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Alternatives in the Design of Sovereign Green Bonds

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Abstract

Many governments have started issuing ‘green’ bonds tied to expenditures on projects with environmental objectives such as climate change mitigation. While well-intentioned, issuance of a green bond by an investment-grade sovereign has no environmental impact, leaves funding costs unchanged, offers no protection from environmental risks, does little for the healthy development of the market for green financing, and represents poor public sector governance. A performance-linked bond whose payoff depends on overall greenhouse gas emissions would be more transparent, cheaper to administer, and more conducive to long-term policy commitment, but may be politically more demanding and difficult for markets to price.

Keywords: green bond; sustainable finance; sovereign debt; fiscal transparency

JEL classification: G18, H63, Q58

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1. INTRODUCTION

The core criterion for a bond to be classified as 'green' is that the proceeds from its issuance go to expenditure on green projects or policies, that is, something that promotes environmental sustainability and in particular the mitigation of or adaptation to climate change. The International Capital Market Association (ICMA) in its Green Bond Principles (GBPs) (2018) provides the definition that 'Green Bonds are any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects … and which are aligned with the four core components of the GBP.' Those four components relate to use of proceeds; process for project evaluation and selection; management of proceeds; and reporting. It is emphasised that '[t]he cornerstone of a Green Bond is the utilisation of the proceeds of the bond for Green Projects.'

This essay describes and compares the various designs of green bonds thus defined that are currently being issued in large volumes by governments, concentrating on those issued by the governments of more advanced economies. That review leads to the question of whether these instruments contribute as much as one might wish to the achievement of public policy objectives, or whether an alternative design might be more effective. The conclusion reached that securities designed to be performance based are more likely to achieve most policy objectives than are the prevailing bonds designed on a 'use of proceeds' basis.

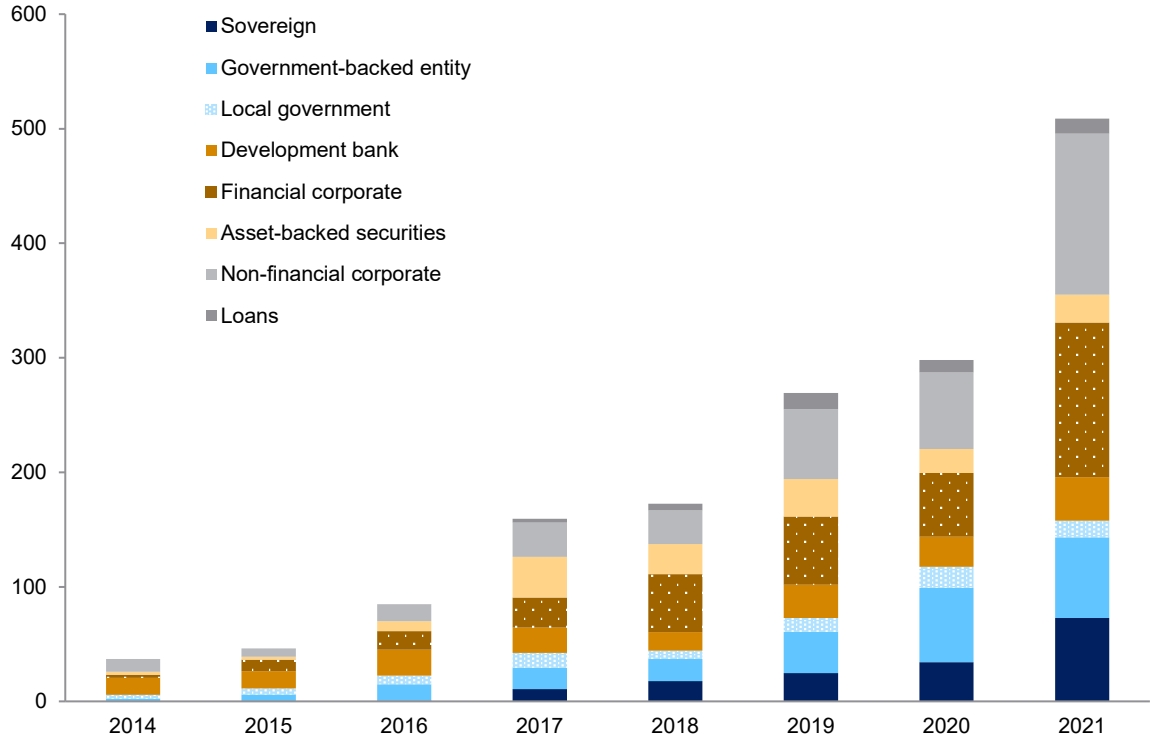
Green financial instruments and in particular green bonds now constitute a distinct and prominent asset class. Issuance of green bonds, including issuance by governments, has grown rapidly in recent years (Figure 1).[1] Ever more governments have issued bonds whose proceeds are meant to be devoted to green causes, among which climate change mitigation is typically the most prominent. Following the initial issuance by multinational banks (MDBs) in 2007, sovereign green bonds (SGBs) have been issued since 2016, with leaders including France, Fiji, and Poland. In the past few years, relatively large amounts have been issued by Italy (EUR19.5 billion), the United Kingdom (GBP25.5 billion) and Germany (EUR38.5 billion).[2] The European Commission will seek to raise up to 30 percent of the Next Generation EU funds (that is, EUR225 billion) through the issuance of green bonds and use the proceeds to finance green policies. Austria inaugurated its SBD with an EUR4 billion issue in May, 2022, followed with an innovative EUR1 billion issue of sovereign green treasury bills in October 2022.

[1] These data cover bonds devoted to financing climate change-related spending only; social and sustainability bonds are excluded.

[2] All data and other information on SGB issues are taken from the websites of the respective debt management agencies, unless otherwise noted.

Figure 1 / Climate Bonds Outstanding

(US$ billions)



Source: Climate Bonds Initiative.

The rapidly expanding supply has been matched by strong demand. Typically, issues have been heavily over-subscribed. The 2019 Chilean US dollar-denominated SGB was 13 times over-subscribed, and the euro-denominated bond was five-times over-subscribed. The 2021 UK issue was about ten-times over-subscribed. The first German green bond in 2020 was over-subscribed five-times, with nearly 200 investors bidding, and the recent inaugural Austrian SGB issue was almost seven-times over-subscribed, attracting 214 bidders, two thirds of whom came from the Eurozone. The 2021 Hungarian 30-year SGB auction was likewise seven-times oversubscribed, and allowed the authorities to increase the issue size by half again to HUF 30 billion.

However, one should not exaggerate the importance of this market: green bonds issued by advanced economy sovereigns still make up only a very small share of the total stock of their bonds outstanding, and also the share of annual gross financing made up of green bonds is typically below ten percent. For example, the UK's green bond issue in 2021 constituted about 5.5 percent of gross funding in that year, and about 0.7 percent of government debt outstanding. SGBs make up a substantial but far from dominate share of the total stock of green securities (Figure 1). Development banks and government-backed entities such as Fannie Mae and Kreditanstalt für Wiederaufbau (KfW) led the early development and remain important, and financial and non-financial corporates have been prominent in the recent expansion.

Governments have issued framework documents in advance of issuing green bonds; Appendix I presents the main points extracted from the framework documents of a selection of advanced economies. The documents explain the overall strategy for achieving sustainability and greening the economy; how the green bond issuance fits into that strategy; the main features of the bonds, such as maturity, coupon, governing law, and other legal matters; the criteria for eligibility of projects to be supported or excluded; the mechanism for verification and obtaining a second party opinion; publication requirements; and the issuance mechanism. The SGBs issued by advanced economy governments are of medium to long-term maturity, with fixed coupon rate and principle, typically governed by respective national laws.[3]

The significant difference relative to a standard conventional sovereign bond lies in the association with certain expenditures. Typical expenditures include investments in renewable energy and public transport projects, but also, for example, research programs and suitable 'tax expenditures' such as tax deductions for insulation costs. Expenditure on items such as the production of fossil fuels is generally excluded, as are expenditures already funded by other green financing, for example, by a development bank.

The greenness of the associated spending activities has to be certified through a so-called second party opinion (SPO): a consultancy is paid to check that the spending to be financed is indeed somehow supporting sustainability, say, by reducing greenhouse gas (GHG) emissions. The certification is undertaken at the time of issue but needs to be repeated periodically for the life of the bond. Countries typically also obtain independent certification of their overall green bond framework, verifying that the program is in line with international market standards such as the UN's Sustainable Development Goals and especially the GBPs promoted by the ICMA. Issuers also submit to external verification the allocation of the proceeds to projects meeting the eligibility criteria. In some cases, countries also use the government's own internal audit service to track the fulfilment of its commitments.

The practice of most countries is to place the proceeds raised by selling SGBs into the government general account along with all other receipts (in line with internationally accepted best practice for cash management). In the case of the UK SGBs, for example, the prospectus and framework document explicitly say that the proceeds are placed in the general government account, subject to overall cash management, pending disbursement. In a few cases the authorities place proceeds in a special sub-account or otherwise try to 'earmark' them, but even then proceeds are subject to normal liquidity management policy. The expenditures on designated projects are tracked and it is announced when the total allocation equals the amount raised.

Some experimentation is on-going to refine the terms and conditions of the bonds, but the differences are not fundamental. Bonds differ across countries on the timing of expenditures to which proceeds are allocated, and how quickly proceeds must be allocated. For example, two thirds of the proceeds from the UK green bonds are meant to go to projects that start within two years of the time of issue. Similarly, the Dutch State Treasury Agency (DSTA) intends to allocate at least half of the proceeds of issued green bonds to expenditures in the budget year of issuance or future budget years, but does not set a deadline for allocating the full amount. The Spanish SGBs are meant to finance current and past expenditures. Proceeds from the Italian SGBs are to go to projects undertaken up to three years before the issuance

[3] OECD (2017, 2018, 2020, and 2022) provide useful overviews of the development of SGB issuance strategies and practices used by advanced economies. The material and reports available from the Green Bonds Initiative (https://www.climatebonds.net) have wide coverage, especially of non-sovereign issuance.

date and one year thereafter, and to be fully allocated within two years. Proceeds from the issue of German green bonds are to go entirely to projects already undertaken.

Another area of experimentation relates to the detail of reporting requirements. For example, both the Dutch and the German authorities are committed to reporting both the allocation of funds to various green projects, as well as the impact in terms of certain environmental metrics, such as a reduction in GHG emissions. Impact reports issued by the UK and Canadian authorities are meant to cover also social co-benefits, such as job creation.

Some more substantial experiments have been undertaken. German green bonds enjoy the provision that investors can at will convert them into “twinned” conventional bonds. In May 2022 the French authorities issued an inflation-linked SGB. Chile has issued a green Eurobond, denominated in US dollars and subject to New York law. Hungary has issued SGBs not only in the local market and denominated in local currency, but also in the form of euro-denominated Eurobonds; Japanese yen-denominated Samurai bonds, Chinese yuan-denominated Panda bonds.

The successful issue of green bonds has inspired the issue of other special-purpose bonds, for example, to support the attainment of sustainability more generally or the promotion of social objectives, such as the wide availability of healthcare. Leaders in the issue of sovereign sustainability bonds, meant to finance both ‘green’ and ‘social’ expenditures, include Chile, Luxembourg, and Slovenia. Mexico has issued bonds denominated in both euros and Mexican pesos linked to expenditures that further the attainment of Sustainable Development Goals (SDGs). Those other special-purpose bonds are conceptually similar to SGBs, so for simplicity attention here focuses on green, climate change-related bonds, which constitute by far the major class for sovereign issuers.

Debt management offices or treasuries, and also market participants and commentators advance several arguments for the new enthusiasm for issuing SGBs. The list of arguments presented below has been gathered from SGB framework documents; bond issue documentation and investor presentations; press releases, surveys of issuers (such as Harrison and Muething, 2021); newspaper reports and opinion pieces; blogs; and presentations given at sundry seminars and workshops by issuers, investors, academics and policy analysts.

These arguments are worth considering and critiquing in order to establish whether the issue of SGBs is worthwhile. Such a review may suggest ways to improve the design of SGBs or how they are issued and promoted. The assessment will be based on considerations of the effectiveness of SGBs in achieving policy objectives related to ‘greening’ the economy and promoting sustainability, and also their compatibility with other objectives, such as good governance, policy transparency, and consumer protection. Caldecott (2020) lays out conditions that any financing or instrument needs to meet to make a difference to the real economy transition, namely, that the activity supported is compatible with the global carbon budget, and that ‘the instrument must make a clear and measurable difference to the activity in the real economy’ through the cost of capital; provision of liquidity; enhancement of climate change risk management; encouraging company or government adoption of practices that support decarbonisation goals; or through spill-over effects. These criteria are implicitly used here, although it is convenient to combine some, for example, enhancing climate change risk management and spill-overs through the development of the green finance market as a whole.

A review of a sample of official framework documents reveals that governments are cautious about expressing publicly their objectives in issuing green bonds. Most published objectives relate to market development, not the environmental impact of government spending or other actions. No framework of which the author is aware establishes criteria or a mechanism to determine whether objectives have been achieved. Explicit claims that the SGBs finance specific expenditures are scarce, despite that being the core criteria for being a green bond as set out in the ICMA GBPs. Also, authorities are careful to distinguish between verifying and reporting that funds equivalent to SGB proceeds have been allocated to eligible projects, on the one hand, and the overall environmental impact of those projects, on the other.

This cautiousness may reflect the awareness in national Debt Management Offices (DMOs) that their primary objective is ensuring the economical funding of government (in terms of risk-adjusted cost over the medium term), and not the pursuit of other government objectives such as greening the economy. The Austrian Treasury, for example, says in its mission statement that its 'central task is to secure the government's funding under a predetermined risk tolerance and at the lowest possible medium- to long-term cost.'[4] This mandate is embedded in law: the Federal Financing Act (2017) Sec. 2a. stipulates that it is to fulfil its tasks according to the principles of risk-averse financial management; strategic planning; a suitable organisational structure; and transparency. Specifically, '[t]he minimisation of the risks is to be weighted more heavily than the optimisation of yields or costs.' Therefore, the issue of SGBs by a DMO has to be rationalised in terms of reducing overall funding costs or risks—perhaps in the long run through the development of the bond market and the investor base—or at least not impeding the achievement of that objective while supporting other government policies.

2. RATIONALES FOR ISSUING SGBS

Financing green government expenditures

The first argument for issuing green bonds is that they finance the expenditures needed to achieve environmental objectives including sustainability and carbon neutrality; the exclusive application of proceeds to these purposes is the defining characteristic of green bonds. Directing funds raised to expenditures on relevant projects and other policies are intended to make them easier to implement. It is well established that a large volume of investment and other spending, including by the government, is needed in order to reduce the emission of greenhouse gases. The issue of green bonds mobilises the needed resources and delivers them on target.

Yet, this argument is undermined by the impossibility of linking specific revenue streams to specific expenditure items, at least for an investment-grade government that is not subject to a liquidity constraint. Money has the property of 'fungibility,' that is, it is an undifferentiated mass, so that one cannot track part of a monetary stream from inflow to outflow, just as one cannot track part of a flow of water from when it enters a pond to when it flows out.[5] The applicability of fungibility may be illustrated using approximations to UK aggregates: total UK government debt in 2021 was about GBP2,300 billion; total government receipts were about GBP1,000 billion, of which gross government financing was about GBP300 billion; and SGB issuance was GBP16 billion. Public sector gross capital expenditures—not all

4 See https://www.oebfa.at and links therein.

5 Financial stocks and flows, which consist only of numerical entries in an electronic registry, meet the criteria for being fungible even better than does water, which consists of individual molecules.

of which is 'green,' but which excludes many 'green' expenditures—was about GBP120 billion. Among such large aggregates, there is no way to substantively connect the GBP16 billion of SGB proceeds to particular expenditures. Such an issuer's green projects cannot truly be said to be financed by receipts from green bond sales (or any other particular source).

To claim that SGB proceeds are allocated to individual expenditure items borders on misleading the investor.[6] The logic of fungibility applies to government as well as the private sector: investors and possibly market conduct authorities would hold to account a company that puts such statements in the issuance prospectus or ex post, when it is engaged in many other activities and has a large and multifaceted treasury operation. The widespread concern about 'greenwashing' in finance relates to when an entity obtains financing on the basis that it undertakes some specific green investment, when the entity's operations as a whole are not environmentally sustainable and most of its cash flow and financing are correspondingly conventional.[7] Some investors have expressed such concerns about SGBs.[8]

Fungibility implies, furthermore, that SGB funding by these issuers has no effect on investments and thus has no environmental impact. Such countries can mobilise financing to enable the chosen investments whether or not the bonds are deemed green. The proceeds from an issue of SGBs may be placed in the general treasury account or in a special sub-account, but spending on particular investments putatively attached to green bond goes on independently. The designated expenditures can be tracked, or sub-account entries can be made, but that does not bind them to specific revenues received before or after.

The lack of impact is most intuitive where SGB proceeds are allocated to refinancing expenditures that have already been made, but the argument applies also to future expenditures. Once monies have been spent on a project, subsequent financial operations cannot affect that project or its impact on the environment. As discussed above, many SGB frameworks allow governments to allocate proceeds to refinancing long-past expenditures. Yet even if the associated expenditures have not yet been disbursed, the design of a bond does not influence the real-world effects of those expenditures.

Only if the government issued such a volume of green bonds that the receipts exceeded what would otherwise be spent on green projects, would fungibility not apply and the SGB issue led to an increase in green spending over what would otherwise occur. This condition is far from being met in any advanced

6 Arguably, the statement that SGB proceeds are allocated to particular expenditure items is not false but meaningless. Under some approaches to the philosophy of language, a statement 'A' that purports to be an empirical fact (rather than, say, a logical necessity) is meaningful if and only if there is some conceivable observational difference between the state signified by 'A' and that signified by 'not A.' In this case, there is no observable difference between the state where a highly-rated sovereign's green projects are partly financed by the issue of green bonds, and the state where they are not and the receipts from green bond issuance flow into general revenue.

7 A search for 'greenwashing' on the Financial Times website yielded 560 hits, including three in the month of March 2022 alone. A typical example is the article by Fletcher and Oliver, 'Green investing: the risk of a new mis-selling scandal,' February 20, 2022. https://www.ft.com/content/ae78c05a-0481-4774-8f9b-d3f02e4f2c6f. Gatti et al. (2019), de Freitas Netto et al. (2020), and Freeburn and Ramsey (2020) are examples from the academic literature on greenwashing by corporates.

8 See quotes in 'Environmental qualms cloud Poland's green bond sale,' Financial Times, February 6, 2018, https://www.ft.com/content/634b4fe8-074b-11e8-9650-9c0ad2d7c5b5. NN Investment Partners 'has decided that Polish green government bonds are currently not credible and therefore not eligible for the green bond portfolio. This is mainly due to the lack of policy in Poland to phase out coal-fired electricity' even though the Polish SGB meets standard criteria; see https://www.nnip.com/en-INT/professional/insights/articles/green-bond-bulletin-market-growth-green-qe-and-beware-of-greenwashing.

economy.[9] Should the condition hypothetically be met, the green funding would have the effect of forcing the government into over-investment, spending more than it judges to be optimal based on an evaluation of normal public expenditure criteria. However, there are two situations when this distortion may be advantageous as a second best. First, a government with a poor credit rating may be subject to a liquidity constraint, that is, it may not be able to obtain as much financing as it wants, or at least not at a reasonable cost. Therefore, it can spend only up to its available liquidity. For such a government, issuing a green bond may loosen the constraint and enable additional worthwhile investment. Second, a government may have difficulty committing to maintaining a large volume of green spending, especially if the party in power changes. Then issuing a vast amount of SGBs may serve as a pre-commitment device, pressuring the new government to keep up green expenditures, although the pressure will not be strong because the new government can ignore the obligation (as will be explained shortly).

In practice, moreover, governments decide on the design and scope of investments and other expenditures well in advance of any funding decision, so the expenditures are pre-determined and cannot be affected by issue of an SGB. When a green bond is to be issued, typically the government looks through its projects and selects some that meet the chosen conditions for greenness. In some cases, the bond proceeds are meant to be spent on projects that have not yet started, but what that means is that they are included in a pipeline of projects in preparation. In any case, what is spent on the projects and their environmental impact is unaffected by the financing through the issue of green bonds.

The concept of fungibility applies to flows, as explained above, and also to stocks, so that what it means for the proceeds of a long-term bond to continue funding green investments after spending is executed is obscure. Some green bonds have a maturity of twenty, thirty or even forty years. Hence, the building phase of projects that are purportedly funded when a green bond is issued are likely to be completed before the bond matures. In some cases, the physical fixed assets (for example, housing insulation) may have fully depreciated and physically disintegrated before the maturity date. Meanwhile, the government may have undertaken refinancing operations equivalent to a multiple of total government debt outstanding. Given all that, one cannot say that a stock of green bonds, constituting a small share of government debt, is somehow attached to a specific stock of physical assets, some of which may not even be owned by the central government.

That governments tacitly accept the implications of fungibility is evidenced by the fact that there is no remedy for non-fulfilment of the pledge to use the proceeds for green purposes.[10] Thus, if the government does not pursue the projects to which the bonds are notionally attached, or if the projects do not achieve the desired outcomes, investors have no recourse or grounds to sue (an extract from the relevant UK disclaimer is reported in the Appendix). The obligation is not binding. Governments' acceptance of this point is evidenced also by the fact that the published 'impact assessments' (measured in reductions in GHG emissions or the like) refer to the projects which are putatively (partly) financed by issuing green bonds, without claiming that the impact is in any way contingent on the form of financing. [11]

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9 The ICMA GBPs recommend that identified eligible expenditures comfortably exceed planned SGB issuance so that proceeds can always be allocated. Countries have explicitly followed this recommendation.

10 See Doran and Tanner (2019) for a legal perspective.

11 Mexico's 2021 allocation and impact report includes the disclaimer that [i]t is imperative for the reader to comprehend that those specific resources [i.e., the net proceeds of the SDG bond issue] were not destined to any precise "Eligible Expenditure"; instead, an amount equal to the net proceeds of our inaugural SDG Bond was allocated to existing Eligible Expenditures.'

Funding costs

A second argument is that green bonds are cheaper, that is, they have a lower yield. A lower yield is good for the government's finances generally, and also reduces the required yield needed for making green projects viable. A lower yield is especially advantageous when the bonds are held by foreigners, who are willing to lend their savings cheaply.

Indeed, it is true that advanced economy SGBs have achieved a small "greenium" as it is called, that is, a somewhat lower yield than on their conventional bonds. The recent experience of the UK and Germany suggest that the yield is reduced by about two basis points (0.02 percent) in the primary market.[12] The difference typically expands to four or five basis points in the secondary market, although that's of no help to the issuing government. The implication, however, is that the gains from issuing bonds are very small indeed. For example, the UK issued GBP16,000 million in green bonds in 2021. Even if it enjoyed a reduction in yields of three basis points, the saving on gross funding costs would amount to only about GBP4.8 million per year. To put that in perspective, in October 2021 the UK government was spending about that much per week on consultants for its Covid track and trace system.[13] The quantity of bids for SGBs has been large, with tenders heavily over-subscribed, but demand is very price elastic: perhaps because investors understand the fungibility argument, they are not willing to accept more than a marginal reduction in yield.

The UK experience suggests that retail investors have no more willing to give up yield for the sake of putatively funding the government's green projects than are professional investors. The UK National Savings and Investment (NS&I) scheme initially offered Green Savings Bonds with a pre-tax interest rate of 0.65 percent, but take-up was reportedly slow.[14] In February 2022 the interest rate was doubled to 1.3 percent for three-year, fixed yield instruments. The NS&I also offers so-called Premium Bonds with an annual prize fund rate of 1.0 percent, where earnings are tax free.[15] For a saver paying the basic rate of income tax of 20 percent, the Green Savings Bonds are 4 basis points more expensive for government than are Premium Bonds.[16]

Moreover, the net reduction in yield is offset by higher costs: as mentioned, issuing SGBs incurs an extra administrative burden and the explicit costs of having the appropriateness of funding associated with green bonds certified by an outside party on an on-going basis. Most countries have offered in addition to prepare and publish regular impact assessments, sometimes with outside verification. Information on the extra administrative costs and fees for outside certification and assessment are not publicly available, but are plausibly on the order of EUR1 million or more per year, with extra costs at

[12] See https://www.insightinvestment.com/investing-responsibly/perspectives/first-issuance-of-green-gilts/; https://www.insightinvestment.com/investing-responsibly/perspectives/second-issuance-of-green-gilts/; https://www.deutsche-finanzagentur.de/fileadmin/user_upload/institutionelle-investoren/pdf/TransactionReview_10YGreenBund_2020-2030_en.pdf ; https://www.deutsche-finanzagentur.de/fileadmin/user_upload/institutionelle-investoren/pdf/TransactionReview_30YGreenBund_2021-2050_en.pdf ; https://www.deutsche-finanzagentur.de/fileadmin/user_upload/institutionelle-investoren/pdf/TransactionReview_30YGreenBund_2021-2050_2022_dt.pdf; Harrison (2021); and Ando (2022).

[13] See https://www.theguardian.com/world/2021/nov/21/england-covid-test-and-trace-spending-over-1m-a-day-on-consultants.

[14] See https://www.theguardian.com/money/2022/feb/19/nsi-doubles-interest-on-green-savings-bond-but-returns-still-lag-market-leaders.

[15] See https://www.nsandi.com.

[16] See https://www.gov.uk/income-tax-rates .

start-up.[17] Hence, the net reduction in costs is significantly less than the reduction in the yield on government debt.

These very small reductions in yields have been obtained for issues that are large in absolute terms but not large relative to the total debt market. If issuance was increased to levels where fungibility would be limited, and assuming that demand is even slightly price elastic, the 'greenium' would be even smaller. Chile's experience is suggestive of what may happen as supply expands: for its first two issues in 2019 it achieved a 'greenium' of 5 to 10 basis points, but by 2021 issues were priced just 0 to 3 basis points below the secondary market yield.[18]

Green bonds may be advantageous for some issuers not because of a lower yield, but because they attract a wider investor base, and thus reduce roll-over risk and, possibly, price volatility. SGBs may attract a new class of investors precisely because of their 'greenness.' The investor base thereby becomes more diverse, with the dedicated green investors perhaps reacting to news (say, about market developments or environmental policy actions) in a distinct manner. Hence, overall demand for the sovereign's debt is more stable. Green investors may also have a distinct 'preferred habitat' along the yield curve, and therefore their presence facilitates issuing bonds within that range of maturities.

The advantage of widening the investor base to green investors is likely to be material to small and irregular issuers, as well as to emerging market issuers, but not to medium- to large-sized, highly rated issuers. Expansion of the investor base, including for longer-dated securities, seems to have been an important motivation for the Irish and Chilean authorities. Yet, few investment-grade sovereigns are small and irregular issues. For example, Belgium, with Federal government securities of about EUR460 billion outstanding in early 2022 (of which about EUR7 billion were green bonds) and annual gross issues of about EUR48 billion, is a large and frequent issuer compared to all but a handful of nongovernment or emerging market sovereign issuers.[19] It can easily tap global markets, including for a fifty-year bond, and has built out average maturity to ten years, so roll-over risk is minimal. Moreover, SGB issuance by a typical advanced economy sovereign would have to be expanded from current levels by at least an order of magnitude before it would make a noticeable difference to the risk-return and roll-over risk characteristics of the overall government debt portfolio. Hence, any benefit from an expanded investor based would require a major shift in strategy, and market behaviour after such a structural change cannot easily be anticipated.

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17 The author requested from the UK government, under the freedom of information act, information on the cost of obtaining second party opinions, but the request was denied on the grounds of 'the strong public interest in protecting sensitive operational and market-related activities of the DMO where disclosure could harm the DMO's ability to achieve best value in financial markets.'

18 https://www.hacienda.cl/english/news-and-events/news/chile-reaches-record-low-yields-in-green-social-bond-issuances

19 Source: Belgian Debt Agency; see https://www.debtagency.be/en/datafederalstatestatistics .

Supporting the market for green bonds

Supporting the market for green bonds, which is connected to expanding the investor base, is the most emphasised motive for SGB issuance in countries' own green bond frameworks. The notion is that issuing an SGB is essential both to meet demand for instruments from green investors, and to develop a thriving market for green finance, which in turn will fund private and non-central government green investment in the needed large volume and moderate cost. An SGB is seen as a public good that only central government can provide, beneficial for the country as a whole even if there is no direct benefit to government.

The government may wish simply to provide what investors seem to desire by substantially expanding the palette of available instruments to include medium- to long-term green bonds that are effectively free of default risk. There is manifestly strong demand for green financial instruments, as shown by the heavy over-subscription of government issues, but the private sector and emerging markets can provide mostly equity and medium-term instruments that carry significant credit risk. Only top investment-grade governments can provide very large volumes of 'riskless' green fixed income instruments, which an investor can place in its green portfolio in order to achieve a desired risk-return balance. As noted above, an SGB shares the same conditions and creditworthiness as the conventional government bond with the same tenor and coupon. If the pricing of investment-grade SGBs is very closely aligned with that of conventional bond—as is the case—they also bear almost the same market risk.

This equivalence in risk exposures between a green and a non-green bond, combined with fungibility, implies that SGBs do not provide what sincere green investors are seeking. A green investor may wish to hold a substantial amount of green assets because that investor feels a moral duty to promote environmental causes, and views funding GHG-intensive investments, say, as unacceptable. Yet, due to fungibility, SGBs do not have any direct environmental impact and cannot meaningfully be connected to particular expenditures. Hence, they do not serve this moral purpose.

Alternately, an investor may view green financial assets as offering a good risk-return trade-off, at least over the longer term (see, for example, Steinmetz and Shah, 2018). The current yield of a green asset may be undistinguished, but perhaps it offers a hedge against environmental risks and especially climate change-related risks, such as more widespread drought or the imposition of carbon taxes.[20] Yet, here too SGBs do not offer any such hedging: their pay-off is independent of the realisation of any environmental risk or even the success of the projects which they notionally finance. The notion that SGBs complete the market for green instruments because they are fully backed by the government and thus default-free contains a contradiction: their default-free status implies that their returns are no more sensitive to environmental risks than are those on conventional debt, so from a risk management perspective they are identical. The riskiness of a sovereign may depend on the respective country's exposure to environmental risks, and the government can do something about that exposure, for example, by improving water management and incentivising decarbonisation. Any improvement in exposure to these risks benefits all government debt and indeed private sector financial instruments related to that economy, not only SGBs. Hence, SGBs do not facilitate management of climate change-related risks.

[20] Sometimes the distinction is made between 'green' or 'sustainability' instruments, whose proceeds are meant to fund green or sustainability projects, and 'environment-social-governance' (ESG) instruments, which are designed to offer protection against ESG-related risks. Using this terminology, the SGBs are green but not ESG instruments.

Asset managers may wish to hold SGBs in order to fulfil a mandate from investors who do not appreciate the limitations of this asset class, or to meet regulatory requirements. Such demand from managers is understandable but does not offer grounds for a government to issue SGBs. The weaknesses of SGBs in satisfying investors' reasons for investing in green assets is discussed above. If instead demand for SGB is based on regulatory requirements, in effect SGBs are being subsidised, financed out of an implicit tax on investors. Such an indirect approach, where both the public benefit and the cost are non-transparent and hard to quantify, is prime facie unsatisfactory and unlikely to help establish a self-sustaining, efficient market.

Looking more at market functioning, it could be suggested that the government is uniquely placed to issue a very large volume of homogeneous green bonds, and thereby promote the liquidity of these bonds and the market as a whole.[21] Many studies have investigated the link between issue size, liquidity, and yields, and found that large issues do tend to achieve greater market liquidity (Hardy, 2022, presents related empirical results and summarises the literature). A sustained commitment to regular issues of suitable instruments seems to be conducive to the establishment of an active market. Market liquidity is of value to issuers and investors, and investors are generally prepared to accept lower yields on a bond that enjoys more market liquidity.

Yet, use-of-proceeds-based SGBs may not be best suited to playing this leading role, partly because the association with specific, identified green expenditures may impede the establishment of a large, regular issuance program of homogeneous assets. First, if each SBG is indeed linked to a designated set of expenditures, as suggested for example by the periodic allocation reports, then SBGs are heterogeneous. Investors may treat issues differently depending on which projects are supported. Second, annual eligible expenditures may be too modest to permit the creation of anything but a niche product. Austria for example claims to have the highest share of green expenditures in Europe, the equivalent of 1.3 percent of GDP or 3.4 percent of central government expenditures in 2021.[22] Government debt currently amounts to slightly over 80 percent of GDP. If one accepts the ICMA guidance that eligible expenditures should comfortably exceed issuance, it would take Austria at least a decade to build up SGBs outstanding equivalent to 10 percent of GDP or one eighth of total government debt.

Furthermore, there is little evidence of liquidity spilling over from one issuer to another, or even from one issue to another, so the presence of a few large-volume benchmark SGBs may do little for the overall market liquidity of green instruments. The empirical evidence from other financial markets is that issuance volume above a threshold improves the liquidity of the instrument in question, and possibly all instruments of a large and frequent issuer enjoy enhanced liquidity. Less clear, and less investigated, is whether the liquidity of similar instruments issued by others is stimulated. For example, many European countries have large and active government bond markets, but their corporate bond markets are relatively small and illiquid, so any liquidity spill-over in these markets seems to be impeded by other factors.

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[21] The German government green bond framework, for example, emphasises the importance of providing a liquid green instrument to serve as a European benchmark. The provision under which an investor can convert a German SGB on demand into a paired conventional bond may widen the appeal of the SGB and therefore deepen the market. However, the same provision may reduce liquidity because an investor who wishes to sell does not need to find a buyer, and diminishes the comparability of German with other SGBs.

[22] See material at https://www.oebfa.at/en/financing-instruments/green-securities/green-investor-presentation.html.

Moreover, the aim of achieving a more stable investor base may work against the aim of enhancing market liquidity. One major debt management motivation for issuing SGBs has been to attract long-term investors who are less sensitive to short-term developments. Yet, a strong presence of such 'buy-and-hold' investors will make the market less liquid, and could even raise funding costs. This phenomenon has been documented in the market for US inflation-linked government bonds, so called Treasury Inflation-Protected Securities (TIPS) (see Andersen et al. (2021) and the literature cited therein going back to 2004).[23]

It has been suggested that SGB issuance helps market development by establishing standards for their specification and by setting a good example for the private sector.[24] The government can issue in sufficient volume to determine a norm, and thereby should enable and inspire others to finance private sector green investments using comparable instruments. Rather than just verbal exhortations to others to mobilise financing for investment in sustainability, a government should show how to do it and have something at stake.

If it is a matter of setting market standards, for example, in the detailed terms and conditions of a green bond, there seems to be no need for many individual sovereign governments each to issue their own green bonds. A few leaders, perhaps MDBs, could take on this role. Indeed, it is the MDBs who initiated the market and still largely set the pattern.

The SGBs issued to date may in fact have inadvertently reduced standardisation by using idiosyncratic eligibility criteria. The international community is still working out the best taxonomy in terms of what counts as being green or sustainable. Rival taxonomies have been put forth by the IFC and the European Commission, for example, but they are still evolving. Some countries have followed the ICMA taxonomy, but others have included other elements related to climate change adaption (e.g., through improving flood defences) that do not meet the ICMA criteria.[25] [26] Thus, the proliferation of national green bonds, often issued under national taxonomies, has increased fragmentation in some dimensions.

One may ask whether sovereign green bonds do indeed set a good example for others to follow. As argued before, there is an element of misleading investors in the claim these SGBs go to financing green investments. That is not a practice one necessarily wants others to follow.

A related argument is that the government issuing an SGB in substantial amounts may help establish a green bond market in the respective country. A critical mass of instruments can be built up in the national financial centre, which should stimulate trading activity and the development of investor expertise and attention. This point may have some validity, although it is essentially a mercantilist one: debt management is being used as a form of industrial policy. A country may feel it has to issue SGBs in order not to fall behind its competitors in what may amount to a zero-sum game. The motivation is,

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[23] Dudley et al. (2009) suggest the illiquidity premium on TIPS has declined over time.

[24] The Swedish government inquiry that preceded SGB issuance placed emphasis on 'making green bonds more conventional and lowering the threshold for other issuers to enter the market.' 'Leading by example' is an explicit objective of the Slovene authorities. The Chilean authorities aspire to set an example and benchmark also for other sovereigns in the Americas.

[25] Government is typically not covered by these taxonomies, in acknowledgement of the difficulty in meaningfully isolating a fraction of government expenditure as "green," even before revenues are considered.

[26] See also Ward et al. (2020).

though, inconsistent with the notion of a European Capital Market Union, where investors, issuers, and intermediaries operate freely across the European Union without regard to location by member state.

The effectiveness of government efforts to 'pump prime' a financial market has proven to be limited in the absence of a pre-existing investor base. The UK, for example, issued small amounts of government sukuk (bonds compliant with the principles of Islamic finance) in 2014 and again in 2021, largely with a view to establishing London as a centre for these instruments.[27] However, UK issuance is trivia compared to that originating in countries from the Gulf Cooperation Council and the Far East, notably Malaysia and Indonesia. London is one centre for Islamic finance generally, but it is difficult to attribute this success to small and sporadic issuance of government sukuk.[28] Regarding green bonds, non-sovereigns have generally led sovereigns (Figure 1). In the case of Hungary, for example, the non-sovereign green bond market developed rapidly in advance of the first local SGB issue (Becsi at al., 2022). Also, non-sovereign green bonds typically had a 10-year tenor, so the local SGB with a tenor of 30 years does not seem suited to be a benchmark.

Transparency, governance, and political economy

Some issuers and commentators have stressed that issuing SGBs increases transparency in regard to government spending on environmental projects. Precisely because the greenness of bonds has to be certified through an SPO, the government needs to describe the planned and realised environmental impact of its projects, and the costs, in an accessible manner. a green bond framework even commits the government to regular updates. Most government projects are not so extensively explained or publicised. Thus, issuing green bonds can occasion a transformation of practice and allow the public to fully understand the scope, rationale, and effects of these projects.

This argument elides the question of why a bond has to be issued in order to generate and publish this information. If greater transparency is the objective, it could be achieved without issuing any bonds, for example, by obtaining and publishing second party opinions on the government's projects, at the initiation stage and regularly thereafter. There is nothing stopping a government documenting and publicising its efforts and outcomes in any policy area. Moreover, transparency and public understanding are ceteris paribus desirable across most government activities. If its enhancement requires the issue of earmarked bonds, many other sorts should be issued—perhaps for schooling, healthcare, and military procurement. The example of SGBs seems to open the door to multiple special-purpose bonds for many other purposes, which would 'cannibalise' the bond market, constrain resource allocation, and perhaps ultimately reduce overall transparency.

In addition, the appeal of greater transparency on specific expenditure items is counterbalanced by the obscurity of the claim that the proceeds of SGBs are used to fund named green projects and of how those specific projects fit into the government's overall policies. As established, for a highly-rated sovereign it is disingenuous to connect spending on specific projects to the proceeds of SGB issuance. Furthermore, the government may offer extra information on the environmental impact of certain projects, but those projects

[27] HM Treasury news story, 25 March 2021, https://www.gov.uk/government/news/uk-bolsters-islamic-finance-offering-with-second-sukuk. The yield is comparable to that on conventional bonds.

[28] According to International Islamic Finance Market (2021), in 2020 the UK's market share in overall international sukuk issuance by location was 0.53 percent (Table 5A); its share by jurisdiction of issuer was 0.12 percent (Table 5B).

may constitute only a small part of the government's activities, and their impact may be unrepresentative of the totality of outcomes of government policies. Greater transparency on a narrow range of activities may give a misleading impression of the impact of government policies in general.

Relatedly, it is emphasised by some issuers of green bonds that the prospect of doing so will galvanise government ministries to address sustainability and its connection to financing. A hard deadline to find and document the projects to be financed, and to certify their greenness, is meant to energise not only the Ministry of Finance, but also other concerned ministries. A variety of agencies should be more motivated to coordinate, cooperate, and communicate better.

This effect may have occurred with some SGB issues, but it is a very negative indication of the functioning of government. One would hope that a government that sets a priority on some cross-cutting area can achieve coordination and effective policy implementation without issuing a bond. If the only way to get such a coherent response is to issue a bond, then perhaps a government should issue bonds for many priority purposes. There is no obvious reason why environmental policy is uniquely challenging.

A connected argument is that the issue of SGBs provides information on the public's willingness to expend resources on sustainability. A lower yield on bonds dedicated for these purposes indicates a general willingness on the part of investors (and implicitly the public) to accept low yield in exchange for improving sustainability and mitigating climate change. Perhaps investors think that the green investments generate somewhat lower yield but also lower risk. The pricing of long-dated bonds may be especially valuable in revealing views on intertemporal trade-offs. Yet, as has been documented above, it seems that the public's willingness to pay for sustainability in the form of lower yields is very modest, even when the amounts issued are small from a macroeconomic perspective or relative to investment needs. Furthermore, if one accepts that the green bonds are dedicated to the financing of particular projects, then the pricing does not tell you about the public's overall interest in undertaking such activities, but only in their valuation of those specific projects.

On a general level, tying receipts to expenditures is regarded as poor fiscal policy and poor governance. A rational government decides its expenditure priorities by equalising marginal social benefits to marginal costs, subject to the total envelope of resources at its disposal and after suitable discounting of future costs and benefits. It does not try to say which particular dollar or euro of revenue goes towards which particular expenditure, and thereby constrain its policy actions unnecessarily. If green bonds were issued in such volumes that fungibility was limited and they had an environmental impact, then the government would be confronted by the drawbacks of having such tied revenues.

Government responsibility regarding achieving carbon neutrality and sustainability goes well beyond the implementation of certain projects or other specific policies eligible to count as 'green' under current frameworks. Rather, government can be seen as being responsible for the overall performance of the country, including aggregate net GHG emissions, other forms of pollution, and measures for climate change adaptation. SGBs emphasise specific investments, perhaps in the form of a few windmills and public transport expansion. However, most relevant government policies and activities are not covered: the crucial areas of regulation, taxation, and compensation of those who lose out from transition are largely neglected, and contrary policies are not taken into account. A country can build any number of carbon-intensive power plants and still issue bonds that follow best practice for being green. Not only for investors, but also for the general public there is an element of being misled when in such circumstances

the government issues green bonds. Public policy would look at the totality of activities of the government and the country as a whole, not just specific projects.

One reason why governments in fact issue green bonds may be that they want to give the impression that they are taking seriously the need to mitigate or adapt to climate change, without having to devote significant resources or address the very difficult distributional effects that effective policy would generate. SGBs are easy for highly-rated countries to issue precisely because they have no real effect on GHG emissions, and do not give rise to conflict over the distribution of burdens that a real adjustment to sustainability would generate. They do not do anything, they do not cost anything, but they give a good impression. Their issue is a form of "virtue signalling."

3. AN ALTERNATIVE

If only from the perspectives of sound fiscal policy and good governance, it would make more sense for the government to issue bonds whose payoff depends on the country's overall performance in achieving sustainability, and specifically in reducing GHG emissions; the link is to the impact, not the funding of specific activities. Many countries have announced commitments to decarbonisation, and some such as the UK and Canada have embedded this commitment in legislation, so in principle they should be prepared to reflect those commitments in their debt instruments. A bond that is fit for this purpose would make excessive overall GHG emissions costly for government, and offer a form of insurance for those who would be hurt by higher national emissions. It will be argued here that a true sovereign sustainability-linked bond (SSLB) would in addition serve other purposes, such as promoting the sound development of the market in green finance and potentially even strengthening policy commitment.

The key feature of a green performance-linked instrument such as an SSLB is the provision that the coupon and/or final principal payment be positively related to the respective country's GHG emissions, or to some close proxy such as the share of hydrocarbons in energy use. [29] The relationship need not be linear or strictly monotonic: one approach would be to reduce the pay-out for over-achievement of targets, with a flat but relatively high playout in case of excess emissions. Other possible approaches include penalising with higher pay-out only very large excess emissions, or using discrete step-ups and step-downs in coupon rates. Choices would have to be made on such matters as the sensitivity of coupon rates to performance; the tenor of the instrument(s); and how to treat progress along the path to net zero. What matters is total cumulative GHG emissions and then reaching a steady state with non-positive emissions; the payoff structure would need to take into account both flows and the accumulating stock.

Corporates and emerging market countries seem to be ahead of large advanced economy sovereigns in developing sustainability-linked bonds (SLBs). Impact- or performance-linked instruments have been proposed for corporate green finance (see for example Ehlers et al., 2020, and Vulturius et al. 2022), and the achievement of development indicators in emerging and developing countries (see Silva and Stewart, 2021a and 2021b). Analogous proposals have been put forward for the Next Generation EU issues (Zachmann, 2020) and the UK (Murray, 2021, and Corfe and Rosales, 2022). Cheng et al. (2022)

[29] ICMA (2020) provides the somewhat wider definition, going beyond climate change, that SLBs 'are any type of bond instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined Sustainability/ESG objectives.' A performance-linked instrument explicitly providing general government funding does not meet the ICMA definition of a green bond. The Green Bond Initiative does not include such bonds in its statistics on green bonds.

argue that SLBs should be developed by advanced economies. A considerable volume of corporate SLBs have indeed been issued since 2019: according to Environmental Finance, the volume outstanding had reached about US$10 billion by end-2021; carbon and GHG emissions-linked, and other climate change-related performance indicators predominate. [30]

Chile has shown that SSLBs are viable by issuing US$2 billion of such instruments in March 2022, attracting a final order book of US$5.8 billion from a wide range of bidders.[31] The yield on the 20-year bond was 4.436 percent, 200 basis points above comparable US Treasury yields. That spread is somewhat higher than what had been achieved by Chile's SGB issues in past years, but all risk premia rose in early 2020 due to increased global macroeconomic and geopolitical uncertainties. The triggers for stepping up the coupon relate to certain key performance indicators (KPIs), namely, a ceiling on GHG emissions in 2030 and cumulative emissions between 2020 and 2030, in line with Chile's Nationally Determined Contributions (NDC) under the Paris Agreement; and achieving 50 (60) percent of electric power generation from Non-Conventional Renewable Energy sources by 2030 (2032). If one (two) of these targets is not satisfied, the coupon step-up will be 12.5 (25) basis points, accrued over 8 years, implying a potential total penalty of 200 bps. The bond is denominated in US dollars but subject to Chilean law.

This structure is explained in the authorities' Sustainability-Linked Bond Framework, which is designed to be in line with the relevant ICMA guidelines. The primary purpose of issuing an SSLB is 'to leverage ambitious timelines to achieve strong sustainable outcomes that are relevant, core and material to Chile and the Chilean people.' The SSLB is to 'build upon Chile's prior Green, Social, and Sustainable bond issuances' and has as a secondary purpose to 'inspire other countries and companies to do the same.' The framework goes on to elaborate on the selection of KPIs; the calibration of Sustainability Performance Targets; the choice of bond characteristics; reporting requirements; and review and verification procedures. Considerable space is devoted to the mechanisms in place to ensure the reliable and independent measurement of GHG emissions and energy inputs in electricity generation, with external verification.

Uruguay published an SSLB framework, but at the time of writing has not yet issued an SSLB.[32] The country intends to 'commit to its sustainability agenda by linking its bond financing strategy to [its NDC] climate and nature targets as established under the Paris Agreement' in an incentive compatible manner, while providing 'investors with enhanced transparency and accountability on Uruguay's progress towards its environmental goals.' Moreover, it is claimed that 'the structuring and issuance of SSLBs addresses the scale liquidity challenges that the Use of Proceeds model may represent [especially] for smaller countries like Uruguay … [and] seeks to broaden and diversify the country's investor base … [while] encouraging other market players … to play a more active role in promoting … (ESG)-linked investments.' Thus, motivation is similar to those that have prompted others to issue SGBs, with the addition of incentive compatibility.

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30 See https://www.environmental-finance.com/content/downloads/sustainability-linked-bonds-and-loans-kpis.html .

31 See https://www.hacienda.cl/english/work-areas/international-finance/public-debt-office/esg-bonds/sustainability-linked-bonds and links therein.

32 See http://sslburuguay.mef.gub.uy and links therein.

The Uruguay SSLB framework is based on 2025 targets for two KPIs, namely, the reduction of economy-wide GHG emissions per unit of real GDP relative to 1990 levels, and the maintenance of native forest cover. Thus, the trigger dates are closer than those set by Chile.[33] Performance linkage is achieved through one-time discrete step-ups (step-downs) in the bond coupon rate, depending on whether the authorities under-achieve (over-achieve) on two NDC-based KPIs, with a middle range of no adjustment.[34] Thus, the coupon rate could for example go up by two steps if both KPIs are missed, but could be unchanged if one is missed and the other over-achieved (the steps are of equal size). Performance relative to the KPIs has to be measured and published in any case to meet Paris Agreement commitments (albeit with a 12- to 18-month lag), but emissions reporting will be enhanced from bi-annual to annual. An internationally-agreed methodology will be used and kept up to date. These arrangements are subject to assessment under the UN International Consultation and Analysis process; verification by the UN Development Program; and an SPO by a private sector provider, which has also vetted the overall framework. The authorities emphasise that strong inter-ministerial coordination was necessary to establish the framework, and will need to be maintained to meet reporting requirements and achieve the self-imposed targets.

Chile and Uruguay have effectively accepted the possibility that missing (achieving) decarbonisation targets will lead to higher (lower) financing costs, the threat (reward) of which reinforces the policy commitment. The bond incentivises the government to take action to reduce the probability of incurring the penalty imposed in the event of high GHG emissions, and to raise the probability of a favourable outcome, by using the full range of its powers to meet its commitment. In effect the government is offering insurance against the possibility of excessive GHG emissions, and is therefore incentivised to avoid that event. It is true that, if costly failure seems imminent, a government can always legislate to change the terms of its domestic debt, but doing so is likely to be politically problematic, especially if the debt is widely held or held by powerful interest groups.

SSLBs explicitly do not serve to finance particular policies and projects; fungibility is accepted rather than swept under the rug. The GHG emissions-linked bonds would thus be more transparent and more honest towards investors. There would be no need to identify and track ‘uses’ of proceeds, obtain second party opinions, or prepare special narrowly-focused impact assessments, so the GHG emissions-linked bonds would incur lower operating expenses. There may be costs in monitoring KPIs and publishing information about performance, but countries have to track them anyway under their Paris Agreement commitments.

Receipts and expenditures would not be tied. The government is responsible for the country’s achievement of progress towards net zero, using its full range of spending, revenue and regulatory instruments. Correspondingly, receipts from a GHG emissions-linked bond would fund all government activities without restrictions. One consequence is that the pricing of this bond would signal investor confidence in the government’s environmental policies, rather than attitudes towards individual spending items.

[33] It may be worth noting that Uruguay has already largely decarbonised electricity generation, but faces more challenges in reducing CO2 emissions from land transport and methane emissions from agriculture.

[34] At the time of writing, the authorities had not published a decision on the size of the steps.

The volume and timing of issue is not limited by the pipeline of identified suitable projects, and therefore the 'critical mass' and regular issuance that promote market liquidity and efficiency would be easier to achieve.[35] They can be issued in large volumes, through regular tenders, initially at shorter maturities. A government could choose to refinance the whole of its debt outstanding with such instruments, or at least rapidly build up the outstanding stock. The DMO could open and re-open sustainability-linked bonds to build a benchmark. Also, they are homogenous—unlike SGBs that are notionally tied to particular expenditures. All of these properties should facilitate the establishment of a large, diverse investor base and a liquid market with good price discovery.

Prime facie, dedicated green investors should be attracted to performance-linked bonds. Those with moral concerns are presumably interested in seeing the achievement of GHG targets and reinforcing the government's long-term commitment, which is what performance-linked bonds would support, not in inputs into a limited range of projects without regard to other policies. Those looking to diversify their portfolio and hedge environmental risks will be offered a true alternative to conventional government bonds, namely, ones that pay off more if the government does not take sufficient measures to decarbonise the economy. A smaller country cannot affect global climate change, but it can offer insurance related to domestic conditions. For example, suppliers of renewable energy would be interested in investing in a bond that paid off more in case of low taxation of carbon.

GHG emissions-linked bonds would also set a better example for non-sovereign issuers because they relate to the totality of the issuers' activities. Establishing this linking would greatly reduce concerns over 'greenwashing.' Provided that a corporate issued a bond linked to group-level performance (rather than that at a subsidiary level, which opens the possibility of manipulation), investors would be reassured that they are financing an overall strategy that improves sustainability. A non-sovereign issuer would be spared the difficulties of identifying specific eligible projects and the costs of obtaining second party opinions, but could rely on reports on its overall environmental impact that it produces and has verified under non-financial disclosure guidelines and regulations.[36] Measuring emissions and other environmental effects, and having these measurements certified is expensive and time consuming for firms, as it is for sovereigns, but the linked bond issuance would not incur additional costs.

An analogy can be made with inflation-linked bonds, which are well established (Box 1). The basis for the market in inflation linkers is the fact that the government and investors are affected in different ways by inflation. Hence there is a natural supply of and demand for hedging instruments, which can be brought together through inflation linkers. For SSLBs, there may be an analogous asymmetry. For example, moving rapidly to sustainability (leading to an over-performance on KPIs) may be relatively expensive for a government, at least in the short- to medium term, as it has to undertake more up-front investment and compensation for adjustment costs. The structure of SSLB returns thus hedges the government. Moving slowly to sustainability may be harmful to certain large groups of investors, such as younger generations and low-emissions sectors, so they should be interested in a bond that pays out more if KPIs are not met. Moreover, the government has significant influence over the inflation outcome,

[35] Kraemer (2019) stresses that the potential issuance volume of SGBs tied to specific expenditures, as currently practiced, is too constrained to be a powerful tool for climate change mitigation and adaptation.

[36] Examples include the 'Recommendations of the Task Force on Climate-related Financial Disclosures' of the Task Force on Climate-related Financial Disclosures (2017); the EU's Directive 2014/95/EU regarding disclosure of non-financial and diversity information by certain large undertakings and groups; and the EU Communication from the Commission 'Guidelines on non-financial reporting: Supplement on reporting climate-related information (2019).

and so can limit its exposure to risk from linkers. Likewise, for SSLBs, governments can enact policies that affect overall emissions and progress against other KPIs, and thereby contain risk from SSLBs.

Yet, the limited popularity of other proposed state-contingent debt instruments suggests that government green performance-linked bonds may face hurdles. The two main types of state-contingent debt instruments, besides inflation linkers, and so-called 'catastrophe bonds,' and GDP-linked bonds or warrants.

Countries vulnerable to natural disasters have successfully issued 'catastrophe bonds' that receive some relief in terms of reduced present value or extended repayment schedule in case the country is struck by a disaster (see for example Michel-Kerjan, et al. ,2011; Asonuma et al., 2017; and Ando et al., op. cit.). Importantly, the trigger event for the relief is readily and objectively observable. The relief often takes the form of postponement of debt servicing rather than variation in present value, the former being more palatable to many institutional investors. The sovereign catastrophe bond market remains small, and they are seen as just one, rather limited instrument in a multi-part approach to catastrophe risk; other parts include, for example, the build-up of reserves and the use of public and private insurance.

BOX 1 / INFLATION-LINKED BONDS

These bonds, whose payoff rises with realised inflation, constitute a large asset class and have been issued by many governments of both advanced and emerging market economies since the 1970s (Israel started earlier). The inflation linkage mechanism has become largely standardised, and 'linkers' are widely held (see for example Price, 1997, and Choudhry et al., 2005).

The market works because incentives and information conditions are aligned:

- the government has a natural hedge unavailable to investors, because government net revenue is positively correlated with inflation;
- there are investors such as pension and life insurance undertakings that have inflation-linked liabilities, who are therefore eager to buy protection against higher inflation;
- methods and procedures for measuring inflation are long-standing and fairly well-established, even if revisions of both specific observations and methodologies occur from time to time. It is helpful that consumer price inflation is to some extent externally verifiable by 'casual empiricism' (Huberman and Schwert, 1985); and
- realised inflation affects the pay-off slowly over time, since each period's inflation is reflected in the coupon and final valuation. Measurement error is likely to even out over time.

Claims have been made for the advantages of GDP-linked bonds, mainly as a means to reduce the risk of sovereign debt distress. [37] However, they have not been taken up by either issuers or investors except as part of debt restructurings. This lack of enthusiasm may reflect the preference of financial market participants for straightforward fundamental instruments, which they can combine at will and use as the basis for derivatives in order to achieve their desired exposure to various risk factors. Investors may look at GDP-linked bonds with added scepticism because measurement of GDP is subject to large revisions

[37] See IMF (2017); Cohen et al. (2020); Igan et al. (2021); and Roch and Roldán (2021).

and may be manipulated by government. In addition, GDP is a non-stationary variable where the trend is not easy to project. However, it is possible to make a first pass at estimating the risk premium that they would incur, which should be largely be a function of the correlation of their returns with that of the overall market portfolio of their investor base (the 'beta') and the expected excess return on that portfolio (Emter and Herzberg, 2018).

GHG emissions-linked bonds, even more so than GDP-linked bonds, have features that reduce their attractiveness: they are relatively complex; they suffer from uncertainty about how accurately the state variable is measured; [38] the state variable's long-term trend is quite uncertain; and the correlation of their returns with that of other assets is not easy to foresee. In particular, it is difficult to estimate ex ante what their 'beta' with a market portfolio might be, and therefore their pricing is very hard to anticipate. If an international investor base is achieved, and assuming that a country's progress in achieving carbon neutrality or sustainability more generally is largely independent of the performance of a global portfolio, the beta may be close to zero. If the investor base is largely national, a range of scenarios could be envisaged. For example, if achieving targets for reduced GHG emission is very expensive, the bond's beta with the national market portfolio could be positive.

It has been suggested above that GHG emissions-linked bonds may offer a form of insurance for certain investors, implying a negative beta, but that advantage may be slight. Demand for insurance against the policies of just one government and national performance, as offered by GHG emission-linked SSLBs, may be weak in the face of the global phenomenon of climate change. One country's actions contribute insignificantly to reducing global GHG emissions and therefore mitigating climate change. Therefore, national performance is not strongly correlated with climate change-related physical risks (e.g., more prolonged drought) or even with most transition risks (e.g., technology change and international carbon pricing). Investors looking for protection from those risks will have limited interest in such bonds, especially from smaller issuers.

SSLBs are not as suited to raising financing linked to climate change adaptation measures, which, however, may be more relevant to many investors than national GHG emissions. It seems more difficult to set and track suitable KPIs related to adaptation rather than mitigation, because adaptation involves myriad local actions rather than a few aggregates. Yet, adaptation measures may be of first-order importance to many investors, and also to the citizens and governments of very vulnerable countries that produce relatively little GHGs. More research on adaptation-based SSLBs may be worthwhile. It is promising that some sovereigns have included indicators such as spending on flood defences or number of homes insulated (which has both a mitigation and an adaptation effect), so it may be possible to find suitable KPIs.

Perhaps the gravest hindrance to the development of these instruments is doubt about the willingness of a government to truly commit to a long-term decarbonisation path. The proposed performance-linked instruments would involve the government establishing a legally binding penalty for policy failings of its own making and for those of future governments. Ex ante, the SSLBs create an incentive to set unambitious targets or adopt a high baseline. However, as the examples of Chile and Uruguay suggest, it is plausible that countries will take KPIs from their existing NDCs. Ex post, the penalty might be

[38] Regarding measurement, the U.S. National Institute of Standards and Technology notes that 'most emissions estimates are based on indirect economic measures, such as the number of vehicle-miles traveled' https://www.nist.gov/greenhouse-gas-measurements .

incurred in case of divergence from the decarbonisation path caused by exogenous shocks. A future government faced with paying out more due to high GHG emissions would be strongly tempted to reject an obligation established by a predecessor, perhaps claiming that the excess was caused by events beyond its control. Thus, returns would be highly dependent on the willingness of government not to renege, across a range of circumstances that is hard to characterise. The associated uncertainty could greatly discourage investors and have to be compensated with a higher yield; in financial market terminology, the bond yields may display a high 'alpha.'

This 'time inconsistency' problem may be avoided by making returns very insensitive to performance, but such insensitivity would undercut the objectives of issuing SSLBs. The coupon would have to vary significantly with performance, or the volume of the SSLBs would have to be very large, to affect the incentives of government to follow a consistent path towards sustainability. Suppose that SSLBs outstanding were equivalent to 10 percent of GDP and the step-up or step-down were a full 100 basis points, that is, a multiple of what Chile has adopted. Then missing a KPI, for example, would cost just the equivalent of 0.1 percent of GDP per year, which hardly seems enough to determine major policy choices, especially those that have to be made years in advance of the test date.

Nonetheless, the Chilean and Uruguay examples suggest that it would be worthwhile for more advanced countries to experiment with sustainability-linked bonds. Given the current enthusiasm for green financial products, the challenges do not seem insurmountable for a medium- to large-sized, investment grade sovereign with a reputation for accurate statistics. Initially perhaps it would be advisable to issue a medium-term bond—the core of the sovereign debt market—with payoffs linked to achievement of 2030 sustainability goals. The payoff might be a function of relevant but still more readily measurable variables, such as the share of renewables in electricity production and/or use of hydrocarbons in overall energy production (including for heating and transport), if possible related to NDCs.[39] Measurement of these proxy variables may be more reliable and more timely than that of overall GHG or CO2 emissions. A retail tranche in smaller units might prove popular. A bond presented as rewarding over-achievement of targets through a lower pay-out, with a fixed pay-out in case of excess emissions, may be more politically palatable than one that would impose explicit, ex posts costs on government in the event that targets are missed.

4. CONCLUSION

The issuers of SGBs and those who invest in them mean well. Issuing such a bond is a very visible way for a government to show that it is aware of environmental issues and that a large and sustained fiscal effort will be required to address the challenges. Especially for a large, investment-grade sovereign, SGBs can be issued quickly and in impressive volumes, at no fiscal or political cost. Investors too feel that they should 'put their money where their mouth is' and demonstrate that they appreciate the potential rewards and reduction in risk from investing in greening the economy.

Yet, it has been demonstrated that issuing SBGs in their current form by an investment-grade government does not contribute to mitigation of or adaptation to climate change, nor to any other environmental objective. The reduction in funding costs is negligible even before accounting for the extra

[39] Such a proxy would capture roughly two thirds of a country's GHG emissions, but miss, for example, CO2 emissions arising from the manufacture of cement, and methane and nitrous oxide emissions.

operational costs they incur. The possible benefit of expanding the investor base is unimportant for medium- to large-sized countries, and may work against the objective of maintaining a liquid market in government debt. SGBs issued by individual countries do little for the healthy development of the overall market for green financing. SGBs do not provide any protection against climate change-related risks, be they physical or transitional. Both the element of pretence and the reintroduction of tied revenues represent poor public sector governance, and reduce transparency overall; any addition to published information on individual projects could be achieved directly and may distract from the assessment of overall policies.

Issuing bonds whose payoff is linked to a country's total GHG emissions (or a proxy thereof) would be superior, but would face challenges. Performance-linked bonds would be more transparent, cheaper to administer, and offer sincerely green investors what they actually want without the taint of 'greenwashing.' Such bonds would also be more conducive to the long-term policy commitment that is a precondition to meeting the challenges of climate change and achieving sustainability. However, financial markets tend to place a high risk premium on state-contingent debt instruments, especially when the issuer does not have a strong 'natural hedge' that allows it to offer insurance against certain states of the world; when those states are hard to verify; or when the forecasting those states is subject to high uncertainty. For an issuing government, a performance-related bond involves imposing an obligation on its own policies and those of successor governments that are difficult to accept both ex ante and ex post. However, Chile's success in issuing such bonds suggests that the demand does exist; other highly rated countries could easily follow the example set and help promote the sound growth of the green finance market.

For all countries, and especially for those that are investment grade, reducing government funding costs and risks in the face of climate change depends primarily on undertaking policies that directly address climate change challenges, not on the design of its financing instruments. Policies to mitigate or adapt to climate change may involve investment in projects and research, but also adjustment to taxes, current expenditures and regulations that incentivise the country's move to sustainability while compensating those who would otherwise lose out in the process—an array much wider than what can be verified to be 'green' expenditures. Investor and financial markets will eventually reward those countries that are less vulnerable, and in particular those that have taken steps to prepare for both the transition to sustainability and the shifting physical risks that are unavoidable.

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APPENDIX: SOVEREIGN GREEN BOND FRAMEWORKS

A review of published SGB frameworks and related documents issued by advanced economies was undertaken. In general, these documents devote space mainly to (i) an overview of the respective government's green and sustainability policies; (ii) a statement of broad objectives to be achieved through SGB issuance; (iii) eligibility criteria for projects and other expenditures to be supported by the issue of SGBs; (iv) issue procedures and management of proceeds; (v) publication commitments; (vi) mechanisms for internal verification, obtaining second party opinions, and possibly certification by an international standard-setting body; and (vii) disclaimers. Typically, less than one percent of the text is devoted to an explanation of the objectives to be achieved by issuing SGBs, and no mechanisms or criteria are established for evaluating the extent to which these objectives are met.

› Austria published its Green Bond Framework in 2022, shortly before its first SGB issue. That framework was deemed in an SPO to be aligned with best practice and in particular the ICMA GBPs. The rationales for the SGB program are manifold: enabling Austria to attract dedicated funding for green government expenditures; providing domestic and international investors with a means to shift their portfolios towards sustainable assets; furthering the development of the domestic and international green bond market and the wider sustainable finance sector; highlighting Austria‘s strong environmental agenda; increasing the participation of the Austrian private sector in sustainable investment; and expanding Austria's investor base and potentially increasing demand for Austrian debt securities overall. Proceeds from issuance will be part of overall government funding, and unallocated proceeds will be managed in line with ordinary cash management policy. No assurance is given that the use of proceeds will satisfy any present or future investor expectations or requirements as regards any investment criteria, guidelines, or regulation, in particular with regard to any direct or indirect environmental impact. Nonetheless, proceeds are to be allocated to eligible expenditure (including tax expenditures) items from the year of issue and the preceding year. An inter-ministerial Green Bond Board has been set up to evaluate and select eligible green expenditures, where eligibility criteria are consistent with the EU taxonomy. The authorities emphasise that Austria has a large portfolio of 'green' public assets, and a large share of government expenditure meets the criteria to be considered as 'green' and in line with the UN SDGs. The allocation of proceeds is to be reported annually, and impact reports outlining the environmental impact of the SGB' proceeds (e.g., in terms of reduced CO2-equivalent emissions, ecologically restored areas, and number of flood protection projects) will be issued biannually, subject to verification by an external reviewer and the Environmental Agency Austria.

› Belgium's 'Green OLO Framework' (2018; "OLO" stands for "obligations linéaires"/"lineaire obligaties"—in effect, standard bonds) stresses that the country 'aims to actively participate in the development of green finance … and decided to underline its commitment with the creation of this Green OLO Framework,' which received a favourable SPO. More specifically, '[i]ssuing the inaugural Green OLO is expected to catalyse the development of the local green bond market and to increase the environmental awareness of the general public in Belgium, as well as capital markets participants.' Moreover, '[i]ssuing Green OLOs would allow the Kingdom of Belgium to …raise funds to support its climate and environmental policies; and support the development of the Green Bond market, especially in Belgium.' The Belgian Debt Agency announced that '[w]ith the aim of actively contributing to climate change mitigation and environmental protection in Europe, the Belgian Debt Agency will be

dedicating the proceeds of this green OLO to the transition to a sustainable economy.'[40] It is anticipated that the Green OLO will perfectly fit the OLO curve, and tap sales will be used to maintain liquidity and build up the outstanding stock. Eligible expenditures include items within the Federal State's budget and expenditures towards Green Holdings within the Federal State Portfolio, and directed towards state agencies, regions and communities, companies and households, except where other green financing is available. Selection of eligible expenditures will be managed by an Inter-Ministerial Working Group, where each ministry of department is meant to identify and report eligible items. Some examples of eligible expenditures include Tax credits for corporates investing in energy efficiency; support to renewable energy infrastructure; and investment in sustainable programs for climate change mitigation and adaptation in developing countries. Budget expenditures may have occurred in the year of issue or the preceding year, while investment in Green Holdings may have been made up to two years before the issue date. Investors will receive detailed, externally audited allocation reports until all funds are spent, and environmental impact reports providing data on such variables as energy savings, reductions in GHG emissions, and recycling volumes.

› The Government of Canada Green Bond Framework (2022) indicates that the authorities are concerned both with financing and with market development. It is stated that the Canadian SGB will 'help finance government investments in green infrastructure and other environmental initiatives. Through green bond issuances, Canada intends to mobilise capital in support of its climate plan and environmental objectives, and to further develop the Canadian sustainable finance market by adding liquidity and highly-rated environment, social and governance (ESG) assets to create a more mature, liquid, and diverse market for investors.' The program is in line with the ICMA GBPs, as verified by an external assessor. '[N]et proceeds ''[are] to finance and/or refinance, in whole or in part, expenditures that meet any of environmental eligibility criteria.' At least half of proceeds are to be allocated to expenditures made in the fiscal year of issue or two subsequent years. A report is to be published annually on the allocation of proceeds (with external verification), as is a report on the environmental and social co-benefits of those expenditures. The disclaimer is included that 'While it is the intention of the Government of Canada to apply an amount equivalent to the proceeds of any Green Bond to Eligible Green Expenditures and to report on the Eligible Green Expenditures as described herein, there is no contractual obligation to do so.'

› Chile was the first country in the Americas to publish a SGB framework (2019) and issue SGBs, in both US dollar and euro. The authorities' SGB framework presents several arguments, centred on market development, for 'the issuance of a sovereign green bond [which] would further develop the market and encourage Chilean corporate issuers to follow with green bonds of their own. A sovereign green bond provides a strong signal of the country's commitment to promote sustainable finance and development of a low carbon, climate-resilient economy. With this in mind, Chile looks to further promote the development of a green asset class that can help attract foreign investment to support the country's sustainable infrastructure needs. As the first sovereign green bond issuer in the Americas, Chile also intends to set a benchmark for future sovereign issuances in the region. With this issuance, Chile seeks to promote a wider regional dialogue, to enhance the consistency and uniformity of future green bonds coming out of the region and contribute to the development and acceptance of this asset class by issuers and investors alike.' Chile has issued green Eurobonds, that is, foreign currency-denominated bonds subject in this case to New York law. Proceeds are first be placed in the

[40] https://www.debtagency.be/en/green-olo-additional-information

government's general account, and then 'allocated to finance new Eligible Green Expenditures … and/or to refinance existing Eligible Green Expenditures.' In this connection, the authorities are to identify eligible projects, from past, current and future years, with an aggregate value well in excess of the planned issuance in order to ensure that proceeds can always be allocated. Annual reporting is to be provided on proceeds, allocation (including co-financing), output, and impact indicators. Chile's approach to SSLBs is discussed in the main text.

› The European Union's Next Generation EU (NGEU) program includes a commitment for substantial issue of SGBs, because '[t]he EU … is committed to developing further the European sustainable finance markets. … The Commission … aims to give the green bond market another push, inspiring other issuers and providing investors with more green diversification options' (European Commission, 2021). The proceeds are to be used by member states to finance and refinance '[i]nvestments and reforms [that] are tagged as climate-relevant using the EU climate coefficient methodology' and that contribute to the national 'Recovery and Resilience Plans (RRPs).' Reporting is to cover member states' RRP expenditures and reimbursement from the Commission, including on green expenditures, and environmental impacts of the various reforms and investments.

› France's 'Framework for the Green OAT' (2017; 'OAT' stands for Obligations assimilables du Trésor) promises that '[t]he Green OAT is designed to provide investors with … liquidity and high standards. It will bring additional liquidity as the Green OAT will progressively grow aiming at an outstanding size comparable to other OATs for comparable maturities. It will follow high standards because, in addition to the compliance with [ICMA] GBPs … and the second opinion from Vigeo-Eiris, France will provide three reports to investors [on allocations, project implementation,] and in particular a report on impacts that will be reviewed by an independent Council.' Documentation for a Green OAT is to include a statement that the French state intends to effect expenditure on eligible sectors in an amount equivalent to the issue size, and that 'Eligible Green Expenditures contribute to one or several of the following objectives: climate change mitigation and adaptation, biodiversity protection and pollution control'. The Framework explains that 'Green Eligible Expenditures include tax expenditures, investment expenditures, operating expenditures and [market] intervention expenditures … used to deploy France's climate and environmental policy' while avoiding double counting (there does not seem to be list of prohibited sectors). At least half of the allocation of the Green OAT is to go to expenditures related to the issue year budget or future year budgets. Reports on allocations are to be subject to external audit. A Green Bond Evaluation Council consisting of independent experts is to report on the environmental impact of eligible green expenditures.

› The German 'Green Bond Framework' (2020) explains that 'The German Federal Government has supported the development of sustainable finance. … Against this backdrop, the German Federal Government has decided to issue the first German Sovereign Green Bond …, which will provide a liquid and solid benchmark for the European green fixed income markets.' More precisely, '[i]t is … the German Federal Government's ambition to establish Green German Federal securities as the interest rate benchmark for the euro green finance market within a short period of time. In practice, Germany plans to establish a green yield curve for the euro area, with the same standard maturities as on the conventional curve. Market participants with different investment horizons will have at their disposal a green, transparent investment opportunity with first-class credit quality.' Consistent with this market development objective, the framework makes explicit mention of the possibility of tap sales. Eligible expenditures include, inter alia, spending on international cooperation including development projects,

and on research, innovation and awareness raising. The authorities are committed to ensuring that 'Green Eligible Expenditures will … exclude any expenditure already known to be used by other public German issuers [such as the KfW] in their own Green Bonds.' Proceeds are to be allocated to eligible expenditures made in the previous year; none of the proceeds are earmarked for future expenditures. The allocation is to be reported annually, and the impact of the expenditures is to be reported from time to time, as appropriate. Thus, the allocation of SGB proceeds is distinct from total expenditures on the respective project, and the environmental impact is not directly linked to the allocation of proceeds.

› The 'Hungarian Green Bond Framework' (2020) rationalizes the green bond program as a contribution to supporting the government's commitment to carbon neutrality and clean development; a means to raise a part of the necessary funding; a contribution to the development of sustainable finance internationally and in the Hungarian domestic capital market (specifically by setting a benchmark and raising awareness); a response to international investors demand for green bonds; and a means to further diversify Hungary's investor base. In practice, Hungary found a ready market for its local-currency 30-year SGBs, and sees them as a means to extend the average term-to-maturity of its debt. The design and implementation of the framework is overseen by a steering committee with representatives from the Ministries of Finance, Agriculture, Interior, and Innovation and Technology, plus the DMO. The SGB initiative complements the central bank's involvement in promoting green financing, for example, through its green bond portfolio and its green mortgage bond purchase programme. The framework is aligned with the (at the time of publication, forthcoming) EU Green Bond Standard and international best market practices, as embedded in the ICMA GBPs. It has also been subject to a SPO, as are allocation and impact reports, which are published at least annually. For the purposes of diversifying the investor base, the framework envisages issuing in the Eurobond, Japanese Samurai and Chinese Panda markets, and domestic retail issues, in addition to local currency wholesale bonds. Proceeds are to be allocated to eligible expenditures executed up to two years before the issue date, and any date thereafter, and not otherwise funded under another green program; proceeds are managed by the Ministry of Finance pending allocation. Eligible expenditures include investments in de-carbonization (mainly in the transport sector) and energy saving, but also adaptation to climate change and related environmental measures such as preservation of natural areas and improved water management.

› The 'Irish Sovereign Green Bond Framework' (2018) states that 'Ireland believes green finance, including Irish Sovereign Green Bonds ("ISGBs"), will contribute and play a key role in financing this transition [to sustainability]. By issuing ISGBs, Ireland also proposes to have a leading role in the development of this important market. … ISGBs will enable Ireland to fund Eligible Green Projects upon which it is engaged and planning for the coming years.' Thus, the Irish authorities were concerned both with market development and with funding projects. The framework is designed to be aligned with the ICMA GBPs (2018) regarding use of proceeds; project evaluation and selection; management of proceeds; and reporting.[41] The implementation of the framework is overseen by an inter-ministerial working group. ISGBs are to rank pari passu with each other and with Irish conventional government bonds. The framework includes an extensive disclaimer, stressing that 'all and any liability, whether arising in tort, contract or otherwise which any purchaser of ISGBs or any other person might otherwise have in respect of this Framework or any ISGBs as a result of any failure to adhere to or comply with this Framework is … disclaimed.' The proceeds may be allocated to both

[41] Relevant EU standards were not available at that time.

eligible new projects and refinancing of existing projects dating from the previous two years. Eligible projects include some adaptation measures and water management projects, but exclude inter alia large hydroelectric projects. The framework emphasises that 'Departments must also ensure that individual projects and investment proposals meet all of the relevant appraisal processes and value-for-money tests.' Amounts raised are to be held pending allocation in the government's Central Fund at the Central Bank of Ireland, subject to normal liquidity management. The allocation of funds by project and category is to be published annually until the full allocation of an amount equal to the net proceeds of the relevant ISGB, and an impact assessment of the projects is to be published biannually. The framework itself and the periodic allocation reports are subject to SPOs.

› The Italian government's 'Framework for the Issuance of Sovereign Green Bonds' (2021) contains a section of 8 lines (out of 18 pages of text) on the reasons for issuing SGBs. The only reason provided is that '[t]he Republic of Italy has decided, through the Budget Law for 2020, to extend its commitment to the environment by issuing SGBs.' The issue of SGBs is to 'finance public expenditures intended to contribute to the achievement of …[the] environmental objectives of the EU Sustainable Finance Taxonomy,' such as climate change mitigation and adaptation. The framework, which is aligned with the ICMA GBPs and (then) draft EU Green Bond Standard) explains the eligibility criteria, and sets out tracking and reporting requirements. Eligible expenses (which may include tax expenses and current expenses) will be selected from a period between three years before and one year after the bond issuance, but all funds are to be allocated within two years of bond issuance. Eligible expenses include, for example, investment in smart grids; expenditures for electrical infrastructures in ports to reduce ship fossil fuel use; tax credit to incentivise an increased use of recyclable packaging; and expenses for protection interventions of environmental heritage against fire, drought, floods. Excluded are items for which the government already has dedicated revenue or financing. Funds raised through issue of SGBs will be transferred to a general Treasury Cash account; proceeds and green eligible expenditures will be tracked as accounting entries. Information is to be published on the allocation of funds and the environmental impact of green expenditures (e.g., in terms of GHG emissions avoided) and the share of green financing, but the impact is not directly attributed to green financing. The reports are to undergo independent external verification.

› Luxembourg, one of the few AAA-rated sovereign debt issuers, released its Sustainable Bond Framework in 2020. The Framework emphasises Luxembourg's commitment to both ecological and social sustainability, and the pursuit of the development of a responsible, sustainable, and innovative financial sector, noting that it is already a leading centre for innovative sustainable finance. Issuing safe (AAA-rated) and liquid sovereign green, social and/or sustainability bond(s) will allow the jurisdiction to lead by example in supporting the development of this segment of the capital market. The instruments will support the government's efforts and ambitions, funding relevant investments (including also R&D), while providing national and international investors with the opportunity to diversify their investments with more sustainable assets. The framework is designed to be in line with the ICMA GBPs, the Social Bond Principles, and the Sustainability Bond Guidelines, as well as far as possible with the EU Green Bond Standard and the EU Taxonomy, which was not finalised at the time of publication. The framework envisages the issue of green, social, and sustainability bonds (the last encompassing the first two; the first issue in 2020 was a sustainability bond). Proceeds are allocated to finance or refinance eligible expenditures that meet the authorities' criteria and objectives, with a commitment on a best effort basis to reach full allocation within two years of issuance. An allocation report and an impact report of the allocated proceeds are to be produced at least annually until all

proceeds are allocated. Impact metrics include not only such variables as CO2 equivalent saved and the number of social service facilities upgraded, but also the number of investment funds that have been launched with the support of Climate Finance expenditures, and their assets under management. Both the framework and the annual reports will be subject to external review.

› Mexico's 'SDG Sovereign Bond Framework' (2020) stands out for its focus on achieving SDGs in less developed regions, as part of its medium-term national development plan. As to purpose, it is stated that '[t]he issuance of Sovereign SDG Bonds … allows the government to pinpoint eligible projects, assets and expenditures that support Mexico's fulfilment of the most pressing SDGs.' The framework, which was evaluated by an SPO provider, is aligned with the ICMA GBPs and Social Bond Principles, and the (then draft) EU Green Bond Standard. Proceeds are linked to eligible budgetary expenditures, with priority given to projects in regions or for social groups where SDG gaps are greatest. The Treasury is to review the budget for suitable projects, which are to be selected by a 'Committee of Inclusive and Sustainable Economy' with inputs from the United Nations Development Program (UNDP). The authorities are committed to maintaining a pool of eligible expenditures that exceeds each associated bond issuance. Proceeds are held in the general treasury account pending execution of eligible expenditures. Allocation reports are to be published annually until related expenditures equal the net proceeds, subject to an independent external audit. Audited impact reports are to be issued for the life of each bond, and include the opinion and recommendations of the UNDP, as informed by the UNDP's SDG Impact Standards for Bond Issuers.

› The Netherlands DSTA 'Green Bond Framework' (2019) contains the statement that 'the Dutch State aims to support the further development of this [Dutch green bond] market with the issuance of a sovereign green bond, thus introducing a solid asset class to this market as well as adding critical mass to the market ... To support this market, the Dutch State aims to lead by example and contribute to the further development of a green financial market, provide the market with highly safe (AAA-rated) and liquid green bonds and inspire others to issue green bonds. The Green Bond issued by the DSTA enables the Dutch State to attract dedicated funding for government expenditures that contribute to greenhouse gas emission reduction targets and climate change adaptation, provide investors an opportunity to diversify their investment portfolios towards sustainable assets, and will further promote and develop the domestic and international Green Bond market.' Proceeds are to finance or refinance budgetary expenditures (including tax expenditures) serving to reduce GHG emissions or to further climate change adaptation, made in the year preceding bond issuance or thereafter, with at most half going to past-year expenditures. The DSTA is to decide on the allocation, while unallocated proceeds are to be managed in line with treasury policy. Eligible expenditures are to be selected annually by an inter-departmental working group, based on an initial review of budget items. The framework mentions not only subsidies for the development of renewable energy generation projects, but also for example the maintenance, management and development of the railway network; incentives for insulation, high-efficiency glazing, more efficient central heating; and expenditures to ensure that flood risk management, freshwater supply, and spatial planning will be climate-proof and water-resilient. The government is to report annually on the allocation of proceeds, and the positive environmental impact of eligible green expenditures and for the Netherlands as a whole, until the full allocation of funds. The framework and the annual reports are subject to external verification by a SPO provider, and the Internal Auditor of the Dutch State will review the annual reports.

› Poland published the first sovereign green bond framework in the lead-up to its innovative issue of SGBs in 2016. While no explicit aim or objective is defined, the framework confirms that, in conformity with the ICMA GBPs, 'the proceeds of each Green Bond will be used exclusively for spending in the form of budget allocation / subsidies / projects for new financing or the re-financing of existing "Eligible Projects".' The framework sets criteria for eligibility and also prohibitions, for example, on financing operations involving the burning of fossil fuel for power generation and transportation, or transmission infrastructure and systems where 25 percent or more of electricity transmitted to the grid is fossil-fuel-generated. The proceeds are to be credited to a separate "Green Cash Account," but unallocated proceeds are to be subject to normal liquidity management policy. Annual reports are to be released until all proceeds are disbursed (but not for the life of the bond). The reports are to present information on allocation by eligible sector; unspent balances; examples of supported projects; and, where possible, the environmental and social impact of the projects. The framework was subject to an external second party opinion, but the annual reports are not.

› Slovenia chose to issue a sustainability bond to fund both environmental and social transition. Its framework (2021), which was subject to a second party opinion, is positioned as part of the country's sustainability strategy, which 'highlights the country's commitment towards environmental and social issues and achieving the UN [Social Development Goals].' More specifically, 'Slovenia intends to lead by example and to support the development of sustainable finance with the issuance of safe … and liquid sovereign green, social and/or sustainability bond(s).' Sustainability Bond proceeds are to be allocated to eligible expenditures from the previous, current and the following years' budgets; unallocated proceeds are to be held temporarily in the State Budget Account. It is made clear that 'Payment of principal and interest will be made from the State Budget Account and will not be conditional on the selection or performance of the Eligible Green and Social Projects. Accordingly, investors in [Slovene State Sustainability Bonds] SSSBs will not bear any project related risks in respect of Eligible Green and/or Social Projects. SSSBs will rank pari passu with each other and with other Slovenian Government Bonds.' Eligible expenditures are to be taken from a list covering energy transition, pollution reduction, and social projects, complemented by an exclusion list. A report on funds allocation is to be published annually, and an impact assessment is to be published at least biennially until full allocation is reached, subject to external review.

› Spain's Green Bond Framework (2021) explains that 'establishing a green bond issuance program … [is] aimed at financing sustainable items of the Central Government Budget as well as boosting sustainable finance markets in Spain' as part of a the 'new strategic axis of Spanish economic policy, whose ultimate goal is the deployment of both public and private investments that will transform the Spanish productive system to achieve a more sustainable and inclusive growth.' Objectives include communication of Spain's policies and commitments to tackle climate change and protect the environment; widening the Treasury's product mix (in part seeking to lengthen the average maturity); broadening and deepening the investor base; responding to the demands of the investment community; supporting the development of sustainable finance in Spain by providing a green liquid benchmark; contributing to the competitive positioning of the Spanish financial sector; and encouraging other agents, both public and private, to join this market. To these ends, the Spanish Treasury is to issue several benchmark SGBs over time, to be reopened via regular bi-monthly auctions. Green bonds proceeds are to be managed by the Spanish Treasury in accordance with its fund management policy. The framework is meant to be aligned with the ICMA GBPs and also the European Union's Taxonomy of Sustainable Finances, and so may have to be adjusted when the

latter's implementation acts are finalised. Eligible expenditures are to take the form of capital expenditures, current expenditures, transfers and subsidies, and tax benefits, devoted to a full range of climate change, pollution, and biodiversity-related projects. Only those expenditures planned for the fiscal year of issuance or executed in the previous two years are to be taken into account. Expenditure on such items as fossil fuel exploitation, and those financed by other dedicated green sources are to be excluded. Reports on the allocation and the impact of programs associated with the bonds are to be published on an annual basis. External review is to cover both the framework and the allocation. The disclaimer is similar to that attached to the UK framework.

› Sweden's sovereign green bond framework (2020) states that '[t]he aim of Swedish sovereign green bonds is to finance a portfolio of expenditures that meets the highest green ambitions and is in line with the goal of carbon neutrality by 2045' but mention is made also of giving 'investors an opportunity to contribute to the transition to an environmentally sustainable society.' A preceding government inquiry into ways to promote the green bond market concluded that '[i]ssuance by the State would help send an important signal about the seriousness of the sustainability issue, it would give the market increased legitimacy and serve as a general reference for issuing green bonds, thus making green bonds more conventional and lowering the threshold for other issuers to enter the market. The Inquiry Chair also considered that it would facilitate more integrated action on the climate objectives.' The adopted framework is closely based on the ICMA GBPs in terms of use of proceeds, process for project evaluation and selection, management of proceeds (which are to be administered within the regular liquidity and debt management framework), reporting, and external reviews. Annual reports are to cover allocations, output, and impact statements, linked to the objectives of the expenditures. The framework was subject to a second party opinion, and the annual report is subject to normal government audit procedures.

› The 'UK Government Green Financing Framework' (2021) asserts that the financial market government bonds ('gilts') and retail savings instrument 'will play a central role in its efforts to mainstream green finance products, attract dedicated funding for climate and environment objectives, deliver much needed infrastructure improvements, and create green jobs across the country.' Rather broadly, '[e]ligible Green Expenditures can include government expenditures in the form of direct or indirect investment expenditures, subsidies, or tax foregone (or a combination of all or some of these) and selected operational expenditures' from one year prior to issuance to two years thereafter. Specific expenditure items mentioned include zero-emissions buses; a renewable heat incentive scheme for properties; a scheme to reward environmentally sustainable farming; and flood protection as an adaptation measure. There is a commitment to providing information on the use of proceeds, including allocation and expected impact, '… regularly to investors, and updated annually until full allocation.' The impact reports are to cover also social co-benefits, such as job creation. External verification is to cover the framework as a whole, the pre-issuance impact assessment, and ex post reporting. The disclaimer is 281 words long, and is unequivocal that

> 'While it is the intention of HM Treasury to apply an amount equivalent to the proceeds … as described herein, there is no contractual obligation to do so. There can be no assurance that … HM Treasury will be able to use the proceeds for such Eligible Green Expenditures as intended. Furthermore, no assurance is given that any projects or uses the subject of, or related to, Eligible Green Expenditures will be completed as expected, that the stated aims and/or impacts of any projects or uses the subject of, or

related to, any Eligible Green Expenditures will be met or made, nor that adverse environmental, social and/or other impacts will not occur during the implementation of any projects or uses the subject of, or related to, any Eligible Green Expenditures. None of these events, nor a failure by HM Treasury to allocate the proceeds of any Green Financing to Eligible Green Expenditures, nor to report on Eligible Green Expenditures as described herein, nor a failure by a third party to issue (or its withdrawal of) an opinion or certification in connection with any Green Financing, nor the failure of any Green Financing to meet Investor Requirements, nor a failure to obtain or maintain any Green Listing, will constitute an event of default or breach of contract with respect to any Green Financing. Any such event may have a material adverse effect on the value of the relevant investment …'

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