



24 August 2016

Green Bonds – certification, shades of green and environmental risks

Contribution to the G20 Green Finance Study Group¹

By Torsten Ehlers and Frank Packer²

Introduction

Green bonds are bonds whose proceeds are invested in an environmentally friendly way. Investors in this asset class require various kinds of information. First, they need to know which bonds are in fact “green”. Because most investors find it too costly to verify and assess for themselves the environmental impact of the use of proceeds, the emergence of coherent, publicly available standards can help to broaden the investor base. Amidst rapid growth in the market, there are still many different definitions and labels for green bonds (green bond principles, climate bond standards, national definitions such as the green bonds endorsed catalogue in China), as well as many different instruments to certify “greenness” (“second opinions”, green ratings, green bond indices). These certification schemes differ across a number of dimensions including their degree of granularity, the availability of ex post monitoring, and the use of quantitative tools.

Second, investors building green portfolios require information for grasping the range of investment opportunities and managing the associated financial risks. The performance of green bonds and related indices should be assessed using both the level and volatility of returns and against appropriate benchmarks. But if limiting exposure to environmental risks is an objective of green bond investors, conventional financial return and risk metrics alone are not sufficient.

The rest of this note proceeds as follows. After a brief review of the composition of green bond issuance, the next section examines and classifies the various instruments provided by the private sector to certify green bond issuance. Are existing schemes appropriate and informative for long-term and other investors, and are there aspects that could potentially be improved? The following section focuses on the financial risks associated with green bonds. In their short history, the return performance of green bond indices has been good relative to comparable bond indices, though only when foreign exchange movements have been hedged; currency movements have substantially reduced the performance of green bond indices otherwise. However, it is not the case that investors in all green bonds are shielded from environmentally

¹ This input paper has been prepared by the authors as a contribution to the G20 Green Finance Study Group (GFSG) but has not been endorsed by it nor does it represent the official views or position of the GFSG or any of its members.

² The views expressed in this note represent those of the authors and not necessarily the BIS. Agne Subelyte provided excellent research assistance. We thank Dietrich Domanski for his valuable comments.

related credit risks. Could investors benefit from there being a clearer distinction made between greenness and exposure to environmental risks? In the final section, we conclude with a summary of policy implications.

Recent issuance of labelled green bonds

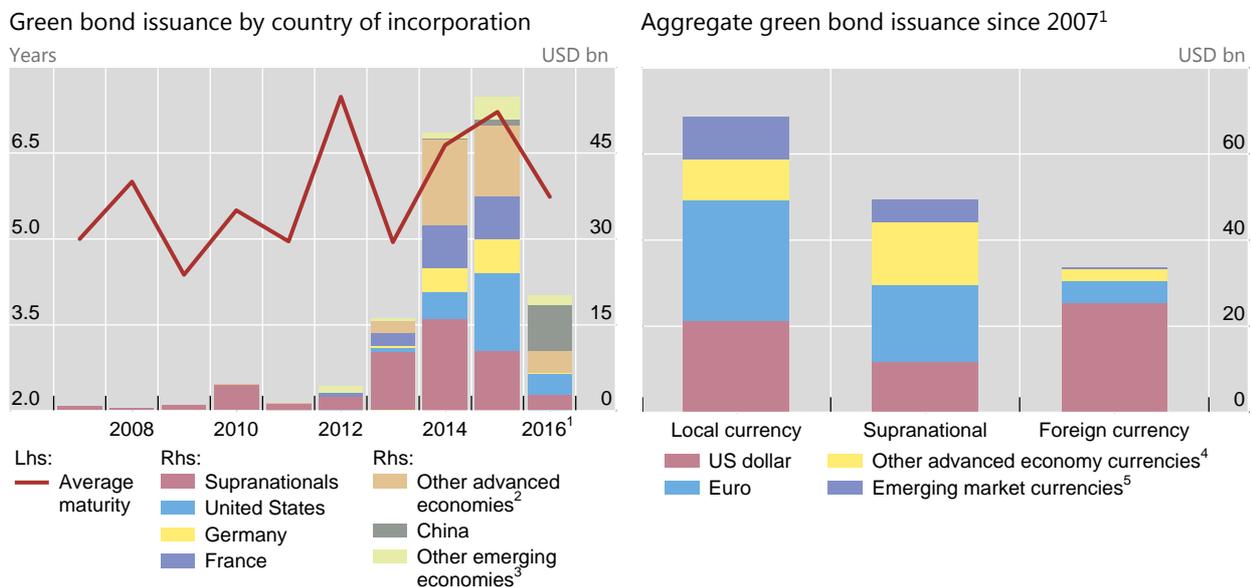
The market for green bonds is growing rapidly. The introduction of green bond principles by the International Capital Markets Association (ICMA) in January 2014 spurred a rapid increase in the issuance of bonds with a green label (Graph 1). Green bonds are typically of medium-term maturity and cover a wide range of issuer jurisdictions and currency denominations. At first issuers were mainly government-related entities, but recently corporate issuers have become increasingly active, especially from China.

The actual extent and composition of issuance depends in part on which lists of green bonds are used. For instance, taking only those in the green bonds list of the Climate Bonds Initiative (CBI), the aggregate issuance of labelled green bonds through Q1 2016 equals USD 117.9bn. The aggregate issuance of labelled green bonds according to Bloomberg (excluding green municipal bonds) is roughly similar at USD 111.7bn, but only USD 77.7bn overlap with the labelled green bonds from CBI.

Aggregate "labelled" green bond issuance

Climate Bond Initiative and Bloomberg labelled green bonds, in billions of US dollars

Graph 1



¹ Data cut-off at end-March 2016. ² Australia, Austria, Canada, Denmark, Estonia, Italy, Japan, Latvia, the Netherlands, Norway, Spain, Sweden and United Kingdom. ³ Brazil, Chinese Taipei, Hong Kong SAR, India, Korea, Cayman Islands, Mexico, Peru, the Philippines and South Africa. ⁴ Australian dollar, British pound, Canadian dollar, Japanese yen, New Zealand dollar, Norwegian krone, Swedish krona, Swiss franc. ⁵ Brazilian real, Chinese yuan, Colombian peso, Hungarian forint, Indian rupee, Indonesian rupiah, Malaysian ringgit, Mexican peso, Peruvian Nuevo sol, Philippine peso, Polish zloty, Russian ruble, Turkish lira, South African rand.

Sources: Bloomberg; Climate Bonds Initiative; BIS calculations.

Forms of green bond certification

For investment in green bonds to take off, it is important that investors be able to make a distinction between bonds that are green versus those that are not. “Green-washing” refers to projects or financial instruments that have been subject to minimal make-over so as to have the appearance of a project with environmental benefits, but in substance do not. To the extent that regulators or the market grants any preferences to bonds with a green label, the incentives to “green-wash” are enhanced. To counter such distortions, a variety of forms of green bond certification have sprung up to ensure investors have an accurate indication of specific bonds’ adherence to environmental principles (Table 1).

Green bond principles vs. climate bond standards. The Green Bond Principles, so-called “voluntary process guidelines” put together by major private financial institutions under the aegis of the International Capital Markets Association (see ICMA (2015)), constitute the highest level criteria. Green bonds should use proceeds for environmentally sustainable activities, have a process for determining project eligibility, manage the proceeds in a traceable fashion, and report annually on the use of proceeds. The standards of the Climate Bond Initiative (CBI) lend themselves more readily to immediate applications, and provide clearer, sector specific eligibility criteria. The key common point to both is the concept that the use of funds and subsequent revenue must be tied to “green” investment, ie in industries or sectors considered to be “green”.

Though a large number of jurisdictions make use of the two schemes mentioned above, an equally large number of jurisdictions have developed their own taxonomies. Most notably, China’s Green Bond Finance Committee has issued a Green Bond Endorsed Project Catalogue. For large domestic markets, this is a sensible option, but to the extent that international harmonization is an issue, domestic guidelines run the risk of limiting the value of any particular green certification scheme to the domestic investor base alone.

Characteristics of different Green Bond identification and certification schemes Table 1

	Green Bond Principles	Climate Bond Initiative	Green Bond Indices ¹	CICERO 2 nd Opinions	Moody’s Green Bond Assessments
Use of funds must be tied to “green” investment	Yes	Yes	Yes	Yes	Yes
Sector-specific eligibility criteria		Yes	Yes		
Ex post monitoring/assessment					Yes
Granular assessments of greenness				Yes	Yes
Quantitative weights for different factors					Yes

¹ Barclays MSCI, Bank of America Merrill Lynch, S&P and Solactive.

Green bond indices. Green bond indices identify specific bonds as green via a stated methodology, and also allow investors to invest in a portfolio of green bonds to diversify risks. Generally speaking, indices which comprise a large number of component bonds (or equities) provide the opportunity for investors to diversify away issuer-specific risk, while at the same time maintaining a thematic focus to their investment. As is well recognized in the academic literature, the very act of insertion of an entity into an index requires an institutional judgment that the entity qualifies and fulfils some standard. To this extent, the green bond index providers are also institutions of certification. At present, we've identified 4 different green bond indices; these are Barclays MSCI, Bank of America Merrill Lynch, S&P and Solactive. Each one of these has their own methodology for choosing the components of the index.

For instance, in the case of the Barclays MSCI index, independent evaluation of securities for the purpose of determining eligibility for the index by MSCI ESG Research, a provider of environmental, social and governance research, occurs along four dimensions that are parallel to the Green Bond Principles: use of proceeds, project evaluation, management of proceeds, and reporting. For a bond to enter the index, it must meet all four criteria. MSCI ESG also identifies the specific industry sectors for the use of proceeds (alternative energy, energy efficiency, pollution prevention and control, sustainable water, and green building).

Second opinions and CICERO. Though it is not a part of the four Green Bond Principles, it is "recommended" that Green Bond issuers "use external assurance to confirm alignment with the key features of Green Bonds." Some so-called "second opinions" by independent institutions working on environmental issues (including academic institutions) are more granular and lend further credibility to the "greenness" of bond issues. A number of providers of second opinions have sprung up in recent years, such as Deloitte, EY, KPMG, Oekom, Sustainalytics, and Vigeo.

The leading provider of second opinions is CICERO, a climate research institute based in Oslo. Upon request, the institute reviews and evaluates the issuer's framework for both project selection and investment (see Cicero (2016)). Generally it provides a "top-down" assessment of the framework, rather than a "bottom-up" evaluation of the environmental impact of projects. A limitation with CICERO and most other existing providers of "second opinions" to date is that they principally only review the green bond framework at the time of issuance. Generally, ex post changes in the framework or environmental impact are not monitored – unless the issuer specifically puts in a request.

One drawback of the green bond principles and standards, as well as inclusion into the green bond indices discussed above, is that they tend to be implemented in all or nothing fashion. The applications result in a bond either being certified as green, or not. In other words, they are zero-one measures that allow little differentiation.

CICERO, however, provides three different degrees of positive assessment ("shades of green"), reflecting the issues' adherence to a long-term vision for a low-carbon, "environmentally resilient" society. "Light Green", the lowest of the positive assessments, indicates a judgement that the project is environmentally friendly, but does not contribute to the long-term vision; "Medium Green" for projects that represent steps to the long-term vision; and "Dark Green" for projects that "already apply solutions of the future". CICERO applies a shade to each of the projects funded by the bond, and then aggregates those to a single shade for the bond as a whole.

Credit Rating Agencies and “Green Bond Assessments”. As mentioned earlier, a limitation of green bond standards as well as the second opinions is that they do not mandate monitoring and verification on an ongoing basis. To have an entity that refreshes its certification is highly useful for investors, particularly if they intend to maintain the investment over a multi-year horizon. Arguably, index providers can serve this function, since they have the capacity to discard entities from an index as well as to include them. However, since inclusion criteria for green bond indices are much less concrete than those for conventional bonds (such as minimum levels of market liquidity and credit ratings), it remains to be seen whether the index providers have the capacity for monitoring such environmental criteria on a continuous basis.

Ratings from major agencies might also be helpful in this regard. Credit ratings agencies are among the major institutions of certification in bond markets, as they provide granular assessments of the degree of credit risk for bonds and bond issuers. In the case of long-term bond ratings, most major credit rating agencies provide up to 21 ordered rankings of default risk. Despite setbacks over the years, such as the sub-prime mortgage crisis, rating agencies have developed a reputation for delivering credible assessments for ranking issuers in a granular fashion. Even if green criteria do not directly overlap with their core competence – the assessment of credit risk – rating agencies might have advantages in providing certification services for green bonds, given their familiarity with the bonds and bond issuers more generally.

Rating agencies also have a regular review process for all of their existing credit ratings as part of their standard operating procedures. Thus, the limitation of some of the principles, standards and “second opinions” mentioned above are unlikely to apply. The granularity of their ratings is sufficiently fine that regular review is an essential component of their business model, and maintaining and refreshing ratings over a multi-year horizon does not represent an unusual challenge.

The first public methodology for the assessment of green bonds by a ratings agency was issued by Moody’s Investors Service this March. The “Green Bond Assessments” (GBAs) are intended to “assess the relative likelihood that bond proceeds will be invested to support environmentally friendly projects”. As with their credit ratings products, Moody’s has attached numerous quantifiable factors to the process of determining the GBAs, with the explicit aim of increasing their transparency and replicability. The determinants of a green bond assessment are based on five key areas with different weights (Table 2). Each of these factors are given scores of 1 to 5, based on numerous quantifiable sub-factors. The weighted average then corresponds to the overall GBA (though low scores of 4 or 5 in the use of the proceeds factor will cap the overall score at those levels). Moody’s also indicates that there may be other considerations not included in the scorecard that may affect its assessment of the future performance, including macroeconomic and financial market factors.

Despite the caveats, it is clear that a more granular assessment, such as the GBAs by Moody’s, provides a quantitative transparency that distinguishes it from the other certification systems discussed above. Even though the factors scored by Moody’s clearly parallel the Green Bond Principles, it weights the factors to obtain an overall assessment on a five-point scale that some investors may prefer to a simpler 0-1 assessment of whether those green bond principles are fulfilled or not.

Comparison of Green Bond Principles and Moody's Green Bond Assessments (GBAs)

Table 2

Green Bond Principles	Moody's Green Bond Assessments (GBAs)
<p><i>Use of Proceeds</i></p> <p>Utilisation of proceeds should be described and present clear environmentally sustainable benefits.</p>	<p><i>Use of Proceeds</i></p> <p>Assessment depends on percentage of proceeds allocated to eligible project categories. Weighted 40% as a factor.</p>
<p><i>Process for Project Evaluation and Selection</i></p> <p>Decision-making process should be outlined; in particular, how projects fit into green categories, eligibility criteria, and environmental sustainability objectives.</p>	<p><i>Organisation</i></p> <p>Includes sub-factors: effectiveness of environmental governance and organisation structure; rigorous review and decision-making process; qualified personnel and/or reliance on third parties; explicit criteria for investment selection; external evaluations for decision making. Weighted 15% as a factor.</p>
<p><i>Management of Proceeds</i></p> <p>Net proceeds should be tracked by formal internal process.</p>	<p><i>Management of Proceeds</i></p> <p>Includes sub-factors: Segregation and tracking of proceeds on accounting basis; tracking of the application of proceeds by environmental category and project type; reconciliation of planned investments against allocations; eligibility rules for investment cash balances; external or independent internal audit. Weighted 15% as a factor.</p>
<p><i>Reporting</i></p> <p>Issuers should provide annual list of projects to which proceeds allocated.</p>	<p><i>Disclosure on Use of Proceeds</i></p> <p>Includes sub-factors: Description of green projects; adequacy of funding to complete projects; quantitative descriptions of targeted environmental results; methods and criteria for calculating performance against targets; reliance on external assurances. Weighted 10% as a factor.</p> <p><i>Ongoing Reporting and Disclosure</i></p> <p>Includes sub-factors: Reporting and disclosure post-issuance; ongoing annual reporting; granular detail on nature of investment and environmental impact; quantitative assessment of impacts to date; comparison of assessments of impacts with projections at time of issuance. Weighted 20% as a factor.</p>

Sources: International Capital Markets Association (2015); Moody's (2016).

Green bonds and financial risks

A green label, if well-designed, has the important function of helping investors to avoid the negative externalities of investing in projects that damage the environment. Projects that have a detrimental effect on the environment may – by themselves – be profitable, but can reduce welfare for the society as a whole. A prominent example of such a negative externality is the economic cost of climate change (eg Stern (2006)). Giving investors a means to easily and precisely identify the greenness of potential investments can help to mitigate these externalities and thereby enhance welfare.

At the same time, many long-term investors are becoming more aware of financial risks related to the environment. Climate change, for instance, but also changes in environmental regulations such as carbon emission rules, can materially affect the financial performance of investments in bonds and other securities. By factoring in such risks, long-term investors effectively internalise their economic costs.

Assessing and internalising environmentally related financial risks could be a way of channelling a substantial amount of funds to greener investments.

The distinction between the “green” label and exposure to environmentally related financial risks. While the label of some green bonds may imply a limited exposure of investors to environmentally related financial risks, this is not always the case. A green label or green index ensures that proceeds are used for projects that are environmentally beneficial, but the issuers of green bonds could still be exposed to substantial environmental risks that can affect the bonds’ financial performance.

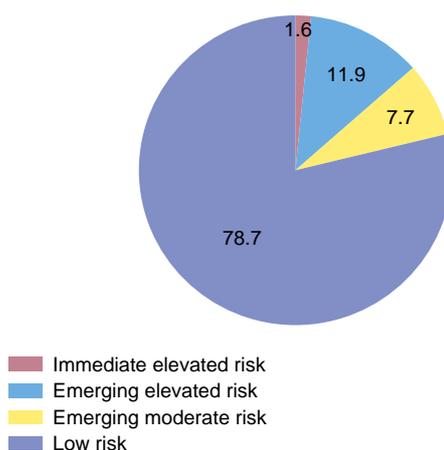
Examples of the distinction between a green bond label and exposure to environmentally related financial risks are many. For instance, an offshore wind park will likely receive a green label or high green rating for its bonds; but at the same time floods or heavy winds could have a material impact on the financial situation of the issuer. Similarly, a large and diversified energy company may invest into green projects, but other parts of its business (for instance coal power plants) may expose it to environmentally related credit risks such as changes in carbon regulations.

At the sectoral level, Moody’s (2015) provides a classification of credit exposures to environmental risks (Table 3). Within the universe of labelled green bonds, almost 80% of the aggregate volume is issued by institutions in industries with a low exposure to environmental credit risk (Graph 2). But a significant fraction of issuers belong to sectors that are exposed to elevated credit risks due to environmental factors. While the actual risk exposure may differ across individual issuers, the sectoral classification illustrates that green bonds do not necessarily minimise environmentally related credit risks. For long-term investors trying to manage the environmental credit risks of their investment portfolio, this may reduce the value of existing green labels.

Environmental credit risk composition of green bonds using the sectoral classifications by Moody’s¹

Share of aggregate issuance since 2007², in per cent

Graph 2



¹ Aggregate issuance of green bonds by issuers from sectors which belong to the above risk categories as defined by Moody’s. See Moody’s investor service (2015): “Environmental risks – Heat map shows wide variations in credit impact across sectors”, September. In case industrial classification are ambiguous, we use equal weights to distribute the issuance volume across the relevant sectors. ² Data cut-off at end-March 2016.

Sources: Bloomberg; Climate Bonds Initiative; Moody’s; BIS calculations.

The financial performance of green bonds. Even if the current green labels may not be sufficient on their own for some investors, well-designed green labels do provide a signal for investors with preferences for environmentally beneficial projects. At the same time it is important to examine the financial characteristics of such investments apart from their environmental impact. To this end, the return characteristics of existing green bond indices are a useful starting point. Green bond indices contain an already well-diversified portfolio of bonds and thereby may present an instrument suitable for a wide range of institutional and retail investors.

By construction, green bond indices include bonds denominated in many different currencies. Currency movements can therefore have a substantial impact on returns. To make returns comparable, index providers calculate so-called hedged returns, which measure returns that can be achieved by buying financial instruments that neutralise the currency exposures of the index³.

Using hedged returns, green bond indices have so far exhibited a financial performance that is in general superior to a broad bond market index. For instance, the ratio of average monthly hedged returns to its standard deviation, which is a standard measure for risk-adjusted performance (the so-called “Sharpe ratio”), was higher for green bond indices than for global bond indices of similar rating⁴ (see Table A1 in the appendix). During April 2014 – March 2016, the Sharpe-ratios for both the Bank of America Merrill Lynch (BofA ML) index (0.54) and the Barclays MSCI Green bond index⁵ (0.55) were more than 20% higher than that of the broad bond market index with a comparable AA rating (0.45). Even though the available green bond indices by BofA ML, Barclays MSCI, S&P, and Solactive, differ slightly in their composition (see CBI (2015)), their return characteristics are very similar (Table A2). Future performance may change, but for now green bonds may benefit from their relatively stable investor base and, possibly, from a perceived added value of the green label.

The existing indices therefore provide a good starting point for a broad range of investors interested in green bonds. However, taking plain (unhedged) positions in a green bond index exposes investors to substantial currency risks. As a result, plain total returns on green bond indices have exhibited higher volatility and lower returns than broad-based bond indices. Ideally, index providers should offer hedged green bond products to broaden the potential investor base as much as possible.

³ Hedging is typically done by selling, on a monthly basis, foreign currency forwards at one-month forward rates. Related transaction costs may not be fully reflected in the hedged returns, but transaction costs will generally be negligible – in particular given the fact that currency hedging mostly involves selling EUR-USD one-month forwards.

⁴ The universe of labelled green bonds from Bloomberg and the Climate Bonds initiative has an average rating of slightly below AA. The average maturity and duration of the global bond indices and the different green bond indices are highly comparable, but sectoral and currency compositions differ.

⁵ Hedged returns were only supplied by BofA ML and Barclays MSCI. For the S&P and Solactive green bond indices, only unhedged returns were available to us.

Moody's sectoral environmental risk classification

Credit exposure to environmental risks

Table 3

Environmental risk classification	Description	Relevant industry examples
Immediate, elevated risks	Sectors are already experiencing material credit implications as a result of environmental risk. There rating changes have either already been occurring for a substantial number of issuers or ratings changes are likely within the next three years	Unregulated utilities and power companies
Emerging, elevated risk	Sectors overall have clear exposure to environmental risks that, in aggregate, could be material to credit quality over the medium term (three to five years), but are less likely in the next three years.	Automobile manufacturers, power generation projects
Emerging, moderate risk	Sectors have a clear exposure to environmental risks that could be material to credit quality in the medium to long term (five or more years) for a substantial number of issuers. However, it is less certain that the identified risks will develop in a way that is material to ratings for most issuers.	Regulated electric and gas utilities with generation, sovereigns – developing countries, environmental services and waste mgmt., paper and forest products
Low risk	Sectors in this category have either no sector-wide exposure to meaningful environmental risks or, if they do, the consequences are not so likely to be material to credit quality	Supranationals and sovereigns – developed countries, banks and finance companies, consumer goods, semiconductors and technology hardware

Source: Moody's (2015).

Summary and policy implications

Green bond principles and standards are an important step towards promoting green finance. With the introduction of the green bond principles by ICMA in January 2014, the issuance of labelled green bonds has increased rapidly, with a growing number of corporate issuers. Several green bond indices have also been introduced, allowing a broader group of investors to take a diversified position in green bonds. Existing green bond indices are generally based on the ICMA green bond principles and overall are consistent in their composition, focus, and financial performance.

However, for this still relatively small market to grow further, potential investors may need to have ready access to information that goes beyond the content of existing green labels. More ongoing monitoring by so-called "second-opinion" providers, and greater provision of granular green bond ratings and other forms of third party verification, may be needed. While second-opinion providers have developed solid frameworks for certifying the "greenness" of bonds, thus far they generally do not provide continuous monitoring services.⁶ Green bond assessments by ratings agencies are in a nascent stage, but could eventually provide greater granularity, ongoing monitoring, and possibly cost advantages for bonds that are already receiving credit ratings. Green bond indices have the potential to provide a

⁶ For instance, for labelled green bonds on the interbank market, the People's Bank of China (2015) requires quarterly disclosure on the use of funds, and encourages audited annual disclosure on the environmental benefits.

constant monitoring function, but then inclusion standards could be maintained so that bonds fall out of indices if they stop meeting them. By construction, green bond indices include securities of various currency denominations. To make green bonds accessible to retail investors, index providers may need to offer products which are hedged against the fairly substantial currency risks inherent in existing indices.

A second informational aspect that is not covered by current green certification schemes is the environmentally related financial risks of green bonds. While the label of some green bonds often is associated with a limited exposure of investors to environmentally related financial risks, this is not always the case. Green bond labels just ensure that proceeds are invested in an environmentally friendly way. But the issuers of green bonds can still be significantly exposed to environmental risks capable of affecting the bonds' creditworthiness (natural disasters, changes in environmental regulation etc). Large institutional investors in particular are becoming more aware of financial risks related to the environment. Green bond standards could be enhanced to reflect the degree of financial risks stemming from environmental factors so as to enable investors to manage these risks effectively. Not only could this help to unleash the potential for green bonds as an asset class, but it could also be important for containing the financial stability risks related to environmental factors.

References

Barclays (2015): "The cost of being green", US credit focus, September.

Barclays MSCI (2014): "Green Bond Indices: Bringing clarity to the green bond market through benchmark indices," September.

CICERO (2016): "Framework for CICERO's 'Second Opinions' on Green Bond Investments," April.

Climate Bonds Initiative (2015): "Bonds and climate change – The state of the market in 2015", report commissioned by HSBC, July.

International Capital Market Association (2014): "Green bond principles", January.

International Capital Market Association (2015): "Green bond principles, 2015", March.

Moody's Investors service (2015): "Environmental risks – Heat map shows wide variations in credit impact across sectors", September.

Moody's Investors Service (2016): "Green Bond Assessment (GBA)" March.

People's Bank of China (2015): "Announcement No. 39," December.

Stern, N H (2006): "Stern Review: The economics of climate change", UK Treasury, October.

Appendix

Green bond indices: return characteristics

Annualized monthly total returns, April 2014 – March 2016, in per cent

Table A1

		Hedged returns ¹				Unhedged returns ²			
		cumulative over 24 months	Mean (1)	Std (2)	Sharpe ratio = (1)/(2)	cumulative over 24 months	Mean	Std	Sharpe ratio
Green bond indices	Standard&Poors					-6.91	-4.37	19.11	-0.23
	BofA Merrill Lynch	8.70	4.35	8.04	0.54	-5.94	-2.97	18.94	-0.16
	Solactive					-4.86	-2.43	18.33	-0.13
	Barclays MSCI	9.96	4.98	9.08	0.55	-2.45	-1.22	16.53	-0.07
Global bond indices	Broad-based	8.02	4.01	11.30	0.36	1.40	0.70	13.92	0.05
	AA average rating	8.85	4.42	9.89	0.45	1.15	0.58	13.24	0.04
	A average rating	8.81	4.40	10.59	0.42	2.02	1.01	12.62	0.08

¹ Hedged returns are total returns for indices hedged against currency risks. Hedged returns allow better comparability across indices that differ in their currency composition. Hedged returns represent a close estimation of the return that can be achieved by hedging the currency exposures of the underlying index by selling foreign currency forwards at one-month forward rates. Hedged returns are not exact measures of the true returns, since they do not include transaction costs for hedging contracts. Those can be considered small, in particular, since Euro exposures present the largest foreign currency component (see also Graph 1). Bid-ask spreads on EUR_USD forwards, which are an indicator of transaction costs, are usually between 1 and 1.5 basis points. ² Unhedged returns are the total returns from holding a simple position in the respective index. Green bond indices differ substantially in their currency composition from the global bond indices. Hence, currency movements will significantly affect return differentials between green bond and global bond indices.

Sources: Bloomberg; Barclays Bank PLC; authors' calculations.

Correlation matrix for Green Bond indices

Correlation coefficients for monthly total returns, April 2014 – March 2016

Table A2

		Hedged returns ¹		Unhedged returns ¹			
		BofA Merrill Lynch	Barclays MSCI	S&P	BofA Merrill Lynch	Solactive	Barclays MSCI
Green bond indices	Standard&Poors (S&P)			1			
	BofA Merrill Lynch	1		0.98	1		
	Solactive			0.99	0.98	1	
	Barclays MSCI	0.98	1	0.98	0.99	0.98	1
Global bond indices	Broad-based	0.84	0.86	0.82	0.81	0.84	0.86
	AA average rating	0.90	0.94	0.87	0.87	0.87	0.91
	A average rating	0.88	0.92	0.82	0.81	0.83	0.87

¹ See footnotes in Table A1.

Sources: Bloomberg; Barclays Bank PLC; authors' calculations.