

WORKING PAPER N° IDB-WP-1577

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**Cataloging-in-Publication data provided by the  
Inter-American Development Bank  
Felipe Herrera Library**

Cunha, Daniel.

The impact of the creation of a sovereign ESG reference yield curve on corporate ESG bonds issuance's from Latin American and Caribbean / Daniel Cunha, Giovana Craveiro, Marina Rossi.

p. cm. — (IDB Working Paper Series ; 1577)

Includes bibliographical references.

1. Investments-Social aspects-Latin America. 2. Investments-Social aspects-Caribbean Area.  
3. Investments-Environmental aspects-Latin America. 4. Investments-Environmental aspects-Caribbean Area. 5. Bonds-Social aspects-Latin America. 6. Bonds-Social aspects-Caribbean Area.  
7. Bonds-Environmental aspects-Latin America. 8. Bonds-Environmental aspects-Caribbean Area.  
9. Sustainable development-Latin America. 10. Sustainable development-Caribbean Area. I. Craveiro, Giovana. II. Rossi, Marina. III. Inter-American Development Bank. Connectivity, Markets and Finance Division. IV. Title. V. Series.

IDB-WP-1577

<http://www.iadb.org>

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## Abstract\*

This paper explores a granular database from the Inter-American Development Bank (IDB) Green Bond Transparency Platform covering the issuance of 430 corporate and sovereign Environmental, Social, and Governance (ESG) bonds in Latin America and the Caribbean (LAC) that are outstanding in international markets. The goal was to investigate how the creation of a sovereign ESG reference yield curve can boost the private ESG bond market. Using a difference-in-differences (DID) approach, we empirically estimate that the creation of a sovereign ESG reference curve roughly leads to a 60 percent increase in the volume of corporate bond issuances and a 25 percent increase in the number of ESG corporate bond issuances in the external markets after three years. On the mechanisms, we argue that the sovereign ESG reference yield curve works as a benchmark for private sector ESG bond issuers by providing a standard against which the performance of ESG bonds can be measured.

JEL Codes: H63, E43, R50

Keywords: ESG, thematic bond, green, social, sustainability, sustainability-linked bond, debt capital markets, sovereign debt, LAC, corporate sector, international markets

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\* The opinions expressed in this work are those of the authors and do not necessarily reflect the views of the Inter-American Development Bank, Brazilian Treasury, or IMF, nor of their Executive Boards or management.

## 1 Introduction

The main contribution of this paper is the analysis of the impact of the creation of a sovereign Environmental, Social, and Governance (ESG or “thematic”) reference yield curve by Latin American and Caribbean (LAC) countries in international debt capital markets. To the best of our knowledge, this is the first study that empirically estimates the knock-on effect of the inauguration of a sovereign ESG market on corporate thematic bond issuance.

For the purposes of this paper, thematic bonds include those labeled green, social, sustainability, and sustainability-linked bonds. Hussain (2022) highlights that ESG bonds are also known as thematic bonds and are fixed income instruments issued to raise financing for projects and activities related to a specific theme—such as climate change, education, housing, ocean and marine conservation—and the Sustainable Development Goals (SDGs).

The yield curve of conventional sovereign bonds carries information about key macroeconomic variables while the ESG sovereign yield additionally unveils information on ESG topics. On one hand, sovereign bonds are debt securities issued by national governments to finance government needs. Different from corporate bonds, the fundamental of a government yields bond is purely derived from the macroeconomic fundamentals of a given economy. Sovereign bonds yields are expressed by the expectation on the future short-term policy rate, inflation, and real interest rates. On the other hand, the sovereign thematic yield curve, on top of unveiling information on macroeconomic variables, underpins ESG policies at the national level. More importantly, with the increase of sovereign issuers in the thematic bond market, public debt has also become a source of information about country-level commitment with environmental, social, and sustainable development topics. Emerging markets still represent a small fraction of the ESG bond market—15 percent of the total amount issued, based on data from Bloomberg<sup>1</sup> as of end-2022, but volume issued is growing. Global issuance

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<sup>1</sup> See Bloomberg’s Global Aggregate Green, Social and Sustainability (GSS) bond indices for further details.

of green bonds began with multilateral development banks raising money for climate change-related projects in 2007–08. Since then, the market has been growing every year. According to Climate Bonds Initiative, the volume of thematic bonds issuance rose by USD 730.5 billion in 2020 to USD 1.1 trillion in 2021, an increase of more than 46 percent. Looking at LAC, the first issuers accessed the market in 2014 and green bond issuances in the region more than doubled in less than two years, from USD 13.6 billion in September 2019 to USD 30.2 billion at the end of June 2021. Of the cumulative issuance as of the end of 2022, Brazil continues to dominate, despite a reduced share of 34 percent compared to 41 percent in 2019. Chile ranks second with 31 percent, followed by Mexico with 13 percent. In terms of issuers, non-financial corporate (39 percent) and sovereigns (25 percent) maintain the top spots among issuer types in cumulative terms, thanks to large issuance from Brazil and Chile.

Is the creation of a sovereign ESG reference yield curve a paradigm shift for private ESG issuance? Looking into the recent developments of the thematic debt market in LAC, Figure 1 shows that the amount of ESG bonds issued by the private sector in international markets has grown more rapidly when the issuer has a sovereign bond as a “thematic benchmark” because private firms use the sovereign ESG yield curve as a reference to tap the markets. Accordingly, since 2016 the group of countries that issued a sovereign thematic bond (“treated countries”) showed an annual average growth rate of issuance around 98 percent; meanwhile, the group of countries without the presence of the thematic benchmark (“never-treated countries”) had an average growth rate of 45 percent. But what would have happened if debt management offices (DMOs) of these countries had issued sovereign thematic bonds?

**Figure 1: Recent Developments in LAC Private ESG Issuance in International Markets**



Source: IDB (n.d.).

The literature on the factors that drive the issuance of thematic bonds by the corporate sector is timid, but it is growing rapidly. Prasad et al. (2022) argues that multilateral banks, national development banks, and public-private partnerships play an important role in boosting ESG corporate bond issuances. Ferreira and Suntheim (2021) highlights that the setting of a proper transparency and accountability of climate data is a key ingredient to back the market. Goel, Natalucci, and Gautam (2022), in turn, points out that emerging markets (EMs) policymakers should focus on improving ESG data quality and fostering green projects. Nevertheless, not much has been debated about the role played by sovereign debt in mobilizing private sector capital into ESG investing.

Our hypothesis is that the first issuance of a thematic sovereign bond is a paradigm shift for the private ESG capital markets due to the creation of a sovereign ESG reference yield curve. The introduction of a liquid sovereign ESG market has spillover effects on the ESG private capital market because it gives rise to a sovereign ESG reference yield curve that reduces information friction in the pricing of ESG debt in private capital markets. We make the case that the creation of a sovereign ESG yield curve is a crucial building block to further foster the development of an ESG debt

market. On the crucial role played by public debt, Martinez et al. (2022) argues that sovereign debt is very different from debt issued by private sector players because the former is both safer and more liquid. Using the Brazilian external debt market as an example, we show that sovereign debt is indeed different from corporate debt with a lower underlying rollover risk and yield, resulting in positive externalities on the private market. Moreover, we argue that sovereign ESG debt is an important booster to private ESG debt for EMs with market access.<sup>2</sup> More precisely, we conjecture the existence of two main mechanisms that channel the knock-on effect of the creation of a sovereign ESG reference yield curve: (i) crowd-in and (ii) novelty/advertisement channels.

First, using a conventional sovereign yield curve as a benchmark has an underlying larger and noisier cost on average than employing a thematic sovereign curve because there is limited market price information on sovereign ESG metrics/performance. As a result, the price effect derived from the inauguration of the sovereign ESG debt would induce private players to tap the market as well.

Second, the issuance of a sovereign thematic bond may lead financial and non-financial corporates to step into the market right after the sovereign issuer. Intuitively, private sector issuers are likely to follow the sovereign because its issuance is a sign of a possible good window of opportunity. Furthermore, by issuing bonds around the time of the sovereign placement, private players ensure their cost will price in the latest sovereign figures.

Research questions. We address key questions for ESG debt market players: (i) What is the impact of the sovereign knock-on effect on the issued volume of private sector issuances? and (ii) What is the impact of the sovereign knock-on effect on the number of ESG debt deals? To answer both questions, we apply a difference-in-differences (DID) approach comparing the outcome of LAC issuers with open and closed sovereign ESG markets.

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<sup>2</sup> If sovereign issuance is sufficiently large, some cannibalization issues may kick in between the two markets. However, this is not likely to be the case in early and middle stages of development.

Contribution to the literature. Our paper is close in spirit to the work of Dittmar and Yuan (2008) insofar as we aim to investigate the positive externalities to corporates derived from the creation of a sovereign reference yield curve. However, instead of focusing on conventional (brown) bonds and price effects on corporate bonds underpinned by the sovereign issuance, we narrow down our analyses to estimate the impact of the creation of a sovereign ESG reference to private players, focusing on the impact on corporate issuance volume rather than price effects. Ramos Murillo and Vasa (2023) examines the behavior of green bonds to negative exogenous shocks. The authors analyze the COVID-19 selloff and find that green bonds yields reacted less to the shock, aligning with investors' preference for long-term holdings. Our study, in turn, focuses on one specific positive exogenous shock to corporate ESG funding: the creation of a sovereign ESG reference yield curve.

Main findings. We argue that sovereign ESG bonds would serve as benchmarks for private sector ESG bond issuers by providing a reference for ESG bonds. Accordingly, we empirically estimate the impact of the creation of a sovereign external ESG debt market, finding that it roughly leads to a 60 percent increase in issuance volumes and a 25 percent expansion in the number of private external ESG issuances after three years.

The paper is structured as follows. Section 2 unpacks insights of the key role played by the sovereign derived from the Brazilian external debt experience on the transmission channels of the sovereign knock-on effect. Section 3 introduces our database and depicts our empirical exercises, while Section 4 presents our final remarks.

## 2 The Role of the Sovereign Reference Yield Curve: The Brazilian Experience

The experience of Brazilian external sovereign issuance provides a useful set of insights with regard to the importance of sovereign bonds as a benchmark for the private sector. More specifically, given that the domestic market represents the Brazilian federal government's main source of funds, the external debt profile is since 2006 characterized by a qualitative approach (Caputo Silva, Oliveira de Carvalho, and Ladeira de Medeiros, 2010) that seeks to establish a liquid and efficient sovereign yield curve in international markets as a reference for corporates.<sup>3</sup>

The role of the sovereign reference yield curve in fostering corporate issuance. While the private sector does not rely on the public sector to access the markets, having shown the capacity to produce its own references of size and liquidity, the government bond market represents a benchmark yield curve that serves as an instrument for the development of bond markets in broader terms.<sup>4</sup> Sarr and Lybek (2002, 29) state that the “secondary market for government securities is generally perceived as being the most liquid of the various bond markets. Government securities often play a special role as collateral and benchmarks for pricing of other securities.” A well-developed sovereign yield curve improves liquidity and cost conditions for the corporate market. We recall that the pricing rationale for a fixed income security is based on curves that represent a risk-free rate, usually government securities, on top of which we add an extra cost that accounts for liquidity premium, credit risk premium, and other factors. In this sense, there are indications in the financial literature and among market participants that an active sovereign issuer makes the market more complete and helps to promote price discovery and transparency that ultimately leads to reduced borrowing costs and lower bid/ask spreads.

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<sup>3</sup>For a detailed discussion, see the 2022 Annual Borrowing Plan of the Brazilian Treasury at <https://www.tesourotransparente.gov.br/publicacoes/annual-borrowing-plan-abp-ingles/2022/114>.

<sup>4</sup>For a comprehensive debate, see Caputo Silva, Oliveira de Carvalho, and Ladeira de Medeiros (2010) and Mohanty (2002).

Positive externalities to private players of developing a sovereign reference yield curve with sufficiently large issuance with a diversified investor base. First, as highlighted by Caputo Silva, Oliveira de Carvalho, and Ladeira de Medeiros (2010), sovereign issuance tends to increase market size, which in turn is important to support liquidity and market depth. In addition, government bonds are also key to attract a diversified base of investors. According to World Bank (2001), a heterogeneous investor base for fixed-income securities is important for ensuring resilient secondary markets and stable demand under a wide range of market conditions. Indeed, measures to expand and diversify its investor base have been one of the Brazilian Treasury's guidelines, given the important role diversity plays in improving liquidity not only because of the size effect but also because different risk profiles help to dissipate market shocks and tend to mitigate funding-related risks.<sup>5</sup>

How the Brazilian sovereign yield curve works as a key reference for corporate helping to increase the efficiency of the market. According to the Trade Association for the Emerging Markets <sup>6</sup> (EMTA), Brazil's sovereign and corporate securities are one of the most liquid among emerging economies. In this context, Figure 2 (a) shows that, on average, Brazilian government securities in international markets have greater maturity in comparison with private players, representing a curve reference that potentially paves the way for Brazilian companies to extend duration. This data comprises a wide range of corporate issuers focusing on relatively new bonds that were originally issued from 2009 to 2022.<sup>7</sup> Moreover, our database includes bonds that are bullet bonds. The original currency is U.S. dollars and the date of reference is September 30, 2022. Figure 2 (b) shows that the average yield per tenor is higher for the corporate sector in comparison to the sovereign yield curve. This indicates that government bonds look to represent a floor for private securities because the former usually account for country-specific risks whereas the latter also reflect company-related risks on top of other factors. This difference seems to be higher for short- and medium-term bonds in

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<sup>5</sup> See World Bank (2001) and Mohanty (2002) for details.

<sup>6</sup> See the following link for more details: [link](#)

<sup>7</sup> Century bonds have been removed from the sample primarily because this type of maturity is usually accessed under specific market conditions and objectives.

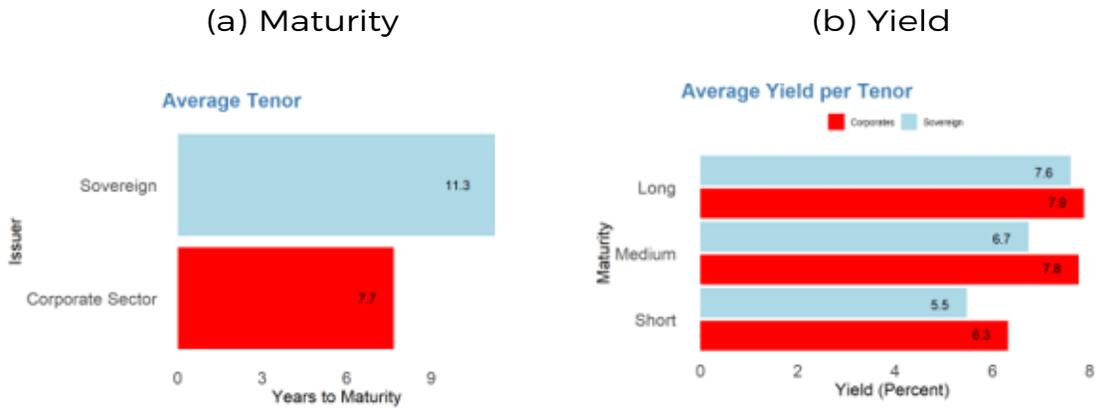
comparison to long-term bonds,<sup>8</sup> which could be associated with the fact that corporate borrowers that are able to offer longer maturities usually exhibit better fundamentals and credit ratings.

The Brazilian experience seems to be in line with the literature that indicates that the benchmark status of sovereign securities is essential not only for developing a robust corporate bond market for emerging economies, but also for developed countries where corporate bonds are often accompanied by active government bond issuance and trading (Dittmar and Yuan, 2008). In particular, when looking at the universe of green bonds more specifically, or ESG more broadly, sovereign issuances would be expected to also help determine to what extent investors attribute any value to the green label in the case of Brazil.

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<sup>8</sup> For the purpose of this study, short-term bonds are those with up to around five years to maturity, medium-term bonds have 6–10 years to maturity, and long-term bonds have as much as 30 years to maturity.

Figure 2: The Brazilian Sovereign and Private External Debt Market



Source: Sovereign and corporate yield from Bloomberg fixed income indices panel

The transmission channels of the knock-on effect on private issuance derived from the creation of a sovereign reference yield curve. We use the evidence of a sovereign reference to private issuers detailed in the Brazilian conventional (brown) external debt experience to conjecture two channels for the knock-on effect of sovereign ESG issuance: (i) crowd-in and (ii) advertisement channels. The first channel depicts the cost and uncertainty reduction caused by the creation of the sovereign ESG reference curve, while the second channel narrows down the analysis to the timing of the private sector issuances because corporates tend to issue thematic bonds once sovereign issuers tap into the ESG bond market. Both channels are closely related. For instance, once a sovereign has set a price reference in a green premium or “greenium” model, private firms are likely to follow suit.

### 3 Empirical Analyses

Identification. We use an event study approach to test our hypothesis that the first issuance of a thematic sovereign bond is a paradigm shift for the private ESG capital markets due to the creation of a sovereign ESG reference yield curve. In a nutshell, the first sovereign ESG issuance, an exogenous shock for private issuance, is a tipping point for corporate because before the event they cannot directly use the sovereign yield curve as a reference but can do so after the issuance. Moreover, we can also compare the performance of private issuance between treated countries (the ones with a sovereign ESG reference yield curve) and never-treated countries (those that cannot directly use the sovereign ESG yield curve as a reference).

#### 3.1 Database

Data. To track the existence of a sovereign ESG market, we rely on the database of sovereign and non-financial corporate ESG issuances provided by the Green Bond Transparency Platform (IDB, n.d.), an initiative developed by the Inter-American Development Bank (IDB) to promote transparency in the green bond market in LAC, covering around 430 issuances of 14 countries from 2015 to 2022. From IDB's dataset we pulled issued volume and number of deals of non-financial corporate ESG issuances before and after treatment (i.e., before and after the issuance of a sovereign ESG bond). For the purposes of this paper, we consider ESG bonds all those labeled green, social, or sustainability bonds (i.e., all the bonds that have been granted through an external review).<sup>9</sup> A labeled ESG bond is considered at a lower risk of "greenwashing"<sup>10</sup> because it has been through an external review that testifies that the proceeds are fully allocated to projects with sustainable benefits.

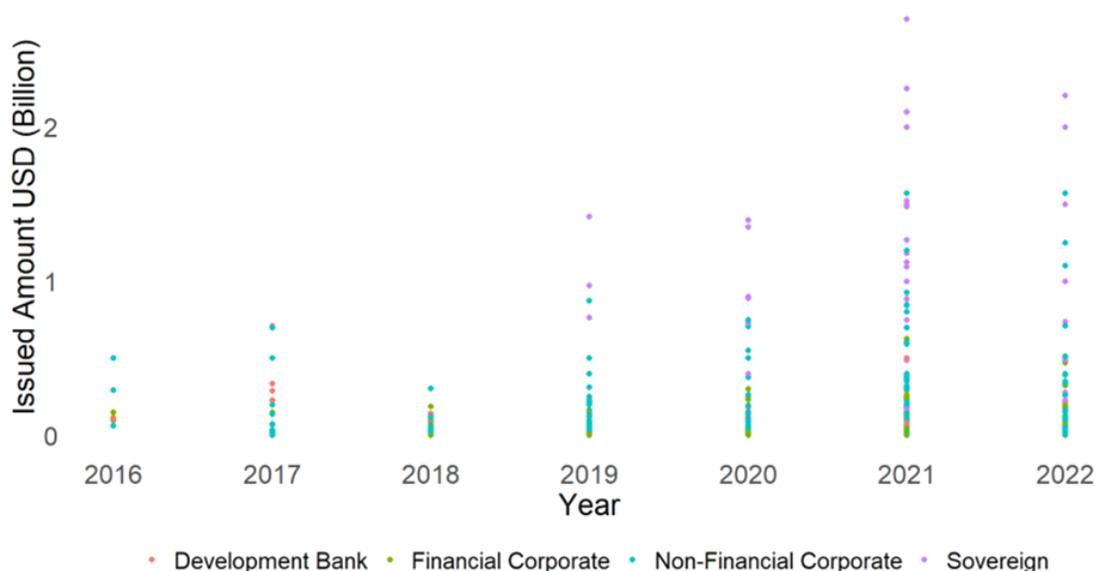
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<sup>9</sup> According to the Green Bond Transparency Platform (IDB, n.d.), an external reviewer is an independent entity that carries out any type of external review pre- or post-issuance. External reviews comprise second-party opinions (SPOs), certifications under the Climate Bond Standard, ratings, assurance statements, and impact verification.

<sup>10</sup> The term "greenwashing" refers to the practice of making exaggerated claims of environmental benefits in an attempt to gain market share (Braga Junior, et al., 2019).

Profile of private ESG issuance in Latin America. Figure 3 details how the individual issued volume and number of deals have evolved since 2016. As expected, financial corporate, non-financial corporate, and domestic development banks were the first participants of the market because they typically have fewer constraints than sovereigns. Interestingly, from 2019 onward, both the issued volume and the number of deals have increased; this is due to the inauguration of the Latin American sovereign ESG debt market by Chile in 2019.

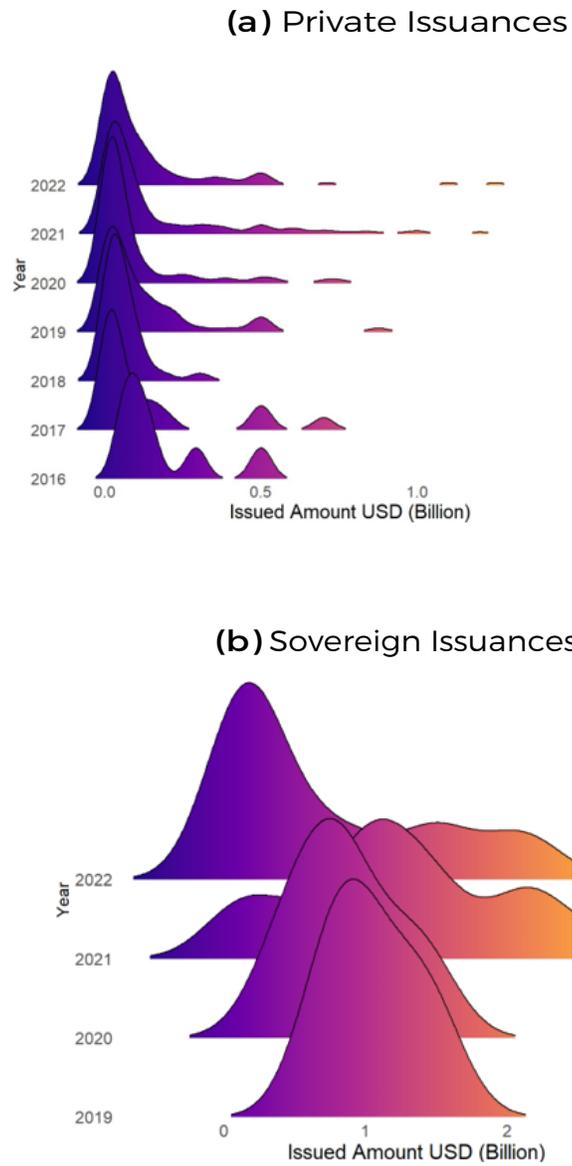
**Figure 3: LAC Thematic Bonds Issuances by Issuer Type**



The distribution of private and sovereign ESG issuance. Figure 4 depicts the evolution of distribution of private (a) and sovereign (b) issuances over time. After the inauguration of Chile's market in 2019, Mexico, Guatemala, and Ecuador issued sovereign thematic bonds in 2020, and Peru and Colombia followed suit in 2021. Uruguay issued its first thematic bond in 2022. From 2016 to 2022, the average ticket of private placement was USD 0.14 billion, while the mean sovereign issuance was around USD 1 billion. After the first issuance of a sovereign thematic bond in 2019, the distribution of private

issuance has become even more right-tailed, signaling that the transmission channels detailed in Section 2 are more effective for non-small private issuance.

**Figure 4: Distribution of Private and Sovereign ESG Issuances in Latin America**



### 3.2 Empirical Strategy

Empirical strategy of the event study. We follow the difference-in-differences (DID) approach of Callaway and Sant'Anna (2021) because a traditional two-way fixed effects (TWFE) event study may be significantly biased.<sup>11</sup> There is growing literature on the casual interpretations of TWFE regressions pointing out that TWFE linear regression should not be used to highlight treatment effect dynamics. Callaway and Sant'Anna's (2021) approach does not rely on restricting treatment effect heterogeneity assuming only the no-anticipation condition and the existence of parallel trend based on a never-treated group. As we are interested in percent rather than absolute changes, we work with the logarithmic form of our left-hand-side variables (issued volume and number of closed deals). Considering that these variables may be equal to zero for a given year, we use country-level logistic transformation of standardized issued volume and number of closed deals to run our estimations.<sup>12</sup>

Specification. As shown by Tables 1 and 2, we work with a full sample covering both domestic and external issuances and a restricted sample showing only external issuance, which is our preferred specification. The restricted sample covers roughly 45 percent of the issued volume of the full sample and around 18 percent of the number of closed deals. The dominance of domestic markets in a comparison with external issuance in terms of number of deals is mainly explained by two factors. First, the domestic market is affected by national financial regulation that aims to boost the ESG market, while the effect on external markets is somewhat limited because such regulations are not easily applied to different jurisdictions. Second, the issued amount could be a binding constraint in the external market, thus limiting the funding of small amounts.

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<sup>11</sup> Callaway and Sant'Anna (2021) and Sun and Abraham (2021) show that when the treatment is not triggered at the same time across different cohorts, as it is in our study, then TWFE is biased. Nonetheless, in Section 3.4 we run robustness tests using the TWFE method.

<sup>12</sup> For a detailed discussion, see Dávila and Parlato (2018).

We aggregate individual private issuance on an annual basis by country, dividing them into two groups: (i) treated countries (those that issued a sovereign ESG bond) and (ii) never-treated countries (those that do not have a sovereign thematic benchmark). We set the pre- and post-treatment periods as follows:  $post_{npost}^j = t_{npost}^j - 1$ , where  $t_{npost}^j$  is the number of years after the first sovereign issuance set by  $npost$  in a country  $j$ . Accordingly,  $t_1^j = 1$  implies that  $post_1^j = 0$ . Similarly, the pre-treatment periods are given by  $pre_{npre}^j = t_{npre}^j - 1$ , where  $t_{npre}^j$  entails the number of years before the first sovereign placement.

This approach protects our analyses from potential concerns about market players anticipating the sovereign thematic issuance. The date of the first issuance is well defined, but the first formal signal from the sovereign to markets on its intentions to issue a thematic bond happens before the issuance through the publishing of a thematic bond framework. The thematic framework sets up the rules for future issuance and, therefore, is a needed condition to create the sovereign thematic market. Because the time between the publishing of the framework and the issuance can be up to 10 months in our sample, we define  $pre_{npre}^j$  and  $post_{npost}^j$  assuming that the publishing of the framework happens up to one year before the issuance. Importantly, we run robustness placebo tests reassuring the respect of DID's no anticipation assumption.

Contingent on Stable Unit Treatment Value Assumption (SUTVA), our DID specification assumes that a private ESG issuance of country  $m$  does not affect the decision of a firm in a country  $j$ , implying that we are ruling out market segmentation effects. Moreover, our baseline specification does control for covariate-specific trends stemming from country sovereign rate scale and the size of the private ESG market before the treatment is factored in.

Controls and robustness tests. We use the sovereign credit rating (average of Fitch, Moody's, and S&P ratings) where 1 represents a technical default and 21 indicates a AAA rating built by Kose et al. (2022) to control for pre-trends related to country-level economic and credit features. We also control for the heterogeneity of the size of private thematic debt before the treatment

(creation of the sovereign ESG market) using the median issued bond before the treatment. Finally, we run robustness tests finding that even after removing controls the economic and statistical significance of the sovereign knock-on effect is still preserved.

**Table 1: Summary Statistics of Private ESG Issuances before the Treatment (Full Sample)**

Statistic	N	Mean	St. Dev.	Median
Never-Treated Units Issued Amount (USD billion)	7	0.07	0.18	0.00
Treated Units Issued Amount (USD billion)	7	0.9	0.09	0.12
Never-Treated Units Number of Deals	7	0.94	2.09	0.10
Treated Units Number of Deals	7	1.09	0.76	1.50
Never-Treated Units Sovereign Rate Scale	7	8.87	2.73	9.00
Treated Units Sovereign Rate Scale	7	12.35	3.46	12.67

*Note:* The unit of analysis is Latin American economies aggregated on a yearly basis. The variables come from averages centered at the country level using the database built by the Green Bond Transparency Platform (IDB, n.d.) over the period 2016–2022. A sovereign credit rating (average of Fitch, Moody's, and S&P ratings) is used where 1 represents a technical default and 21 indicates a AAA rating built by Kose et al. (2022).

**Table 2: Summary Statistics of Private ESG Issuances before the Treatment (External)**

Statistic	N	Mean	St. Dev.	Median
Never-Treated Units Issued Amount (USD billion)	7	0.07	0.18	0.00
Treated Units Issued Amount (USD billion)	7	0.10	0.09	0.12
Never-Treated Units Number of Deals	7	0.94	2.09	0.10
Treated Units Number of Deals	7	1.08	0.76	1.50
Never-Treated Units Sovereign Rate Scale	7	8.87	2.73	9.00
Treated Units Sovereign Rate Scale	7	12.35	3.46	12.67

*Note:* The unit of analysis is Latin American economies aggregated on a yearly basis. The variables come from averages centered at the country level using the database built by the Green Bond Transparency Platform (IDB, n.d.) over the period 2016–2022. A sovereign credit rating (average of Fitch, Moody's, and S&P ratings) is used where 1 represents a technical default and 21 indicates a AAA rating built by Kose et al. (2022).

### 3.3 Discussion

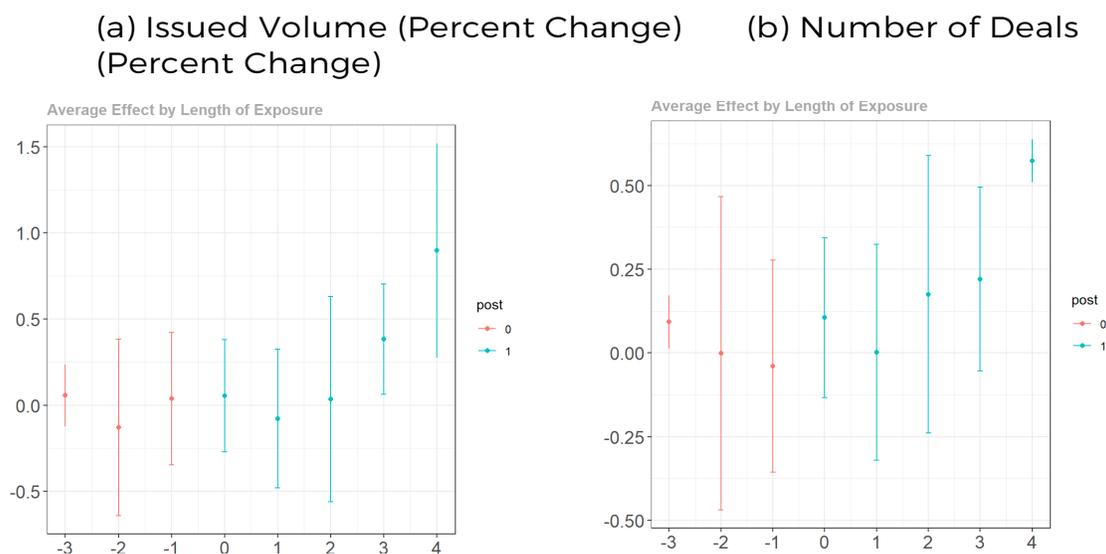
The creation of a sovereign ESG reference yield curve leads to a significant statistical and economic improvement of issued amount of private ESG debt as well as the number of closed deals. The estimated effect is highly significant for external funding, but it is not significant for domestic issuance. This finding is consistent with the main takeaways of the Brazilian external debt experience and the key mechanisms discussed in Section 2.

Section 2 shows that Brazilian sovereign external issuance causes a positive externality on the external private market. In addition, Section 2 unpacks how the crowding-in and advertisement channels unlock the sovereign ESG knock-on effect, mainly due to the greater impact at the margin of sovereign external issuance vis-à-vis a domestic funding transaction.

Figure 5 (a) details the response (percent change) of the average issued amount of private ESG debt for treated countries after the treatment kicks

in and the number of thematic debt deals closed in the post-treatment period. The vertical lines indicate a 95 percent confidence interval. The benefits from the issued volume and closed deals improvement underpinned by the opening of the ESG market take three years to factor in, implying a 50 percent jump in terms of issued volume and a 25 percent increase looking at the number of closed deals. The peak response happens four years after the creation, meaning an even larger expansion of the issued volume (100 percent) and number of closed deals (60 percent).

**Figure 5: Baseline Average Effect (Full Sample) by the Length of Exposure Since the Opening of the ESG Sovereign Market**

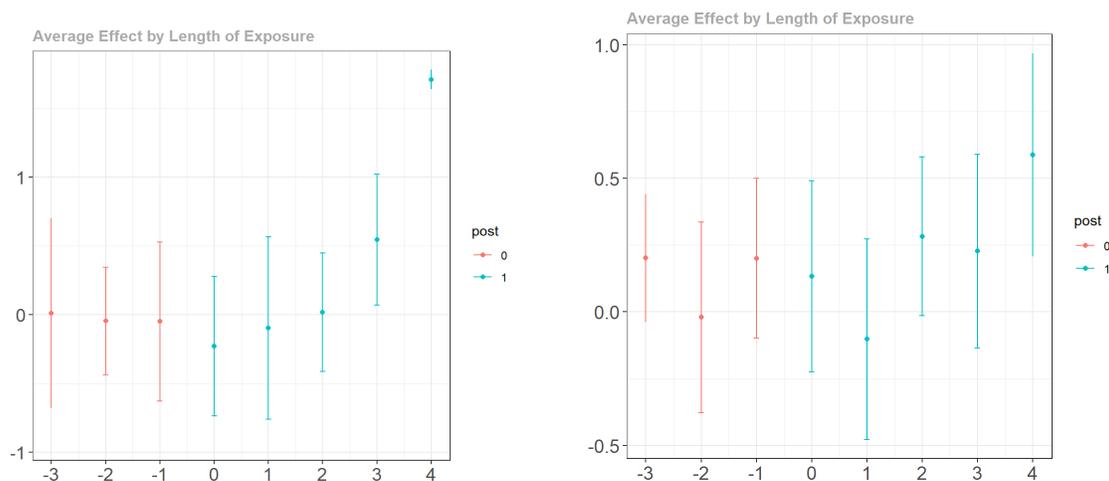


Replicating the same exercise to our restricted sample (external issuance), the magnitude of the outcomes shown by Figure 5 is amplified (Figure 6) in line with rationale of the transmission channels of the knock-on effect detailed in Section 2. The impact on issued volume also takes three years to kick in, but with a larger impact entailing an increase of around 60 percent. The impact on the number of closed deals, in turn, takes two years to kick in instead of three years (Figure 5), implying a 25 percent increase. The peak response also occurs four years after the creation, but the magnitude of the

effect is larger in comparison with Figure 5, showing a jump in the issued volume (175 percent) and number of closed deals (60 percent). Importantly, Figure 6 also provides evidence that pre-trends are respected. Restricting our sample to domestic private issuance, however, did not find any significant evidence of changes in the issued volume and number of closed deals; only Colombia has exclusively focused on the sovereign domestic ESG market since 2021.

**Figure 6: Baseline Average Effect (External Issuance) by the Length of Exposure Since the Opening of the ESG Sovereign Market**

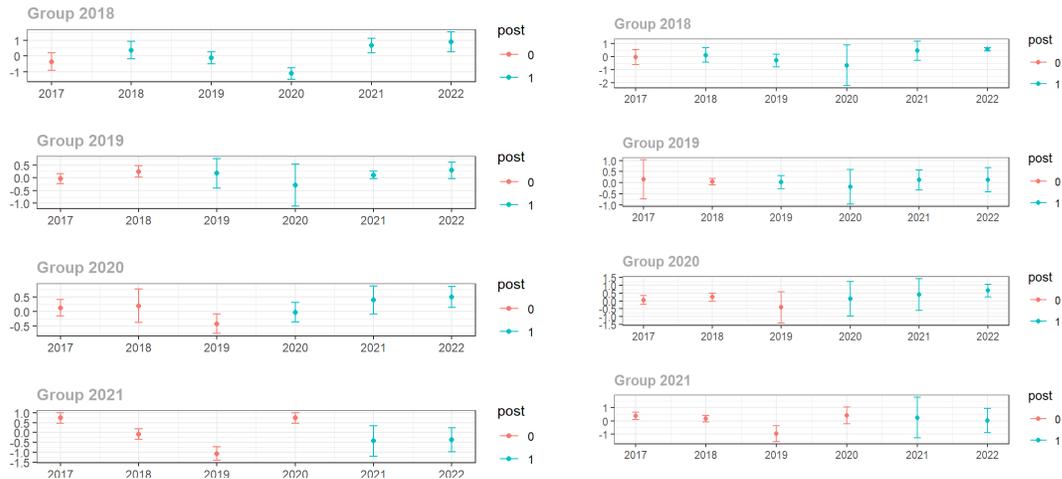
(a) Issued Volume (Percent Change)      (b) Number of Deals (Percent Change)



Looking at the estimation of Figure 5 (full sample) from another angle, Figure 7 displays the same information shown in Figure 5 but breaks down the event study charts by the four treatment cohorts. The first cohort, group 2018, represents Chile with its underlying sovereign issuance in 2019. The second cohort, group 2019, is the representative group of the countries that issued a sovereign in 2020 (Mexico, Ecuador, and Guatemala). The third cohort, group 2020, aggregates the countries that posted a sovereign thematic issuance in 2021 (Colombia and Peru). Finally, the fourth cohort, group 2021, unfolds the knock-on effect for Uruguay’s 2022 inaugural thematic issuance via an SLB.

**Figure 7: Baseline Average Effect (Full Sample) by Cohorts**

(a) Issued Volume (Percent Change)      (b) Number of Deals (Percent Change)

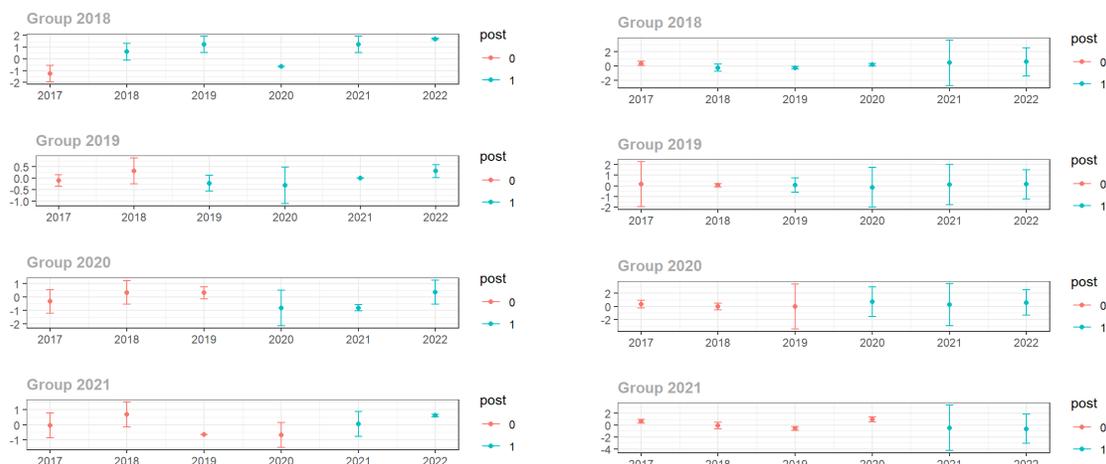


Considering the issued volume and number of deals, the estimated effects of the first, second, and third cohorts (groups 2018, 2019, and 2020) are economically and statistically significant, while the outcome of the fourth cohort (group 2021) is not significant. The estimated effect of the fourth cohort is explained by the knock-on effect of Uruguay's SLB issuance, which chiefly unlocked external private placements rather than domestic ones.

Still analyzing the impact of the creation of a sovereign ESG market by cohorts, Figure 8 details the estimated results for the restricted sample (external issuance). Interestingly, by removing the domestic issuance, the outcome of the fourth cohort (group 2021) becomes more economically and statistically meaningful, providing further evidence that the inauguration of sovereign external ESG issuance is a paradigm shift for the international private ESG debt market.

**Figure 8: Baseline Average Effect (External Issuance) by Cohorts**

(a) Issued Volume (Percent Change)      (b) Number of Deals (Percent Change)



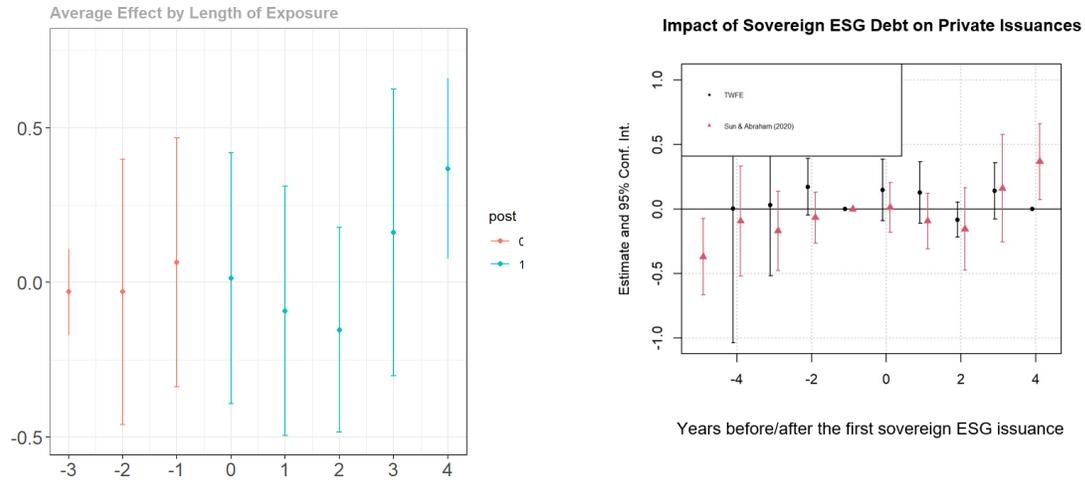
### 3.4 Robustness

Alternative estimation. As highlighted in Section 3.2, DID literature has been evolving at a fast pace, mapping a potential bias in the use of TWFE for event-study estimation in the presence of treatment effect heterogeneity. Callaway and Sant’Anna’s (2021) approach does not rely on restricting treatment effect heterogeneity, assuming only the no-anticipation condition and the existence of a parallel trend based on a never-treated group comparison. Additionally, our baseline specification does control for covariate-specific trends stemming from country income group, sovereign rate scale, and the size of private ESG market before the treatment is factored in.

We run an alternative specification with unconditional parallel trends (removing the controls of the baseline specification) through three different estimation methods: (i) Callaway and Sant’Anna (2021), (ii) TWFE, and (iii) Sun and Abraham (2021), the latter of which also addresses the heterogeneity in time treatment issue. Figures 9 and 10 depict the impact on issued volume and number of deals for the full and restricted sample respectively, showing that even in the alternative specifications parallel trend condition still holds, and the estimated effect is significant.

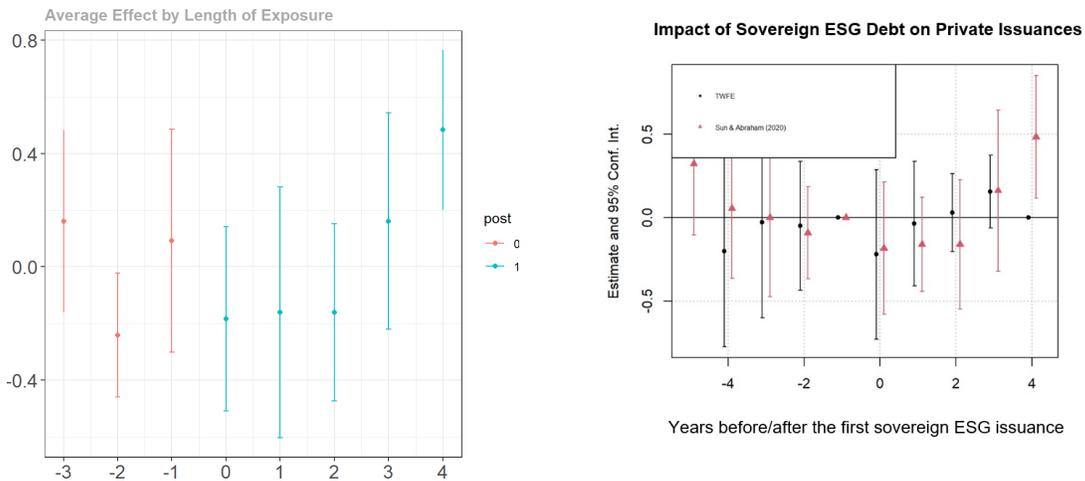
Figure 9: Issued Volume Robustness Test Average Effect (Full Sample) by the Length of Exposure Since the Opening of the ESG Sovereign Market

(a) Callaway and Sant’Anna (2021) method (b) TWFE and Sun and Abraham (2020) methods



**Figure 10: Issued Volume Robustness Test Average Effect (External Issuance) by the Length of Exposure Since the Opening of the ESG Sovereign Market**

(a) Callaway and Sant'Anna (2021) method      (b) TWFE and Sun and Abraham (2021) methods



Placebo test. To make the case that our results are not driven by the setting of the pre/post period and the composition of the treatment group, we re-estimate our baseline specification considering three scenarios: (i) setting a fake treatment time two periods before the baseline, (ii) setting a fake treatment time one period before the baseline, and (iii) setting a fake treatment group using never-treated countries. The goal of these placebo exercises is to test the falsifiability of our premises, meaning that a fake input leads to an outcome statistically equal to zero. Figures 11 and 12 indeed show the estimated effects become insignificant.

Figure 11: Issued Volume (Full Sample) Robustness Placebo Test

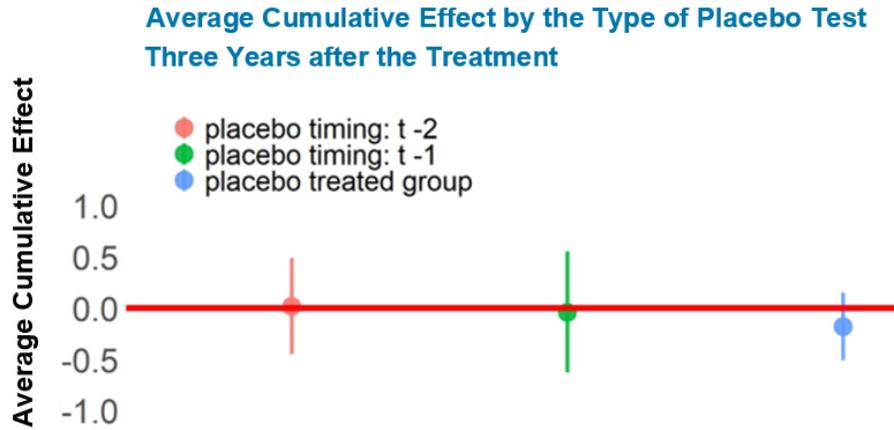
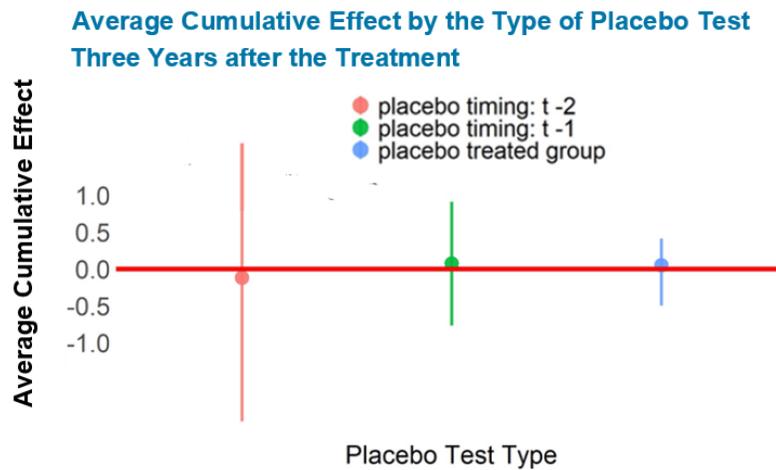


Figure 12: Issued Volume (External Issuance) Robustness Placebo Test



## 4 Conclusions

We provide an estimate of the knock-on effect of the creation of a sovereign ESG reference yield curve on corporate ESG bonds from LAC issuers. To the best of our knowledge, ours is among the first studies to focus on the key role played by sovereign debt in fostering the development of private thematic debt markets.

Using a difference-in-differences approach, we empirically estimate the impact of the creation of a sovereign external ESG debt market, finding that the opening roughly leads to a 60 percent increase in issuance volumes and a 25 percent expansion in number of private external ESG issuance after three years. On the mechanisms, we argue that the opening of a sovereign ESG market provides a reference that enhances the price discovery process of private issuance. Our estimation method considers time and country fixed effects, implying that the creation of a sovereign thematic bond in Brazil could provoke a substantial impact on thematic bonds issued by Brazilian private players.

We contribute to the development of the literature by being, perhaps, the first empirical study to focus on the estimation of the impact of the creation of a sovereign ESG reference to private players. Looking ahead to further work, while our study contributes to the assessment of size of the knock-on effect in LAC, more analysis is needed to understand the heterogeneity of the knock-on effect in non-LAC EMs. Moreover, the analysis of the knock-on effect at the domestic level is also welcome as several EMs have started to issue thematic bonds in their local market.

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