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Aligning sovereign bond markets with the net zero transition: the role of central banks

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Alexander Wollenweber

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Summary

Sovereign bonds and the transition to net zero

Sovereign bond markets are essential for aligning finance flows with the transition to net zero.

Sovereign bonds are the main channel through which national governments issue debt to fund public services and investments: they represent about half of total debt securities globally. The global investment required to achieve net zero economies amounts to trillions of dollars – a large part of which needs to be delivered through the public sector. The public sector currently accounts for more than half of climate finance worldwide, with about three-quarters of this financed through debt instruments.

The soundness of sovereign bonds is vital to providing the financial and economic stability needed for a timely transition to net zero. They are a pivotal asset for financial institutions' risk management because they are generally considered safe and liquid investments. Serving as a benchmark for other assets, sovereign bonds are an anchor for domestic interest rates and financial conditions. They also facilitate access to international capital flows because their yields and ratings serve as general indicators of a country's economic and financial risk for global investors.

Aligning sovereign bonds with net zero requires coordinated action by several stakeholders across the financial system. Private financial institutions (e.g. investors) have started connecting their sovereign portfolios to net zero goals, but they face practical challenges in delivering these targets. Policy actions by issuing governments are also essential. Here, achieving consistency of sovereign bonds with the net zero transition involves two interlocking steps, ensuring: (i) that public expenditure and policies financed through sovereign bonds are consistent with net zero; and (ii) that the economy at the macro level is geared towards the timely achievement of the country's net zero goals.

Central banks have a unique opportunity to contribute to the alignment of sovereign bond markets with net zero through reallocation, financial supervision and public engagement. However, they must work within the constraints of their mandates and monetary policy obligations. At a minimum, central banks should assess and disclose the net zero alignment and climate risk exposure of their sovereign bond portfolios as this information is important to all stakeholders.

Aligning sovereign bonds with net zero: practical challenges

Assessing the net zero alignment of sovereign bond proceeds is a fundamental starting point, but doing so is not straightforward. Net zero-aligned sovereign bonds provide reassurance to investors that they are funding public efforts towards the transition. However, classifying sovereign bonds as such requires the significant task of determining whether public budgets, fiscal frameworks, sovereigns' policies and, ultimately, the economy, are in line with a net zero transition. Solutions are emerging to identify, measure and monitor public finance alignment (such as climate budget tagging), but are yet to become mainstream.

Climate risk exposure also needs to be considered in the management of sovereign bond portfolios. There is growing evidence that the increasing physical and transition risks of climate change in the economy will impact sovereign creditworthiness and borrowing costs. Evidence is also emerging showing that strong institutions and climate policies can mitigate the adverse impacts of physical and transition risks on sovereign risk premiums. In this context, short-term climate risk considerations should not undermine the ability of governments to finance the transition and adaptation measures that decrease these risks in the longer term. Concerns about fairness and inequalities are particularly pronounced in the sovereign space as poor countries are less able to fund the low-carbon economic transformation while often being the most vulnerable to and unable to address climate risks.

There is no definitive approach to assessing the net zero alignment and climate risks of sovereign portfolios, but solutions for investors are emerging. Financial institutions and asset managers have started to integrate net zero considerations into their sovereign bond portfolios, but there are several competing methodologies and metrics for this complex task, and no clear net zero roadmaps or disclosure frameworks for sovereigns. Further, the sovereign credit ratings provided by agencies are criticised for lacking transparency and a forward-looking approach. In this context, global frameworks are emerging such as the Partnership for Carbon Accounting Financials (PCAF) and

Assessing Climate-Related Opportunities and Risks (ASCOR), which enable investors to assess sovereign bond alignment in a consistent way.

Investors cannot transfer the same strategies for aligning their corporate portfolios with net zero and mitigating their climate risk exposure to the sovereign context, partly because divestment strategies may undermine sovereigns' ability to finance transition policies in the first place. Also, investor engagement with sovereigns is more challenging than with corporate entities. Thematic green, sustainable and sustainability-linked sovereign bonds provide one way they can link portfolio holdings with net zero. Sovereign green bonds are currently the main tool governments are using to raise funds for sustainable objectives. However, they represent only a fraction of overall public spending and do not necessarily ensure that government policies overall are compatible with net zero. Sustainability-linked sovereign bonds provide a promising mechanism for connecting capital raising with macro policy outcomes, such as achieving national climate targets, but their market is currently too limited for broad use by investors.

The role of central banks

Central banks can contribute to the net zero alignment of sovereign bond markets in three ways:

1. **As one of the largest owners of sovereign bonds globally, central banks can reallocate part of their domestic and foreign sovereign bond portfolios to better align them with the transition to net zero and manage their climate risk exposure.** They have some degree of freedom here, particularly with their non-monetary portfolios, but face tight policy constraints over their monetary policy and foreign reserve portfolios, significantly limiting possibilities for reallocation. The use of thematic sovereign bonds such as green bonds, sub-sovereign bonds and supranational bonds could help to circumvent these limitations.
2. **Central banks can use their role as standard setters and financial supervisors to contribute to the alignment of sovereign bond markets.** With their unique system-wide perspective, central banks can play an important role in supporting the development of assessment and disclosure frameworks for sovereigns, which are required by all market players. Where they have a supervisory mandate, central banks are well placed to assess the alignment and climate risk management practices of financial institutions when it comes to sovereign bonds. They can highlight examples of best practice and support their adoption.
3. **Central banks can engage publicly on net zero national and international policies and objectives.** Within the independence principles that govern their relations, central banks can engage and support governments and public agencies in different ways: from calling on them to deliver on their net zero pledges to providing them with information and technical assistance on climate-related economic strategies. They can also foster useful dialogues between public bodies and national stakeholders. And through their memberships in international forums, central banks can contribute to the development of solutions and financial market architecture that support sovereigns globally to fund the necessary measures for the net zero transition.

As first steps, central banks should:

- Disclose the alignment of their sovereign holdings on net zero.
- Identify options to better align their sovereign portfolios.
- Contribute to initiatives that provide market participants with adequate information and methodologies to assess sovereign alignment and risk exposure.
- Highlight best market practices for sovereign net zero alignment and risk management.
- Engage with domestic stakeholders to develop national transition policies.
- Identify and support international finance solutions for the global transition to low-carbon economies.

1. Introduction

To limit average global temperature rise to around 1.5°C above pre-industrial levels, in line with the Paris Agreement, urgent action to mitigate climate change must be implemented around the world and across all areas of the economy. Emissions need to peak by 2025, fall by nearly half by 2030, and reach net zero by 2050 (IPCC, 2023). Financial markets are pivotal to facilitating an orderly process as they mobilise and allocate the capital necessary to finance the transition. This is acknowledged by the Parties to the Paris Agreement, who have pledged to make “finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development” (UNFCCC, 2015). The consistency of finance flows generated by financial markets with a pathway towards net zero emissions – i.e. their alignment with net zero – is imperative to achieve climate change and sustainable development objectives.

Sovereign bonds are central to aligning finance flows with the net zero transition. This report aims to understand the system-wide context within which central banks can make a responsible contribution to this alignment, reviewing market innovations and challenges, understanding existing practice and setting out robust options for action.

Sovereign bonds and the net zero transition

The sovereign bond market (including sub-sovereign bonds; see Box 1.1) represents about half of total debt securities globally (BIS, 2023). Financial flows will never be completely aligned with the net zero transition if sovereign bonds are not. Beyond their market size, sovereign bonds also underpin funding for the large public services and investments – in education, health, social services and infrastructure – that are a central part of the transition. In addition, their soundness is essential to providing the financial and economic stability needed for an orderly low-carbon transition.

The alignment of sovereign bonds with net zero depends on the public expenditure and policies to which they contribute financing and, ultimately, on the alignment of the economy at the macro level. Net zero alignment in the context of sovereign bonds is therefore connected with greening public budgets and policies and involves decarbonising the whole economy. This process requires system transformation over the next decade¹ through the coordinated actions of several private and public stakeholders, including central banks.

The role of private investors

Some private institutional investors have already started to connect their sovereign portfolios to net zero goals. Assessing the alignment of sovereign bonds with the net zero transition – and their exposure to climate-related risks – is a challenging first task, but global frameworks, including the Partnership for Carbon Accounting Financials (PCAF) and Assessing Climate-Related

Box 1.1. Definitions

Sovereign bonds: debt securities issued by national governments, sold to domestic and international creditors, and then traded on global financial markets.

Sub-sovereign bonds: debt securities issued by subnational government entities such as federal states, provincial, municipal or local governments, state-owned enterprises and supranational consortia (OECD, 2020).

Supranational bonds: debt securities issued by organisations representing multiple governments such as the European Union or by financial institutions with a public investment purpose and established by national governments, such as the European Investment Bank (EIB) or International Bank for Reconstruction and Development (IBRD).

Net zero alignment: making financial flows consistent with a pathway towards net zero emissions that meets international climate agreements and sustainable development goals.

¹ According to the 2022 Sharm el-Sheikh Implementation Plan, no less than a “transformation of the financial system” is needed to mobilise the investments required for climate action.

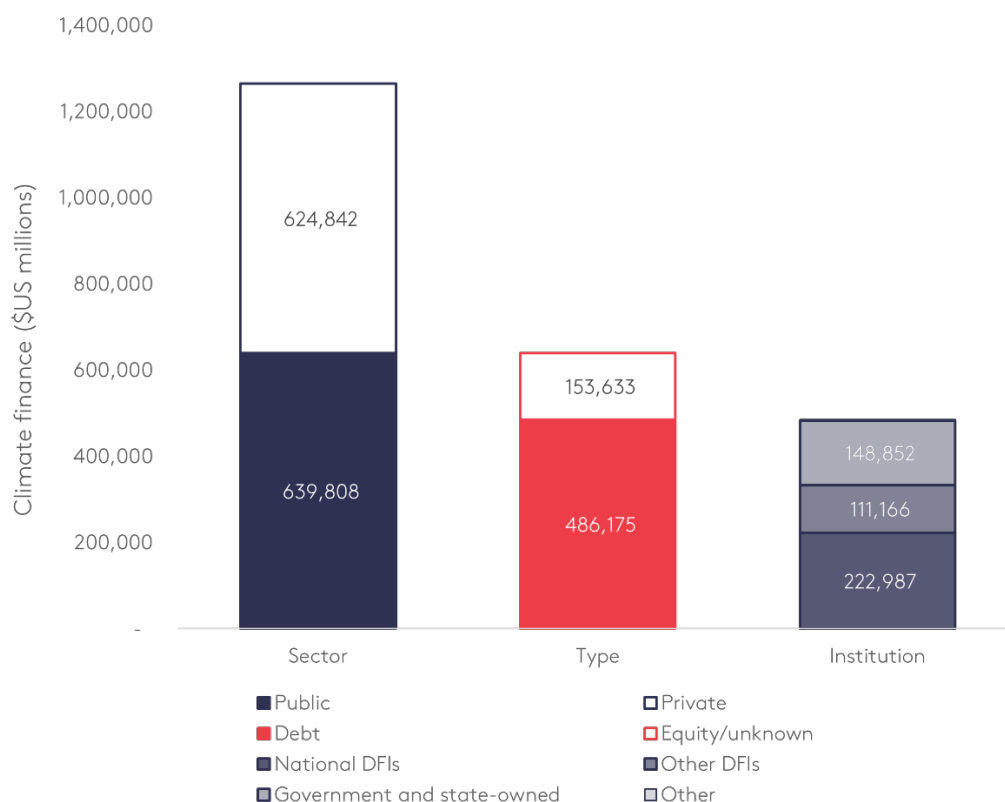
Opportunities and Risks (ASCOR), are starting to emerge, enabling them to take consistent approaches. Traditional net zero alignment strategies used by private investors, like portfolio reallocation and engagement with issuers, have their shortcomings in the sovereign context. For example, divestment is not always possible without excluding key assets in portfolio allocation, and engaging with sovereigns is less straightforward than with corporate entities. Alternative instruments and approaches are therefore being trialled, such as thematic sovereign bonds (e.g. green bonds and sustainability-linked bonds) and engagement with public authorities – increasingly known as ‘macro-stewardship’ (see PRI, 2020).

The role of the public sector

Public finance already accounts for more than half (US\$640 billion) of the US\$1.27 trillion total climate finance worldwide (CPI, 2023; UNFCCC SCF, 2022). This only represents a fraction of the annual investments needed to reach Paris-aligned emissions reduction targets: the Intergovernmental Panel on Climate Change (IPCC) estimates annual investment needs of US\$2.3–4.5 trillion up to 2030 (IPCC, 2023). To close this finance gap, all public institutions must therefore be aligned with net zero transition targets, as must overall public budget expenditures and investment.

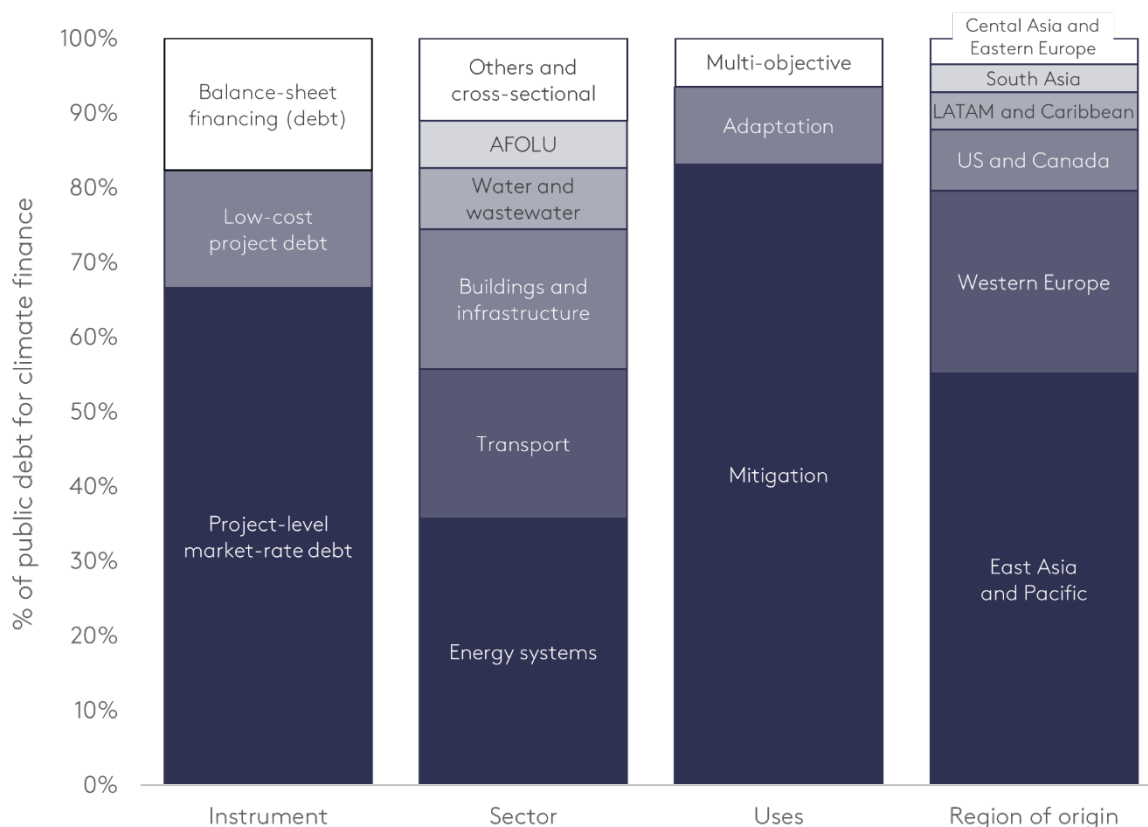
Debt instruments, including sovereign bonds, are currently the most important contributor to climate finance, representing over three-quarters (US\$486 billion, or 76%) of the US\$640 billion in public climate finance over 2021–2022 (see Figure 1.1). National development finance institutions (DFIs) are by far the largest debt issuers, but governments and state-owned enterprises or financial institutions also play a significant role by issuing nearly US\$150 billion in bonds and loans to fund climate mitigation and adaptation efforts. Public debt-funded climate finance is primarily financed at the market-rate to fund mitigation projects in energy systems, transport, buildings and infrastructure, especially in East Asia and the Pacific and Western Europe (see Figure 1.2).

Figure 1.1. Climate finance flows by sector, instruments and institution, 2021/2022



Source: Authors’ own calculations based on Climate Policy Initiative [CPI] (2023)

Figure 1.2. Public debt by instrument, sector, use and region of origin, 2019–2020



Note: AFOLU = agriculture, forestry and other land use.
 Source: Authors' own calculations based on CPI (2023)

The role of central banks

Public policy action is essential to aligning sovereign bond markets with net zero. Sovereign issuers need to develop a clear 'net zero sovereign pathway' to enable market participants to allocate their portfolios accordingly. This is primarily the responsibility of finance ministries but involves all government policies to some extent.

Central banks are not exempt from this effort – as they are covered by Article 2.1(c) of the Paris Agreement (Feyertag and Robins, 2023) – and they have an interest in monitoring and supporting sovereign bond markets in the transition to net zero to ensure that they fulfil their various roles. Central banks are among the largest single owners of sovereign bonds globally, and they rely on them to implement monetary policy through domestic operations and foreign reserve management and thus fulfil their mandate of price and exchange rate stability. Sovereign bonds are also central to financial institutions' financial risk management and thus play an important role in financial stability, another central bank mandate. The soundness of domestic sovereign bond markets contributes to the stable economic conditions in a country that are conducive to the long-term investment needed for sustainable economic development, which is also often part of the mandate of central banks.

Aims and structure of this report

Through the work of the Central Banks and Supervisors Network for Greening the Financial System (NGFS), central banks, as monetary policymakers and financial supervisors, have extensively studied their policy options to support the alignment of corporate asset markets with the transition to net zero and several have started to implement some of these options. However, when it comes to sovereign bonds, they are only at the beginning of this exploration. The approach that central banks have developed for aligning corporate asset markets cannot be

transferred to sovereign markets. This report therefore takes a fresh look at the broad role of sovereign bond markets in the net zero transition and specifically at central banks as a key actor in this process, suggesting policy options central banks can consider to contribute to the alignment of sovereign bond markets.

The report is structured as follows:

- **Section 2** outlines the key functions of sovereign bonds, the different types of thematic bonds and their uses, and provides contextual facts and figures.
- **Section 3** discusses how sovereign bonds can be used in support of the low-carbon transition, from risk assessment to net zero alignment. It also examines the conceptual and practical challenges that market participants face in assessing and aligning their sovereign bond portfolios and presents emerging options to overcome them.
- **Section 4** turns to the role that sovereign bonds play in central bank policies, possibilities for aligning them with the low-carbon transition, and associated constraints. It also provides examples of actions taken by central banks to date.
- **Section 5** presents ways forward for central banks to contribute to the alignment of sovereign bond markets with the net zero transition.
- **Section 6** concludes and provides recommendations.

2. Sovereign bond markets: key characteristics

Before exploring how sovereign bonds can support the transition to net zero, and central banks' and supervisors' role here, it is necessary to understand the functions that sovereign bonds play in financial markets.

Functions of sovereign bonds in global financial markets

Sovereign bonds are:

- **A key source of funding for public services and investments.** Sovereign bonds are the main channel through which national governments issue debt to finance public services and investments.² Borrowing on domestic and international markets using sovereign bonds enables the continuous provision of essential public services in many economies, and enables governments to fund large upfront capital expenditures. They are also an important channel for sovereigns to access international capital flows.
- **A pivotal asset for the management of financial risks.** Most sovereign bonds are generally considered relatively safe and liquid investments.³ This is reflected in international financial regulatory frameworks such as the Basel framework, which currently allows national jurisdictions to apply a 0% risk weight for domestic sovereign bonds denominated and funded in local currency for capital requirements (BIS, 2018). They are also a global asset class that allow financial institutions to hedge their currency and geographical exposure. These features make sovereign bonds a key asset class for financial institutions such as banks to manage risks and liquidity, as they represent a large part of their portfolios (Dell'Araccia et al., 2018). Therefore, sovereign bonds and markets are central to the stability of financial institutions and the financial system at large.
- **An anchor for domestic interest rates and financial conditions.** Sovereign bonds are a benchmark for other domestic asset markets. Their yields and risks serve as a basis for assessing other financial assets in an economy. Sovereign rates determine credit conditions on domestic markets, and therefore indirectly drive the provision of credit in the economy.⁴ This in turn impacts the cost of capital facing firms and households, which influences their investment and consumption behaviours (Augustin et al., 2018).
- **Key for access to international capital flows.** Sovereign bond yields and credit ratings serve as general indicators for assessing the economic and financial risks a country faces. They reflect investors' confidence in an economy and its business environment, and therefore affect sovereigns' access to international capital and its cost. Financial conditions for sovereign bonds also impact foreign funding inflows for the private sector in an economy.⁵

Sub-sovereign bonds and supranational bonds share some of these features: they finance the provision of public services and investments and are considered relatively safe and liquid, although to a lesser extent than sovereign bonds.

² Sovereigns also fund themselves through direct bilateral syndicated loans (public and private, and sometimes with the central bank). However, compared to sovereign bonds these amounts are smaller (Abba and Pienkowski, 2022). There are other financial instruments through which a sovereign can borrow, but these tend to be much smaller in scale.

³ Liquidity ratios similarly favour sovereign debt holding. For example, no limits or haircuts are applied to domestic sovereign bond exposures that are eligible as high-quality liquid assets (BIS, 2018).

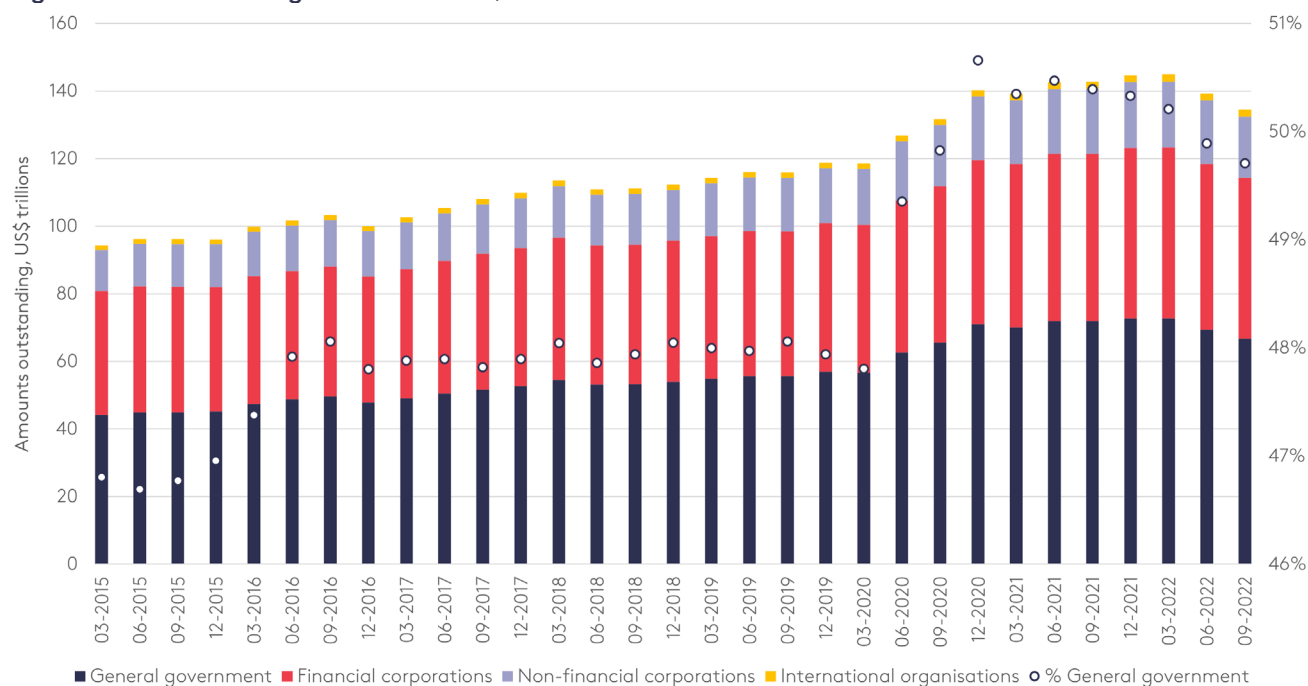
⁴ Credit provision by domestic financial institutions is negatively impacted by sovereign bond risks and unstable credit ratings (Committee on the Global Financial System, 2011; Riaz et al., 2019). Part of this negative effect can be explained by the fact that sovereign risk is a crucial determinant of private sector access to international capital (Das et al., 2010).

⁵ Sovereign bond yields and credit ratings have been shown to affect capital inflows between OECD and non-OECD countries (Cai et al., 2018), into the Eurozone (Ioannou, 2017), and in Africa (Arogundade et al., 2022). Kellard et al. (2022) find that the sovereign risk of the country of origin also impacts foreign direct investment flowing from it.

The importance of sovereign bonds to global financial markets

Sovereign and sub-sovereign debt together represents around half of global debt securities. The overall market size of sovereign debt securities has increased over time (see Figure 2.1) and saw a significant increase during the COVID-19 pandemic to a high of 50.7% of global debt securities by the amount outstanding. Sub-sovereign debt increased to roughly one-quarter of the overall sovereign debt market in 2022, up from one-fifth in 2012. The share of sub-sovereign debt as a percentage of total general government debt is particularly high in federal government systems such as Canada (48%), India (35%) and Switzerland (35%) (BIS, 2023).

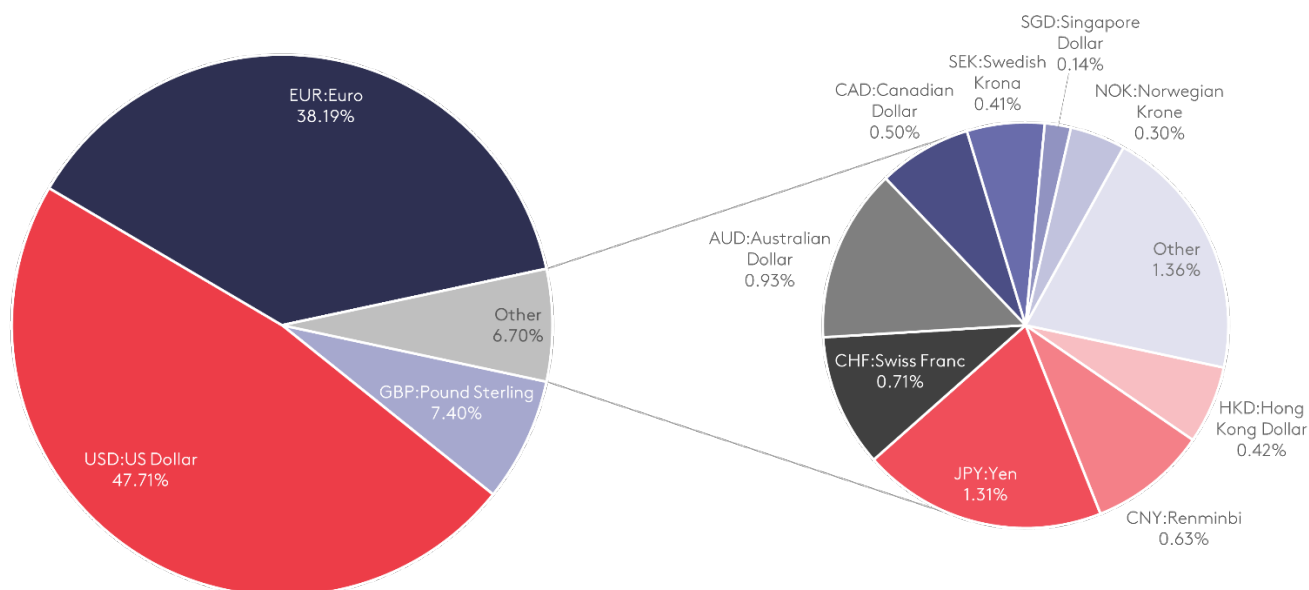
Figure 2.1. Outstanding debt securities, Q3 2015–Q3 2022



Source: Authors' calculations based on Bank for International Settlements [BIS] (2023)

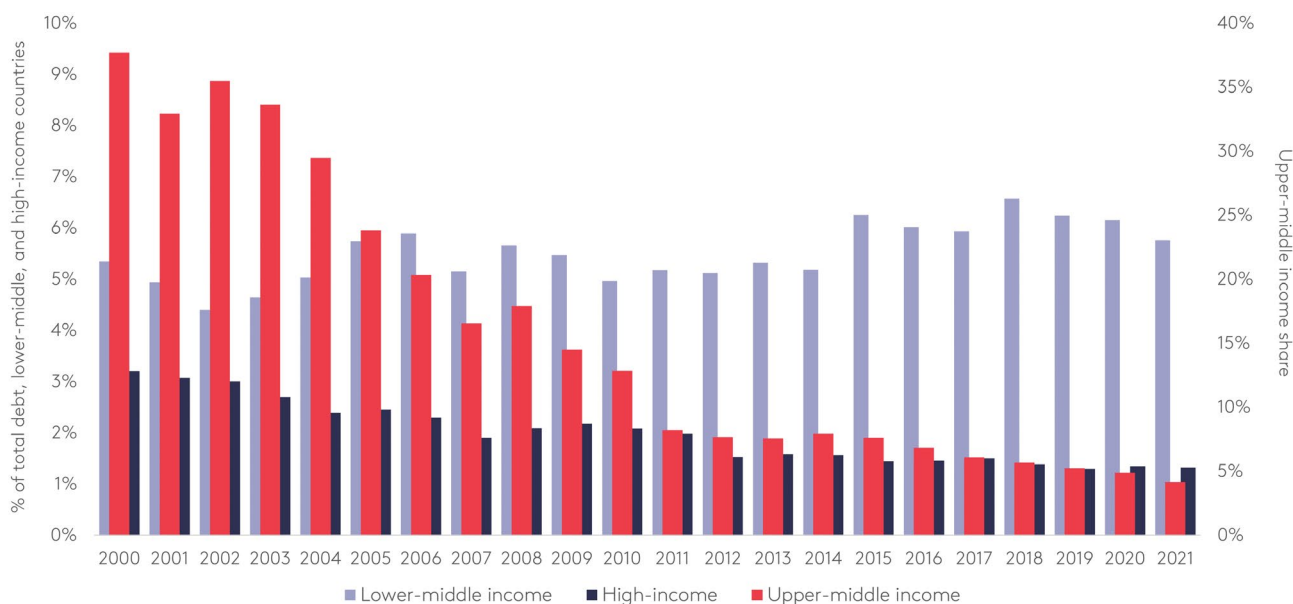
Most sovereign bonds are issued in only a few currencies. About 85% of sovereign debt is issued in US dollars and euros (see Figure 2.2). The prevalence of these currencies reflects the size of the US dollar and euro area economies, but other countries also issue sovereign bonds in these currencies to access lower interest rates and sovereign borrowing costs, and to diversify their investor base (Gopinath and Stein, 2021). Issuances in domestic currencies have, however, started to gain traction since the early 2000s, especially in upper-middle-income countries (see Figure 2.3). This trend is driven by a reduction in foreign currency sovereign borrowing since 2004 in countries such as Brazil and Colombia and an increase in China's domestic currency borrowing since 2011. More broadly, it reflects the increased depth and liquidity of some domestic capital and currency markets, which improves the ability of sovereigns to borrow in their domestic currency (Onen et al., 2023).

Figure 2.2. Sovereign bonds issued in international markets by currency, Q4 2022



Source: Authors' calculations based on BIS (2023)

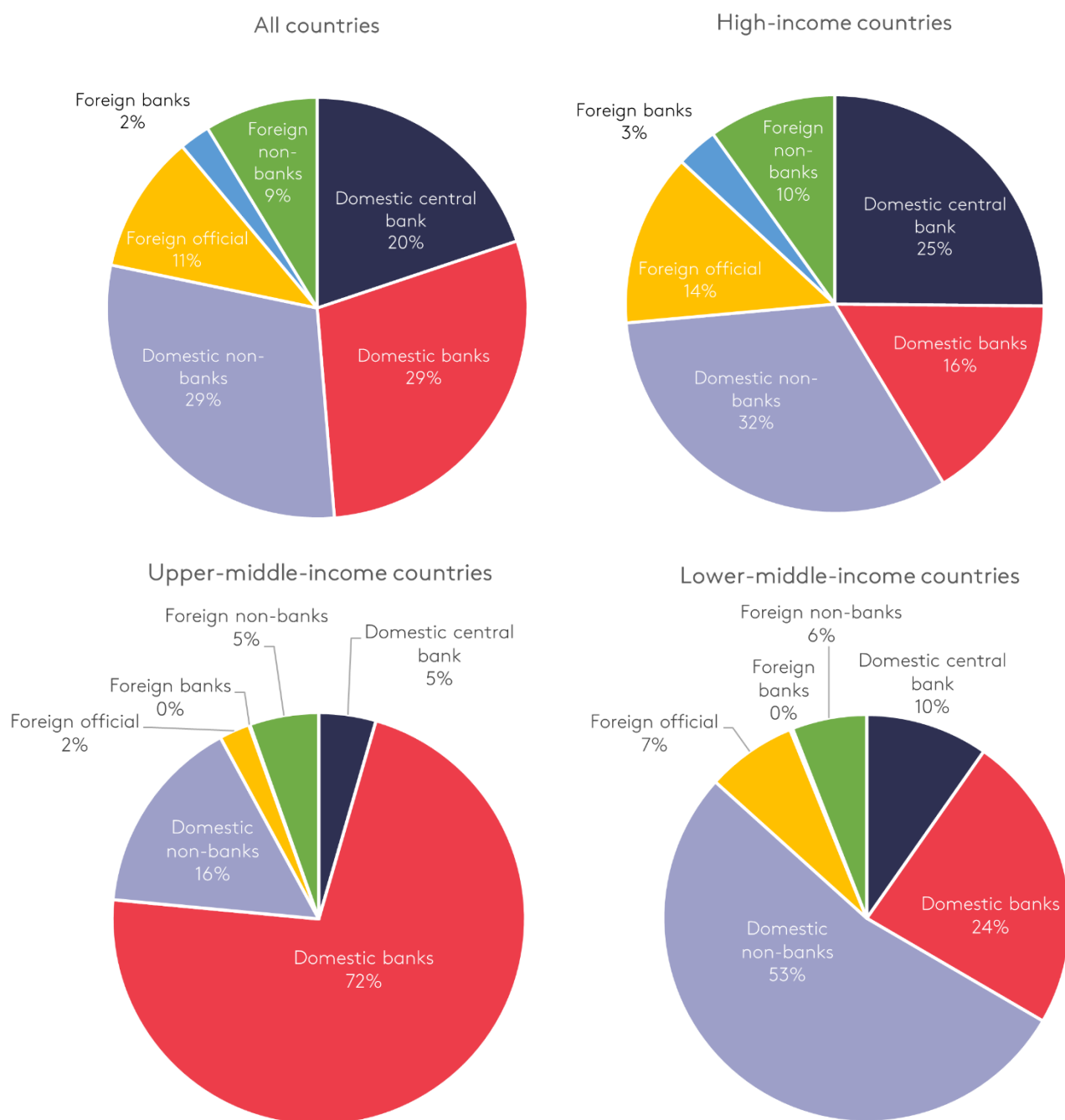
Figure 2.3. Share of sovereign bonds denominated in foreign currency, 2000–2021



Source: Authors' calculations based on BIS (2023)

Central banks are important investors in sovereign bond markets. In 2022, central banks owned around 20% of domestic sovereign bonds, although their share of ownership varies across countries and is driven by monetary policy strategies (see Figure 2.4). For example, domestic central banks' share of sovereign bonds is highest in some high-income countries, where the monetary policy strategy of quantitative easing (QE) led to large-scale domestic asset purchases in the last decade. This type of ownership is concentrated in a few high-income economies including the US and the euro area and, to a lesser extent, Japan, Canada, Australia and the UK (see Figure 2.5). In middle-income countries, domestic banks (upper-middle-income countries) and domestic non-bank financial institutions such as pension funds and insurers (lower-middle-income countries) are more important purchasers of sovereign bonds than in high-income countries, and central banks play a smaller role as domestic sovereign bond markets (Figure 2.4).

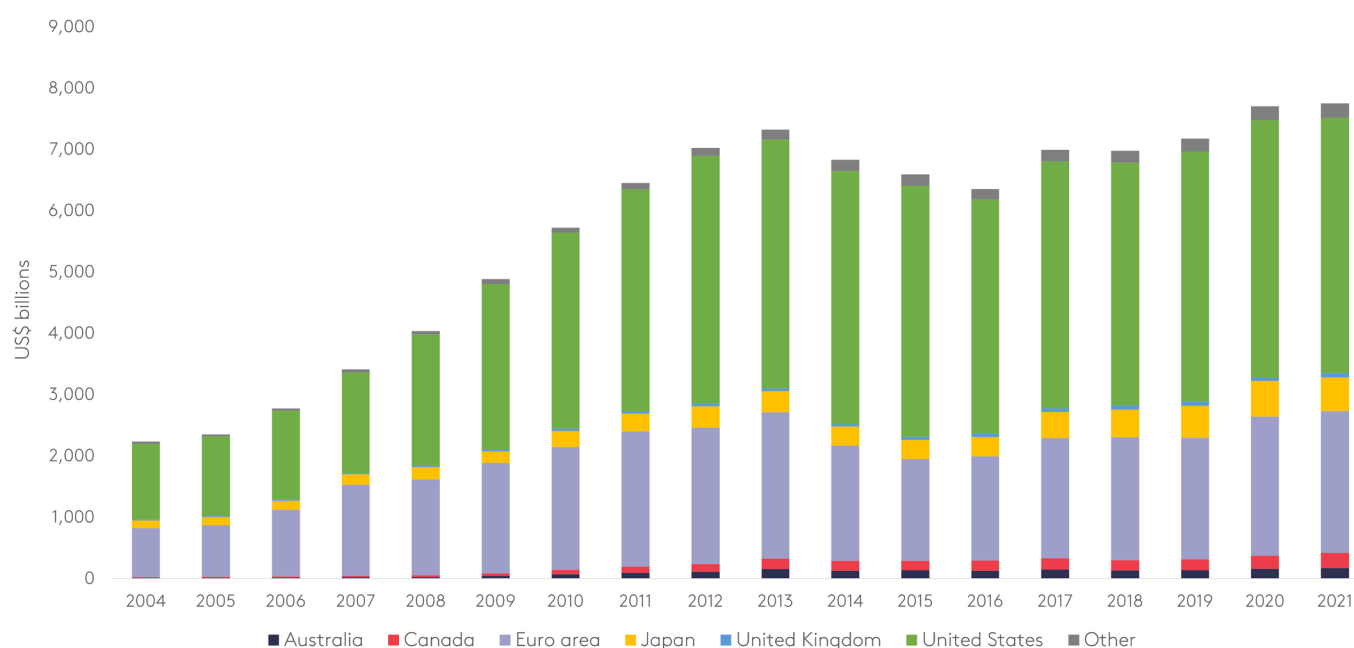
Figure 2.4. Sovereign debt ownership by country group (% of issued sovereign debt)



Source: Authors' calculations based on IMF (2023)

Foreign central banks are also important owners of foreign sovereign bonds, mostly through their foreign reserve portfolios. The amount of sovereign bonds held by foreign central banks has more than tripled in the last two decades. Sovereign debt issued by the US and euro area countries constitutes more than 80% of the sovereign debt owned by foreign central banks (see Figure 2.5).

Figure 2.5. Foreign central banks' sovereign debt ownership (by issuer), 2004–2021



Source: IMF (2023)

Thematic sovereign bonds

Thematic sovereign bonds are an asset class that investors are increasingly using to align their sovereign portfolios with the net zero transition. These are bonds that are issued to finance projects and activities with a specific objective (see Box 2.1 for different types of thematic bonds and Box 2.2 later in the section for a focus on sovereign green bonds).

Sovereign green bonds (SGBs) currently dominate the thematic sovereign bond market, representing US\$263.3 billion of the US\$324.2 billion issued to date (CBI, 2023a). SGBs in particular experienced rapid growth driven by governments' increased targeted fiscal support during the COVID-19 pandemic (Figure 2.6). As of February 2024, 51 sovereigns⁶ had issued 220 green, social, sustainability and sustainability-linked bonds, with green bonds comprising 76% of

Box 2.1. Types of sovereign bonds, thematic and state-contingent

- **Sovereign green bonds** tie the use of proceeds to the financing of projects that have a positive environmental impact, such as renewable energy, energy efficiency and climate resilience.
- **Social bonds** are used to finance projects that have a positive social impact, such as affordable housing, education and healthcare.
- **Sustainability bonds** are used to finance a broader range of projects that have both environmental and social benefits.
- **Sustainability-linked bonds** are used to finance projects or activities that help achieve predefined key performance indicators (KPI) linked to sustainability objectives, such as reduced emissions. They are agnostic about the use of proceeds and link the bond's coupon rate to progress on KPIs such as emission reductions.
- **Transition bonds** are specifically used to fund the transition towards reduced environmental impact or carbon emissions, including in hard-to-abate sectors.

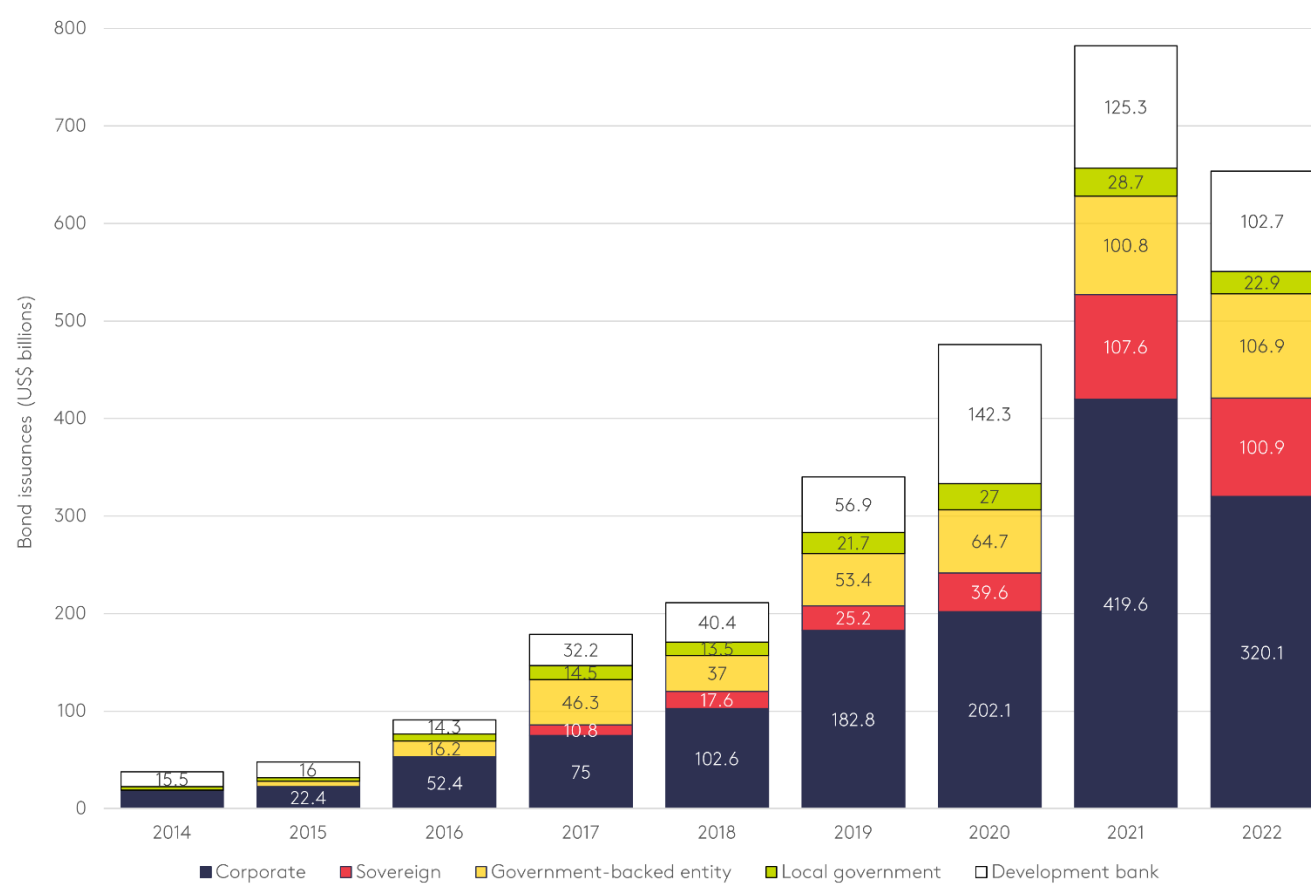
⁶ The Isle of Man is treated as part of the United Kingdom.

the total issuance amount (Luxembourg Green Exchange, 2024). SGB issuances are particularly concentrated in Europe, where they constitute 98% of thematic bond issuance.

Alternative, state-contingent, debt instruments such as sustainability-linked bonds (SLBs) are emerging, offering promising ways to overcome some of the drawbacks of conventional thematic bonds discussed later (in Section 3). Unlike thematic bonds, they are agnostic about the use of proceeds but tie the bond’s coupon rate to the progress towards sustainability-related KPIs. Sustainability and sustainability-linked bonds account for over 54% of thematic issuances in emerging markets and developing economies (EMDEs), whereas SGBs (39% of thematic issuances) play a much smaller role there than in Europe (Luxembourg Green Exchange, 2024).

Compared with corporate green bonds or conventional sovereign bonds, the role of SGBs is still relatively small, representing one-fifth (20%) of the overall green bond market (MSCI, 2023) and around 5% of total sovereign bond issuances (Cheng et al., 2022). However, demand for SGBs outstrips supply, as evidenced by the oversubscription of SGBs at their issuances. For example, the UK green gilt was 12 times oversubscribed (HM Treasury, 2021) and Egypt’s seven times oversubscribed (World Bank, 2022b) at the point of issuance.

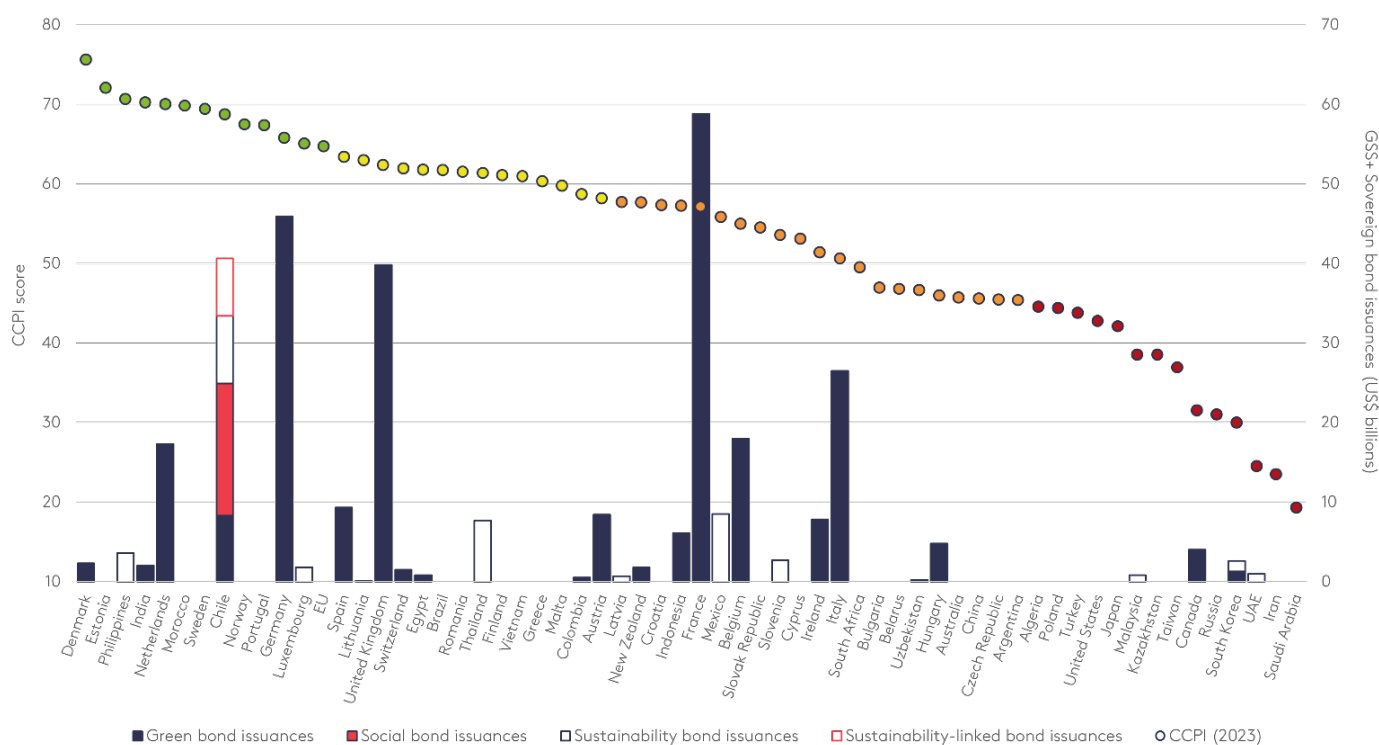
Figure 2.6. Green and sustainability-linked bond issuances by issuer type, 2014–2022



Source: CBI (2023a)

Increased thematic bond issuance does not necessarily imply sovereign alignment. It does not in itself indicate the overall net zero alignment of a government’s policies or expenditures and governments can have policies, funding and debt management frameworks in place that support the net zero transition without them being earmarked through a green bond framework. Figure 2.7 shows that the issuance of SGBs is not a robust indicator of sovereign alignment with the net zero transition.

Figure 2.7. Green bond issuances (US\$ billions) and sovereign alignment (CCPI score*)



Notes: GSS+ data is as of November 2023. *CCPI is an independent monitoring tool that tracks governments’ efforts to combat climate change. Note that some countries and territories that have issued significant volumes of sovereign thematic bonds are not shown due to CCPI data not being available (these include Uruguay, Peru and Hong Kong).

Source: Burck et al. (2023); CBI (2023a; 2023b; 2023c)

Box 2.2. Characteristics of sovereign green bonds

Principles and frameworks

By issuing green bonds, a sovereign commits to using their proceeds to finance projects and activities that have a positive environmental impact, such as renewable energy, energy efficiency or climate resilience. Eligible use-of-proceeds are typically published in the issuer’s green bond framework, with criteria based on principles-based frameworks such as the International Capital Market Association’s (ICMA) Green Bond Principles (GBPs).

The GBPs rest on four key issuer commitments: (i) specification of the use of proceeds; (ii) a process for project selection and evaluation; (iii) a framework for managing the bond proceeds (e.g. ringfenced accounts); and (iv) ongoing reporting of spending from the bond, typically using annual allocation reports. The GBPs also require issuers to seek a second-party opinion (SPO) from independent providers to verify the use of proceeds. To date, all sovereign issuers have adhered to the GBPs.

Another widely used standard is the Climate Bonds Standard (CBS), an extension of the GBPs published by Climate Bonds Initiative (CBI). The CBS includes sector-specific guidance of what constitutes ‘green’, whereas the GBPs provide a non-exhaustive list of green project guidelines. Alongside these frameworks, issuers can self-label their bonds as green bonds. For corporates, as many as one-fifth of green bonds are self-labelled (Cheng et al., 2022).

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Green premium

Several studies have attempted to assess whether green bonds issue and trade at a higher price than conventional bonds issued by the same entity with identical credit risks – in other words, whether there is a green premium ('greenium'). Evidence on the greenium is mixed: it depends on the size of the bond compared with a conventional bond, the timing of its issuance, whether the bond is traded on the primary or secondary market, and whether it is issued as a twin bond (see e.g. Baker et al., 2022; Doronzo et al., 2021; Karpf and Mandel, 2018). Some studies have shown that where greeniums exist, they are miniscule (Bolton et al., 2023) or insignificant relative to additional issuance costs associated with SGBs (Grzegorczyk and Wolff, 2022; Lehmann and Martins, 2023).

Experience in Europe shows that early issuances of SGBs benefitted from a greenium averaging 3.5 basis points, but that this has shrunk over time (ECB, 2023a). By contrast, the International Monetary Fund (IMF) has observed that greeniums grow as SGBs become more established, and that greeniums are larger in emerging market and developing economies (EMDEs) that face transition risks, due to large mitigation investment needs (Ando et al., 2022). EMDEs such as South Africa and India could therefore be set to benefit most from green bonds issuances, enabling them to tap into wider capital markets at reasonable rates.

Benefits for sovereigns

In addition to a possible greenium, which would allow governments to potentially borrow at lower costs to fund green projects, SGBs have other potential benefits for sovereigns. First, the maturity of green bonds is typically longer than for conventional bonds, reflecting the longer time horizon of green projects. This makes them attractive to the buy-and-hold strategies of institutional investors such as insurance corporations and pension funds (ECB, 2023a). Such investors are important for sovereigns as they provide a wide source of stable financing.

SGBs also have reputational benefits. They send a powerful signal about a sovereign's intentions around climate policy action and their commitment to mitigate environmental risks or manage the intergenerational trade-offs of climate-related policies (Doronzo et al., 2021).

3. Sovereign bonds in the transition to net zero

Some private institutional investors have already started to connect their sovereign portfolios to net zero goals. As a first step in this direction, they can assess the exposure of their sovereign bond portfolios to climate-related risks, and the alignment of these portfolios with net zero goals. Methodologies to assess climate-related risk exposure and alignment are rapidly evolving but some important challenges remain. In parallel, private investors are also exploring approaches to proactively managing climate-related risks and aligning portfolios in the sovereign bond space. We review these methodologies, challenges and approaches in this section.

Climate risks in sovereign bonds

Like other financial assets, sovereign bonds are exposed to climate-related risks. There is growing evidence that physical risks adversely impact sovereign creditworthiness and borrowing costs through multiple transmission channels, such as reduced GDP growth due to lower agricultural and industrial production (Dell et al., 2012), declining worker productivity and firm output (Kling et al., 2021), and growing conflict and political instability (Hsiang et al., 2013). Several studies provide empirical evidence that countries that are more vulnerable or less resilient to the physical effects of climate change face lower credit ratings (e.g. Cevik and Jalles, 2022), higher bond yields and greater sovereign borrowing costs (Beirne et al., 2021a; 2021b; Bingler, 2022; Boehm, 2022; Kling et al., 2018; Painter, 2020; Volz et al., 2020) and sovereign defaults (Mallucci, 2022).

There are comparatively fewer studies on the impact of transition risks on sovereign creditworthiness. However, it has been shown that sovereigns with lower carbon emissions, increased renewable energy consumption and reduced earnings from natural resource rents (all proxies for transition risks) are associated with lower sovereign risk premia (Collender et al., 2022). Furthermore, there is evidence that higher transition performance, lower transition risk exposure and greater transition opportunities are associated with lower yields, especially for long-term maturity bonds in sovereigns rated AA- or higher, and for the period following the Paris Agreement (Bingler, 2022).

Strong institutions and ambitious climate policy reduce the impact of climate risks. There is emerging evidence that strong institutions and climate policies can mitigate the adverse impact of physical and transition risks on sovereign risk premia (e.g. Battiston and Monasterolo, 2020; Beirne et al., 2021b; Bingler, 2022; Boehm, 2022; Boitan and Marchewka-Bartkowiak, 2022; Cheng et al., 2023). Some studies show that stronger institutions can increase resilience to and insulate sovereign bonds from climate risks (Beirne et al., 2021b). Others show that progress on the implementation of green monetary and financial policies can reduce the magnitude of the adverse impacts on sovereign borrowing costs from climate risks (e.g. Cheng et al., 2023).

With historically elevated debt levels and servicing costs in many climate-vulnerable EMDEs, a growing body of research investigates how climate and financial resilience jointly affects sovereign debt – see Box 3.1 for an overview.

Box 3.1. Climate risks and sovereign financial resilience in emerging markets and developing economies

Reducing debt burden

From 2013 to 2022, the percentage of low-income countries at high risk of debt distress – or are already in it – increased from 21% to 56% (IMF, 2022). Poor credit ratings restrict the ability of sovereigns to raise funds on global capital markets, and thus also limit their access to funding for climate action (Alayza and Caldwell, 2021). Furthermore, low-income countries often face relatively higher climate risks than high-income countries. Recent studies highlight that many countries face a double jeopardy of elevated climate-related and economic fragility (Feyen et al., 2020). Examples of pre-existing financial fragilities range from debt distress (Monasterolo et al., 2022) to low currency liquidity (Wollenweber, 2024), which can exacerbate the adverse impact of climate risk exposure on sovereign bonds – and public finances.

Several financial schemes are currently being developed for countries, especially EMDEs, to build resilience and reduce debt burdens. Debt-for-nature swaps (in which developing countries' debt burdens are reduced in exchange for investments in nature conservation) linked to sustainability-linked bonds and catastrophe bonds are being proposed as ways of reducing or restructuring low-income countries' debt burdens (UNFCCC, 2022; Volz, 2022), while giving them greater fiscal resilience to the physical effects of climate change. Debt-for-nature or debt-for-climate swaps, such as those completed in Belize, Cape Verde and Barbados, can be linked to a nature-related performance index to create sustainability-linked bonds (Chamon et al., 2022; Volz et al., 2021).

Demands for addressing the simultaneous impacts of climate risks and financial fragility are increasing. The Bridgetown Initiative, for example, calls for a systematic approach to solving debt crises along with other measures such as extending the IMF's Special Drawing Rights (SDRs), expanding repurchase facilities such as the Liquidity and Sustainability Facility (LSF), or expanding grant and equity financing (Mottley, 2023).

Coping with climate costs

Catastrophe bonds are one financial instrument that sovereigns can use to cope with the costs of climate change. For example, they can include liquidity clauses that allow sovereign issuers to receive immediate cash relief, maturity extensions and suspend debt service payments in the event of catastrophic climatic conditions such as extreme weather events (Mallucci, 2022). Multi-country sovereign disaster insurance and catastrophe bonds have been proposed as fiscal tools to increase post-disaster liquidity and reduce debt default (UNFCCC SCF, 2022).

Typically, catastrophe bonds are insulated from the financial condition of the issuer because they are held by a special purpose vehicle (SPV). They therefore do not increase the issuer's debt. To date, most catastrophe bonds have been issued by the US against earthquakes or pandemics, but their use has expanded to climate-vulnerable EMDEs such as Barbados, Mexico and the Philippines.

The net zero alignment of sovereign bonds

While assessing the net zero alignment of a sovereign bond may be straightforward where proceeds from the issuance of thematic sovereign bonds are earmarked for specific policies or projects, in practice most proceeds from sovereign bond issuances are used to finance the public budget. The extent to which sovereign bond portfolios are aligned with net zero goals thus depends on the alignment of the sovereigns that issue them. This necessitates a broader assessment of whether government policies and actions are aligned. It is therefore vital for financial institutions to have access to this information so that they can manage their sovereign portfolios in a way that supports net zero transitions.

We can identify four levels of net zero alignment:

- **Proceeds.** Sovereign bond proceeds can be considered aligned with the transition if its associated funds are spent on net zero-aligned public policies, services and investments. This relies on adequate identification, reporting and monitoring of the fiscal measures to which the bonds' funds are earmarked.
- **Public finance.** Most sovereign bonds are not earmarked, and their proceeds are used to finance general government policies, investments and other sovereign expenditures (e.g. servicing existing debt). In this case, the alignment of sovereign bonds will strongly depend on the overall alignment of public finance and the fiscal framework. The more a sovereign spends on public services and investments that support the transition, the more its sovereign bonds can be considered aligned with the transition.
- **Public policy.** In general, sovereign bonds finance government actions and thus the policies that government implements and supports – such as its nationally-determined net zero development pathway. A government's overall policy stance on the net zero transition thus also reflects how much funding is dedicated to these outcomes and is therefore a relevant measure for assessing alignment.
- **Economy.** A country's economic structure largely influences how the sovereign can allocate its current spending and investments. It is much more difficult for a country to ramp up sustainable activities if its economy is not aligned with the net zero transition. The structure of the economy also partly reflects public policies. The more a country's economy is aligned with the net zero transition, the more a sovereign portfolio with its bonds can be considered aligned.

Distinguishing these four levels is important for assessing alignment. For instance, the alignment of proceeds, if taken in isolation, can be a misleading yardstick as the inflows they generate may be transferred or free up fiscal headroom for continued fossil-fuel subsidies or other carbon-intensive activities. Similarly, while it is useful in theory to determine the net zero alignment of public finances and policies, in practice this is strongly dependent on the overall starting point, structure and trajectory of a sovereign's economy. Alignment of sovereign bond portfolios thus hinges on adequate information, reporting and monitoring at the level of the economy. Focusing on economy-level alignment resonates with the 'all-encompassing' interpretation of Article 2.1(c) of the Paris Agreement, which implicates financial flows and the financial system in its entirety in the delivery of its goals (Feyertag et al., 2023).

Challenges in assessing alignment

It is difficult to establish the attribution of sovereign bond proceeds to public financing and expenditures that support net zero for the following reasons:

- **Fungibility of public fiscal management.** Expenditures for specific activities usually cannot be directly tied to individual sovereign bond-related receipts. This means that it is not always possible to attribute specific spending items – such as green projects or policies – to individual bond issuances (Hardy, 2022; Cheng et al., 2022). In many countries, this fungible fiscal revenue framework is a principle that is enshrined in the constitution or

basic law (OECD, 2014), which conflicts with the need for use-of-proceeds earmarking that is central for green bonds.

- **Absence of clear net zero roadmaps and disclosure from sovereign issuers.** For corporate issuers, there is a strong focus on the delivery of net zero transition plans as one way for investors to assess the credibility and integrity of net zero policy commitments. An equivalent process is yet to emerge for sovereign issuers. Market participants and supranational institutions have increasingly called on governments to publish analogous disclosures (World Bank, 2022a), and some countries have begun to use climate and green budget tagging as a tool to highlight the allocation of public funds for climate-related activities (PRI, 2022; World Bank, 2021). However, the absence of a common disclosure framework, limited harmonised practices on green budget tagging, and the possibility of double-counting obscure the extent to which public finances are funding carbon-intensive or other unsustainable activities. No sovereign issuer has yet set out a roadmap for how its funding, including both thematic and conventional bonds, or its policies will be progressively aligned with net zero over the coming decades.
- **Greenwashing concerns.** Even where proceeds from SGBs can be attributed to green assets and projects, there is usually no obligation to monitor the environmental impacts at an asset or project level, which can lead to concerns over greenwashing (e.g. Bolton et al., 2023; Claessens et al., 2022). There is also no legal or practical way of enforcing green bond commitments beyond the reputational damage that a lack of action would cause to governments' credibility on climate change (Bolton et al., 2023; Doran and Tanner, 2019).
- **Additionality.** Most SGB proceeds currently go towards refinancing existing expenditure that fits into green categories (Kramer, 2020), making it unclear whether spending in support of climate goals would have been any greater without the green bond (Lehman and Martins, 2023). SGBs may therefore not result in a material reduction in carbon emissions, even if the promised use-of-proceeds is met (Ehlers et al., 2022). To understand the extent to which SGBs contribute to the net zero transition, it is therefore important to assess their contribution to generating fresh, new capital for additional mitigation or adaptation activities – i.e. their additionality (Fatica and Panzica, 2021).⁷ Currently, the additionality of SGBs is restricted by a lack of bankable green projects, policies and other eligible expenditures. To sustain the supply and liquidity of green bonds, a steady pipeline of new green projects with large capital costs and secured income streams needs to be established (e.g. OECD, 2021; Ando et al., 2022).

Emerging solutions to identify, measure and monitor sovereign bond alignment focus on the broader levels of alignment. For instance, some governments are beginning to adopt climate budget tagging (see PRI, 2022) of fiscal expenditures: this is a way to ensure that proceeds are associated with activities consistent with climate or sustainability-related objectives such as those in the Paris Agreement (Volz et al., 2020). Climate budget tagging tools can be linked to green bond frameworks and green taxonomies (World Bank, 2021).

State-contingent sovereign bonds

State-contingent bonds, such as SLBs, linking the coupon rate to KPIs, are a possible tool for overcoming the limitations of SGBs. As mentioned above, SLBs are agnostic about the use of proceeds or allocation of public expenses, focusing instead on verifiable performance- and outcome-oriented climate indicators, such as the reduction of a country's overall greenhouse gas emissions. By rewarding issuers for positive outcomes, SLBs can help issuers overcome the complications that the use-of-proceeds restrictions of green bonds cause for the fungibility of sovereign debt management (Lehman and Martins, 2023). For instance, Uruguay's 2022 sovereign SLB linked the coupon rate to aggregate emissions reductions per real GDP and avoided

⁷ For example, the UK has committed to spend 50% of SGB proceeds on same-year expenditure, and 50% on future expenditure (Cheng et al., 2022).

deforestation of native forest areas compared with the 1990 reference year (Ministry of Economy and Finance of Uruguay, 2023).

However, SLBs are not a panacea: there are several challenges associated with them. Currently, the sovereign SLB market is limited to issuances totalling US\$3.5 billion by Chile and Uruguay in 2022 (World Bank, 2023). SLBs also face criticism over the design of KPIs and liquidity premia (Volz, 2022). They are not entirely free from greenwashing concerns either, with persistent doubts about the credibility of the monitoring, reporting and verification of KPIs (Lehmann and Martins, 2023). To be effective, penalties for not meeting performance indicators need to be set high enough to generate material financial incentives for complying with sustainability targets (Cheng et al., 2022). Thus, similar to SGBs, financing public expenditure through SLBs does not necessarily imply the full alignment of a sovereign's policies and broader real economy with the net zero transition.

Risk and alignment assessments: market practices and challenges

Financial institutions are increasingly using a variety of metrics, datasets and frameworks to assess the risk exposure and transition alignment of their sovereign debt holdings, often building their own methodologies and models in-house.⁸ These include carbon accounting and risk assessment standards for sovereign debt, which rate governments' climate-related commitments, policy frameworks and actions (UNEP FI, 2023). Examples include the Partnership for Carbon Accounting Financials (PCAF), the Assessing Sovereign Climate-related Opportunities and Risks (ASCOR) project and Germanwatch's Climate Change Performance Index (CCPI).⁹ These can help assess whether public policies and economies, and therefore sovereign bond proceeds, are aligned with the net zero transition and therefore do not pose high climate risks (see more in Box 3.2 and Table 3.1). Credit rating agencies (CRAs) play a crucial role in this context because market participants rely extensively on their ratings to assess climate-related risks in sovereign bonds. CRAs have also started to develop methodologies to assess these risks, but these too have their limitations (see more in Box 3.3).

The growing use of sovereign climate risk assessment methodologies has led to a proliferation of early-stage methodologies and measurement approaches. There is no consensus on which best capture a sovereign's climate risk exposure, attribution of emissions and net zero alignment. Wide disagreement persists on key issues, such as the use of produced or consumed emissions, absolute emissions or emissions intensity, and whether to consider developmental thresholds and other equity-related adjustments in the allocation of 'fair share' carbon budgets compatible with 1.5°C emission pathways (Scheer et al., 2023). Furthermore, existing data and information sources do not cover all sovereigns and tend to be backward-looking, providing limited insights into forward-looking climate risks, opportunities and preparedness (PRI, 2023).

Despite these obstacles, it would be misguided to call for an immediate, single standard of climate risk metrics as there are significant benefits to a dynamic process whereby different perspectives improve instruments and practices. Nevertheless, it would be useful to define common principles for the methodologies used by different frameworks so that market participants can compare the metrics available to them consistently (Bingler et al., 2020).

⁸ Heterogeneity is also present in broader sovereign ESG-related data, which exhibits a relatively low (42%) correlation between sovereigns' environmental-related scores (Gratcheva et al., 2020).

⁹ The Paris-Aligned Investment Initiative's Net Zero Investment Framework (NZIF), which uses investor networks to develop a methodology covering various asset classes, recommends the use of CCPI to assess the Paris-alignment of sovereign bonds.

Box 3.2. Example sovereign risk assessment methodologies

Partnership for Carbon Accounting Financials (PCAF, 2022)

PCAF is a financial industry-led initiative that aims to help financial institutions calculate and disclose greenhouse gas emissions associated with their loans and investments, including sovereign debt. Greenhouse gas accounting for sovereign debt is calculated using the following equation:

$$\text{Attributed emissions} = \frac{\text{Exposure to sovereign bond (USD)}}{\text{PPP – adjusted GDP (int'l USD)}} \times \text{Sovereign emissions (tCO}_2\text{e)}$$

This approach considers a sovereign’s economic output as a proxy for its equity, which PCAF uses to assess emissions from a listed company. However, unlike the Enterprise Value Including Cash (EVIC) for companies, there is no comparable measurement of a sovereign’s equity. Using only outstanding debt to attribute sovereign emissions is not an alternative, due to the fungibility of public budgets that are generated from both debt and revenues.

Although PCAF recognises data limitations in the assessment of sovereign emissions, it recommends accounting for both production-based emissions (generated domestically, including exports) and consumption-based emissions (consumed domestically, including imports).

Assessing Sovereign Climate-related Opportunities and Risks (ASCOR)

ASCOR is an independent tool that has been developed to assess countries’ progress in managing the low-carbon transition and the impacts of climate change. The tool collects climate data across 13 indicators and three key pillars (see table below) to inform financial analysis of sovereign debt.

Pillar 1: Emission Pathways (EP)	Pillar 2: Climate Policies (CP)	Pillar 3: Climate Finance (CF)
EP 1. Emission trends EP 2. 2030 targets	CP 1. Climate legislation CP 2. Carbon pricing CP 3. Fossil fuels CP 4. Sectoral transitions CP 5. Adaptation CP 6. Just transition	CF 1. International climate finance CF 2. Transparency of climate costing CF 3. Transparency of climate spending CF 4. Renewable energy opportunities

Source: Scheer et al. (2023)

Table 3.1. Range of frameworks for assessing climate risk and net zero alignment

Level	Physical risk exposure	Physical risk preparedness	Transition risk exposure and alignment
Proceeds	n/a	<ul style="list-style-type: none"> - ASCOR framework: emissions pathways and climate adaptation policies [see also Box 3.2] - ICMA Green Bond Principles (GBPs) and Sustainability Bond Principles (SBPs) - CBI Climate Bonds Standard 	
Public policy and spending	n/a	<ul style="list-style-type: none"> - National Adaptation Plans (NAPs) 	<ul style="list-style-type: none"> - Climate Action Tracker (CAT): government climate action and measures against Paris Agreement - PCAF: financed greenhouse gas emissions by sovereigns [see also Box 3.2] - Climate-budget tagging linked to taxonomies
Economy-wide	<ul style="list-style-type: none"> - ETH Zürich’s CLIMADA: measure of expected economic damage from weather and climate impacts - WorldRiskIndex: indicator of disaster risk e.g. extreme natural events from climate change impacts - IMF Climate Change Indicators Dashboard: climate-driven INFORM Risk - Germanwatch: Global Climate Risk Index 	<ul style="list-style-type: none"> - ND-GAIN Index: vulnerability to and readiness for climate change impacts - International Finance Corporation’s Building Resilience Index: hazards to the building sector 	<ul style="list-style-type: none"> - European Commission’s EDGAR: anthropogenic greenhouse gas emissions by country and sector - Global Carbon Atlas: carbon monitor and carbon budgets - Global Footprint Network: ecological footprint - PRI Inevitable Policy Response: climate transition scenarios - Net Zero Tracker: country-level performance against net zero targets - Our World in Data: greenhouse gas emissions data - Climate Change Performance Index (CCPI): comparisons of countries’ performance on emissions, renewable energy, energy use and climate policy
	<ul style="list-style-type: none"> - IMF Climate Change Indicators Dashboard - NGFS Scenarios of transition and physical risks - World Bank Sovereign ESG Data Portal 		

Source: Compiled by authors based on PRI (2023)

Table 3.2. Overview of the three main credit rating agencies' methodologies for integrating climate change risks into ratings

	Fitch Ratings	Moody's Investors Service (MIS)	S&P Global Ratings
Integration of physical risks	Via "natural disasters and climate change" risk factor within ESG assessment.	Physical Climate Risk Indicator as part of ESG assessment.	As part of ESG assessment.
Metrics used	No details given. Fitch claims that metrics such as increased incidents and intensity of natural disasters are partially captured by variables feeding into its econometric model, such as GDP growth.	Relative exposure to heat stress, water stress, flooding and extreme precipitation, hurricanes and typhoons, sea level rises or wildfires, via Four Twenty Seven.	Extreme weather events (no details of sources given).
Integration of transition risks	As an ESG credit factor. A recent proposal suggests the use of UN PRI's Inevitable Policy Response (IPR) Forecast Policy Scenario (FPS).	Carbon Transition Risk Indicator as part of ESG assessment. A separate Carbon Transition Assessment (CTA) is carried out to analyse the most material carbon transition factors for specific sectors.	As part of ESG assessment.
Metrics used	No details given. Fitch claims that metrics such as reduced fiscal and external revenue from fossil fuels are partially captured by variables feeding into its econometric model, such as GDP growth.	Hydrocarbon sector as % of GDP; government revenue and exports (IEA and Rystad); technology; market and policy risk; actions to mitigate risk and long-term resilience to risk.	Lack of diversification (e.g. high agricultural output), reliance on imported energy, among others (no details given).
Other environmental risks	Water risks, natural capital, waste and pollution.	Water management, waste and pollution, natural capital.	None provided.
Methodological approach	Quantitative – Sovereign Rating Model (SRM); and qualitative – Qualitative Overlay (QO). Ratings can be adjusted using ESG relevance score (ESG.RS) or ESG climate vulnerability score (ESG.VS).	Qualitative – Issuer Profile Score (IPS) and the Credit Impact Score (CIS) can be used to adjust overall scorecard or individual score card factors (most common are economic and fiscal strength). The CTA is not considered a credit rating but can inform the IPS.	Qualitative – ESG Credit Indicators can be used to adjust overall credit rating by a notch.
Time horizon	Three-year average (SRM) and forward-looking (QO), although no fixed time horizon is given.	Forward-looking (no details given).	5-10-year outlook.

Box 3.3. Role of credit rating agencies

Credit rating agencies (CRAs) play a crucial role in sovereign bond markets because market participants rely extensively on these ratings to assess the creditworthiness of sovereign issuers and allocate their sovereign portfolios. But CRAs' assessments have their limitations when it comes to assess climate-related risks. These include the fact that they tend to be conducted as broad ESG assessments rather than specifically focusing on climate-related sources of risk. This makes it difficult for market participants, including central banks, to assess the specific impact of environmental risks on rating outcomes (see e.g. Breitenstein et al., 2022; NGFS, 2022). CRA metrics have also been criticised for not being forward-looking enough (see e.g. NGFS, 2022) and thus only reflecting climate risks to a limited extent.

A recent study that modelled sovereign credit ratings under future emissions scenarios found that 63 sovereigns would experience climate-induced downgrades by 2030, averaging 1.02 notches (e.g. the difference between a BB+ and a BB rating). A total of 80 sovereigns were predicted to experience average downgrades of 2.48 notches by 2100 (Klusak et al., 2023). The study does not include consideration of future transition or litigation risks, which could lead to further down- or upgrades, depending on whether or not measures increase resilience to the physical effects of climate change.

Currently, CRAs only consider climate change risks that emerge over a relatively short (e.g. one year) or unspecified time horizon as part of a qualitative assessment (see Table 3.2). These do not therefore capture medium- to long-term climate transition risks, which are especially relevant to sovereign bonds with longer maturities.

The three main CRAs have been responding to these criticisms by performing separate scenario analyses:

- **Moody's Investors Service** (2022) published an analysis of the credit implications of a just transition in terms of a sovereign's economic and fiscal exposure to transition risk (e.g. CO₂ emissions per capita) and the social costs of the low-carbon transition (e.g. in labour and income terms). The analysis considers various transmission channels, including job displacement, fiscal revenue losses and increased inequalities, as well as resilience factors such as strong governance and social protection systems, and whether just transitions are embedded in decarbonisation plans. The analysis rates sovereigns on a scale of 1–5 across these factors, finding that Nigeria, Angola and the Republic of Congo are most exposed to just transition risks.
- **Fitch Ratings** has started performing 2050 scenario analyses of the impacts of climate change on creditworthiness but has so far limited this to corporates and infrastructure entities. The organisation previously stated that for the foreseeable future further integration of climate change risks is likely to be based on its qualitative overlay (Fitch Ratings, 2020). However, in 2023 Fitch Ratings released a discussion paper that proposed enhancements to the inclusion of climate risks in its credit rating process. The proposal suggests the use of UN PRI's Inevitable Policy Response Forecast Policy Scenario for assessing transition risks, and the use of entity scores for measuring climate vulnerability across sectors and entities (Fitch Ratings, 2023).
- **S&P Global Ratings** has similarly carried out an exploratory scenario analysis of the vulnerability to and readiness for climate change of 135 countries over the next 30 years. The analysis reinforces its expectations that physical climate risks are likely to become more material in their sovereign rating analysis over time (S&P Global, 2022).

Emerging strategies to support the net zero alignment of sovereigns

A prominent issue that sovereign bond market participants face is how to effectively use the tools at their disposal, such as portfolio allocation, price signals and engagement with issuers, to encourage and advance progress in the net zero transition at the sovereign level. In this context, strategies commonly used in the corporate space have limitations for sovereigns.

For example, divestment strategies may undermine the ability of governments to finance transition policies in the first place. Concerns about fairness and inequalities are particularly pronounced in the sovereign space as poor countries are less able to fund the low-carbon economic transformation while often being the most vulnerable to and unable to address climate risks. Such countries would be disproportionately affected by divestment. Moreover, what works in advanced economies may not frictionlessly transfer to other contexts. In EMDEs, for example, higher currency risk, lower issuance volumes and liquidity premia limit the pool of credible alternatives to implementing portfolio reallocation. Despite these issues, in the face of governmental inaction, divestment may still serve as an effective, time-limited investor response if conducted at scale.

Engagement strategies face hurdles too. Engagement with sovereigns – macro-stewardship – is a less straightforward and more sensitive process than corporate stewardship. To ensure that sovereign engagement is not viewed as political interference, it can be rooted in politically agreed objectives, such as the Paris Agreement or NDCs. Considering the limited leverage of individual investors over sovereigns, large-scale collective action, bringing private and public stakeholders together, is needed even more than in the corporate space to create a supportive market environment within which fiscal reform and progress towards net zero in the real economy can be achieved.

4. Sovereign bonds in central bank policies – opportunities and constraints

This section gives an overview of the role sovereign bonds can take in central bank policies to achieve the objectives of price, exchange rate and financial stability, and reviews the policy constraints that central banks must account for in the allocation of these sovereign portfolios, along with the impact of allocation on risk management and the transition to net zero. It concludes with examples of relevant policies implemented by central banks.

The role of sovereign bonds in central bank policies

Monetary policy implementation

Sovereign bonds are a key asset class in the open market operations through which central banks implement monetary policy. Central banks buy and sell them, usually on secondary markets, to influence the price and quantity of money supply and thus, indirectly, the level of interest rates in the economy. Central banks also largely rely on them for the implementation of unconventional monetary policy operations such as large-scale asset purchases or their sale for quantitative tightening. Conventional and unconventional monetary policy operations impact the demand for sovereign bonds, their market prices, and thus their yields. Sovereign bonds are also assets that financial institutions rely on as collateral to access central banks credit operations: another important instrument that central banks deploy to implement monetary policy (see Nyborg, 2016).

Exchange rate and foreign reserves management

Central banks with exchange rate objectives extensively buy and sell sovereign bonds denominated in foreign currencies to stabilise the exchange rate of domestic currencies around its target level. They hold a large share of their foreign reserves in sovereign bonds to implement such strategies. They also hold sovereign bonds to keep the exchange rate stable: they can serve as a backstop during periods of exchange rate market volatility or liquidity stress, helping to maintain confidence in the currency. Sovereign bonds can also prevent potential shortages in domestic firms' currency needs for international transactions.

Financial stability

Sovereign bonds are central for financial stability: they are low-risk and liquid assets that financial institutions can use directly or as collateral to settle short-term financial claims with other financial institutions. This enhances the resilience of the financial sector in periods of liquidity stress. Central banks can contribute to the stability and liquidity of sovereign bond markets by intervening in them when needed.

The essentiality of sovereign bonds for central banks

Several other classes of financial assets can be used by central banks to implement monetary policy and manage foreign exchange reserves, and, in practice, a mix of private, public and sovereign financial assets serve this purpose. However, sovereign bonds are of particular interest to central banks for the following reasons:

- Sovereign bonds are generally a comparatively low-risk asset. By owning them or accepting them as collateral, central banks minimise the financial risks in their balance sheet, which is a core principle of sound monetary policy implementation and foreign reserve management.
- Sovereign bonds tend to have deep and liquid markets. The high liquidity and availability of sovereign bonds enables central banks to implement their monetary policy smoothly and continuously at the macroeconomic level. Further, sovereign bond markets are deep

enough to pass through the large transactions that are necessary to restore stability during stress episodes.

- Sovereign bonds serve as a benchmark interest rate for other financial instruments. Changes in sovereign bond yields indirectly affect the prices of most financial assets in the economy, e.g. mortgages and stocks. Implementing monetary policy through them is thus likely to percolate through all financial markets and effectively transmit monetary policy to the economy.

Central banks' sovereign bond portfolios

Central banks hold sovereign bonds in all their portfolios, including: their monetary policy portfolios, which result from the implementation of monetary policy; their foreign reserves, used to manage the value and the stability of their domestic currency; and their own investments, i.e. the assets that do not result from the implementation of their policies. Sovereign bonds are also present in the pension funds that central banks manage for their employees.¹⁰

Each portfolio is subject to its own policy constraints, which leaves central banks with different degrees of freedom to manage their climate risk exposure and align it with the net zero transition.

Policy constraints

Monetary policy portfolios and foreign reserves, which comprise the majority of a central bank's balance sheet, are subject to several policy constraints. Their size and allocation are essentially determined by the monetary policy framework in which a central bank operates, the volume and composition of assets that the implementation of a monetary policy stance requires, and the legal basis governing central bank asset ownership and investments.

Central banks implementing monetary policy through domestic markets face strong constraints in their sovereign bond portfolio. Since their monetary portfolio essentially constitutes one asset – domestic sovereign bonds – and its volume is mainly determined by monetary policy parameters, the central bank has no significant room for diversification or reallocation to align it with the transition or to manage the inherent climate risks. The alignment and climate risk exposure of a central bank's sovereign bond portfolio essentially depends on the alignment and risk exposure of the sovereign's finance and policies.

Central banks implementing an exchange rate objective have somewhat more room to manoeuvre with foreign reserve management. In this case, their sovereign bond portfolio is a basket of foreign sovereign bonds which, to some extent, allows space for allocation towards alignment with the transition and climate risk management. However, central banks face strict policy constraints in this context: the allocation across currencies is essentially determined by monetary policy parameters, which often reflects the currency needs from financial markets and the economy resulting from financial claims and trade relations. Once this currency allocation is determined by policy parameters, there is limited room for central banks to diversify across sovereigns since each currency is usually associated with one sovereign.

Monetary unions provide interesting case studies for monetary policy portfolios and foreign exchange reserve management. Central banks implementing monetary policy through domestic markets can potentially integrate transition and risk considerations into the portfolio allocation across sovereigns within the union. However, doing so could be politically contentious, and could have significant implications in terms of monetary policy transmission within the union. These constraints are somewhat less relevant for the management of foreign reserves. In this context, a central bank could integrate transition and risk considerations into its allocation across sovereigns issuing debt in the same currency.

¹⁰ Note that central banks often also manage sovereign portfolios on behalf of other national institutions. For example, the Deutsche Bundesbank manages the pension funds of several other German government agencies. This report does not explicitly analyse this function, but parallels can be made with the management of their own investments and pension funds.

Central banks have much more freedom when it comes to the allocation of sovereign bonds in their own fund and pension fund portfolios, where monetary policy constraints do not apply. Central banks are subject to different legal constraints to private financial institutions but are in a relatively similar situation to other public and private investors when it comes to aligning sovereign bond portfolios with the transition and climate risk management.

Climate risks

Central banks are directly exposed to climate risks through the sovereign bonds they own: generally, the greater the climate risks a country faces, the larger the climate risk exposures for the central bank that owns its sovereign bonds. As for any other financial risk, monitoring climate risks and keeping them under control in their balance sheets is a core task of central banks. As Jens Weidmann, former President of the Deutsche Bundesbank, said in the context of general climate-related financial risks: “we owe it to European taxpayers to keep the financial risks that arise from our monetary policy operations in check” (Weidmann, 2020). This view is shared by NGFS members, who recommend that central banks “at the very least, [...] carefully assess, and where appropriate adopt, additional risk management measures to protect their balance sheets against the financial risks brought about by climate change” (NGFS, 2021). This holds true for the climate risks embedded in sovereign bonds, too.

Central banks have highlighted their options for managing climate risks within corporate asset portfolios (NGFS, 2021). However, they face significant and specific challenges in the context of sovereign bond portfolios. First, their space for diversification and reallocation is much more limited than for corporate bonds. Central banks sometimes only have one sovereign bond in their balance sheet (bonds from their own sovereign), and when they have a few more (e.g. in foreign reserves), monetary policy imperatives largely determine the allocation across sovereigns. This limits the possibility of mitigating climate risks through portfolio allocation. Furthermore, cutting climate risk exposure now could lead to a funding squeeze for sovereigns in regions that critically need it for adaptation measures, working against the aim of mitigating sovereign bond risks in the future.

Net zero alignment

By purchasing and selling sovereign bonds, central banks impact the funding conditions that sovereigns face on domestic and foreign financial markets. This in turn affects the capacity and costs of sovereigns to finance public services, investments and policies, including those aligned with the transition to net zero. Central banks seeking to align their sovereign portfolios with the transition to net zero must take this indirect impact on sovereign budgets and the economy into account. By allocating more of their portfolio to sovereigns that are positively contributing to the low-carbon transition of their economies, central banks can marginally improve funding conditions for sovereigns on financial markets. And by allocating more of their portfolio to sovereigns that are *not* aligned with the transition, they marginally support a potential misalignment of sovereign bond markets and wider economic activities.

Select examples of central bank practices

Central banks are beginning to implement various options to assess and manage the climate risk exposure and net zero alignment of their sovereign bond components across their portfolios.

Assessment of sovereign bond portfolios – recent developments

Several central banks have started to disclose their assessment of the net zero alignment and climate risk exposure of their sovereign bond portfolios. Central banks generally track metrics such as a portfolio’s weighted average carbon intensity (WACI) of both monetary and non-monetary policy portfolios. To do this, central banks calculate each sovereign bond’s carbon intensity, i.e.

greenhouse gas emissions measured relative to gross domestic product (GDP) or GDP per capita, weighted by their relative size in the portfolio.¹¹

The precise method to assess the WACI of sovereign bond portfolio components varies. For example, the Bank of England (2023), Bank of Canada (2022), Sveriges Riksbank (2023) and Danmarks Nationalbank (2023) publish production-based emissions, i.e. emissions within the territory of the sovereign, while the European Central Bank (ECB) (2023b, 2023c), Banque de France (2023) and Banca d'Italia (2023) also report consumption-based emissions, which include emissions embodied in trade. By attributing the emissions of goods and services to where they were consumed, rather than where they were produced, the consumption-based approach accounts for carbon leakage that might arise in territory-based approaches.

In addition to point-in-time assessments such as the production or consumption-based WACI, some central banks, including the Bank of Canada and Bank of England, are assessing their sovereign portfolio's carbon footprint with forward-looking scenario analysis. This approach more comprehensively includes the impact of hypothetical future governments' policies on carbon emissions (Bank of Canada, 2022; Bank of England, 2023).

Some central banks have also started to assess the climate risk exposure of their sovereign bond portfolios beyond the carbon intensities of portfolios to include physical risks – for example, the Banque de France (2023) and Bank of England (2023).

Table 4.1 on the next page provides further examples of central bank practice in this area.

Alignment of sovereign bond portfolios – recent developments

Several central banks have started using thematic sovereign bonds to better align *non-monetary* sovereign portfolio components in their own funds and pension funds with the transition. In Europe, several central banks including the ECB are investing in thematic bonds such as sovereign green bonds to achieve this objective. They also invest in sub-sovereign and supranational bonds and, in the case of the ECB, in the Euro-denominated green bond investment fund for central banks launched by the Bank for International Settlements (BIS) in January 2021 (ECB, 2023b).

To our knowledge, central banks are not actively using thematic sovereign bonds to better align their *monetary* policy portfolios with the net zero transition. Most central banks do have sovereign thematic bonds in their policy portfolios but they usually hold thematic bonds in proportion to their market share in the sovereign bond space and do not overweight them in their sovereign bond portfolio allocation.¹²

Some central banks have pursued a more active management approach involving divestment. Concerning its foreign exchange reserves portfolio, the Riksbank, the central bank of Sweden, started to divest from sub-sovereign bonds of provinces and regions in which the economy is heavily reliant on fossil fuels. In 2019, the Riksbank decided to divest from sub-sovereign bonds issued by the Canadian province of Alberta and by the Australian states of Queensland and Western Australia on the grounds that these regions' economies have a significantly larger climate footprint than other provinces and states in their portfolios (see Riskbank, 2019). In early 2023, the German Bundesbank introduced a similar new sustainable investment strategy for sub-sovereigns in its foreign reserve portfolio. With this strategy, the Bundesbank only purchases bonds issued by sub-sovereigns that have a "better climate profile than the corresponding sovereign" (Bundesbank, 2023) – provided that it does not impede its currency policy. The climate profile of a sub-sovereign is determined by the total greenhouse gas emissions and the volumes of fossil fuels produced in the region relative to the size of its economy. These two examples illustrate how alignment strategies could be pursued through sub-sovereign bonds.

¹¹ There is currently no universally agreed metric for assessing sovereigns' carbon intensity. Central banks usually use emissions relative to GDP but some, such as the ECB or Banca d'Italia, also report using per capita as the denominator.

¹² The Banca d'Italia is one exception in the sense that it follows sustainability considerations for sovereign bonds in its foreign reserves. However, these considerations have not so far led to a higher proportion of green bonds as liquidity and risk consideration have remained the main drivers of its investment decision (Banca d'Italia, 2023).

Table 4.1. Examples of sovereign bond assessment and alignment practices by select central banks

	Non-monetary policy portfolios		Monetary policy portfolios	
	Pension funds	Own funds	Forex reserves	Domestic
Assessment	Canada France ECB Italy Spain	France Italy UK ECB Germany Spain Greece	Sweden Denmark Italy Germany Brazil	Canada UK
Investment in thematic bonds	France	ECB France Italy Spain Greece	Italy	–
Net zero alignment	–	–	–	–
Divestment	–	–	Sweden Germany	–
Carbon footprint assessment methodology				
Production-based WACI	Canada	UK Germany	Denmark Sweden Germany Brazil	Canada UK
Consumption-based WACI	ECB France Italy Spain	ECB France Italy Spain Greece	Italy	–
Scenario analysis	Canada	UK	Germany (in progress)	UK

Source: Authors' own research (based on: Banca d'Italia, 2023; Banco Central do Brasil, 2021; Banco de España, 2023; Bank of Canada, 2022; Bank of England, 2023; Bank of Greece, 2023; Bank of Japan, 2023; Banque de France, 2023; Bundesbank, 2023; Danmarks Nationalbank, 2023; ECB, 2023c; 2023b; Sveriges Riksbank, 2022; Swiss National Bank, 2023)

5. Ways forward for central banks

Central banks are beginning to reflect on how they can best contribute to the alignment of sovereign bond markets with the transition to net zero. Many of the challenges that central banks face are the same as those faced by other financial institutions, but central banks are subject to additional constraints: they operate within clear mandates that determine how they can respond to net zero objectives and they must not allow the pursuance of net zero objectives to impede their ability to implement monetary and prudential policies. However, as monetary and financial policymakers, central banks have opportunities that other financial institutions do not. Their role as financial supervisors and the close relationships they have with sovereigns offer unique possibilities for them to support the alignment of sovereign bond markets with the net zero transition.

This section explores some ways forward for central banks as they navigate these multiple objectives, constraints and possibilities.

Monetary policy implementation

In the corporate space, central banks usually also disclose metrics that track the alignment of their portfolios and their exposure to transition risks (NGFS, 2023). Central banks should do the same for their sovereign portfolios. When it comes to mitigating risks in corporate portfolios and aligning them with net zero, the NGFS has highlighted two main strategies for aligning monetary policy operations with the net zero transition and managing climate risk exposure (NGFS, 2021). The first is to reallocate domestic and foreign assets portfolios and the pool of collateral that they accept towards bonds issued by corporates that are aligned with the transition and less exposed to climate risks (i.e. 'tilting'). The second is to screen out bonds issued by corporates that do not meet a given level of alignment or that are too highly exposed to climate risks from their asset portfolios and accepted collateral. Applying these strategies to sovereign bond portfolios is more challenging, and options are sometimes very limited. Possible alternative options for central banks in the sovereign space include prioritising thematic sovereign bonds and making greater use of sub-sovereign and supranational bonds.

Assessing and disclosing alignment and risk of sovereign portfolios

Assessing and disclosing sovereign bond portfolios' alignment with the net zero transition and climate risk exposure is a straightforward and important first step that central banks should take. Doing so is not likely to contradict any part of central banks' mandates, and in some cases might even be required. Such disclosures provide crucial information to financial market participants on the soundness of central banks' balance sheets, and therefore their credibility and ability to fulfil their objectives and withstand economic and financial shocks. This confidence helps maintain stability in money markets and strengthens the value and perception of the currency.

Some central banks have started disclosing this information. They can rely on the methodologies and metrics developed and used by other financial institutions, and contribute to their development. By systematically assessing and disclosing this information, central banks would significantly contribute to making such practices standard for other financial institutions, thus ensuring that financial market participants have access to the information they need to assess the alignment and risk exposure of sovereign bond markets.

Reallocating sovereign bond portfolios

As in the corporate space, central banks can consider reallocating part of their sovereign portfolios to better align them with the transition to net zero and to mitigate their climate risk exposure. They could also consider divesting from some sovereign bonds that are misaligned with the transition or exposed to large climate risks. However, these options pose important challenges for central banks.

First, some central banks (e.g. the Federal Reserve, the Bank of England and the Bank of Japan) operate with only one sovereign bond in their main monetary portfolio: their domestic sovereign. Neither reallocation nor divestment is possible in such a situation. The central bank must instead depend on the climate action and policies of the government, which is strongly dependent on the structure of the economy. Other central banks implement monetary policy for several sovereigns in a monetary union (e.g. the ECB and the Banque Centrale des États de l’Afrique de l’Ouest [BCEAO]). In these cases, the central banks could in theory integrate net zero dimensions into the allocations of their domestic sovereign portfolios. However, the allocation across sovereigns within a union is generally defined by the legal framework of the central banks, and some potential flexibility is subject to strong macroeconomic and political economy constraints.

Second, all central banks have foreign sovereign bonds from different issuers in their foreign reserves. They could potentially reallocate these sovereign bonds to better align them with a net zero transition and minimise their climate risk exposure. However, central banks have limited degrees of freedom here, too. Central banks that implement monetary policy based on exchange rate management usually target one currency – often the US dollar or the euro – or a basket with a few major currencies. The allocation across currencies is essentially set by monetary policy constraints and consists of just one or a small number of sovereigns. Other than for exchange rate management, central banks hold foreign reserves to ensure the continuity of financial and commercial international transactions in case of market stress. Here, the potential for reallocation is larger but also strongly dependent on risk considerations and on the structure of financial and economic exchanges.

For some major currencies, like the US dollar and the euro, central banks have some freedom to diversify sovereign bond portfolios in their foreign reserves across a few sovereign issuers. Several countries issue sovereign debt in US dollars in addition to bonds in their own currency. Similarly, debt in euros is issued by all the members of the euro area. Central banks could consider allocating their sovereign portfolios in these currencies across issuers to reflect their different alignment with the transition and risk exposure. However, the risk associated with different sovereign issuers within one currency like the US dollar can vary significantly, as does the depth and liquidity of their markets. Risk and liquidity considerations might be more important than the net zero transition dimension in this context.

Finally, divestment is likely an unviable option for central banks in the context of foreign reserve management. Excluding a sovereign issuer is often equivalent to excluding a currency from foreign reserves, which is not possible in the case of major currencies. Additionally, divestment strategies may be limited in effectiveness as they could hinder governments’ ability to finance their transition policies and improve the resilience of their infrastructure to climate change in the first place.

Ultimately, a reallocation of monetary policy portfolios must not impair central banks’ role in delivering core monetary and exchange rate objectives. Domestic sovereign portfolios must continue to closely drive domestic interest rates. For foreign reserves, their control of the exchange rate, liquidity, security and return are important objectives.

Aligning collateral frameworks

In the corporate space, central banks have highlighted three main options to align the collateral that they receive from banks with net zero and manage their climate risk exposure: (i) screen the assets that they accept as collateral; (ii) align collateral pools; and (iii) adjust haircuts (NGFS, 2021). Sovereign bonds constitute a central part of the assets that banks pledge as collateral to central banks (Nyborg, 2016).

Central banks could consider screening out the sovereign bonds that they accept as collateral based on their alignment with the transition and their exposure to climate risk. However, this could have important repercussions in terms of monetary policy transmission and financial stability. The pool of assets that banks can pledge as collateral must be large enough to allow banks to access central banks’ refinancing operations, a key instrument for the transmission of

monetary policy, and to meet their liquidity needs, which is necessary for financial stability. Aligning the collateral pool that banks pledge, and adjusting haircuts to reflect bonds' alignment with the transition and their exposure to climate risks, are less likely to have these negative side-effects.¹³

Another way for central banks to better align their collateral frameworks is to accept sovereign green bonds and sustainability-linked bonds as collateral from banks in refinancing operations – a step that the ECB took in the corporate space (ECB, 2020). This could enable central banks to support the development of deeper markets for such assets. Academic research finds that when an asset is accepted as collateral by central banks, financial institutions tend to increase its uses and issuances (see e.g. Van Bakkum et al., 2018).

Prioritising thematic bonds

When diversification and reallocation possibilities across sovereigns are limited, central banks could consider increasing their share of thematic instruments, including sovereign green bonds – domestic and foreign – in their monetary policy portfolio and foreign reserves, which would potentially increase their alignment with the net zero transition. However, this option also raises challenges.

First, sovereign green bonds markets are growing, but not universally. This option is therefore inaccessible to central banks when their own sovereign does not issue green bonds or when the sovereign green bond market size is limited in the major currencies that constitute the majority of their foreign reserves. In this case, central banks could engage with their own sovereign, as well as with major currency issuers, to develop these markets.

Second, increasing the share of green bonds in sovereign portfolios does not necessarily lead to a better alignment of sovereigns and sovereign bond markets in general. Governments can use them to fund existing projects, but this may not add to the alignment of public spending and thus of the sovereign. Green sovereign bonds can also potentially unlock new fiscal space for sovereigns, which could then be used to increase spending in economic activities not aligned with a transition.

Central banks could expand the use of SLBs as these assets are likely to have more impact on the net zero alignment of public finance than other thematic bonds since their payoff is linked to the overall performance of the public sector. However, SLBs might pose problems to monetary policy portfolios as they have variable and uncertain interest rates that depend on the degree to which sustainability objectives are achieved. They thus do not constitute a fixed anchor to drive other interest rates in the economy, which might impair the transmission of monetary policy. Bonds with variable coupons are usually not accepted by central banks in their monetary policy operations. Furthermore, as only two sovereign SLBs have been issued to date, the market does not yet have the critical size to serve as a conduit for the transmission of monetary policy. (These constraints do not apply to non-monetary portfolios; central banks could increase the use of SLBs in these portfolios.)

Expanding sub-sovereign and supranational bond portfolios

To generate greater freedom in the allocation of their sovereign portfolios, central banks can consider increasing their allocation to sub-sovereign bonds and supranational bonds. These bonds have similar characteristics to sovereign bonds, making them a potential alternative. Like sovereign bonds, both sub-sovereign and supranational bonds are conduits through which central banks can implement monetary policy, with the public services and investments provided by institutions pursuing public objectives. Both instruments are considered a relatively safe investment, although some sub-sovereign bonds have higher risks than sovereign bonds.

¹³ See Oustry et al. (2020) for an analysis of the alignment of collateral pools in the corporate space.

However, sub-sovereign and supranational bonds are not perfect substitutes for central banks in the implementation of monetary policy or the management of foreign reserves. Their markets are less deep and often less liquid than sovereign bond markets: two characteristics that are key to an efficient implementation of monetary policy at scale. In addition, their interest rates have much less weight than sovereign rates in anchoring the general interest rate and exchange rate in an economy, which is key to conducting monetary policy. Nor are sub-sovereign and supranational bonds always available in all the currencies needed by central banks. Finally, central banks do not always consider sub-sovereign bonds as part of their sovereign bond portfolios.

Financial supervision

Given the limited freedom of central banks in terms of sovereign bond portfolio allocation, the main contribution that central banks can bring to the alignment of sovereign bond markets with the net zero transition arguably lies in their role as regulatory standard setters and supervisors of financial institutions.¹⁴

Standard setting

Central banks, together with other financial supervisors, have a unique system-wide perspective. With their broad knowledge of the economy, sophisticated tools and extensive data, central banks and supervisors are ideally placed to contribute to the development of methodologies to assess the alignment and risk exposure of emerging sovereign markets. They can also help to drive public and private disclosure initiatives that improve sovereign data availability, accessibility and accuracy for all stakeholders. International data disclosure and collection tools, like PCAF and ASCOR, can play a key role here. Central banks can also support the implementation of green public budgeting frameworks, which provide meaningful information for these initiatives on sovereign spending alignment with net zero to markets.

Central banks can also contribute to defining the standards that apply to thematic bonds, like SGBs and SLBs, and make sure that the different standards proposed by private initiatives meet the needs of investors in terms of alignment with the net zero transition and sovereign climate risk management. When they act as supervisors, or in collaboration with them, central banks can ensure that these standards are enforced by issuers to limit greenwashing. Given the heterogeneity of methodologies and frameworks to assess sovereign alignment and risk exposure that are available to market participants from different providers, supervisors can set requirements for information disclosure and transparency about data and methodologies. This would enhance investors' ability to compare available metrics and methodologies and make informed choices on which best fits their needs.

Supervision of financial institutions

Central banks and supervisors are also well placed to assess the alignment and climate risk management practices of the entities they supervise when it comes to sovereign bonds. They can then form an opinion on whether current practices are in line with the pathway to net zero in their jurisdiction. They can also suggest how financial institutions can better align their practices with the transition and improve sovereign climate risk management.

Such monitoring and guidance measures for financial institutions have already been taken by many central banks and supervisors in the more general context of managing climate risks (see e.g. BCBS, 2022). They include, for example, setting expectations on how financial institutions should manage climate risks, checking whether financial institutions meet these expectations, and, if not, requiring corrective actions to be taken (see e.g. ECB, 2022b). Central banks and supervisors could take similar steps for financial institutions' practices when it comes to sovereign bond portfolio alignment and sovereign climate risk management. In parallel, and as they sometimes do for climate risk management in general (see e.g. ECB, 2022a) central banks and

¹⁴ It is important to note that not all central banks have this supervisory role, and it is sometimes limited to a specific segment of the market like banks. The options presented here also apply to other supervisors.

supervisors could highlight forms of best practice in this domain and support – or even incentivise – their adoption by all market participants.

Public engagement

Central banks are in a privileged position relative to other financial institutions in that they have a broader scope for stewardship and engagement. They are important interlocutors for their respective sovereigns and they participate in international policymaking through diverse forums. Central banks could use this opportunity to support the alignment of sovereign bond markets and the management of sovereign climate risk at the national and international levels.

Engaging with sovereigns on net zero policies

Central banks have direct lines of communication with their governments' ministries and public agencies. International climate agreements that governments have committed to can be used to anchor sovereign engagement efforts at different levels. Central banks can support other public authorities in different ways: from calling on governments to deliver on their net zero pledges to providing them with information and technical assistance on climate-related investment strategies, including of sovereign bonds.

Engagement activities should respect the independence principles that govern interactions between central banks and sovereigns, which vary across jurisdictions (Unsal et al., 2022). In any case, central banks and sovereigns should develop a shared understanding of the objectives of debt management, fiscal, monetary and financial sector policies (IMF, 2014). In practice, all central banks have processes in place to exchange information and cooperate with the government (Moser-Boehm, 2006). Central banks' expertise can foster useful dialogues with governments within the boundaries of their respective roles and the institutional framework they operate within. Central banks can also provide national forums for governments, academics, think tanks and other stakeholders to jointly discuss and develop national policies and practices to align their activities on net zero.

Contributing to international financial market solutions

Achieving the net transition at the global level requires the coordination of international finance flows to provide capital in regions where climate mitigation and adaptation measures are most needed. This requires a significant increase in international capital flows to finance investments in low-carbon technologies in emerging economies and adaptation measures in economies where the population and infrastructure are hardest hit by climate change.

Through their memberships in different international forums, central banks can contribute to the development of international investment solutions and more broadly of an international financial market architecture that fulfils these global imperatives. In this context, supporting debt instruments that address both high debt management issues and climate objectives – such as debt-for-nature swaps (see e.g. Paul et al., 2023) – are a promising avenue. Central banks and supervisors could also contribute to the development and implementation of other potential measures such as extending the IMF's Special Drawing Rights, expanding repurchase facilities such as the Liquidity and Sustainability Facility, or expanding grant and equity financing (Songwe et al., 2022).

6. Conclusion and recommendations

The alignment of sovereign bonds with the net zero transition essentially depends on whether the public expenditure and policies they contribute to financing are also consistent with net zero and, ultimately, on the alignment of the economy at the macro level. Aligning sovereign bond markets thus requires several stakeholders to act. National governments are first in line, but central banks can also make meaningful contributions. Here we summarise three key ways in which central banks can pursue this, and recommend first steps for putting these into action.

1. Central banks can make steps to align their sovereign bond portfolio with net zero

Despite the constraints they face over their monetary policy and foreign reserve portfolios, there are some options central banks can take. As first steps, central banks should:

- **Disclose the alignment of their sovereign holdings on net zero.** This is a straightforward and essential step for central banks. It will provide crucial information to market participants, increase central banks' own understanding of the risk exposure and alignment of their sovereign portfolios, and start useful reflections and dialogues on how they can contribute to the alignment of a global sovereign bond market. Assessing financial institutions' alignment with the transition through sovereign bond markets will also increase central banks' technical knowledge and capacity.
- **Identify their options to better align their sovereign portfolios.** Each central bank operates in different monetary policy and institutional frameworks. Some of the options suggested in this report may apply to some central banks but not others. They should rapidly assess and communicate the options that are relevant and feasible for them without jeopardising the transmission of monetary policy and the liquidity and safety requirements that these portfolios require. Alternatives involving a greater use of sub-sovereign and supranational bonds, and sovereign green bonds and sustainability-linked bonds, should be part of this assessment.

2. Central banks can contribute to the net zero alignment of sovereign markets as standard setters and supervisors

Central banks have a unique system-wide perspective and can play an important role in supporting the development of assessment and disclosure frameworks for sovereigns, which are required by all market players. Where they have a supervisory mandate, they are well-placed to assess the alignment and climate risk management practices of financial institutions when it comes to sovereign bonds. As first steps, central banks should:

- **Contribute to initiatives that provide market participants with adequate information and methodologies to assess sovereign alignment and risk exposure.** Global initiatives like PCAF or ASCOR are key to this. Green budgeting frameworks are also central in this process. Central banks can use their economic expertise, including of sovereign bond markets, to actively contribute to global and domestic initiatives and support the technical development of assessment methodologies.
- **Highlight best practice.** As financial supervisors, central banks are ideally placed to collect information about market practices relating to sovereign bond portfolio management and highlight which are most effective for the net zero alignment of sovereign bond markets and reduction of climate risk exposure at the macroeconomic level. They can engage with financial institutions now to support them to develop and adopt such practices.

3. Central banks can contribute to the alignment of sovereign markets through engagement with public authorities and memberships in different international forums

The institutional framework that governs relations between central banks, governments and public agencies will affect the characteristics of this engagement. As first steps, central banks should:

- **Encourage domestic stakeholders to develop national transition policies.** With their knowledge of financial markets and the economy, central banks can start providing important information and technical support to governments and their agencies on climate-related investment strategies when necessary and appropriate. Central banks can initiate forums for governments, academics, think tanks and other stakeholders to jointly discuss and develop national policies and practices to align with net zero.
- **Identify and support international finance solutions for the global transition.** Collectively, and together with other international financial institutions, central banks can highlight the existing international financial instruments that are best able to increase cross-border funding for the transition to net zero, and support their expansion in the diverse international forum in which they participate. In this context, it is essential to promote international finance schemes that support risk mitigation and adaptation measures in the long term for regions most vulnerable to climate-related risk.

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