantees[19]. There are other instruments and innovations that have been introduced in the last few years such as of catastrophic bonds and oil hedging solutions. There are variations of these instruments but as of December 2020, MDBs had not introduced anchoring of sovereign bonds in primary issuances as development financing instruments. In terms of clients, the sovereign guaranteed areas of MDBs deal mostly with sovereigns. Subnational governments are also potential clients that have been an elusive target for MDBs because in most cases they cannot borrow or deal directly with MDBs.

MDBs could anchor a thematic bond by taking up a share of its issuance in the primary market and provide investors with extra confidence. Even though the certification processes for green bonds have made important progress, they have not been completely standardized. Most importantly, as countries develop, new green technologies with varying impacts will appear and the heterogeneity of use in bond proceeds will grow. In this context, the participation of an MDB in the structuring of a bond issuance and especially its participation as an early holder can bring credibility and comfort to investors. MDBs can bring the special rigor and criteria used for their loan their provisioning such as environmental, social, and financial safeguards.

Financially speaking, bond anchoring is similar to loan provisioning. A loan and a share in a bond issuance are both financial obligations that would fall on the assets' side of an MDB. MDBs can help countries tailor their primary thematic bonds issuances to the highest standards and adapt the covenants to accommodate MDB anchoring. Covenants can also be tailored to address preferred credit treatment considerations. It is important to keep in mind that bond anchoring would not be an activity carried out by the treasury departments of MBDs as part of their asset management strategies. Rather, anchored bond holdings could be tested as a partial substitute of loan provisioning. One potential financial difference could be that bond rates could be higher than those paid by loans. Because anchoring would be carried out in new bond issuances for countries with low market access, rates paid to MDBs would be set by the market. Nevertheless, the specific levels could be lower than those obtained if countries did not have MDB participation. This is because MDBs unconditional commitment to anchoring would help compress yields.

Bond anchoring can be done for issuances from small countries and other SG vehicles that fund subnational projects. As mentioned above, there could be important benefits for low market access countries from issuing thematic bonds. Nevertheless, issuing bonds for the first time can not only be a daunting task because low of capacity but a task that requires to borrow MDB credibility. Countries with high access to market are known by investors, therefore MDBs would add little value by anchoring their bonds. Other final recipients that could benefit from anchoring are subnationals. MDBs can help create SPVs that issue thematic bonds anchored by MDBs so long as national governments provide a counter-guarantee to MDBs. Subnationals in turn can "apply" to SPVs to use

[18] Bond anchoring is usually carried out by MDBs but only for private sector issuances (non-sovereign guaranteed). For example, in November 2020, IDB Invest acquired $40.3 million of the four-year social bonds from Colombia's Banco W, the first gender bonds issued by a microfinance institution in Latin America.

[19] For more information see Faure, Prizzon and Rogerson (2015). "Multilateral development banks A short guide."

the funds, knowing beforehand where and how they can use the proceeds of such financing. This is a solution that can also help the municipalities of countries with high market access but underdeveloped markets for their subnational governments. These types of solutions could help mobilize private resources that would otherwise not be available for subnationals.

Technical assistance can help finance the creation of SPV for subnationals and fund the creation of anchoring schemes. As of now, TA, among other things, has been used to create framework certifications and other market-enabling mechanisms for the proliferation of thematic bonds. Nevertheless, their role can be further enhanced by financing the creation of the legal, financial, and marketing schemes for subnational SPVs. Post issuance reporting is one important are currently lacks standardization and could decrease investors' confidence in the true greenness of issuances.

Guarantees can do for high and medium market access countries what anchoring can do for low market access countries. MDBs could further amplify the benefits mentioned above for issuers by providing guarantees for thematic bonds. Some of the main reasons for selloffs is "flight to quality". If green issuances continue reacting less during selloffs, the addition of guarantees to their issuance could raise their profile even further to a point where they behave akin to much safer assets. This can derive in small movements of capital rather than large outflows.

As green bonds develop a negative liquidity premium materialize and MBDs could have a role to play. If highly diversified bondholder bases develop for green bonds and retain bonds for long periods, green bonds could deliver negative liquidity premia. This could be a deterrence to invest issue green bonds. In this case, MDBs could have a role. For example, green bonds with a) higher post-issuance reporting transparency and standardization b) investments that decrease the total country risk to climate change, c) higher credit ratings and d) strong safeguards, can compensate investors with less risk in exchange for lower liquidity. In fact, post-issuance reporting has not been standardized yet and this could be one of the reasons why green issuances do not carry a greenium yet.

Thematic bonds are instruments that can accommodate different goals. Most of the analysis in this document has focused on green bonds due to their data availability. Nevertheless. thematic bonds include diverse areas of development such as gender, blue economy (*e.g.*, ocean-friendly) and orange sectors (*e.g.*, cultural infrastructure). Similarly, they can serve different objectives within their specific umbrella. Nearshoring or even re-shoring are examples. In some cases, such initiatives could decrease transportation pollution not only from final products but from intermediate products crossing borders several times during the manufacturing process. For instance, the fabrication of titanium aircraft parts in South Africa. With traditional manufacturing, titanium is produced in blocks in one location and sent to another country for cutting. The cutting delivers parts but produces more than 80% of wasteful shavings. The shavings are then shipped back to the original titanium-melting country to be melted again into blocks only to be shipped again for cutting. If the final percentage use of each block is 20% each time that means that the rest of the metal in the block crosses different borders several times to be melted and cut. An alternative method is additive manufacturing (titanium 3D printing). This reduces waste to almost zero and concentrates manufacturing in one location, saving energy from melting and avoiding transportation pollution. The same applies to digitalization efforts. As jobs migrate from offices to homes, digitalization can reduce car usage and pollution. This type of pollution reduction can be quantified and financed with appropriate instruments incorporating multiple objectives.

8. Conclusions

So far, green bonds have not proven to deliver a financial advantage for issuers in the secondary market. Nevertheless, existing data from green bonds and their comparables from Nigeria, BNDES (Brazil) and Chile point at a smaller reaction (lower yield jumps) during the COVID19 selloff that started in March 2020. Smaller yield changes of around 1% less on average for four months or more from green bonds could translate into lower funding costs for countries that issued green bonds instead of non-green comparable ones. There are several potential explanations for this. Nevertheless, this document only lightly explores the investor base composition because of limited data availability. That is, there seems to be a higher number of investors holding smaller percentages of green bonds (a more diversified base) compared to their non-green equivalent. If green bond investors continue to behave in this manner during selloffs, issuing green could bring important benefits to countries. Multilateral Development Banks can foster the development of green bond markets by 1) anchoring issuances from low market access countries and special purpose vehicles from subnational governments 2) issuing guarantees to raise the profile of bond issuances by high market access countries and 3) use technical assistance funds to create the environment necessary for the creation of SPVs, standardization and frameworks.

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