Summary of the workshop on the role of technology in green finance

Held virtually on 19 April 2023, 13:00 – 14:30 CET, via WEBEX platform.

Disclaimer: The views and opinions expressed in this workshop are those of the speakers and do not necessarily reflect the views or positions of the BIS, BIS Innovation Hub nor any entities they represent.

Introduction

On 19 April 2023, the Working Group on Green Finance of the BIS Innovation Network (BISIN) organized a workshop on the role of technology in green finance. The workshop was chaired by Mr José Manuel Marqués Sevillano, Chair of the Working Group.[1]

The program included opening remarks from Ms Cecilia Skingsley, Head of the BIS Innovation Hub, followed by three dedicated sessions covering the work developed by each workstream of the group, during the last year. The workshop was attended by 80 participants from BISIN members and representatives of BIS departments.

This note summarizes the workshop sessions and highlights the issues discussed.

Background

To mitigate and adapt the materialisation of climate change is one of the biggest challenges to date. It requires more involvement of many authorities and policymakers. This emergency call has been corroborated by scientific evidence, as recently published by Intergovernmental Panel on Climate Change (IPCC) in its last Assessment Report (AR6). Notably, transformational changes need trust, which builds upon a combination of political commitment, science-based targets, climate legislation, international cooperation, and public and private sector collaboration to deliver an effective action to address potential climate risks. Cornerstone in this challenge is the involvement of the financial sector, to advance sustainable finance activities, and to internalise the financial risks related to climate change, with the aim of prioritizing green finance as one of the mainstreams.

With the advancement of technological innovation today there is an opportunity to harness its potential to overcome the operational barriers and bottlenecks that might prevent green finance to scale up, such as the limited access to reliable data, and the statistical complexity to model the non-linear behavior of climate change as a risk factor. The BIS Innovation Hub (BISIH), together with central bank community, explores technological innovation through experimentation to develop public goods in six different areas, including green finance.

In this context, the BISIH has developed a number green finance projects. Project Genesis, in its first version (1.0), developed a prototype for digitising retail green bond issuance using both permissioned and permissionless distributed ledger technology. The investigation went further to test the use of smart contracts and the internet of things (IOT) to track carbon credits related to green bonds in project Genesis 2.0. Project Viridis, which builds on the previous work of Project Ellipse, developed a prototype of a climate-risk platform to help financial institutions identify and assess climate-related financial risks. Finally, Project Gaia aims to establish a platform to assist analysts search corporate climate-related disclosures quickly and efficiently, harnessing the power

[1] Ms Kusuma Ayu Kinanti, Adviser, BIS Innovation Hub, and Mr Hamad Allahim, Adviser, BIS Innovation Hub provided invaluable support in organising the webinar. This summary document was prepared by Mr Andrés Alonso-Robisco, Senior Economist, Bank of Spain.

of large language models.

In addition, the BISIH established the Green Finance Working Group as a forum for members to exchange views and discuss potential technology solutions relevant to central banks' problems in the green finance area. It also supports the BISIH priorities in developing its projects. Since its inception, this group has been working in three different workstreams, aiming to understand how technology can answer three of the most relevant problem statements that central bank members have identified as potential barriers in green finance. In particular, the topics identified as priorities were (i) how to increase the quantity of sustainability-related data, (ii) how to increase the access of SMEs to green bond financing, and (iii) assess the environmental materiality of information. Each session of the workshop was dedicated to presenting the result and discussion in each workstream.

First session[2]: Increasing the quantity of sustainability-related data

In this session, participants have discussed how physical climate-related risks can have a material financial impact to economy, especially that central banks and supervisors still lack the data needed to account for these risks in decision-making. For example, when natural catastrophes occur, or when changing circumstances affect forward-looking estimates of risk. To overcome this problem, the concept of "digital twinning" was explored as a technological innovation to import external climate-related data and link this to financial data (e.g. supervisory reporting data). For instance, in case of flooding, a digital twin solution may immediately show central banks and supervisors which financial entities are most affected, and whether there might be macroprudential risks arising from the impact of the event on various institutions at the same time. By modelling the impact of hypothetical events based on the latest information available, better assessments of physical risks on a forward-looking basis are also facilitated.

In this session, the speaker presented the work of the workstream, mainly the development of an experiment on a digital twin solution for flood and tropical cyclone risk affecting real estate exposures in three different jurisdictions (the Netherlands, France and Hong Kong). The aim was to better understand practical barriers and opportunities related to the integration of financial and regulatory data sources. This included experimentation with more innovative environmental data, such as near real time insights in flooding based on satellite imagery.

The workstream first established a general framework to analyze different risk types and jurisdictions in a comparable structure and language. This theoretical basis of the minimum viable product (MVP) is drawn from the hazard-vulnerability-exposure-finance framework commonly adopted in catastrophe modelling in the insurance industry. The general framework used in this exercise is as the following:

- **The hazard module** models the frequency and intensity of hazards. This is often done by generating a stochastic event set: possible event scenarios are simulated based on hazard characteristics, historical data, and assumptions about future climate change. Given the

[2] Speaker: Sjoerd van der Zwaag, Senior Sustainable Finance Officer at the Netherlands Bank

complexity of this module and expertise required, it may suffice to rely on publicly available hazard intensity data and climate modelling results.

- **The exposure module** collects the geographical and physical characteristics of the properties at risk, such as the asset, and its construction type (house, condo, building, factory, etc.). Exposure data can come from various sources and does not have to be based on regulatory reporting by supervised entities.
- **The vulnerability module** calculates the amount of expected damage to the properties at risk based on hazard intensity and exposure of the buildings. Publicly available damage functions are essential to establish vulnerability.
- **The financial module** translates the damage from the vulnerability module into financial metrics for financial institutions, taking into account the relevant exposure of the relevant financial institution. To conduct the analyses in the financial module, institution-specific information is required. The need to work with both external and internal data makes this step particularly challenging to execute.

Based on the above-mentioned framework, the workstream created an MVP of an open-source IT solution. Adopting a modular approach, this experimental digital twin solution was applied in three jurisdictions to two different risk types as the following:

1. Flood risk in the Netherlands: De Nederlandsche Bank (DNB) applied the digital twin tool to assess flood risk scenarios affecting residential real estate in a real-time and interactive manner (incl. by using satellite data to determine which scenario might be playing out).
2. Flood risk in France: Banque de France (BdF) tested the digital twin MVP for flood risk, focusing on the exposure and vulnerability modules.
3. Tropical cyclone risk in Hong Kong: The HKMA conducted a study using the digital twin tool to gauge the impact of tropical cyclones on residential real estate in Hong Kong.

These case studies are purely experimental, and did not yield representative data on vulnerabilities, exposures, or financial loss, but have demonstrated technical and theoretical feasibility. It also showed that for all three use cases, 80-90% of the code needed to conduct the analysis was generic (i.e. could be reused).

Some of the main challenges identified by this work stream concern the difficulties in obtaining near real time data in a usable format, including the requirement of significant processing power. Additionally, a lack of granular supervisory data can prevent an assessment of financial risks. Other limitations point towards the importance of publicly available damage curves and hazard projections, as well as the fact that such information may not always capture the interaction between different drivers of damage (e.g. interaction between flooding and storm risk).

The workstream also distilled several lessons learnt. Importantly, by starting small, much could already be achieved in a short time span. Such success on a smaller scale could open the door to incremental improvement, wider use, and the exploration of synergies with other institutions. Also, working from the start with different jurisdictions on the solution has helped to ensure that the solution is suitable as a public good. And finally, experimenting with technology and innovative concepts create more concrete insights in the challenges that still need to be tackled to increase the quantity of sustainability-related data.

Second session[3]: Access of SMEs to green debt financing

In this session the speaker pointed out that small- and medium-sized enterprises (SMEs) are underrepresented green debt issuers, despite being a substantial share of the global economy. SMEs which cannot regularly issue large, investment-grade rated corporate bonds are unlikely to capture the same borrowing cost advantage that is typically associated with green bond issuance by large corporate issuers. That is, SMEs are less likely to capture a so-called *greenium* (the yield difference between a comparable conventional bond and a green bond), which appears to be the result of demand pressure at issuance. Since SMEs' green bonds typically do not meet bond index inclusion requirements, they face less investor demand and are underrepresented in bond mutual fund and ETF portfolios, even though the sustainable asset management industry has rapidly grown over recent years. In fact, when SMEs issue green bonds they may experience a small or potentially negative greenium when taken net of fees and compliance costs, particularly for small and first-time issuers. Consequently, SMEs may refrain from issuing green bonds and financing green projects altogether.

Given the strong demand for green debt from the sustainable asset management industry, there is an opportunity to look into solutions to make this type of funding more accessible, viable, and cost efficient for SMEs. Addressing current challenges that disincentivize small-scale green bonds issuance is one path toward more robust SME bond supply and essential for a green transition at the required speed. Another potential solution lies in green securitization.[4] While green securitization markets are still small, they can improve SMEs' access to sustainable debt markets by bundling their smaller-scale green assets into tradable financial debt instruments that cater to large institutional investors.

Distributed ledger technologies (DLT) can bring cost savings and operational efficiencies to structured products and thereby support the growth of the market for green securitization. For instance, DLT can improve green securitization through programmed replacement and compliance solutions for collateral pools. DLT can streamline the records management and the warehousing of green assets between lenders. Lastly, DLT also promise better transparency and auditability of collateral pools.[5] All of the above can support the creation of green securitized debt that caters to the growing demand from the sustainable asset management industry.

However, green securitization does not use DLT yet, except for a few pilot-projects. Similarly, current collateral pool management solutions do not yet include DLT. Some of the limitations arise due to the need for DLT to be integrated into legacy systems, as well as existing legal and regulatory fragmentation, which prevents financial institutions from further exploring this avenue. Additionally, DLT bond pilots are costly upfront, while DLT benefits materialize only later in the issuance process.

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[3] Speaker: Andreas Rapp, Principal Economist at the Board of Governors of the Federal Reserve System

[4] Green securitization describes debt instruments, such as green covered bonds or various types of green asset-backed-securities (ABS), that are backed by pools of green assets.

[5] For example, a U.S. investment advisor simulated an entire ABS life cycle on a blockchain. Two partially DLT-supported green bonds have been issued by European issuers (impact reporting and collateral management were not yet included). And, a Japanese institution announced to issue a digitally tracked green bond.

Still, DLT-based green securitization seems to be the next step for financial institutions piloting blockchains in structured finance. What's more, the targeted adoption of DLT-based green securitization appears like a project candidate for multilateral development banks (MDBs), which are relevant supranational green bond issuers and hold strong funding relationships with SMEs.[6] MDBs could either encourage the matching of issuers, originators, and securitizing agents, or create securitized green bonds themselves.

To further promote DLT-based green securitization, more progress is needed in the standardization of green securitization, the introduction of DLT into bond markets, and the aggregation of small-scale green projects for bundling. Key stakeholders in this process are:

- Financial markets authorities designing the frameworks that lay the groundwork for green securitization.
- Banks leading the inclusion of DLT into bonds, specifically those with a focus on green securitization.
- Fintech firms developing automated collateral management solutions.
- Rating agencies assessing DLT-based replacement of a non-performing assets on counterparty risk.
- MDBs supporting green securitization with an ability to encourage or lead SMEs' green asset aggregation.

Overall, green securitization appears like a viable solution for the bundling of SMEs' small-scale green assets into tradable financial debt instruments. But further growth seems to crucially depend on greater incentives and global standardization (for instance, clear definitions of what constitutes green securitization and a well-established green collateral eligibility criterion). DLT can introduce features to green securitization that greatly cater to large institutional investors, thus indirectly giving SMEs access to the growing demand of the sustainable asset management industry. Lastly, the results from DLT bond pilot projects—particularly those focusing on green securitization—should be encouraged and monitored going forward.

Third session[7]: Environmental materiality of information

In this session, participants discussed some of the issues related to climate-data such as standardization, difficulty of validation, and data inconsistency. Under this circumstance it becomes imperative for investors to separate noise from signal in order to really take into account climate change on their financial decisions.

New technologies could be particularly valuable to address these issues in two particular areas. First, to identify and compare the available information in order to check the level of compliance

[6] Insufficient volumes of green assets within one lender may be a limiting factor for green securitization. A few platforms aim to aggregate small-scale green projects in emerging markets, for example the UNDP's Climate Aggregation Platform in collaboration with the Climate Bonds Initiative.

[7] Speaker: Jose Manuel Marques Sevillano, Director Financial Innovation and Market Infrastructures Department, Bank of Spain

with reporting requirements, and secondly, to improve the verification and validation process of reported information. In particular, three of them were investigated in more detail:

Natural Language Processing (NLP)

The analysis of sustainability data is cumbersome due to its fragmentation. The heterogeneity of standards makes it difficult to compile and validate climate-related information. This could become a large-scale issue affecting all companies subject to mandatory reporting: roughly, in Europe, it is estimated that the proposal for Corporate Sustainability Reporting Directive (CSRD) will require up to 49,000 corporates to report climate-related information. Under this scenario, NLP technology can contribute to the objective of classifying and comparing information and resolving the issue of lack of standardization in sustainability information. NLP might be used to read corporate statements and assess materiality or to locate fixed assets to verify physical risk exposure, for example.

As a proof of concept, Bank of Spain has been working on an initial project at national level that could be a basis for other jurisdictions.[8] This work analyzed the corporate reports of the 12 significant Spanish Banks from 2014 to 2019 using text mining techniques to create a compliance index of the TCFD recommendations. For that purpose, it was created a tool that tagged different words combinations and allowed analysts to find fragments in the texts that had specific sets of tags or labels.

Although a technological solution of this kind could be provided by the private sector, all explored commercial alternatives present limitations and none of them seems to fulfil the needs of banking supervision, with the required flexibility and open access to retrieve data with high transparency of the algorithms. Therefore, this motivated the set-up of Project Gaia, which is currently undergoing under the remit of the BISIH Eurosystem Centre.

Earth Observations Systems

Tying asset-level data of physical ownership with observational granular data on climate-related risks and impacts can help create truly actionable insights aiming to assist market participants and regulators to validate the materiality of climate information reported by corporates. Importantly, information must be auditable, therefore, verification becomes at this stage a key challenge.

Some regulatory initiatives are being undertaken on this front (see previous section, ie: Project Gaia). However, concerns still arise on green-washing and it remains difficult to compare heterogeneous information. To this purpose relevant exploitation of space-based data could be a valid source of information for external verification, aiming to facilitate reliable audits, and traceability of the Greenhouse Gas ("GHG") emissions, assess climate physical risk and biodiversity loss.

In order to assess the potential adoption of this technology by financial supervisors, a first approach,

[8] See "Application of Text Mining to the Analysis of Climate-Related Disclosures". Moreno and Caminero, 2020. See also, "Analysis of ESG disclosures in Pillar 3 reports. A text mining approach". Moreno and Caminero, 2022.

as proof-of-concept, could be to get access to Copernicus, the Earth Observation program of the European Union, aiming to explore the potential of Satellite imaginary (SatEO). A good example of added value to the civil society by means of exploiting these datasets is the Copernicus CO2 Emissions Monitoring & Verification Support Capacity, which allows to verify company disclosures and track asset financing, using a neutral, unbiased source of information from satellites. Additionally, more information can be retrieved from satellite navigation (SatNav), useful for financial services requiring location; and satellite communication (SatCom), which could facilitate access to financial services from those locations in the world without access to the internet.

To achieve this global solution, it is required to use recent advances in artificial intelligence and machine learning to allow for automated analysis of large, complex EO datasets and matching with other data sources. A final goal might be to create an open global asset-level dataset for public domain.

Alternative data

Company-provided data, taken at face value, may not reveal the greatest risks that companies face – and may even mask them, providing insufficient information about their exposure to climate risks. Alternative data sources could help fill this informational gap. Alternative climate-related data, when sourced and assessed by advanced analytical techniques, could enable Central Bank to better classify and compare climate information reported by companies. Alternative datasets are generated from non-traditional channels such as stakeholder information, social media, news articles, tweets and social media metrics, business transactions and raw material purchasing statistics. Alternative data utilises and incorporates not only what companies report about their activities, but also what the rest of the market participants think about them. Consequently, alternative data could pave the way for Central Banks and regulators to scrutinise the differences across companies in which environmental, social, and governance (ESG) factors are considered material.

To create the highest value with alternative climate-related data, Central Banks and regulators could use these data in conjunction with traditional environmental data which is often more subjective. By combining the two types of data together, they could leverage the strengths of both strategies and determine whether a company's ESG claims are consistent with its behaviour. With the assistance of alternative data providers, Central Banks would be capable of designing and building an infrastructure for working with alternative climate-related data by establishing a user-friendly data platform that would allow to track corporate performance towards the ESG.

Alternative data can be best capitalised through advanced analytical techniques such as machine learning. In particular, NLP capabilities have the knack to scrutinise and interpret the tone of news feeds, long articles, financial statements, brokers' reports and industry documents about particular companies as to whether there is a negative or positive connotation to the published materials. NLP could also identify indirect and subtle links between companies. These undetected connections could be gleaned by NLP models from the observed clustering of corporate news, industry reports, regulatory filings and other text-based materials making it easier to compare climate information.

Conclusion

Participants generally agreed that there is need to adopt technological innovations to

assist green finance to scale-up, which act as public goods, to solve particular operational problems. In this workshop, speakers presented the three main areas where different technologies could help risk assessment or unlock green markets and instruments. In particular, satellite data and digital twins may facilitate the modeling and management of complex physical risk phenomena. Also, DLT technologies could make green securitization viable for SMEs, especially due to its value for monitoring, verification, and management of green assets as collateral. Finally, an improvement in the quality of climate-related information reported by companies and financial institutions is required for a just and efficient green transition. The workshop also highlighted several other technologies that might be valuable, such as natural language processing (for climate-disclosures and reporting), earth observation systems (to assess the materiality of information through satellite imagery and sensors), and alternative data, as a means to contrast self-reported information.

It is with hope that the result of the discussion is useful to advance the work of central banks and supervisors community, international organization, private sector, fintechs, and academic researchers who are investigating and experimenting with new technologies applied to this topics. With this motivation, the working group will continue to explore the potential of technology to address the above mentioned topics, as well as other issues currently being identified as highly relevant. For instance, the role of satellite data to assess biodiversity loss, using applied machine learning algorithms to improve the accounting of GHG Scope 3 emissions, or using IoT, artificial intelligence and DLT to set up digital measurement, verification and reporting (MRV) systems to assess reliably climate-related risks embedded in the value chain of products.