

# Understanding dynamics between sustainable and traditional debt: To SLB or not to SLB?

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As the Sustainability-Linked Bond (SLB) market expands, investors are given more choice as to the products they use to express their credit and sustainability views. We examine the relationship between sustainability and credit performance, and explore how investors can convey their views using SLBs compared to traditional bonds.

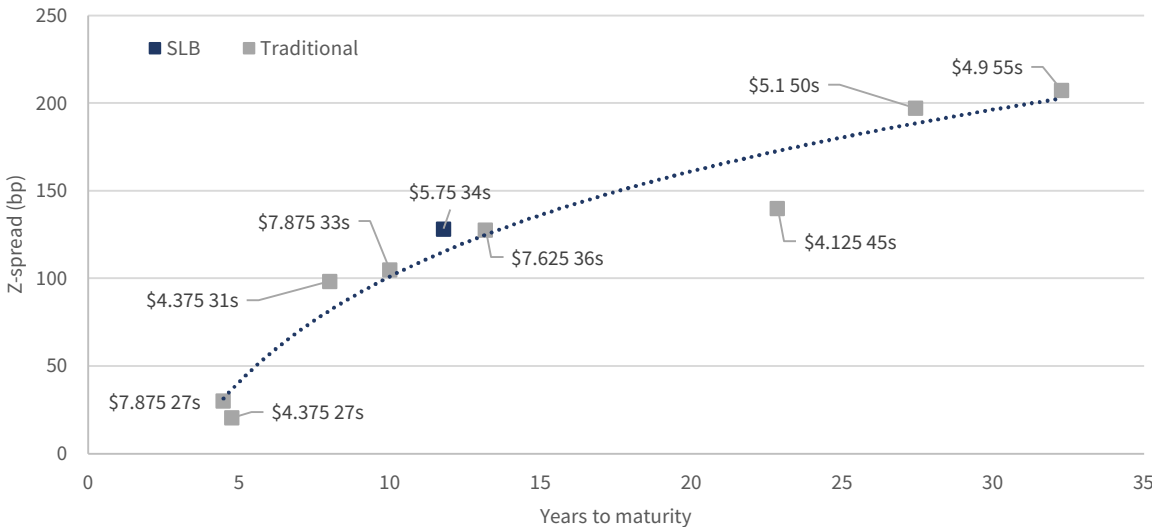
The defining features of the SLB is an option-like pay out tied to sustainability performance, which will lead to differing behaviour from traditional bonds in some situations. If, as some studies advocate, there is a positive correlation between sustainability and credit-worthiness, then this can offer protection against economic downside due to missing targets.

**SLBs provide protection if poor sustainability performance results in the issuer missing a Sustainability Performance Target (SPT). SLBs thus provide a hedge for investors, mitigating downside risk, and will outperform in this scenario.**

**If, on the other hand, strong sustainability performance drives credit improvement, the hedge (which has been paid for) is unnecessary and so an SLB is less valuable. Traditional bonds could be used for a more leveraged position if an investor has a strongly bullish view on the issuer.**

We include three case studies on issuers with extensive credit curves comprising a variety of instruments. In these examples, investors have a choice of products and so take a position on credit and sustainability when they buy. We apply the AFII option pricing model to help analyse value in these situations.

Figure 1. Uruguay bond spreads. Source: Bloomberg, accessed 10 Jan 2023.



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## Background

The SLB is a credit product in which financial returns are linked to performance against a sustainability KPI. It is a powerful product, allowing virtually any issuer to align its financing costs with improving sustainability.

From an investor perspective, it is necessary to understand the dynamics of SLBs (how they move when things change), and not only their value at a point in time. It can be challenging to model the sustainability performance of an SLB and accurately value the embedded option. To assist investors, we have developed an ‘option pricing’ model.<sup>1</sup> The value of this framework extends beyond pure pricing; it helps investors to understand the changing aspects of the security, and its relative performance in a fixed income portfolio.

Although SLBs are a nascent market, some early issuances are reaching the observation dates of their KPIs.<sup>2</sup> To date, one Polish SLB has triggered a step-up to its coupon<sup>3</sup> and, as full-year 2022 sustainability reporting is published, there may well be more such triggers.

As market demand for SLBs increases, more issuers will have a full spectrum of debt instruments available to them. Understanding how these instruments behave relative to each other will be important. As more volatility around sustainability performance is observed, we believe the market profile of SLBs as an option will increase, and any volatility and convexity dynamics will represent another opportunity for SLB investors.

## Correlation

Before analysing the value of convexity in SLB investments, we consider whether there is a positive correlation between creditworthiness and sustainability performance.

The big three rating agencies incorporate ESG criteria into their credit rating analyses,<sup>4</sup> albeit without explicitly disclosing the direction of the impact.<sup>5</sup> S&P gives more detail on the specific ESG credit factors that are considered to have material impact on credit, depending on whether they represent a risk or an opportunity.

The accompanying text makes it clearer that environmental issues are considered a risk: “Climate transition risk and physical risk-related factors may be among the most significant ESG credit factors that affect the creditworthiness of rated entities. This is primarily because of policymakers’ efforts to reduce emissions or to ensure that greenhouse emissions reflect their full social costs (“climate transition risk”) and climate change, which is leading to more frequent and severe extreme weather events (“physical risk”).”<sup>6</sup>

When considering the market reaction, the question of how environmental performance impacts pricing is a topic of much research. It has been concluded that the impact of ESG factors is greater

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<sup>1</sup> For a framework to price this embedded option using a Black-Scholes framework please see “[An option pricing approach for sustainability-linked bonds](#)”, AFII, 8 Nov 2022.

<sup>2</sup> “[A review of Sustainability-Linked Bonds approaching KPI observation dates](#)”, AFII, 17 Nov 2022.

<sup>3</sup> “[One small step for Orlen, one giant leap for the SLB market](#)”, AFII, 29 Nov 2022.

<sup>4</sup> An overview of the different criteria considered by the three rating agencies is given in “[How sustainability risks factor into credit ratings](#)”, Nordea, 9 Nov 2022.

<sup>5</sup> Although it is assumed risks contribute to deteriorations in ratings.

<sup>6</sup> “[General Criteria: Environmental, Social And Governance Principles in Credit Ratings](#)”, S&P Global Ratings, 10 Oct 2021.

for credit performance than equities, and environmental factors specifically impact credit negatively as a stress factor.<sup>7</sup> It has also been shown that higher carbon emissions and carbon intensities can impact the market's view of default-likelihood, perhaps due to anticipated policy responses.<sup>8</sup>

## Convexity

Once a positive correlation between credit and sustainability performance is accepted, it follows naturally that, since SLBs have a contractual return difference depending on sustainability performance, they have positive convexity to these parameters, and are therefore less volatile.<sup>9</sup>

This effect is in both directions; outperforming on the downside and underperforming on the upside.<sup>10</sup> For example, in a step-up SLB, if an issuer misses its KPI, then spread widening is expected that will impact both the SLB and its traditional debt. The SLB will receive a step-up to the coupon, and an outperformance equal to increasing the option value to 100%. If the issuer meets its KPI, spread tightening is expected. For the SLB, the option value reduces to zero as no step-up will be paid, and this will dampen the appreciation compared to a traditional product.

These impacts will be equal in size,<sup>11</sup> and so there should be no net value implications for SLB investors. All else being equal, these impacts should dampen volatility, and this may give rise to increased investor demand.<sup>12</sup>

In option dynamics, it is observed that volatility has a “smirk” - downside volatility trades at a higher implied level than upside volatility. This is driven by investor flows; there are more buyers of options to protect against losses. Applying a skew to the numerical example in Appendix 3 can give a positive value to this convexity.

## Comparing sustainable with green and traditional bonds

SLBs include optionality to sustainability results, which provides a hedge for investors against poor sustainability performance. This hedge costs money, usually manifesting itself as a reduced financing spread for the issuer.

To mitigate downside risk, especially on high yield or higher leveraged issuers, the investor could consider investing in SLBs instead of traditional debt. If sustainability performance is poor, the

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<sup>7</sup> Please see “[ESG factors for predicting changes to CDS spreads](#)”, S&P, 27 Oct 2022

<sup>8</sup> Please see “[Climate Change and Credit Risk](#)”, Capasso, Gianfrate & Spinelli, 2020.

<sup>9</sup> This finding is dependent on the calibration of the step. If the associated spread widening resulting in a KPI miss is very small, it could be that the step-up creates a spread tightening of larger absolute magnitude. We believe the breakeven is a spread widening of half the implied option value, so a quarter of the step if the probability of meeting the step is 50%. Given the criticism of the SLB market for using immaterial steps, we will continue this note assuming that steps are sufficiently small for them contribute to a reduction in volatility. For a numerical example showing these results, please see Appendix 1.

<sup>10</sup> In options terminology this is a ‘risk reversal’.

<sup>11</sup> This ignores bond convexity. Given most traditional debt has positive convexity, i.e., duration increases when spreads tighten, the lost upside on spread tightening will slightly outweigh the avoided downside on spread widening, resulting in SLBs having a slightly lower expected value. For a numerical example showing that this effect is very small, please see Appendix 2.

<sup>12</sup> Reduced volatility of green bonds is often cited as a reason for their trading at lower spread levels than equivalent non-green assets. This is explored in detail, concluding that volatility differences cannot be universally observed, in “[Green Bond Risk Premiums: A Twin-Bond ULFP Approach](#)”, Ulf Erlandsson, 2 Jun 2020.

hedge will perform. The step-up coupon will reduce losses on a sustainability deterioration, either providing a higher coupon, or a reduced Mark-to-Market (MTM) loss where an investor may choose to liquidate their position.

In the other direction, traditional debt represents a more leveraged exposure to credit improvement if an investor holds a strongly bullish view on the issuer. If strong sustainability performance drives a credit improvement, the traditional bond will outperform, especially if the bonds can be bought below par and there is MTM upside as well as a coupon.

On market announcements that impact KPIs and, therefore, the probability of hitting SPTs, it is helpful to know which securities might react the most. On an announcement crystallising an SPT miss, SLBs should outperform traditional debt. On an announcement crystallising an SPT meet, SLB should underperform traditional debt. The AFII option pricing model can be used to estimate the magnitude of these moves.

When talking about traditional bonds we include use-of-proceeds instruments such as green, social, and sustainable bonds. While they are considered sustainable debt, after issuance from a credit perspective, they are not different to traditional debt. Any sustainable benefits from the green investments will impact the issuer and so all debt equally and, in a default, green bonds are pari passu with traditional debt when claiming assets. In conclusion, we consider use-of-proceeds bonds to be traditional debt in considering the different behaviour of SLBs.

## Case Study – Chile

The Republic of Chile has shown a leading commitment to sustainable finance amongst sovereigns. In June 2019 it issued its first green bond,<sup>13</sup> and followed this with another three green bonds, seven social bonds, and five sustainability bonds,<sup>14</sup> with the most recent in Jan 2022. Indeed, Chile issued only one traditional bond in this period in May 2020 (see

Figure 2. Chile bonds issued since Jun 2019. Source: Bloomberg, accessed 11 Jan 2023.

Description	Label	Issue Date	Maturity	Currency	Amount	
					Outstanding	
CHILE \$3.5 50s	Green	25-Jun-19	25-Jan-50	USD	2,318,357,000	
CHILE €0.8 31s	Green	02-Jul-19	02-Jul-31	EUR	1,954,685,000	
CHILE \$2.5 32s	Green	27-Jan-20	27-Jan-32	USD	1,500,000,000	
CHILE €1.25 40s	Green	29-Jan-20	29-Jan-40	EUR	1,269,017,000	
CHILE \$2.4 31s	Traditional	12-May-20	31-Jan-31	USD	1,758,000,000	
CHILE €1.25 51s	Social	22-Jan-21	22-Jan-51	EUR	1,250,000,000	
CHILE \$3.1 61s	Sustainable	22-Jan-21	22-Jan-61	USD	2,000,000,000	
CHILE \$3.5 53s	Sustainable	15-Apr-21	15-Apr-53	USD	1,500,000,000	
CHILE \$3.1 41s	Social	07-May-21	07-May-41	USD	2,700,000,000	
CHILE €0.1 27s	Social	26-Jul-21	26-Jan-27	EUR	1,000,000,000	
CHILE €1.3 36s	Social	26-Jul-21	26-Jul-36	EUR	750,000,000	
CHILE \$2.5 33s	Social	27-Jul-21	27-Jul-33	USD	2,250,000,000	
CHILE €0.5 29s	Social	21-Sep-21	21-Jan-29	EUR	918,000,000	
CHILE \$3.25 71s	Social	21-Sep-21	21-Sep-71	USD	1,000,000,000	
CHILE \$3.5 34s	Sustainable	31-Jan-22	31-Jan-34	USD	1,500,000,000	
CHILE \$2.75 27s	Sustainable	31-Jan-22	31-Jan-27	USD	1,500,000,000	
CHILE \$4 52s	Sustainable	31-Jan-22	31-Jan-52	USD	1,000,000,000	
CHILE \$4.3 42s	SLB	07-Mar-22	07-Mar-42	USD	2,000,000,000	

<sup>13</sup> “[Republic of Chile](#)”, Climate Bonds Initiative, accessed 11 Jan 2023.

<sup>14</sup> These are all bonds whose proceeds are ringfenced for different purposes; green for environmental investment, social for projects that achieve positive social outcomes or address a social issue, and sustainable for a combination of green and social activities.

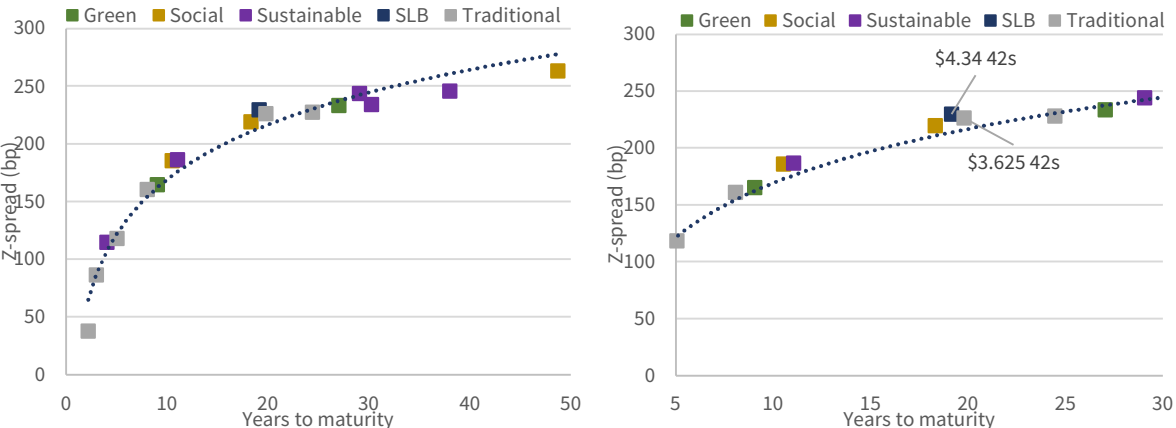
Figure 2).<sup>15</sup> In Mar 2022, Chile became the first sovereign issuer of an SLB, issuing a \$2bn 20yr paper with two sustainability targets, one on absolute GHG emissions and the other on renewable energy generation.<sup>16</sup>

AFII’s analysis on the SLB considers its KPIs to be robust, although we recognise the challenges of materiality given the step-up applies for only 8/20 years of the bond.<sup>17</sup> We reported the bond coming slightly wide of the secondary curve (although that probably included general market new issue premium); it then outperformed to finish the month flat to the traditional 3.625 42s.

Updates to the option pricing done at issuance has left the total value relatively unchanged; the impact of higher rates roughly offsets the shortening of maturity. Despite a high probability of being triggered (99% and 50% respectively) because the coupon steps are small (12.5bp) and paid only for 8 years of the remaining 19, the total running value of the option is 6.8bp.

Figure 3 shows the current spread levels of USD bonds, with the SLB looking slightly wide of the curve. On a mid-spread basis, the SLB 4.34 Jul42s is 3.5bp wider than the traditional 3.625 Oct42s. By rotating from the traditional into the SLB, an investor can be paid 3.5bp to receive the SLB optionality, and benefit from reduced downside in the event of missing an SPT. As the option is being received for free, there is no upside lost if SPTs are met, and spreads tighten.

Figure 3. Chile USD bond spreads. Source: Bloomberg, accessed 10 Jan 2023.



### Case Study – Suzano<sup>18</sup>

Suzano is a Brazilian producer of paper and pulp, the largest in Latin America. Across its issuing family, it has 13 securities outstanding, with total debt USD 9.33bn. In 2016 and early 2017, Suzano issued two green bonds, then returning to traditional issuance. In Sep 2020, it issued the first SLB in the Americas and Emerging Markets, followed by two more SLBs in 2021, which is all their

<sup>15</sup> We note that in this period all issuance has been in USD/EUR. Chile have several small and three large CLP bonds outstanding, due 2026, 2035 and 2043. It may be that taps or refinancing of these issues generates some ongoing traditional issuance.

<sup>16</sup> “Chile prices first sovereign sustainability-linked bond”, IPE, 3 Mar 2022.

<sup>17</sup> Please see “Chile sustainability-linked bond: Optionality analysis”, AFII, 5 Apr 2022.

<sup>18</sup> “Sustainability-linked bond of the year: Suzano”, Environmental Finance, 2021.

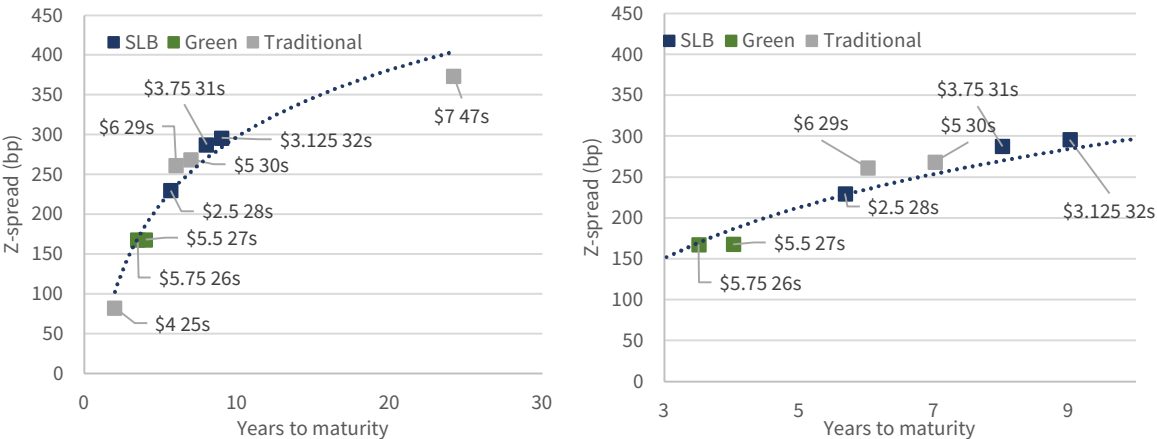
issuance since. The bonds were well received by the market, with the first two achieving an estimated benefit of 15bp compared to traditional issuance.<sup>19</sup>

Figure 4. Suzano outstanding bonds above USD100mm. Source: Bloomberg, accessed 4 Jan 2023.

Description	Issuing Entity	Label	Issue Date	Maturity	Currency	Amount
						Outstanding
SUZANO \$4 25s	FIBRIA OVERSEAS	Traditional	14-Nov-17	14-Jan-25	USD	339,652,000
SUZANO BRLFloat 26s	SUZANO SA	Traditional	29-Jun-18	29-Jun-26	BRL	4,681,100,000
SUZANO \$5.75 26s	SUZANO AUSTRIA G	Green	14-Jul-16	14-Jul-26	USD	516,581,000
SUZANO \$5.5 27s	FIBRIA OVERSEAS	Green	17-Jan-17	17-Jan-27	USD	700,000,000
SUZANO \$2.5 28s	SUZANO AUSTRIA G	SLB	13-Sep-21	15-Sep-28	USD	500,000,000
SUZANO BRLFloat 28s	SUZANO SA	Traditional	17-Oct-19	15-Sep-28	BRL	750,000,000
SUZANO \$6 29s	SUZANO AUSTRIA G	Traditional	14-Aug-19	15-Jan-29	USD	1,748,160,000
SUZANO \$5 30s	SUZANO AUSTRIA G	Traditional	14-Aug-19	15-Jan-30	USD	999,904,000
SUZANO \$3.75 31s	SUZANO AUSTRIA G	SLB	14-Sep-20	15-Jan-31	USD	1,250,000,000
SUZANO \$3.125 32s	SUZANO AUSTRIA G	SLB	01-Jul-21	15-Jan-32	USD	1,000,000,000
SUZANO \$7 47s	SUZANO AUSTRIA G	Traditional	16-Mar-17	16-Mar-47	USD	1,250,000,000

Figure 4 shows Suzano’s outstanding bonds, and Figure 5 shows two charts of bond spreads for the USD issuance. It has a full curve of securities, with the labelled bonds occupying different parts of the curve, probably owing to funding needs when they were issued. This offers a deep pricing curve for SLBs compared to traditional issuance.

Figure 5. Suzano USD bond spreads. Source: Bloomberg, accessed 10 Jan 2023.



The richest bond on the curve seems to be the green bond, \$5.5 27s. This is one of only two bonds issued from Fibria Overseas Finance, a special purpose entity issuing debt for Fibria, which merged with Suzano in 2019. The other is the \$3 25s, which has no natural comps at the very short end of the curve.

Figure 6. Suzano SLB details. Source: Bloomberg, Suzano.

Description	KPI	Observation		Total present value of Step
		Date	Total Step	
SUZANO \$2.5 28s	Water withdrawal intensity /	Dec-25/Dec-26	25bp	0.43%
	Female leadership representation			
SUZANO \$3.75 31s	Emissions intensity	Dec-25	25bp	1.05%
SUZANO \$3.125 32s	Water withdrawal intensity /	Dec-25/Dec-26	25bp	1.07%
	Female leadership representation			

<sup>19</sup> “Suzano Sustainability-Linked Bond”, Blended Finance.

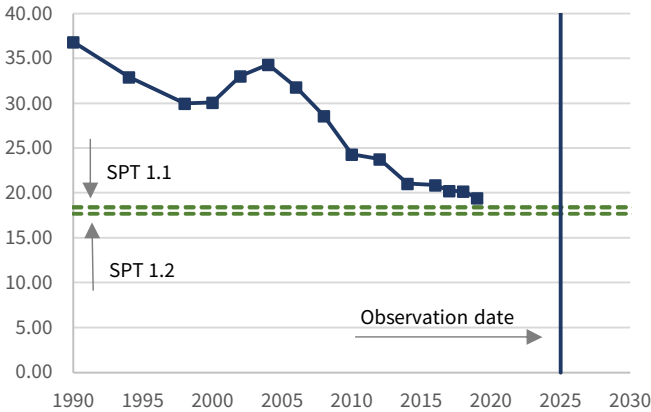
Suzano has published two Sustainability-Linked Financing frameworks,<sup>20</sup> which cover its three SLBs. In terms of materiality, the observation dates are the same for all issues, and so the longer two will pay the step for longer and therefore have higher financial materiality.

The SLBs look slightly rich on the curve, \$6 29s is just over 30bp wider than the \$2.5 28s (without adjusting for maturity) although it has a higher coupon and cash price, which may drive some of the difference. The 3.75% 31s looks to be the cheapest bond, and this has the emissions intensity KPI that, it could be argued, will have a higher correlation to creditworthiness given it is a more conventionally acceptable KPI.

Case Study – Uruguay <sup>21</sup>

Uruguay had never used sustainable finance until, in Oct 2022, it issued a novel step-up/step-down structure where there are both penalties and rewards for missing or achieving targets.<sup>22,23</sup> The bond in question, URUGUA 5.75 34s, has two KPIs; aggregate GHG emissions per real GDP unit and native forest area. As the step-ups/step-downs are all structured in the same direction, they will serve to increase the convexity effects described at the start of this paper; indeed, it is as if the bond has four options.

Figure 7. Aggregate GHG emissions / real GDP for Uruguay. Source: Uruguay.



For the first (KPI1), the base year is 1990, and a reduction of less than 50% (SPT 1.1) by 2025 will induce a step-up of 15bp, whereas a reduction of more than 52% (SPT 1.2) will induce a step-down of 15bp. This is shown in Figure 7. The base year in 1990 is very long ago, and the trend has been for meaningful reductions over most of that period. The last reading of 19.45 GgCO<sub>2</sub> per real GDP was in 2019, and projecting this forward using recent trends suggests it is likely that both SPTs

have already been met, especially as SPT 1.1 and SPT 1.2 are very close together. Figure 8 shows the dynamics of the historic data over different periods. The drift of -1.57% is most conservative and estimates a 2022 figure of 18.42. With this drift, the forward level at 2025 is 17.69, i.e., exactly on SPT 1.2, leaving the option price relatively indifferent to levels of volatility.

Figure 8. Uruguay GHG emissions / real GDP historical dynamics. Source: Uruguay, AFII.

	Average annual drift	Annualised volatility
1990-2019	-1.98%	3.65%
2010-2019	-2.43%	2.23%
2014-2019	-1.57%	1.58%

<sup>20</sup> The first with a single SPT on emissions intensity covers the 3.75% 31s; “[Second Party Opinion](#)”, ISS ESG, 1 Sep 2020. The second with two SPTs, on industrial water withdrawal intensity and female representation in leadership, covers the 2.5% 28s and 3.1% 32s; “[Second Party Opinion](#)”, ISS ESG, 28 Jun 2021.

<sup>21</sup> “[Uruguay’s Sovereign Sustainability-Linked Bonds \(SSLB\)](#)”, accessed 10 Jan 2023.

<sup>22</sup> “[More sovereign SLBs ‘on the way’ after landmark Uruguay deal](#)”, Responsible Investor, 24 Oct 2022.

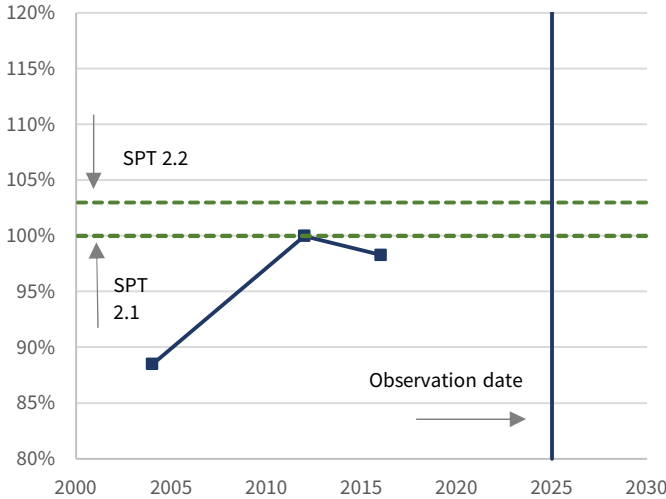
<sup>23</sup> Even just its inclusion of a step-down feature made the bond original. A binomial tree pricing approach is presented in the context of step-down SLBs in “[Notes on risk-neutral pricing of SLBs and step-down structures](#)”, AFII, 25 Oct 2022.

The probability of missing SPT 1.1 and so receiving the step-up is 7%, and there is a 50% of reaching SPT 1.2 and so suffering the step-down. In total, the value of these options is -0.43% upfront, which is -4.3bp running on the structure.

For the second (KPI2), the base year is 2012, and having any reduction at all (SPT 2.1) by 2025 will induce a step-up of 15bp, whereas an increase of more than 3% (SPT 2.2) will induce a step-down of 15bp. There is much less data available on this KPI but what there is, is shown in Figure 9. The lack of data makes it much harder to estimate the achievability of these SPTs. We will use a 50% chance of meeting SPT 2.1 and a 25% chance of achieving SPT 2.2. These probabilities translate into an upfront value of 0.25%, which is 2.5bp running.

The total value of optionality is -0.18% or -1.8bp running.

Figure 9. Native Forest Area compared to 2012 in Uruguay. Source: Uruguay.

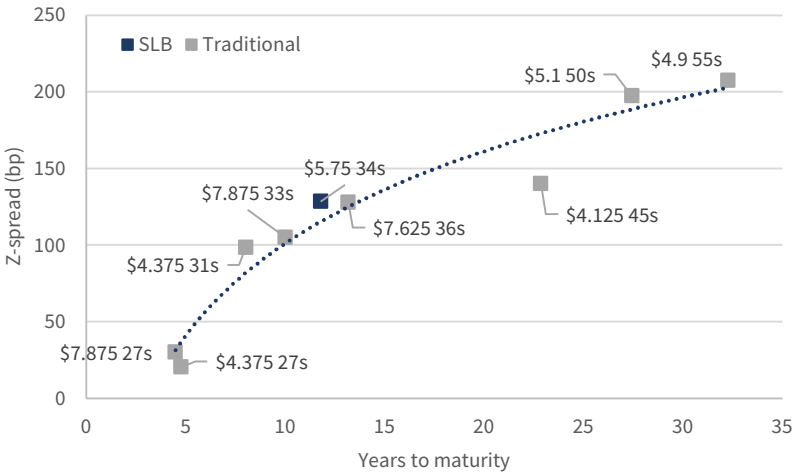


The SPO, provided by Sustainalytics, rates each target as ‘ambitious’, and the 3% increase in native forest area (SPT 2.2) as ‘highly ambitious’.<sup>24</sup>

Figure 10 shows the current pricing levels of Uruguay debt; the SLB seems to be trading slightly cheap, and flat to the 7.625 36s despite a shorter maturity of 18 months. Due to the step-up/step-down nature of this SLB, the optionality can have negative value, as our analysis shows it currently does. This means the traditional bond does not necessarily represent a lower boundary for the price of the SLB. This structure is complex, and

it would make sense to have some kind of illiquidity premium which might further widen the spread.

Figure 10. Uruguay USD bond spreads. Source: Bloomberg, accessed 11 Jan 2023.



<sup>24</sup> “[Second Party Opinion](#)”, Sustainalytics, 14 Dec 2022.



## Appendix 1

Figure 11. Hypothetical pricing for an SLB with duration of 5.

	Mid Spread	Duration	SLB base		SLB Option probability	SLB Vanilla Price	SLB Option Premium	SLB Price	EVB	
			Coupon	SLB Step					Coupon	EVB Price
SPT achieved ->	1.00%	5.000	0.875%	0.250%	50%	99.4%	0.6%	100.0%	1.00%	100.0%
SPT achieved ->	0.75%	5.000	0.875%	0.250%	0%	100.6%	0.0%	100.6%	1.00%	101.3%
SPT missed ->	1.25%	5.000	0.875%	0.250%	100%	98.1%	1.3%	99.4%	1.00%	98.8%
								Move	0.6%	1.3%

	Mid Spread	Duration	SLB base		SLB Option probability	SLB Vanilla Price	SLB Option Premium	SLB Price	EVB	
			Coupon	SLB Step					Coupon	EVB Price
SPT achieved ->	1.00%	5.000	0.875%	0.250%	50%	99.4%	0.6%	100.0%	1.00%	100.0%
SPT achieved ->	0.95%	5.000	0.875%	0.250%	0%	99.6%	0.0%	99.6%	1.00%	100.3%
SPT missed ->	1.05%	5.000	0.875%	0.250%	100%	99.1%	1.3%	100.4%	1.00%	99.8%
								Average move	0.4%	0.2%

Figure 11 gives hypothetical pricing for an SLB that has a positively correlated spread move on achieving/missing its SPT. In the first example, the move is 25bp. The SLB moves on average 0.6% compared to 1.3% for the Equivalent Vanilla Bond (EVB – the vanilla bond which has the same price as the SLB). In the second example, where the spread move is only 5bp, we see the SLB move in the unintuitive direction; selling off to 99.6% on positive news of achieving the SPT and rallying to 100.4% on negative news of missing the SPT. This also gives a move of 0.4% compared with 0.2% for the EVB, and therefore has a larger volatility.

These are hypothetical scenarios to illustrate low levels of correlation. This spread move would not happen overnight, but gradually, as the probability of the SPT being met moved from 50%-100%.

## Appendix 2

Figure 12. Hypothetical pricing for an SLB with convexity. Durations are calculated using Bloomberg YAS and ENELIM 0.375% 27s, calculated 20 Jan 2023.

	Mid Spread	Duration	SLB base		SLB Option probability	SLB Vanilla Price	SLB Option Premium	SLB Price	EVB	
			Coupon	SLB Step					Coupon	EVB Price
SPT achieved ->	1.00%	4.219	0.875%	0.250%	50%	99.5%	0.5%	100.0%	1.00%	100.0%
SPT achieved ->	0.75%	4.230	0.875%	0.250%	0%	100.5%	0.0%	100.5%	1.00%	101.1%
SPT missed ->	1.25%	4.209	0.875%	0.250%	100%	98.4%	1.1%	99.5%	1.00%	98.9%
								Average price	100.00256%	100.00263%

Figure 12 gives hypothetical pricing considering convexity. The SLB has a slightly lower average price; it gives up upside at a higher duration in favour of avoiding downside with a lower duration.

## Appendix 3

Figure 13. Hypothetical pricing for an SLB with convexity and skew.

	Mid Spread	Duration	SLB base		SLB Option probability	SLB Vanilla Price	SLB Option Premium	SLB Price	EVB	
			Coupon	SLB Step					Coupon	EVB Price
SPT achieved ->	1.00%	4.219	0.875%	0.250%	50%	99.5%	0.5%	100.0%	1.00%	100.0%
SPT achieved ->	0.75%	4.230	0.875%	0.250%	0%	100.5%	0.0%	100.5%	1.00%	101.1%
SPT missed ->	1.50%	4.198	0.875%	0.250%	100%	97.4%	1.1%	98.4%	1.00%	97.9%
								Average price	99.47988%	99.47925%

Figure 13 gives hypothetical pricing considering skew, which is that volatility is considered higher for downside moves than upside. This is represented as a 50bp widening on missing the SPT with only a 25bp tightening. In this situation the SLB has a higher average value.

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