



The green bond market is expanding rapidly but needs to be measured more accurately

Green bonds differ from conventional bonds in that they are used to finance projects expected to have environmental benefits. In the four years since the Paris Climate Agreement (2015), the green bond market has grown rapidly. However, it is still far below the scale needed to finance the ecological transition. In addition, in the absence of a precise legal definition of the assets that can be financed, issuers run the risk of being suspected of greenwashing, while investors face increased information costs in order to determine the type of project they are funding. In response, European institutions have begun discussions on a classification system (taxonomy) for sustainable economic activities, which would be a first step towards an official definition. The statistical evaluation of green financing is also made difficult by the lack of easily accessible data on the sectors that are the final beneficiaries of the financed projects. Bridging these gaps would considerably improve the quality of analyses on the financing of the transition to a sustainable economy.

Pierre Bui Quang
Directorate General Statistics, Economics and International
Jean-Brieux Delbos, Simon Perillaud*
Data and Analytic Services Directorate
Clément Bourgey
Directorate General Financial Stability and Operations

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G12, G18,
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* Unit to which he was attached at the time of writing.

USD **464** billion
global outstanding amount
of green bonds at end-2018
(0.4% of global outstanding bonds)

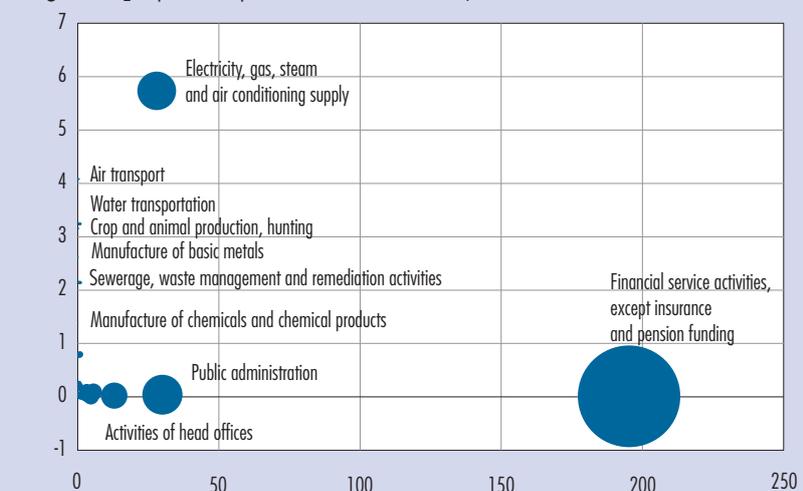
USD **171** billion
global issuance of green bonds
in 2018

3rd
France's global ranking for
outstanding green bonds
1st in Europe

77%
share of green bonds
that are investment grade
20% share that are unrated

Outstanding labelled green bonds and greenhouse gas (GHG) emissions intensity per sector of activity

(x-axis: outstanding in EUR billions; y-axis: emissions intensity in kg of CO₂ equivalent per euro of value added)



Sources: Eurostat, Bloomberg and Centralised Securities Database; authors' calculations.



1 There are various definitions of the green bond market

What is a green bond?

The first green bond dates back to 2001 and was issued by the city of San Francisco in the United States in order to finance solar energy. However, the market really took off after the 2015 Paris Climate Agreement, despite the lack of a clear and internationally recognised definition of what these securities can be used to finance. For the time being, the only way of distinguishing a green bond from another type of bond is by the nature of the underlying project – green bonds can only be used to finance projects classified as “green”. They can be issued by any type of issuer (private or public, international

institution), and can be used to finance a new project or to refinance an existing one. They also have the potential to attract new types of investor, notably those who are concerned about the environment.

To justify that the financed project qualifies as “green”, issuers can refer to the Green Bond Principles (GBP) – a set of broad principles set out in 2014 by a global consortium of investment banks known as the International Capital Market Association (ICMA). These principles are updated regularly, but do not constitute an official label or taxonomy. They distinguish between four types of green bond (see box), and take the form of recommendations on the use of the proceeds, the process for evaluating and selecting projects, the management of the proceeds, and reporting.

BOX

The four types of green bonds identified by the ICMA

The relationship between the flow of payments generated by a green bond and the financed project varies depending on the type of bond. The International Capital Markets Association (ICMA), a global consortium of investment banks, identifies four types of green bonds in its Green Bond Principles.

- Standard Green Use of Proceeds Bonds which are ordinary debt securities with general recourse to the issuer. This category includes the European Investment Bank’s Climate Awareness Bonds.
- Green Revenue Bonds which provide a guarantee that they will only be serviced from certain of the issuer’s revenue streams, which may pre-exist the project (and be unrelated to it). The State of Hawaii, for example, has issued bonds to finance green infrastructure, which are backed by green fees on customer electricity bills.
- Green Project Bonds where the investor’s claim is only on the assets of the financed project(s). This type of bond was notably used to finance the Luz del Norte photovoltaic project in Chile.
- Green Securitised Bonds, where the investor has a claim on a series of projects grouped together into a special purpose vehicle, and which generate the flows used to service the bond. Toyota Financial Services notably issued a securitised bond backed by consumer loans used to finance the purchase of electric Toyota vehicles.



The issuer of a green bond has to provide a detailed description of the project to be financed. It can also request that the bond's "green" status be certified by a third party: an international organisation such as the Climate Bonds Initiative (CBI),¹ a public authority,² a specialised rating agency (Vigeo Eiris) or a generalist rating agency (e.g. Standard and Poor's). The CBI's Climate Bonds Standard and Certification Scheme, launched in December 2010, includes a taxonomy which consists of an evolutive table listing eligible assets and projects by sector. The CBI's taxonomy is currently used as a global reference tool by the majority of green bond issuers and investors. It distinguishes between "labelled" green bonds which are used to finance projects that are 100% green, and "aligned" bonds which are used to finance projects that are at least 75% green but not fully green.

Green bonds have to meet the specific needs of the issuer while avoiding the risk of opportunism

Despite the apparent diversity of products on offer, there are doubts as to whether the market has effectively met the needs of issuers. In a report published in February 2018, the Institute for the Climate Economy (I4CE)³ showed that green bonds are in fact used to finance projects that would have been financed anyway using conventional debt securities.⁴ It is likely that the environmental benefits of green bonds will increase as the market develops. As the use of a green label becomes more widespread, the windfall effects should diminish. The lack of a green label will increasingly be perceived as negative.

Moreover, the products currently available are adapted to large-scale projects, such as those linked to renewable energy, and are less suited to energy efficiency in buildings or clean vehicles, where projects are generally smaller.⁵

For investors, the lack of a legal and incontrovertible definition of green bonds is a source of uncertainty and means they incur additional costs for analysing potential projects. One of the attractions of green bonds is the positive reputational effect expected by investors.⁶ However, this leaves the market exposed to the risk of "greenwashing", whereby bonds are described as green even though the environmental benefits of the underlying project are in fact questionable. It is vital that any "green" label be credible, and there are two requirements for this: it needs to be possible to assess the bond's environmental effectiveness; and investors need to have access to intelligible and transparent information both on the project and on the use of the proceeds post-issuance. In a joint Position Paper published in April 2019, the *Autorité des marchés financiers* (AMF – French Financial Markets Authority) and its Dutch counterpart, the *Autoreit Financiële Markten* or AFM, recommended that green bond issuers include "reasonable" additional information in their prospectuses.

The start of three-way talks between the European Commission, the Council of the European Union and the European Parliament, on the adoption of a European-wide taxonomy of sustainable economic activities⁷ is a significant step towards establishing an official definition. The discussions draw on the work of the Technical Expert

1 The CBI is an international non-profit organisation created and financed by commercial banks, development banks, environmental associations, and national and international public bodies. Its missions are to monitor the growth of the green bond market and to estimate its potential for expansion, to establish a benchmark taxonomy (Climate Bonds Standard and Certification Scheme), and to advise public and private agents on how to develop the market.

2 For example, in 2015 the French Environment Ministry created a government "Transition énergétique et écologique pour le climat" label (TEEC – Energy and Ecological Transition for the Climate), which became the Greenfin label in June 2019.

3 See Nicol et al. (2018). The I4CE (Institute for Climate Economics) is a think-tank set up by the *Caisse des dépôts et consignations* and the *Agence française de développement*. It provides public and private policymakers with expertise on economic and financial issues linked to the energy and ecological transition.

4 This phenomenon is known as "absence of additionality".

5 Asset-backed securities (ABS) backed by green bonds could be better suited to these projects as they enable small individual loans to be grouped together into special purpose vehicles.

6 A positive reputational effect means the issuer's image is improved, especially with investors. The reputational risk for the issuer is that its image might be tarnished, leading investors to avoid any financial products that it issues. For the investor, holding an asset from an issuer with a positive reputation is likely to lead to an increased sense of well-being. However, the counterpart to this reputational effect is that the issuer may also offer the investor a lower return.

7 At this stage, the European taxonomy is scheduled to be finalised at the end of 2021 and put into application at the end of 2022.



Group (TEG) on sustainable finance, which in a June 2019 report proposed a European taxonomy and label for green bonds. At this stage, the taxonomy is only a technical proposal. It is based on the NACE industry classification (Standard Classification of Economic Activities in the European Community), which provides an exhaustive list of activities, is widely used in the EU and is consistent with international standards. For each activity, the TEG taxonomy defines the conditions and principles required to obtain a “green” classification, and in certain cases thresholds for emissions.

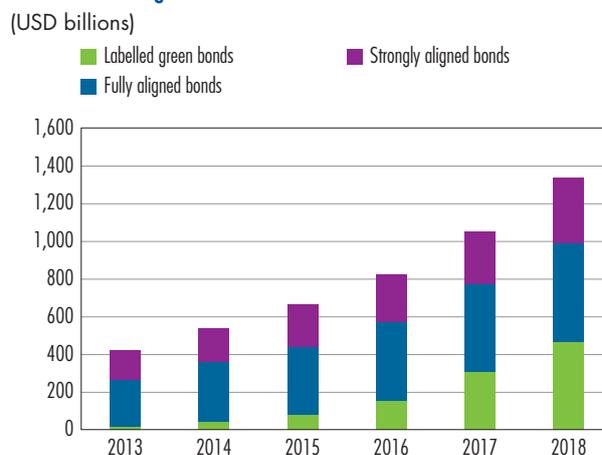
2 The green bond market is growing rapidly but is still far too small to meet the identified needs

According to the CBI (2019), close to USD 171 billion worth of bonds declared as green by the issuer were issued globally in 2018,⁸ accounting for 2% of total bond issuance for the year. The outstanding amount of green bonds reached USD 464 billion at the end of 2018, or 0.4% of total global outstanding bonds. The CBI estimates that USD 250 billion of green bonds will be issued in 2019.

However, bonds labelled green according to CBI criteria only account for 35% of the climate-aligned bond universe, which at end-2018 was estimated to have a total outstanding of USD 1.343 trillion (see Chart 1). This universe includes not just labelled green bonds, but also bonds identified by the CBI as being “fully”⁹ or “strongly”¹⁰ aligned with its climate criteria.

The biggest issuers of green bonds are the United States (USD 90 billion in the first half of 2018), followed by China (USD 55 billion) and France (USD 44 billion;¹¹ see Chart 2).

C1 Outstanding amount of labelled green bonds or bonds aligned with CBI criteria



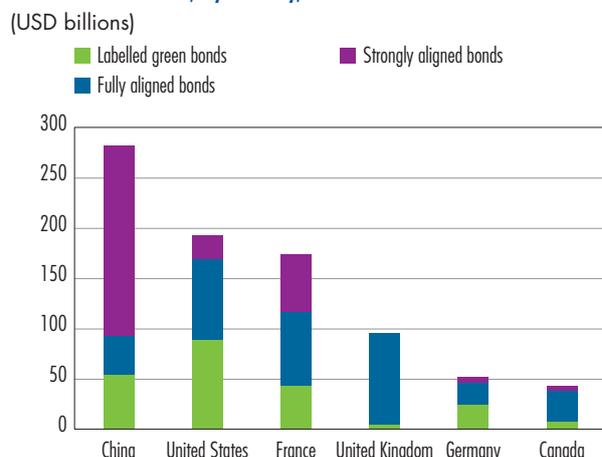
Source: Climate Bonds Initiative (CBI).

Notes: Data for green bonds are available on the CBI website (2019).

For aligned bonds at end-2018, the figures have been estimated by the authors as the CBI report only provides data for the first half of 2018.

Moreover, the outstanding amounts only include bonds issued after 1 January 2005 (entry into force of the Kyoto Protocol).

C2 Outstanding labelled green bonds or bonds aligned with CBI criteria, by country, in H1 2018



Source: Climate Bonds Initiative (CBI; 2018).

Note: Countries are shown in descending order of total outstanding climate-aligned bonds (which comprises green bonds, fully aligned bonds and strongly aligned bonds).

⁸ Standard & Poor’s and HSBC also publish statistics that the reader can refer to.

⁹ Bonds that are fully aligned with the CBI’s criteria are those from issuers that derive at least 95% of revenues from business lines classified as “green” by the CBI.

¹⁰ Bonds that are strongly aligned with the CBI’s criteria are those from issuers that derive 75-95% of revenues from business lines classified as “green” by the CBI.

¹¹ In France, non-financial corporations, especially large energy and transport firms, account for 44% of French outstanding green bonds, public administrations for 37% (the government issued EUR 10 billion of green bonds in 2017 and EUR 5 billion in 2018) and financial corporations for 19% (authors’ calculations).

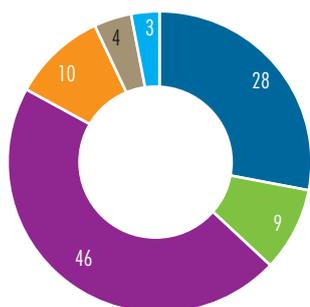


C3 Breakdown of outstanding green and climate-aligned bonds by sector of activity in H1 2018

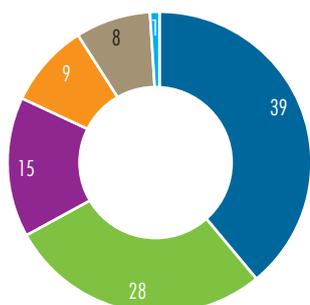
(%)



a) Climate-aligned bonds



b) Green bonds



Source: Climate Bonds Initiative (CBI; 2018); authors' calculations.

Notes: Climate-aligned bonds include green bonds and those bonds deemed fully and strongly aligned under CBI criteria. CBI data show the sector that is the final beneficiary of the funds and not the issuing sector.

In China, the market consists primarily of strongly aligned bonds, whereas in the United Kingdom fully aligned bonds are predominant.

In the first half of 2018, two thirds of outstanding green bonds were used to finance the energy and construction sectors (39% and 28% respectively; see Chart 3). This was followed by the transport sector (15%) then by water management (9%). Energy and construction are thus strongly over-represented compared with the broader climate-aligned bond universe, whereas the transport sector is significantly under-represented.

Nonetheless, despite the dynamism of the green bond market, the I4CE estimates that it is still far from sufficient to cover the volume of investment required to meet current targets for the reduction of greenhouse gas (GHG) emissions. An annual volume of between USD 580 billion and USD 3.2 trillion of investment is estimated to be required in order to meet the 2015 Paris Agreement target of limiting global warming to below 2%. By way of comparison, USD 160 billion of green bonds were issued in 2017, covering between 5% and 28% of this requirement. The Organization for Economic Co-operation and Development (OECD) estimates that this type of investment could account for more than 40% of outstanding low-carbon investment by 2035. In 2016, it only accounted for 6%.

3 More transparent information is needed on the final use of the proceeds of green bonds

The criterion often used to determine whether a low-carbon investment is "green", including by the CBI, is the potential reduction in GHG emissions. Consequently, a first way of gaining more insight into the green bond market would be to conduct an exploratory analysis comparing GHG emissions intensity (in kilograms of CO₂ equivalent emitted per euro of value added, or kg/€) to the outstanding amount of green bonds for each economic sector. To do this, we use the statistics published by the European Commission on individual activities¹² and countries.

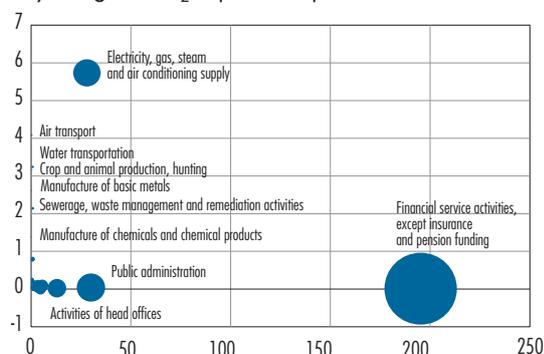
Several conclusions can be drawn from Chart 4 below. First, those sectors with the highest GHG emissions in the period 2008-16 do not necessarily have the largest amount of outstanding green bonds at end-2018. Apart from the energy sector (electricity and gas supply) which has the highest emissions (5.7 kg/€) and EUR 28 billion of outstanding green bonds, the outstanding volume of green bonds is very low in high-polluting sectors, i.e. air transport (4.1 kg/€), water transportation (3.2 kg/€) and crop and animal production (3.2 kg/€) and

¹² Based on the NACE Rev. 2 classification of activities (2008 version), which is also used for the European taxonomy published in the June 2019 technical report.



C4 Outstanding labelled green bonds and greenhouse gas (GHG) emissions intensity per sector of activity

(x-axis: outstanding in EUR billions; y-axis: emissions intensity in kg of CO₂ equivalent per euro of value added)



Sources: Eurostat, Bloomberg and Centralised Securities Database; authors' calculations.

Key: Each point in the chart corresponds to a NACE (Statistical Classification of Economic Activities in the European Community) sector of activity that is a direct issuer of green bonds. The circles are proportional in size to the outstanding amount of green bonds. Methodological note: The figures on GHG emissions intensity are calculated for the period 2008-16. The figures for outstanding green bonds are those at end-2018.

manufacture of basic metals (2.6 kg/€). The limited use of green bonds by these sectors could be attributable to the restricted scope of existing taxonomies, as they do not recognise inherently polluting technologies as green. For example, the development of a standard engine with lower emissions in the aeronautics industry is not considered to be a green investment, whereas the development of an electric engine is.

Moreover, the construction and real estate sectors – which are not direct emitters of GHGs – benefit from green funding (EUR 6 billion and EUR 5 billion respectively) to finance investments that reduce their recourse to GHG-emitting sectors. This is consistent with the goal of saving energy by using these sectors to a lesser extent.

After the energy sector, the highest volumes of outstanding green bonds are found in financial services activities excluding insurance and pension funds (outstanding of EUR 195 billion), public administration (EUR 30 billion) and head office activities (EUR 13 billion), which all produce very low levels of emissions. In general, however, these three sectors are not the final beneficiaries of the financing. Investors can identify the final beneficiary of an issue by studying the accompanying financial documents. However, for statisticians, it is more difficult to identify them systematically, making the allocation of green financing somewhat “opaque”. It would therefore be useful to have regular and easily accessible data on the final beneficiaries of green bond proceeds, in order to measure their ecological effectiveness without having to sift through issue prospectuses manually or using text mining techniques.

Based on the data currently available, it is only possible to identify the large volume of green bonds issued by the energy supply sector, which has the highest GHG emissions intensity.

4 Green bonds do not differ much from conventional bonds in terms of risk and return

The rise in green bond issuance is being accompanied by a growing investor appetite for so-called “responsible” financial products. The terms “climate” or “ESG” (environmental, social and corporate governance) appear with increasing frequency in the prospectuses submitted to the Securities and Exchange Commission (SEC) by US investment funds.¹³ The share of prospectuses featuring terms linked to green investment has risen from 0.1% in 2014 to 0.4% in 2018. The share containing references to responsible investment has risen from 0.2% to 1.4% over the same period.

¹³ This analysis is based on the SEC's Mutual Fund Prospectus Risk/Return Summary Data Sets.



Rating of green bonds: limited risk

The CBI's 2018 report shows that, at the global level, the financial risk associated with green bonds, or more broadly with climate-aligned bonds, is limited. Nearly a quarter of outstanding green bonds (23%) are rated AAA. The proportion is similar for climate-aligned bonds (see Chart 5). More than three quarters (77%) of green bonds are investment grade, i.e. rated between AAA and BBB, (84% of all climate-aligned bonds). Only 3% of green bonds are non-investment grade, i.e. rated BB or below. For the broader climate-aligned universe, this proportion rises to 6%. It is therefore lower than the proportion observed for government bonds (8% at end-2018) and is relatively low in comparison with the proportion of all rated securities or issuers that are

non-investment grade (17%). The share of green bonds that are unrated is 20% (10% for climate-aligned bonds), which is also lower than the share of global outstanding bonds that are unrated (33%).

Can issuers be said to benefit from a "green premium" (or "greenium")?

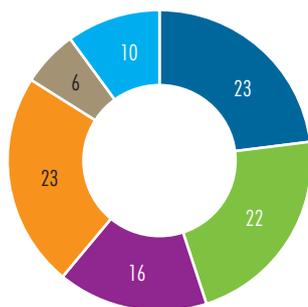
Although the dynamism of the green bond market reflects strong interest on the part of investors, the financial benefit for issuers or investors remains to be proven. To determine whether a bond's "green" status is of benefit to the issuer, we assume in the following analyses that when a green bond is traded in the secondary market with a positive premium, this is unfavourable for the issuer. Conversely, when this premium is negative, it is the investor that accepts a lower yield in order to hold the green bond.

C5 Breakdown of outstanding climate-aligned and green bonds by credit rating in H1 2018

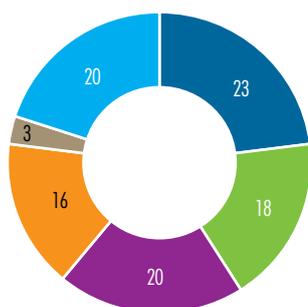
(%)



a) Climate-aligned bonds



b) Labelled green bonds



Source: Climate Bonds Initiative (CBI; 2018).
Note: Climate-aligned bonds include green bonds and those bonds deemed fully and strongly aligned under CBI criteria.

The assessment of the financial benefit to the issuer needs to take into account the differences between issuers of green bonds and other issuers. In the case of euro area non-financial corporations (see table below), issuers that have issued at least one green bond have the best market access, as well as having a higher volume of outstanding bond debt, longer average residual maturity and lower cost of financing (excluding green bonds) than other issuers.

Comparison of the characteristics of euro area non-financial corporations (NFCs) that are issuers of green bonds and other NFC bond issuers

(amounts in EUR billions, maturity in years, yield in %)

	Issuers of green bonds	Other bond issuers
Average amount of bond debt	6.8	0.5
Average residual maturity of bond debt	15	8
Average yield on bond debt	1.2	1.7

Sources: Centralised Securities Database and Bloomberg; authors' calculations.

Note: For the calculation of average yields, green bonds are excluded and only euro-denominated fixed-rate securities with a yield between -1% and 20% are taken into account.



To study the impact of a bond's green status on its yield, we conduct an econometric analysis of the secondary market yields on all bonds (green and non-green) from issuers that have issued at least one green bond, taking into account the other determinants of the cost of financing (residual maturity, type of rate, currency, issuer's sector of activity, rating of the security, etc.).¹⁴ The different models tested (five variants are studied, see table in the appendix) suggest that, all else being equal, the fact that a bond is "green" reduces the return for the investor. However, this negative greenium is not generally statistically significant, especially when the analysis is strictly controlled for issuer heterogeneity.

Academic and market analyses find mixed results. Bloomberg specialists detect no positive or negative greenium (Antunes and Mallah, 2018), whereas a study by the Bank for International Settlements (BIS; Ehlers and Packer, 2017) finds a negative greenium at issuance but not in the secondary market over the period 2014-17. A study by the CBI (Harrison and Filkova, 2018) suggests that, over the 2016-18 period, green bond issuers have tended to offer slightly higher yields more often than the opposite. A recent study by Bachelet et al. (2019) shows that only public institutions benefit from a negative greenium, which is linked to investors' willingness to pay for the environment. Conversely, the premium is positive – and therefore unfavourable – for private issuers, and is particularly high when the bond's green status has not been certified by a third party.

Conclusion: the new frontier of green finance data

At this stage, there is insufficient easily-accessible data available to monitor the green bond market or evaluate the efficiency of these instruments. In many cases, it is impossible to ascertain which sector is the final beneficiary of the proceeds, or to obtain precise details on how the financed project qualifies as green. As a result, it appears important to develop an official taxonomy of green projects and to compile statistics on the financed sectors rather than just on issuers. This applies not just to the green bond market, but to all modes of green financing.

Central banks have clearly identified this need. In its first comprehensive report published in April 2019, the Network for Greening the Financial System (NGFS)¹⁵ stated in recommendation No. 3 (Bridging the data gaps), that it wants "public authorities [to] share data of relevance to Climate Risk Assessment (CRA) and, whenever possible, make them publicly available in a data repository". It thus urged interested parties to establish a detailed list of the data that would be needed to gain a better understanding of the extent and scope of climate-related risks and their impact on the financial system.

The NGFS also encouraged policymakers "to bring together stakeholders and experts to develop a taxonomy [...] of economic activities" (recommendation No. 6). This taxonomy should be sufficiently transparent and detailed to enable a harmonised analysis of the risks.

¹⁴ Liquidity risk is not taken into account as a study conducted by Wulandari et al. (2018) for the period 2013-16 suggests this risk has become negligible.

¹⁵ At the first One Planet Summit organised in Paris in 2017 by France, the United Nations (UN) and the World Bank, eight institutions, including the Banque de France which provides secretariat functions, set up the NGFS. The network now comprises 40 members and six observers.



Appendix

Study of green bond yields in the secondary market

Econometric results: effects of explanatory variables

	(1)	(2a)	(2b)	(3a)	(3b)
Residual maturity	-0.016*** (0.005)	0.024*** (0.002)	0.027*** (0.001)	0.024*** (0.002)	0.032*** (0.002)
Residual maturity (log)	0.204*** (0.047)	0.559*** (0.030)	0.565*** (0.015)	0.551*** (0.031)	0.506*** (0.021)
Floating coupon	-0.043 (0.058)				
Fixed coupon	0.646** (0.266)				
Currency USD	1.642*** (0.075)				
Other currency (neither USD nor EUR)	2.078*** (0.071)				
Financial corporations				0.055 (0.374)	0.084 (0.243)
Public administrations				-0.161 (0.913)	-0.279* (0.168)
Is a green bond	-0.127 (0.161)	-0.085 (0.095)	-0.067 (0.044)	-0.015 (0.094)	-0.152*** (0.059)
Has options	0.474*** (0.051)	-0.150*** (0.049)	0.082*** (0.024)	-0.140*** (0.037)	0.008 (0.023)
Total bond debt				-0.054 (0.095)	-0.165*** (0.056)
Rating of security/issuer	0.114*** (0.020)	0.076*** (0.009)	0.049*** (0.004)	0.115*** (0.005)	0.088*** (0.003)
Constant	0.020 (0.213)	-0.627*** (0.197)	-0.759*** (0.091)	-1.254*** (0.233)	-0.985*** (0.167)
Observations	13 383	2 395	2 224	2 395	2 214
R ²	0.204	0.596	0.858	0.484	0.681
Adjusted R ²	0.192	0.575	0.851	0.480	0.678

Sources: Centralised Securities Database and Bloomberg; authors' calculations.

Key: The thresholds of statistical significance are set at 15% (*), 10% (**) and 5% (***). The higher the number of asterisks, the more statistically significant the variable.

Methodological note:

- the explained variable is the yield-to-maturity observed in the secondary market,
- type (1) and (2) models include indicators of issuing companies (not shown in the table) whereas type (3) models include indicators (shown) of the NACE sector of activity,
- type (2) and (3) models are restricted to euro-denominated fixed-rate securities,
- models with the suffix (b) exclude statistical outliers and influential points.



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