

Open finance in Brazil: moving towards environmental and social sustainability

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Abstract

Purpose – This study aims to examine how Brazil’s regulatory framework for open finance – initially designed to promote financial inclusion through competition – can evolve to integrate broader environmental and social objectives.

Design/methodology/approach – It used a qualitative approach, drawing on thematic analysis of semi-structured interviews with key stakeholders in Brazil’s open-finance ecosystem. Insights inform a middle-range theory for sustainable open-finance implementation, supported by an adapted impact value chain framework.

Findings – The Brazilian Central Bank (BACEN) has advanced inclusive finance innovation, yet environmental objectives remain marginal in open-finance implementation. The study identifies three potential pathways for embedding sustainability into open finance: “policy for sustainability”, “reducing risks” and “national and international collaboration”.

Practical implications – The findings offer insights for regulators, particularly BACEN, to reorient open-finance implementation toward sustainability and support Brazil’s inclusive and climate-resilient development agenda.

Originality/value – This paper contributes to emerging literature on sustainable open finance by combining stakeholder insights with recent policy developments to propose a conceptual model linking open finance with environmental and social objectives.

Keywords Fintech, Open finance, Environmental sustainability, Financial inclusion, Central banks, Brazil
Paper type Research article

1. Introduction

Brazil is a vibrant market for banking and financial technology (fintech), and with its strong economy and consumer base, it is a leader in South America ([Instituto Brasileiro de Geografia e Estatística, 2025, 2024; Boroski, 2024](#)). With oversight from the Brazilian Central Bank (BACEN), the country has adopted open finance to improve competition, innovation and financial inclusion ([BACEN, 2025](#)). While this presents an opportunity to advance inclusive growth and support environmental objectives, the focus of implementation has been on socio-economic outcomes.

Recommendations for central banks in emerging economies include directing investments and loans toward climate and environmental goals and incorporating climate and nature-related risks ([NGFS, 2024b](#)). The principle of double materiality recognises that environmental changes can impact resource-dependent businesses and that financial institutions can, in turn, affect natural resources through their operations and investment decisions ([NGFS-INSPIRE, 2021](#)).

Although research on open finance has focused on financial inclusion and competition, its role in promoting environmental and social sustainability remains largely unexplored. This gap is particularly relevant in Brazil’s nature-rich context, where digital financial



infrastructure could significantly contribute to climate resilience and biodiversity protection. This study fills this research gap by addressing two questions: (1) Is Brazil capitalising on open finance opportunities to achieve environmental and socio-economic goals? (2) What mechanisms enable environmentally and socially sustainable open finance?

The study employs a qualitative method suitable for analysing a novel issue with limited existing data. It includes interviews with stakeholders from the Brazilian open-finance ecosystem, thematic analysis of those and the development of a middle-range theory (MRT). The findings are organised using an adapted impact value chain framework, identifying barriers and drivers, key practices, expected outcomes and pathways to sustainability-related impacts.

The remainder of this study is organised as follows. [Section 2](#) describes Brazil's open-finance framework and thematically reviews the literature on open finance, its socio-economic goals and emerging environmental dimensions. [Section 3](#) outlines the methodology. [Section 4](#) presents the results, followed by a discussion in [Section 5](#) connecting stakeholder insights to broader sustainability initiatives. [Section 6](#) concludes with contributions, limitations and directions for future research. Additional regulatory details and the interview questionnaire are provided in the [Supplementary Information](#).

2. Background

2.1 The BACEN policy

In May 2020, BACEN and the National Monetary Council (CMN) issued Joint Resolution 1, initiating open finance in Brazil ([BACEN and CMN, 2020](#); see [SI.1.1](#)). The regulation aimed to foster innovation, promote competition, enhance the efficiency of the Brazilian national financial system and payments system and advance financial inclusion. It established minimum requirements for participating institutions; the regulated entities include financial and payment institutions and other licensed entities. It also outlined their data-sharing obligations and specified the implementation timeline.

Brazil began implementation in 2021 through four phases ([Associação Open Finance, 2025](#)); each furthered the gradual integration of data, products and services. In the first phase, financial institutions were required to share information about their banking products, services, technologies and fees in a standardised format. In the second phase, this framework was expanded, and financial customers could (consensually) share information, such as account transactions, cards and credit operations, with institutions of their choice. In the third phase, customers could access various financial services, including those provided by a Payment and Transaction Initiator (ITP) from outside the banking sector and without going through their existing financial institutions. The fourth phase focused on open and transactional data related to a broad range of services and products, including insurance, pensions and investments.

The ITP also facilitated transactions through Pix, an instant payment system in Brazil created and managed by [BACEN \(2020\)](#); see [SI.1.6](#)). Pix allows payments and transfers to be executed within seconds and 24/7. Within four years, over 90% of the adult population and nearly 18 million Brazilian companies had either received or initiated Pix transactions ([Aurazo et al., 2025](#)).

Open finance evolved from open banking, which had a limited scope, covering information about products and services, customer and transactional data and payment initiation. In March 2022, [BACEN and CMN \(2022\)](#); see [SI.1.2](#)) adopted Joint Resolution 4/22, amending Joint Resolution 1/2020 and formally transitioning to open finance. This marked the final phase of implementation and introduced data sharing between BACEN-regulated institutions and insurance and pension entities overseen by the Superintendência de Seguros Privados (SUSEP).

The regulation specifies requirements for obtaining explicit and informed consent from financial consumers to access their data and initiate payments and allows consent to be revoked at any time. Participants must adhere to strict rules regarding privacy, storage,

encryption and data processing in addition to the provisions outlined in Brazil's General Data Protection Law, No. 13.709/2018 ([Presidência da República, 2018](#); see [SI.1.5](#)), which governs the collection, handling, storage and sharing of personal data. Related security measures must also follow the cybersecurity standards for financial organisations established by the Resolution 4,658/2018 ([BACEN, 2018](#); see [SI.1.3](#)).

Brazil's regulations also require data reciprocity between banks and third parties and allow data holders to charge an access fee to cover the costs of maintaining and securing a data-sharing infrastructure, thereby encouraging data holders to participate in the open-finance ecosystem. Among open-finance regulatory frameworks worldwide, Brazil's approach is groundbreaking and addresses data asymmetry, which is a barrier to competition and consumer welfare ([Di Porto and Ghidini, 2020](#); [Carr, 2022](#); [Colangelo, 2024](#); [Australian Treasury, 2023](#); [European Commission, 2023](#)).

BACEN's governance structure ensures representativeness and non-discriminatory access for participating institutions and mitigates potential conflicts of interest. Under Resolution 400/2024, [BACEN \(2024\)](#); see [SI.1.4](#)) introduced a new open-finance governance framework that includes the relevant governance bodies, a senior management team and a board of directors. Notably, this structure allows the direct participation and voting of all open-finance participating entities.

2.2 Literature on open finance

Open banking enables customer-permissioned access to payment and account data through Application Programming Interfaces (APIs; [Preziuso et al., 2023](#)). Open finance extends open banking to a broader range of financial products and providers, including investments, pensions, mortgages and insurance ([OECD, 2023](#)).

The socio-economic benefits of open finance include greater customer empowerment, improved risk management and efficiency in financial services, which can improve affordability for underserved populations ([Arner et al., 2022](#); [Awrey and Macey, 2023](#); [Colangelo and Khandelwal, 2025](#); [Remolina, 2024](#); [Fernandez Vidal, 2024](#)).

However, risks persist for vulnerable populations with low financial literacy. Understanding the relationship between fintech, financial literacy and inclusion is crucial for enhancing the financial well-being of impoverished populations. Effective inclusion requires adequate safeguards across technological, regulatory and market domains ([Preziuso et al., 2023](#); [Sant'Anna and Figueiredo, 2024](#)), supported by collaboration between the industry and regulators ([De Pascalis, 2022](#)), clear consumer benefits ([Grassi, 2024](#)), privacy-centric rules and incentives for early adopters ([Chen et al., 2025](#)).

Brazil-focused studies highlight opportunities for competition and financial inclusion but also the need for regulatory clarity and infrastructural improvements. [Tolentino and Cataldo's \(2023\)](#) quantitative assessment used BACEN data to show that although the use of API calls and data exchanges has increased, open finance is highly concentrated and competition is limited. [Cunha e Melo and de \(2023\)](#) have pointed out the regulatory complexities and low rates of adoption of open finance, noting the relatively low share of bank accounts connected to open-finance platforms. [Herrera et al. \(2023\)](#) offered comparative insights from Latin America and the Caribbean, including Brazil, highlighting the shared opportunities of open finance, such as improved competition and financial inclusion, along with risks, including regarding cybersecurity. [Chomczyk Penedo \(2024\)](#) has argued that developing a cross-border open-finance ecosystem is complicated by the various approaches to data-sharing consent and the lack of a regional data-protection framework.

2.3 Socio-economic goals and implementation challenges

The long-term goal of the Brazilian regulator in implementing open finance was financial inclusion, understood as expanding access to financial markets for populations not served by banks ([BACEN and CMN, 2022](#); [Herrera et al., 2023](#)). Additional objectives included

promoting competition and financial education to increase savings and participation (BACEN and CMN, 2022; Herrera *et al.*, 2023). Historically, Brazil's national savings rate has been low. Up to 61% report an inability to save (De Luca, 2024). This tendency is reflected in the rate of indebtedness; 78.3% of Brazilian households were in debt in April 2023 (Saraiva, 2023).

Among the factors contributing to low savings is low financial literacy, which impacts confidence and the extent to which financial products, concepts and risks are understood (Corrêa *et al.*, 2024). Brazil also has one of the world's highest interest rate burdens, with a real interest rate of almost 40% (World Bank Group, 2023). These high rates are partly due to the highly concentrated banking sector (Zeidan, 2020).

The Brazilian open-finance ecosystem has expanded, with over 2.3 billion weekly communications, and the market boasts over 65 million active consents (OFB, 2025). However, the consent conversion rate remains low at 45%; this is the ratio of consents granted to the number of consent requests initiated by a receiver (OFB, 2025). Only 20% of consents result in payments, indicating low product utilisation (OFB, 2025).

Despite banks affiliated with the Brazilian Banks Federation having invested 2 billion Brazilian Reais over three years of operations (FEBRABAN, 2024), open finance still faces significant obstacles, particularly in terms of customer awareness. According to the 2024 Open Finance Maturity Index, awareness had stalled at 64%, and the consent renewal rate, between 10 and 12%, indicates that users do not yet perceive clear value. Further, most consenting clients are younger, higher-risk individuals and borrowers rather than savers (Capgemini Brasil, 2024).

Awareness is higher among individuals with greater income and education, yet even informed users struggle to identify concrete benefits: only 4% cited lower interest rates and 3% mentioned improved payment solutions, while 36% reported no awareness of any benefits. Among those unable to identify benefits, half belonged to lower socio-economic classes (Zetta, 2024).

The goal of open finance to enhance competition and deliver more personalised, accessible and affordable services remains aspirational. Since its introduction the system has largely operated as a closed loop: eight major entities account for roughly 90% of all data received (OFB, 2025). Accessing the open-finance ecosystem profitably is difficult for smaller institutions, limiting competition. As a result, it remains unclear whether open finance can meaningfully influence Brazil's persistently high interest rates and inflation.

2.4 Greening finance in Brazil: emerging environmental dimensions of open finance

Although Brazil has an advanced environmental sustainability framework, there is no direct link between the implementation of open finance and environmental and climate goals. Environmental and climate variables, however, directly affect the financial sector.

The Network for Greening the Financial System (NGFS) emphasises the role of central banks in identifying climate and environmental risks, including transition risks arising from low-carbon policies and physical risks linked to climate events and ecosystem degradation (Gardes-Landolfini *et al.*, 2024). Neglecting these risks can disrupt supply chains and generate credit, market and liquidity instability (NGFS, 2024a). Brazil's economy depends heavily on ecosystem services, particularly water and climate stability (Calice *et al.*, 2021), and its agriculture and energy sectors are particularly vulnerable in this regard (Chen *et al.*, 2024).

Extreme events like floods and droughts can create hydrological risks for a country where hydropower supplies around 60% of electricity (Paim *et al.*, 2019; EPE, 2024). Brazil is a leading producer of soy, meat and sugarcane, and agriculture contributes over 23% of its gross domestic product (GDP) (CNA, 2024). However, agricultural expansion also drives deforestation and ecosystem conversion, reducing natural carbon storage and increasing emissions (Soterroni *et al.*, 2023). About 20% of the financial sector's credit portfolio is exposed to vulnerable sectors (Chen *et al.*, 2024). Agriculture alone accounts for around 12% of total bank loans (Chen *et al.*, 2024), and 46% of non-financial corporate loans are concentrated in ecosystem-dependent sectors (Calice *et al.*, 2021).

Explorative studies suggest open finance could support environmental goals. [Yu et al. \(2022\)](#) demonstrate that inclusive digital finance can reduce CO₂ emissions and aid the low-carbon transition. [Feng et al. \(2022\)](#) and [Zheng et al. \(2025\)](#) highlight the role of digital finance in green innovation and the reduction of carbon emissions. [Bowden et al. \(2024\)](#) propose using open-finance APIs to track consumer-level carbon footprints.

In parallel, Brazil's financial-market sustainability agenda is advancing. The Securities and Exchange Commission (CVM) Resolution 193 (2023; see [SI.2.2](#)), mandates that, starting in 2026, listed companies, funds and securitisation firms must make sustainability-related disclosures in line with the standards of the International Sustainability Standards Board and Task Force on Climate-Related Financial Disclosures (CVM, 2023; FSB, 2024; CISL, 2021).

Since 2008, [BACEN \(2008; see SI.2.1\)](#) has required environmental compliance when granting rural credit (through Resolution 3545), and recent guidelines have strengthened the capacity of banks to manage social, environmental, climate and deforestation risks ([Souza et al., 2024](#)). The Rural Credit Bureau (RCB) system integrates rural credit data with environmental registries, which has allowed the Brazilian Institute of Environment and Renewable Natural Resources to block non-compliant operations. The 2022 legislative proposal for a Brazilian Sustainable Taxonomy of sustainable economic activities according to their climate, environmental and social impact, establishes objective sustainability criteria and directs financial resources towards sustainable practices (Bill 2838/2022 [National Congress, 2022](#); see [SI.2.3](#)); after public consultation ([Ministério da Fazenda, 2023](#); see [SI.2.4](#)), Brazil is expected to propose a global "super-taxonomy" at COP30 in 2025.

In summary, Brazil is increasingly recognised as a global leader in sustainable financial innovation. In the 2024 Green Central Banking Scorecard, Brazil ranked fifth globally and first outside Europe, earning a "B–" for climate-focused reforms ([Positive Money, 2024](#)). BACEN was commended for integrating climate risk into financial supervision and rural credit oversight. These developments underscore Brazil's growing institutional capacity to align open finance with environmental objectives.

Given the qualitative and inductive nature of this study, no formal hypotheses are formulated. Instead, the literature review identifies themes guiding the MRT.

3. Methodology

This study's qualitative design combined a comprehensive literature review, email-based interviews with open-finance stakeholders and thematic analysis to uncover and analyse emerging sustainability trends within Brazil's open-finance ecosystem. Given the absence of empirical studies linking open finance with environmental and social sustainability, an exploratory qualitative design was adopted to inductively develop conceptual insights grounded in stakeholder perspectives. The research involves the development of an MRT, as conceptualised by [Merton \(1948\)](#). MRT is suited to exploratory studies in emerging domains, enabling empirically anchored theory-building without relying on grand abstractions.

The study's thematic coding followed [Braun and Clarke's \(2006\)](#) six-phase framework, supported by an adapted impact-value-chain model ([IMWG, 2014](#)), allowing empirical insights to inform conceptual generalisation and align with the exploratory and interpretive nature of the study. The findings are structured around key dimensions – inputs, outputs, expected outcomes and pathways to impact – that illustrate how sustainability can be embedded within Brazil's open-finance ecosystem.

3.1 Data collection

A structured email questionnaire with six open-ended questions was developed based on a review of the literature on sustainable open finance (see [SI.3](#)). Email-based interviews allow participants time to reflect and articulate experiences at their own pace ([Meho, 2006](#); [Dahlin, 2021](#)),

enhancing narrative ownership (Pell *et al.*, 2020). The asynchronous format allowed participation from across Brazil and ensured continuity following the researcher's field trip.

The questionnaire was sent to 55 stakeholders identified via professional networks and prior fieldwork, and 23 responses were received, a strong rate of response (around 42%) for qualitative research in a specialised domain. Interviews were conducted between April and October 2024, allowing time for iterative analysis and clarification. Responses were substantive, with 90% of them ranging between 600 and 1,600 words, indicating strong engagement. Saturation was reached when no new themes emerged from the final five responses, consistent with Eisenhardt's (1989) principle of theoretical saturation. Sampling followed a purposive and snowball strategy (Yin, 2014), targeting individuals in Brazil's open-finance ecosystem. The final sample, detailed in Table 1, included representatives from fintech firms, technology providers, government agencies and financial institutions (Lee and Shin, 2018), as well as Big Tech, consulting firms, non-profit organisations and law firms.

3.2 Data analysis

Thematic analysis was used to extract insights from interviews (Braun and Clarke, 2006; Clarke and Braun, 2013). This method is effective for studying emerging phenomena and systematically identifying and organising meaning within data. The analysis began with conventional coding (Hsieh and Shannon, 2005), appropriate when theory is limited. Later, selective coding (Patton, 2002) was conducted, focusing on themes addressing the research questions. The impact value chain (IMWG, 2014, p. 6) guided the analysis and was adapted to the characteristics of open finance. Data were organised into four aggregated dimensions: inputs (OF-related barriers and drivers), outputs (OF-related practices), expected outcomes (OF-related short-term changes) and pathways to impact (OF-related long-term sustainability goals). Following Gioia *et al.* (2013), codes were merged, deleted or renamed, resulting in 18 first-order concepts grouped into 10 second-order themes across the 4 dimensions. These results informed the conceptual model (Figure 1), which maps relationships among first-order concepts, second-order themes, aggregated dimensions and key research questions, increasing transparency (Gioia *et al.*, 2013).

The aggregated dimensions are elaborated in Section 4. Following Magnani and Gioia (2023), the narrative is presented in a journalistic style, paraphrasing quotes for clarity. Section 5 connects interviewee perspectives to the research context, highlighting pathways for open finance with potential environmental and social impact. Coding reliability was supported through iterative review and refinement (Gioia *et al.*, 2013). Thematic coherence was validated against the conceptual framework to ensure consistency and transparency throughout. Limitations related to sample scope, interpretive bias and generalisability are discussed in Section 5.

4. Results

4.1 Inputs: the drivers and barriers of open finance in Brazil

4.1.1 Policy. Stakeholders in the Brazilian open-finance ecosystem generally expressed their satisfaction with BACEN's approach, now regarded as a benchmark for other countries. One stakeholder (#13) noted that the implementation was successful largely because "it was mandatory for financial institutions and took into account their sizes, roles and impact". By allowing non-traditional financial institutions to participate, the framework has encouraged innovation and increased the use of open finance. Established financial institutions have adapted their platforms, and new technology-driven companies have entered the market, contributing to innovation. Furthermore, open finance is increasingly being integrated with other solutions, such as Pix and BACEN's digital currency initiative.

Although the ecosystem has matured significantly, the implementation of open finance still faces several challenges, including unclear priorities, short deadlines and regulations that

Table 1. Interviewees

No.	Organisation type	Description of organisation	Role of interviewee
1	Government	BACEN is the leading authority overseeing the implementation of open finance in Brazil	Senior adviser – open finance
2	Law firm	Brazilian law firm with a strong reputation in banking, finance and fintech regulation	Partner – financial services
3	Law firm	Highly regarded for its work in banking law, payment systems, project finance and financial regulation	Lawyer – banking and finance
4	Consulting company	A Brazilian boutique advisory firm that specialises in financial innovation, fintech strategy and open-finance ecosystem development	Financial innovation expert
5	Consulting company	A consultant with extensive experience in payments, digital banking and open finance who has held institutional leadership roles	Fintech expert
6	Fintech company	A São Paulo-based fintech providing automated banking APIs, payment solutions and financial data services for companies	Regulatory affairs
7	Non-profit organisation	A non-profit organisation supporting financial innovation and education in collaboration with the Central Bank of Brazil	Mentor – Fintech acceleration program
8	Law firm	A São Paulo-based legal firm recognised for its expertise in banking law, payment systems, foreign exchange, crypto assets and open-finance regulation	Lawyer – banking and finance
9	Financial institution	An investment bank offering services in M&A advisory, capital markets and structured finance, with a strong focus on the technology and fintech sectors	Vice president, investment banking – tech coverage
10	Fintech company	A São Paulo-based startup using AI, data analytics and financial modelling to improve access to credit in Brazil's agricultural sector	Chief business officer
11	Technological provider	A company specialising in open-finance architecture, cloud migration and digital business automation	Open finance solution architect
12	Big Tech	A multinational platform operating at the intersection of digital infrastructure, data ecosystems and financial innovation	Payments officer
13	Non-profit organisation	A non-profit organisation supporting financial innovation and education in collaboration with the Central Bank of Brazil	Head of innovation projects
14	Government	Brazil's Ministry of Finance	Program director
15	Law firm	A São Paulo-based legal firm recognised for its expertise in banking law, payment systems, foreign exchange, crypto assets and open-finance regulation	Fintech lawyer
16	Non-profit association	A non-profit representing payment transaction initiators in Brazil's open-finance ecosystem	Director
17	Fintech company	A global provider of digital financial infrastructure specialising in cross-border payment flows, regulatory interoperability and consent-based data exchange within open-finance ecosystems	Latin America – legal counsel
18	Financial institution	One of Brazil's largest privately held financial institutions, offering retail, corporate and investment banking services	Product specialist – open finance
19	Fintech consultant	A global fintech consultant, entrepreneur and thought leader specialising in digital identity, open finance and data ecosystems	Fintech expert

(continued)

Table 1. Continued

No.	Organisation type	Description of organisation	Role of interviewee
20	Consulting company	A global consulting and technology firm specialising in digital transformation	Head of financial services, Brazil
21	Government	Non-profit organisation that supports financial innovation and education in collaboration with the Central Bank of Brazil	Sustainable finance expert
22	Fintech company	A Brazilian startup specialising in open-finance data intelligence, credit risk reduction and financial inclusion	Co-founder and CEO
23	Fintech company	A fintech helping users navigate their financial lives through open-finance, AI and data-driven tools	Chief product officer

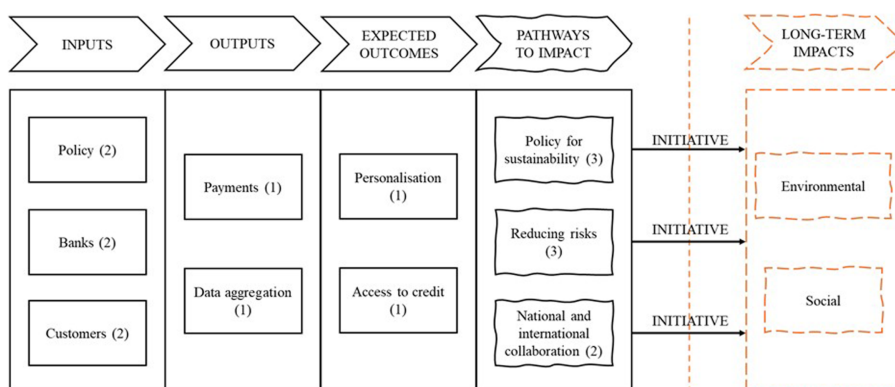


Figure 1. Brazilian open finance: conceptual model

require stronger enforcement. Additional challenges include the integration of diverse technical systems, ensuring data protection, building trust, aligning regulations with emerging technologies and improving digital infrastructure.

The criteria for participation and the structure of payment initiation services were recently changed. Some elements continue to depend on manual processes, but automation is underway. The market is maturing, distinguishing more effective solutions. The governance structure aims to maintain transparency and balance through stakeholder participation. However, without specific regulations concerning data partnerships, this legal uncertainty hinders innovation.

As the model also contemplates self-regulation, overseen by BACEN, further challenges arise. There are, for example, concerns regarding data-sharing responsibilities, balancing of security with user-friendly access and representing the interests of diverse stakeholders. While the governance structure has developed APIs for data sharing and launched a platform to monitor related issues, further improvements are necessary. The progress of open finance has also been hindered by internal challenges. For instance, limited workforce resources have made it difficult to secure licences from BACEN. Additional resources are essential for consistent policy delivery.

4.1.2 Banks. Many interviewees thought banks had slowed the implementation of open finance. They argued that while the open-finance framework is secure and robust, its implementation can be cumbersome. The simultaneous introduction of various Pix regulations has added complexity, making it challenging for institutions to match the pace of change.

As a result, a small number of financial institutions handle most of the data captured through open finance. Smaller institutions must be involved to limit the concentration of power. However, they currently face challenges owing to limited resources and lower levels of digital maturity, leading to high compliance costs.

The technical complexity involved in integrating financial institutions with fintech companies requires significant investment in technology and infrastructure. Additionally, data integration is a persistent challenge because of unreliable, inadequate or outdated data from various sources. There are also issues related to system interoperability and data uniformity among participants, which limit access to and the optimal use of open-finance services. There is also notable hesitation to embrace the risks associated with using open-finance data in new business models, even when such use is authorised. Unlike Pix, where BACEN enforced implementation and had clear guidelines, the success of open finance relies on the proactive efforts of financial institutions. The development of efficient and high-quality APIs, creative solutions, a diverse range of financial service providers and the establishment of trust are thus crucial for the growth of the open-finance ecosystem.

4.1.3 Customers. The interviewees considered levels of consumer adoption to be one of the barriers to open finance. Currently, open finance represents only a small portion of the total financial transactions conducted by Brazilians. Organisations engaged in open finance must implement measures that enhance the quality of the customer journey to boost the adoption of revenue-generating products and services. Poor experiences can negatively affect consumers' perceptions of open finance, and multi-channel journeys have a significant influence on consumer trust and adoption. BACEN has introduced the journey without redirection (JWR), which allows users to make payments without needing to open a banking app.

Issues related to poor data quality have also contributed to low trust in the system. For the ecosystem to mature, data must be treated as a product and customised to meet individual users' needs concerning access rights, quality and requirements. Financial education is another critical factor for successful implementation. The lack of financial literacy and understanding of the concepts of open finance presents a significant barrier. Many consumers are hesitant to trust financial institutions with their data because of a lack of knowledge about the associated benefits and risks. Implementation has been impeded by the absence of policies and campaigns to increase awareness of open finance, clarify its financial benefits and introduce practical improvements for users. The governance structure and BACEN should focus on empowering consumers by clearly communicating the benefits of open finance.

4.2 Outputs: emerging practices and services

4.2.1 Payment solutions. Open finance has given rise to new types of companies, particularly in payment solutions. A key business model revolves around ITPs, which facilitate transactions. Open finance has enabled the development of "enhanced payment services offering seamless and integrated payment experiences across multiple accounts and platforms" (#7). ITP is especially relevant within the Pix framework. Current efforts focus on improving the payment journey via JWR, which has been hampered by complexity and limited interoperability. An emerging model allows customers to use Pix balances across accounts to meet obligations from a single account. Other innovations include smart transactions, where users set triggers to automatically move money between accounts.

By 2025, advancements in payment journeys and the shift towards embedded finance are expected to drive new payment-facilitation use cases. Additionally, Pix by Near Field Communication is set to launch in February 2025, enabling direct bank transactions without debit cards and making payments more cost-effective for merchants. ITPs also combine their capabilities with data aggregation, offering software as a service, banking as a service and data analytics. Beyond the regulated framework, other profitable models are emerging, including technology and consultancy services for API implementation.

4.2.2 Data aggregation. A major outcome of open finance is data aggregation, which integrates data from various sources into platforms that deliver value to customers. BACEN has not established a specific licence for providers of account-information services, meaning any participant can aggregate user data if aligned with their corporate purpose. This allows institutions to deliver more customised products and services, including account aggregation and simplified credit and salary portability. Aggregation solutions fall into personal financial management and business financial management.

Platforms engaged in the former help consumers monitor finances in one place and support scoring personalised offerings. The main challenge is creating perceived value to encourage adoption. The market for personal financial management is evolving, with each player competing to become the leading app by gathering financial and non-financial data to deliver tailored insights and experiences.

Business financial management platforms focus on automating payments, managing cash flows and simplifying access to credit. Applications include commercial intelligence and helping businesses decide what to sell, when and at what price. Banking as a service is also expanding, allowing non-financial firms to use open-finance services via white-label structures. Regulators are also developing new rules to support additional business products. One such rule concerns bulk payments, which would allow third-party providers to debit business accounts directly, competing with firms' resource-planning systems. Emerging solutions include peer-to-peer lending platforms, tailored investment advice, and credit-analysis platforms using behavioural insights. These aim to offer fairer conditions and personalised products such as insurance and intermediary services that encourage consent to data sharing.

4.3 Expected outcomes: open finance as an evolving framework

4.3.1 Personalisation. One of the primary goals of open finance in Brazil is to empower financial consumers. By consenting to data sharing, consumers can access products and services tailored to their profiles. Regulations promoting JWR payments aim to reduce transaction times and facilitate new business models. By gathering data on consumers' financial activities, institutions can make more accurate investment recommendations and meet the suitability requirements set out by the Brazilian CVM. Emerging models focus on enhancing customer experience and personalisation, including through alternative credit options, data aggregation for risk analysis and instant payment platforms, such as pay-by-bank solutions. Financial marketplaces offering customised services also show promise. These trends have increased data sharing, with many consumers expressing a greater willingness to adopt personalised financial products.

4.3.2 Access to credit. Sharing information about new customers with limited credit history can help credit providers offer lower interest rates by reducing information asymmetry. Open finance enables newer and smaller financial institutions to access the same quality of information available to established banks, thereby addressing the lack of a comprehensive credit bureau in Brazil. Consequently, improved credit scoring represents a key benefit of open finance, allowing access to better credit cards, enhanced scores and cards with higher limits. Preliminary evidence suggests that open finance assists those disadvantaged by traditional credit risk assessment models – such as individuals and businesses operating in the informal economy – to obtain credit. Further data will be needed to validate this. As one respondent (#17) noted, “access to credit has not yet shown concrete results due to the population's lack of awareness about open finance and the fact that the credit access and information market remains concentrated”.

4.4 Pathways to impact: emerging topics on the opportunities for long-term open-finance-related environmental and social impacts

4.4.1 Policy for sustainability. Several respondents were of the view that Brazil's open-finance policy promotes sustainability through a strong regulatory framework. In this sense,

open-finance regulation democratises access to quality financial services, benefiting underserved customers. This process is expected to support sustainable development, align with existing environmental policies and foster sustainable business models, paving the way for an era of sustainable open data. BACEN's regulations on microlending and its innovation agenda are linked to sustainability and include requirements for financial institutions to address social, environmental and climate issues. Sharing investment data through open finance can also encourage the provision of credit for sustainable initiatives. While open-finance regulations do not explicitly address sustainability, business models focused on sustainability-oriented lending for small and medium-sized enterprises are emerging.

Some respondents were less optimistic, citing the immaturity of the open finance and sustainability sectors as barriers to developing sustainable business models. They suggested Brazil should first improve competition and reduce prices. BACEN was nevertheless seen as crucial in accelerating the open-finance–sustainability link, and several called for greater collaboration among public institutions and market players to identify challenges and enhance innovation. Without such collaboration, smaller sustainability-focused actors may struggle to compete in a concentrated market, limiting their ability to scale and attract investments.

Respondents also recommended interoperable systems to monitor and evaluate the impact of open finance on sustainability. Limited technological infrastructure could restrict access in less-developed areas and adapting to new data-security regulations may increase costs. In the early stages, sustainability-oriented open-finance solutions are highly volatile and risky, posing challenges for institutional investors. Making sustainable practices a regulatory requirement could attract these investors and address issues in key sectors, such as agriculture, guiding the industry towards sustainable development. This approach could also help incorporate non-regulated stakeholders into open finance and broaden the dissemination of data through a centralised open-data hub.

4.4.2 Reducing risks. Sustainability-related risks in open finance include misuse of personal data, digital exclusion, profiling, financial instability, fraud and cyberattacks. Despite these risks, some respondents viewed the benefits as outweighing the drawbacks. Open finance is limited to regulated entities, and BACEN has established a structure that emphasises privacy and fraud prevention. Data-protection legislation and consent management guidelines are in place. The framework includes mechanisms such as limits on Pix transactions and strict sharing requirements for fraud-related data.

The data-sharing model is considered sufficiently robust to address these challenges. As one respondent noted, “All the institutions that participate in open finance must comply with cybersecurity, fraud prevention, risk management, anti-money laundering, combating the financing of terrorism, data protection and other matters that contribute to ensuring security in the financial and payments systems” (#8). Data sharing enhances traceability and control over data origins and destinations, improving security.

Other respondents highlighted persistent risks in internal controls, noting that institutions often fail to apply BACEN and CMN policies correctly. For instance, while data protection laws exist, they are not fully enforced because “the market hasn’t had time and been able to adapt to those new rules, and many processes are still too manual or poorly managed and are difficult to change within a big legacy machine” (#13). Institutions must protect consumer data and finances, act as gatekeepers against scams and cyberattacks and implement robust controls to address breaches. Many participants in the open-finance sector, especially newer fintechs, will need to invest in strong security systems. Regulatory bodies also face resource constraints; for example, BACEN “does not have enough personnel to supervise the various technology service providers involved in the technological implementation required to create the sharing APIs (#17)”. Brazil remains highly exposed to fraud, which continues to challenge individuals and businesses. As one respondent warned, “The sharing of data is concerning, as people don’t fully understand the risks (involved) and how much data they have shared online” (#13). There is a pressing need for educational campaigns to improve public understanding and trust in open

finance. Given the complexity of sustainable development, comprehensive programs should inform consumers about their rights and the benefits and risks associated with open finance.

4.4.3 National and international collaboration. Interviewees emphasised the need for coordination among governments, businesses and financial institutions to promote sustainable investments through open finance. Policies encouraging sustainable innovation and collaboration – such as tax incentives, subsidies and targeted financing programs – are essential. Connecting with initiatives such as the guarantee fund of the Brazilian Development Bank (BNDES) and the Brazilian Service of Support to Micro and Small Enterprises could further sustainable development.

International collaboration is key to building better systems by sharing lessons learned, especially regarding the sustainability of open finance, which depends on the integration of global data. This approach could help bridge gaps and ensure open finance in Brazil develops in a sustainable and inclusive way. Organisations such as the Bank for International Settlements (BIS) and the Consultative Group to Assist the Poor have begun discussions on global standards for open finance. However, differences in countries' levels of development and priorities complicate standardisation. There is, as yet, no basis for implementing cross-border integration within an open-finance framework; however, this may improve with the maturation of central banks' digital currencies.

Against this backdrop, the BIS model, in which recommendations are adopted internally by central banks, offers a feasible path for collaboration among regulators and private stakeholders to align open finance with global goals for financial stability and sustainability. It is also essential to adapt successful international experiences to local contexts, ensuring alignment with national financial markets and supervisory models. Networks such as the Global Financial Innovation Network, the Financial Action Task Force and the Global Partnership for Financial Inclusion can facilitate knowledge sharing, harmonise standards for data sharing, security and privacy and coordinate efforts to address global challenges such as financial inclusion and broader social and environmental sustainability.

5. Discussion

The interviews revealed three potential pathways for achieving long-term environmental and social impacts through open finance. The first pathway concerns “policy for sustainability”. Several respondents highlighted the significance of BACEN-led open-finance initiatives, such as improving collaboration, integrating policies and investing in technology, to create a socially and environmentally focused financial system. However, there is a consensus that the implementation of open finance should initially prioritise socio-economic outcomes. Once implementation challenges are addressed and customer benefits materialise, environmental outcomes are expected to follow. This approach emphasises market solutions while overlooking the urgent realities of climate change and biodiversity loss, which demand robust financial policies and resources (IEA, 2023; NGFS, 2024a). Both the Brazilian Sustainable Taxonomy and CVM's mandatory sustainability disclosures could help close this gap by guiding sustainable lending and investment decisions, particularly in sectors exposed to climate risks, supporting real-time reporting and the aggregation of environmental data.

In addition, BACEN should require financial institutions to share real-time environmental data within the open-finance framework (initiative 1) to limit climate-related financial risks and support climate transition policies (Banco Central do Brasil, 2025). Environmental data could be integrated into risk assessment tools used to calculate traditional portfolio-level metrics, such as value at risk (market risk), expected losses (credit risk) and damage-factor thresholds (underwriting risk; Bank of England, UN Environment Inquiry and CISL, 2017). This dataset would improve understanding of the size and concentration of financial firms' exposures, as well as their impact on GDP and consumption (Bank of England, UN Environment Inquiry and CISL, 2017). BACEN could then link liquidity provision to institutions' climate-related financial risk profiles, offering more favourable terms to greener institutions. Additionally,

reallocating assets and collateral to low-carbon sectors would reduce their capital costs relative to high-carbon options (Schoenmaker, 2019). This strategy could also enhance the effectiveness of green quantitative easing policies (Ferrari and Nispi Landi, 2024), tilting the central bank's balance sheets towards green bonds issued by low-carbon firms.

Meanwhile, tools such as the Exploring Natural Capital Opportunities, Risks and Exposure platform (UNEP FI, 2020) and UNEP's Nature Risk Profile (2023) enable the financial sector to measure nature-related risks by providing scientifically robust sustainability analytics. As institutions adopt the Task Force on Nature-related Financial Disclosures (TNFD, 2024) framework, integrating nature-related data into open-finance-mandated datasets will become increasingly feasible.

Regarding the second pathway, "reducing risks", a group of respondents expressed a generally positive view of the individual and systemic risks associated with open finance, suggesting that the benefits of the current framework outweigh these risks. They highlighted existing privacy, cybersecurity and anti-fraud regulations as a solid foundation for developing secure solutions through competition. However, some respondents noted that competition is limited by the prohibitive investment requirements for small institutions. Moreover, open-finance regulation appears to prioritise industry interests over thorough assessments of benefits and risks. It assumes competition leads to better consumer outcomes, yet the financial sector may hinder inclusion by exposing underserved populations to discriminatory algorithms. As Awrey and Macey (2023) argue, true customer empowerment depends on transparent governance and inclusive design – conditions not automatically guaranteed by competition. Many fintech services are designed primarily for mainstream customers, exacerbating existing inequalities (Sant'Anna and Figueiredo, 2024). Adjusting strategies to better meet the needs of underserved populations – for example, by developing inclusive digital interfaces (Koefer *et al.*, 2024), using effective communication strategies (Preziuso *et al.*, 2023) and providing appropriate incentives for participation (Grassi, 2024) – could significantly increase customer awareness, willingness to adopt open finance, actual adoption and renewal of consent for open-finance services, which currently remain low (Zetta, 2024).

Consumers also lack financial knowledge, increasing the risks associated with open finance (Colangelo, 2024). The OECD (2013) defines financial literacy as a mix of skills, behaviours, knowledge, awareness and attitudes needed to make sound financial decisions. Low financial literacy is associated with a greater tendency to incur debt (Gathergood, 2012), especially among members of Generation Z, who face increasingly complex digital financial products (Tay *et al.*, 2022). In Brazil, financial education became law under Joint Resolution No. 8 (December 2023), requiring institutions to enhance citizens' financial capabilities and prevent over-indebtedness (BACEN, 2023). However, challenges remain because adherence to these guidelines varies, many programmes lack depth and engagement (Corrêa *et al.*, 2024) and consumer disinterest and product complexity persist (Santos and Oliveira, 2018).

There has been insufficient attention to the connection between environmental and financial education. Environmental education is regulated by Law No. 9,795/99 and Decree No. 4,281/02, which established Brazil's National Policy for Environmental Education (GEEP, 2025).

BACEN could extend financial education regulations to include environmental literacy and require open-finance institutions to provide environmental-finance-literacy dashboards (initiative 2) to raise awareness of the opportunities and risks of open finance for Brazil's environmental sustainability agenda.

The third pathway, "national and international collaboration", emphasises sharing open-finance experiences domestically and abroad, especially when aligning open finance with long-term environmental and social objectives. Respondents disagreed on how coordination of this complex ecosystem should be structured, with some advocating a top-down approach. Cross-sectoral integration with SUSEP, formalised in the final phase of open-finance implementation, creates opportunities to embed climate-related risk data into insurance and pension products. In the coming years, open finance will likely expand beyond financial services.

In Brazil, BACEN could engage stakeholders from key economic sectors, such as agriculture, and gradually integrate them into the open-finance ecosystem (initiative 3). As former BACEN Governor Roberto Campos Neto noted in 2021, incorporating the RCB as an environmental dataset would allow rural credit beneficiaries to share data directly, eliminating intermediaries and lowering credit costs (Ayres, 2021). This integration could reduce information asymmetries, improve the allocation of public resources and support green agriculture. BNDES now requires sustainability-impact screening in its tenders and excludes projects with negative impacts. Linking BNDES funding to RCB and open finance could enhance environmental and social progress. In parallel, environmental-finance-literacy dashboards tailored to agribusinesses would equip them with the knowledge and skills needed to access appropriate financial services and contribute to Brazil's green transition.

Ultimately, as highlighted in Figure 2, the combined outcomes of the three initiatives – (1) mandating financial institutions to share real-time environmental data, (2) promoting environmental-finance literacy (through dashboards) and (3) incorporating strategic sectors such as agriculture into the open-finance ecosystem – will prompt participants in the open-finance (and future open-data) ecosystem to compete and offer sustainable financial products. A sustainable open-finance ecosystem will emerge through a strategy combining a technology-push strategy – fuelled by environmental data integration – with a market-pull strategy focused on environmental-finance literacy (Di Stefano *et al.*, 2012), further strengthened by the gradual incorporation of strategic sectors such as agriculture. This approach aims to create a market for highly personalised, sustainable open-finance products, aligned with customers' profiles, following the suitability rules established by CVM (2021).

BACEN oversees and continuously refines these initiatives to reduce climate-related financial risks and support Brazil's transition to a net-zero economy by 2050 (Soterroni *et al.*, 2023). These efforts are expected to generate significant long-term environmental and social impacts by establishing a robust market for sustainable, green and inclusive open-finance products.

5.1 Policy and practical recommendations

This study builds on previous research focused on the socio-economic dimension of open finance by incorporating environmental sustainability. The three proposed initiatives align with BACEN's sustainability agenda, which has a clear strategy for financial inclusion but a fragmented approach to green finance. The study identifies opportunities for practical action to encourage open-finance institutions to compete more effectively and develop personalised,

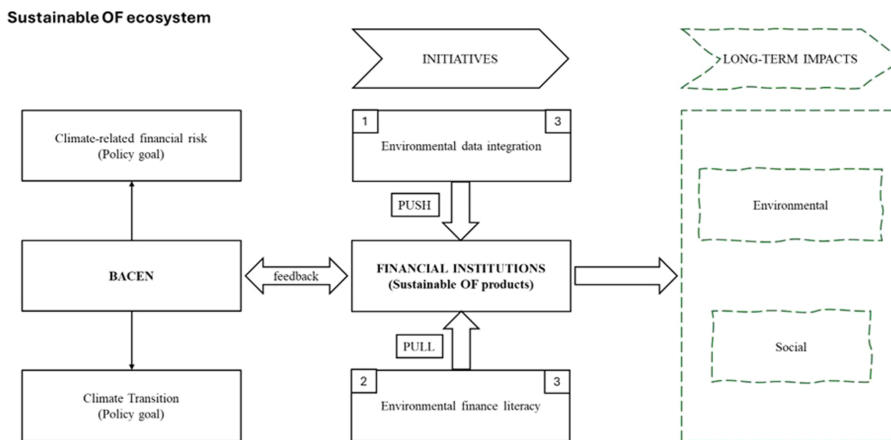


Figure 2. The emergence of a sustainable open-finance ecosystem through a push-pull strategy

5.2 Limitations and future research

This study is exploratory and based on a purposive sample of expert stakeholder representatives from Brazil's open-finance ecosystem. While the findings offer a reliable indication of the sustainability direction of Brazilian open finance, they may not be directly applicable to other jurisdictions. As the focus was primarily institutional, future research should incorporate the perspectives of end users, particularly those from underserved communities, to validate and extend the findings. Additionally, while the study highlights the potential of environmental data integration and environmental-finance literacy, it does not empirically test the effectiveness of these interventions or assess their influence on consumer decision-making, consent renewal and trust-building.

6. Conclusion

Brazil has established one of the most comprehensive open-finance regulatory frameworks globally, supported by high levels of digitalisation and digital banking in the country. However, its potential remains under-realised, primarily due to market concentration, which limits consumers' uptake. Moreover, the agendas for open finance and environmental sustainability continue to be treated separately despite Brazil's significant environmental vulnerabilities and opportunities.

To align open finance with Brazil's environmental and social goals, this study recommends that BACEN require financial institutions operating under the open-finance framework to share real-time environmental data. This would help BACEN manage climate-related financial risks and support climate transition policies. Furthermore, BACEN should consider extending the existing financial literacy regulations and mandating that open-finance institutions provide dashboards that enhance environmental-finance awareness among consumers and businesses.

Finally, as Brazil advances towards open data, BACEN should initiate discussions to integrate key economic sectors into open finance. This process could begin with the agriculture sector, linking the RCB and BNDES funding to strengthen environmental-finance literacy and empower this pivotal sector in Brazil's net-zero transition. Ultimately, these initiatives will encourage open-finance institutions to compete more effectively and offer personalised, sustainable financial products.

Supplementary material

The supplementary material for this article can be found online.

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