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Regulatory Orchestration as a Driver of innovation and competition: a framework for regulators and firms in Open Finance ecosystems

TESI DI LAUREA MAGISTRALE IN
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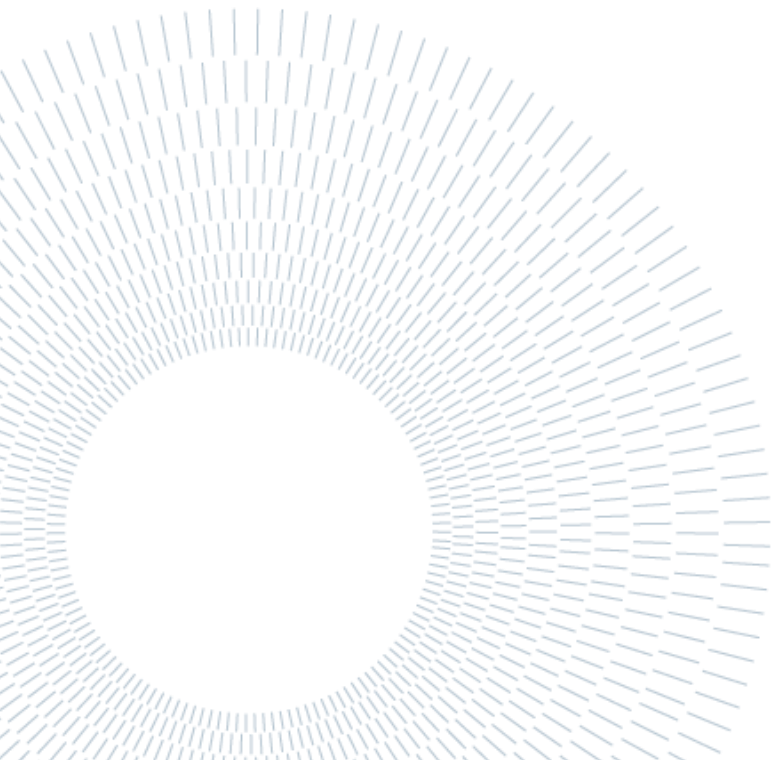
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*A mia madre, per avermi insegnato che il coraggio e la forza
d'animo non hanno limite. A te dedico ogni singolo successo,
sacrificio e attimo di felicità della mia vita.*

*A mio fratello, per avermi insegnato che la vita restituisce
ciò che siamo capaci di donare. Sei la mia fonte di ispirazione
più grande, grazie per essere il pilastro fondante della mia persona.*



Abstract

Open banking and open finance initiatives are expanding globally, yet jurisdictions differ significantly in their ability to translate regulatory ambition into sustained innovation and ecosystem competitiveness.

This study investigates how regulatory clarity, complexity, and fragmentation influence innovation and ecosystem competitiveness within open banking and open finance frameworks. Based on a systematic literature review and qualitative evidence from semi-structured interviews with regulators, policy advisors, and industry practitioners across multiple jurisdictions, the study identifies the key governance dimensions that shape data resource orchestration and implementation dynamics.

The findings are synthesised into a Regulatory Resource Orchestration Framework that extends Resource Orchestration Theory beyond the firm level to conceptualise regulators as ecosystem-level orchestrators. The framework explains how regulatory actors structure, bundle, and leverage institutional and governance mechanisms to reduce uncertainty, enable supervised experimentation, and support incremental and scalable innovation. In this perspective, ecosystem competitiveness refers to the capacity of regulatory environments to attract innovation, investment, and entrepreneurial activity through coordinated and adaptive governance architectures.

For firms, the framework highlights the strategic importance of regulatory engagement, continuous dialogue, and adaptive orchestration capabilities in navigating evolving implementation environments. For regulators, it provides actionable principles for designing governance systems that foster clarity, minimise fragmentation, embed feedback loops, and promote experimental learning.

By reframing regulation as an enabling and orchestrated resource rather than a static constraint, this study offers a structured explanation of how differences in regulatory design influence innovation trajectories and ecosystem competitiveness across institutional contexts.

Key-words: Open Banking; Open Finance; Regulatory Design; Resource Orchestration Theory; Innovation; Ecosystem Competitiveness.

Abstract in italiano

Le iniziative di open banking e open finance si stanno espandendo a livello globale, ma le diverse giurisdizioni differiscono significativamente nella loro capacità di tradurre l'ambizione regolatoria in innovazione sostenuta e competitività dell'ecosistema.

Questo studio analizza come la chiarezza, la complessità e la frammentazione normativa influenzino l'innovazione e la competitività dell'ecosistema nei contesti di open banking e open finance. Sulla base di una revisione sistematica della letteratura e di evidenze qualitative raccolte attraverso interviste semi-strutturate a regolatori, policy advisor e operatori di settore in diverse giurisdizioni, la ricerca identifica le principali dimensioni di governance che modellano l'orchestrazione delle risorse informative e le dinamiche di implementazione.

I risultati confluiscono in un Regulatory Resource Orchestration Framework, che estende la Resource Orchestration Theory oltre il livello d'impresa, concettualizzando i regolatori come orchestratori a livello di ecosistema. Il framework spiega come gli attori regolatori strutturino, combinino e valorizzino meccanismi istituzionali e di governance per ridurre l'incertezza, abilitare sperimentazioni supervisionate e sostenere innovazioni incrementali e scalabili. In questa prospettiva, la competitività dell'ecosistema è intesa come la capacità degli ambienti regolatori di attrarre innovazione, investimenti e attività imprenditoriale attraverso architetture di governance coordinate e adattive.

Per le imprese, il framework evidenzia l'importanza strategica dell'engagement regolatorio, del dialogo continuo e di capacità di orchestrazione adattiva per navigare ambienti di implementazione in evoluzione. Per i regolatori, offre principi operativi per progettare sistemi di governance che favoriscano chiarezza, riducano la frammentazione, integrino meccanismi di feedback e promuovano apprendimento sperimentale.

Riformulando la regolazione come una risorsa abilitante e orchestrata, piuttosto che come un vincolo statico, questo studio fornisce una spiegazione strutturata di come le differenze nel design regolatorio influenzino le traiettorie di innovazione e la competitività degli ecosistemi nei diversi contesti istituzionali.

Parole chiave: Open Banking; Open Finance; Progettazione regolatoria; Resource Orchestration Theory; Innovazione; Competitività dell'ecosistema.

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1 Introduction

In recent years, the economics and public-policy debate have converged on a central insight: innovation, competitiveness and long-run growth are increasingly shaped by the way societies govern data and technology. This evolution in thinking is reflected in the 2025 Nobel Prize in Economic Sciences, awarded to Joel Mokyr, Philippe Aghion and Peter Howitt (2025) for their foundational contributions to the theory of technology-driven growth, creative destruction and the institutional determinants of innovation. Their work *Sustained economic growth through technological progress* underscores a principle that has become critical for digital finance as well: prosperity depends on regulatory architectures that enable experimentation and entry while preventing stagnation, concentration and excessive market power.

Within this broader transformation, open banking and open finance have become the flagship policy tools. Originating as innovation and competition remedies in the United Kingdom and the European Union and now spreading globally, these frameworks institutionalise consent-based data portability: consumers and firms can authorise secure sharing of their financial data with accredited third parties via standardised interfaces (Bonvino & Giorgino, 2026; Competition and Markets Authority, 2018; European Commission, 2023), leveraging the evolution of Fintech (Puschmann, 2017) and the relevance of data (Bonvino & Giorgino, 2026). The promise is twofold. On the one hand, open banking and open finance are meant to increase innovation and competitiveness, by lowering information barriers, reducing switching costs, and enabling new fintech and data-driven business models. On the other, they should rebalance power in data-driven markets, giving users greater control over their information and constraining anti-competitive data hoarding by incumbents.

However, the global experience so far shows that the design of regulation is as important as its ambition. Jurisdictions differ widely in how they specify standards, allocate liability, orchestrate consent, and coordinate financial and data-protection rules. Some adopt regulation-led models with mandated standards and clear technical rulebooks; others rely on market-led frameworks where data sharing rests on voluntary schemes and bilateral agreements (Bonvino & Giorgino, 2026); Grassi et al., 2022). These differences shape not only legal certainty but also firms' strategic choices: whether to invest in open-Application Programming Interface (API) capabilities, to

partner with fintechs or techfins, to scale cross-border offerings, or to retreat into “walled gardens” and defensive compliance.

Against this backdrop, this work asks a focused research question:

How does open banking and open finance regulation clarity, complexity, and fragmentation affect innovation and competition in different regulatory frameworks?

This work investigates how the design of open-banking and open-finance regulation shapes innovation and competitiveness in data-driven financial ecosystems using a systematic literature review and illustrative case studies. By structuring concepts and theoretical background from information economics, platform theory, dynamic capabilities, and innovation-and-growth frameworks with empirical insights, it advances a conceptual bridge between regulatory architecture and management choices in an ecosystem context. The analysis isolates the specific regulatory features—clarity, complexity, and fragmentation—that influence market contestability, partnership formation, product development, and technological adoption, and proposes a framework that enables managers and policymakers to orchestrate policy measures to foster competitive and innovative success, thus benefiting scholars, managers, and policymakers.

The remainder of the work is organised as follows. First, we present the methodology, followed by the findings. Next, we introduce the framework along with a discussion of its implications for scholars and practitioners. Finally, we conclude with key remarks.

2 Methodology

Conducting a literature review is essential for establishing the conceptual foundations of this thesis and for demonstrating the originality of its contribution. Existing research on open banking and open finance is extensive but fragmented across technical, legal, economic and information-systems lenses, with limited integration of managerial and strategic perspectives. One of the most recent systematic reviews on open finance and data democratization provides an important conceptual map of the field, clarifying how data-sharing architectures, ecosystem roles and governance models have evolved over time, and synthesising dispersed evidence into a coherent interpretive lens (Bonvino & Giorgino, 2026). This contribution is valuable because it organises previously fragmented discussions on technological enablers, regulatory trajectories and stakeholder configurations. However, as the authors themselves acknowledge, the review limitedly examined how regulatory design features, such as clarity, complexity and fragmentation, shape firms' strategic behaviour or the competitive dynamics of open-finance ecosystems. Furthermore, given the accelerating pace of regulatory reforms, the diffusion of cross-sector data-sharing models, and the global divergence of open-finance trajectories, the need to synthesise existing evidence is increasingly timely. Situating open banking and open finance within broader debates on regulatory clarity, complexity, and fragmentation allows this thesis to frame the phenomenon not merely as a technological or compliance-driven process, but as a multidimensional policy architecture whose design has tangible implications for innovation, competition, user empowerment and cross-border scalability. By acting as an analytical bridge that organises fragmented insights into a coherent conceptual framework, the review provides the foundation for the research question and demonstrates the relevance of the study. Its development followed a structured, multi-stage process designed to ensure methodological transparency and conceptual coherence with the interdisciplinary nature of open banking, open finance and digital-finance regulation.

Following the approach adopted by Tranfield et al. (2003), the review began with two comprehensive searches on Scopus aimed at capturing both the domain-specific and the adjacent theoretical literatures. The first query —“open banking” AND “open finance”— yielded 96 documents, capturing scholarship directly focused on data-sharing frameworks, API-enabled financial architectures, and the regulatory evolution of openness. The second query—“fintech” AND “innovation” AND “regulation”— returned 169 documents and served to map the broader conceptual foundations on which open finance builds, including regulatory governance, financial innovation, technological infrastructures and supervisory design. The queries were limited within the areas of Business, Management and Accounting, Limited to Economics, Econometrics and Finance, quality journals and conferences, and English. The documents were extracted on 26/05/2025. All retrieved documents underwent a two-step screening process. In the first step, titles, keywords and abstracts were evaluated to assess alignment with our research question, searching but not limiting for the following themes: open banking and open finance, fintech and innovation dynamics, regulatory design and data governance, risks arising from digital architectures, platform economies, institutional design and technological change. In the second step, full texts of potentially eligible studies were examined to confirm substantive relevance, conceptual clarity and methodological adequacy. Both steps followed a double-blind process, one author assessed the documents, and field experts randomly verified process and documents, and misalignments were reviewed till agreement. This process yielded a core sample of 34 systematically selected papers —14 from the first query and 20 from the second. This corpus was complemented with 7 grey literature documents capturing complementary academic papers and practitioners’ reports. The final review therefore draws on a total of 41 documents (Figure 1).

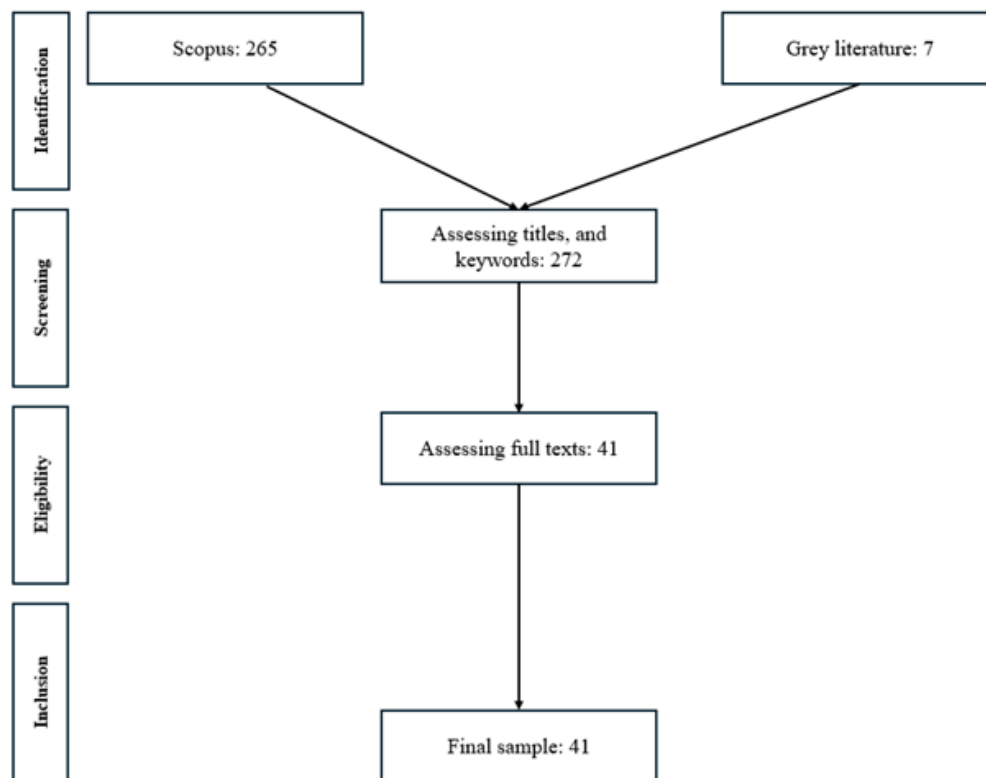


Figure 1 Systematic literature review following PRISMA reporting guidelines

To organise the evidence systematically, each paper was coded into a structured database following a standardised data-extraction protocol, ensuring consistent comparison across heterogeneous disciplinary contributions. For each article, bibliographic information and relevant paragraphs were recorded with discipline. Each relevant paragraph within the selected papers was coded across a set of analytical dimensions capturing first order dimensions and second order dimensions (Table 2). This coding structure supported a granular decomposition of each paper's contribution and allowed the identification of conceptual regularities and divergences across studies. A narrative synthesis enabled the embed the insights within broader theoretical perspectives and define semi-structured questions for the illustrative case studies. The resulting review is therefore both systematic—in its search strategy, screening protocol and coding methodology—and constructive, in that it reframes heterogeneous evidence into a coherent conceptual account of how regulatory architecture shapes the emergence, diffusion and distribution of innovation in open banking and open finance.

Content validity was supported through the use of two complementary search queries. Internal validity was reinforced through the application of transparent inclusion and exclusion criteria, a multi-stage screening process, and systematic cross-checks of the process and selected documents. To reliability, the review followed a standardised coding protocol: all 41 papers were extracted using the same structured matrix, with predefined variables, decision rules, and consistent coding definitions. The coding process was iteratively verified to ensure stability and reduce subjective bias. All methodological steps—including search strings, screening decisions, and extraction rules—were documented to allow full replicability by other researchers. This systematic approach increases the likelihood that independent reviewers applying the same protocol would arrive at a comparable evidence base and similar analytical interpretations.

This thesis employs a multiple illustrative case-study design to examine how specific features of open-finance regulatory design shape innovation incentives, competitive dynamics, and ecosystem coordination. This design is particularly suitable because the phenomenon under study is still emerging and only partially theorised in existing research, making it well aligned with the exploratory and theory-elaborating purposes of case-based inquiry (Eisenhardt, 1989). Following Eisenhardt's view of multiple-case research as an iterative process in which cases serve as replications that progressively refine constructs and deepen theoretical insight, each case provides an opportunity to examine how actors interpret and operationalise regulatory design choices in practice (Eisenhardt, 1989). Experts are treated as embedded units of analysis situated within their institutional and professional contexts. Accordingly, while individual experts

constitute embedded units of observation, the unit of analysis is defined at the level of processes and decision mechanisms through which regulatory design influences innovation incentives and market behaviour. In this study, the primary unit of analysis is therefore the interpretive and operational response of institutional and industry actors to specific features of open-finance regulatory design. The cases therefore capture how different categories of actors (regulators, policy specialists, incumbents, and fintech practitioners) perceive, translate, and enact regulatory clarity, complexity, and fragmentation within their organisational and institutional settings. Individual experts serve as embedded units of observation, but the analytical focus remains on the patterns of reasoning, decision processes, and implementation behaviours through which regulatory design shapes innovation incentives and competitive dynamics. Data are therefore collected through semi-structured interviews with policy specialists, regulators, and financial-innovation practitioners whose roles expose different facets of how open-finance regulation is designed, implemented, and experienced.

The logic of case selection follows theoretical sampling: interviewees are selected because they occupy differentiated regulatory, supervisory, technological, and industry positions, allowing the study to capture contrasting perspectives and to observe meaningful variation in the mechanisms through which regulatory design influences innovation and market behaviour. Previous studies confirm that theoretical sampling, rather than random selection, allows researchers to purposefully choose cases that replicate, extend, or contrast emerging theory, thereby making underlying processes more transparently observable and enhancing the analytical generalizability of case-based findings (Eisenhardt, 1989). Furthermore, to enhance the persuasiveness and theoretical contribution of the analysis, the study aligns with Siggelkow's argument that the value of case research lies not in sample size but in its ability to offer a compelling, conceptually anchored illustration of mechanisms that would otherwise remain abstract (Siggelkow, 2007). Accordingly, the aim of the illustrative cases is not to test hypotheses but to clarify, exemplify, and sharpen the theoretical model emerging from the literature review. By contrasting perspectives across heterogeneous expert profiles, the study is able to surface explanatory mechanisms that would remain less visible through single-source evidence. Interviewees are therefore selected from multiple countries and institutional settings to reflect variation in regulatory approaches, market maturity, and technological development in open finance. This cross-jurisdictional and cross-contextual design enables the analysis to observe how similar regulatory principles produce different outcomes depending on institutional configurations and market structures. Involving experts from regulatory, policy, and industry contexts further allows the study to capture how regulatory design is translated into practice and interacts with innovation and market behavior across the open finance ecosystem. Data collection and analysis proceed iteratively, in line with

Eisenhardt's description of case-based theory building as a process involving continual cycling between data and emerging constructs. Each interview is first analysed individually to identify within-case themes, followed by cross-case comparison to refine categories, confront rival explanations, and strengthen internal validity. Expert insights are triangulated with regulatory documents, institutional reports, and secondary analyses to reinforce construct validity (Bans-Akutey & Tiimub, 2021). In this way, the illustrative expert cases contribute both to the clarification of theoretical constructs and to the demonstration of their practical manifestations within the evolving landscape of open-finance regulation (Table 1).

Table 1 Informants

Interviewee	Role	Category	Geography	Size
A	Chief Operating Officer	IT Services and Consulting	Kazakhstan	11-50
B	Supervision Officer - Crypto Assets	Financial Services	Europe	201-500
C	Fintech Expert	Banking	Italy	5.001-10.000
D	Chief Policy Advisor	Business Consulting and Services	Central Eurasia	11-50
E	Fintech Expert	Banking	Italy	5.001-10.000
F	Group Risk & Compliance Officer	Insurance	Italy	51-200
G	Engineer	Banking	Italy	5.001-10.000
H	Business Development	Banking	Europe	201-500
I	Director Business Development	Software development	Global	201-500
J	Fintech Community Manager	Financial Services	Italy	2-10
K	Legal Specialist	Banking	Italy	1.001-5.000
L	Policy Advisor	Banking	Italy	5.001-10.000

The interview protocol was grounded in resource orchestration theory, which conceptualizes value creation as the outcome of managerial actions aimed at structuring, bundling, and leveraging resources. Building on this perspective, the protocol investigated how regulatory and data governance frameworks influence the orchestration of data resources in open banking and open finance. Specifically, it examined the extent to which governance mechanisms enable or constrain the design, implementation, and scaling of data-sharing initiatives, as well as the actions undertaken by regulatory, financial, and fintech actors to operationalize regulatory requirements in practice.

The sample consists of 11 interviews, conducted with participants' consent, anonymised, and transcribed, amounting to approximately six and a half hours of recorded material. One interview was conducted as a joint interview involving two participants, resulting in contributions from 12 informants overall. Interviewees were selected through purposive sampling, with the objective of capturing multiple perspectives on open banking and open finance governance. In particular, the sampling strategy aimed to include informants representing a broad range of professional roles and institutional positions within the ecosystem, including policy advisors within banking institutions, regulatory and supervisory authorities, professionals working in fintech firms, and independent experts in open banking and open finance.

Potential interviewees were identified primarily through LinkedIn, using targeted searches for professionals with demonstrated expertise in open banking, open finance, data sharing regulation, fintech policy, and financial regulation. Keywords such as open banking, open finance, policy advisor, regulator, and fintech expert were used to identify suitable candidates. Particular attention was paid to selecting informants with direct involvement in regulatory interpretation, implementation, or strategic decision-making related to data sharing frameworks.

An effort was made to extend the sample beyond the Italian context to gather insights with a more global perspective on open banking and open finance developments. While several interviewees possessed international experience or were involved in cross-border initiatives, the majority of respondents were Italian professionals based in Italy. Nevertheless, most informants demonstrated global expertise, either through participation in international regulatory discussions, involvement in multinational organizations, or professional experience across multiple jurisdictions.

Interviews were conducted in January 2026 and took place remotely. A semi-structured interview protocol was employed to ensure consistency across interviews

while allowing flexibility to explore context-specific insights related to regulatory clarity, complexity, and implementation challenges in open banking and open finance. This methodological approach informed a systematic qualitative analysis of the interview data. Following an inductive coding process, interview transcripts were first analysed to identify first-order codes closely reflecting participants' own language and descriptions. These codes were then iteratively compared and aggregated into second-order themes capturing recurring patterns across interviews. Finally, higher-level aggregate dimensions were developed to synthesise the main empirical insights. This analytical process resulted in a structured data framework comprising six aggregate dimensions, which form the basis of the study's findings and are illustrated in Figure 3.

3 Literature review

This literature review establishes the conceptual and analytical foundations for assessing how the design of open-banking and open-finance regulation shapes innovation and competitiveness. To do so, it proceeds in a cumulative way. The review first clarifies what open banking and open finance are, tracing their evolution from competition remedies to data-infrastructure frameworks and mapping their diffusion across jurisdictions as regulation-led or market-driven constructs. It then examines the technological architecture—APIs, cloud infrastructures, data systems, distributed ledgers—and the innovation dynamics they enable, followed by an assessment of the risk surface that accompanies the programmable and interoperable nature of open finance. Building on this, the review analyses the regulatory design dimensions most frequently identified in the literature—clarity, complexity, and fragmentation—and how they shape firms’ incentives, market entry, and ecosystem development. Finally, it brings together the theoretical lenses that structure scholarly interpretations of the phenomenon, ranging from information economics and platform theory to dynamic capabilities, orchestration theory, and co-evolutionary systems. Together, these components provide a coherent analytical scaffold for explaining the state-of-the-art of the phenomenon.

Table 2 summarises the key studies included in the review, outlining their research focus, methodological approach, and principal findings.

Table 2 Systematic literature review documents

Author(s), Year	Title	Type of study	Themes	Findings and results	Theories	Future Research
Dirk A. Zetsche , Douglas W. Arner, and Ross P. Buckley, 2020	Decentralized Finance	qualitative	Open finance, DeFi, Technolo gies, Financial regulation and innovation	DeFi concentrates new governance and accountability risks, requiring targeted regulatory responses.	Information asymmetry	Need for research on embedded regulation and cross- jurisdictional supervision for DeFi.

Rebecca Chan, Indrit Troshani, Sally Rao Hill and Arvid Hoffmann,2022	Towards an understanding of consumers' FinTech adoption: the case of Open Banking	quantitative	Open banking	Open Banking adoption is driven mainly by performance expectancy, social influence and effort expectancy, while perceived risk reduces intention and financial literacy lowers initial trust.	-	Future research should test Open Banking adoption using real user experiences and cross-country comparisons
Ross P. Buckley, Douglas W. Arner, Dirk A. Zetsche, Rolf H. Weber,2019	The road to RegTech: the (astonishing) example of the European Union	qualitative	Financial regulation and innovation	EU post-crisis rules, GDPR, PSD2 and eIDAS jointly and unintentionally triggered a RegTech ecosystem, accelerating datafication and digital compliance.	Information asymmetry	Future research should examine how RegTech ecosystems can be purposefully designed to balance data, technology, and regulatory objectives
Laura Grassi, Nicolas Figini and Lorenzo Fedeli,2022	How does a data strategy enable customer value? The case of FinTechs and traditional banks under the open finance framework	qualitative	Open Finance	Retail banks follow three distinct approaches to open finance, shaped by culture, architecture and data strategy, with internal/external information asymmetries driving customer-value creation.	Dynamic capabilities	Future research should examine customers' perspectives on Open Finance and compare approaches across countries and regulatory contexts.
Dize Dinçkol, Pinar Ozcan, Markos Zachariadis,2023	Regulatory standards and consequences for industry architecture: The case of UK Open Banking	qualitative	Innovation, Technologies, Financial regulation and innovation	Regulator-led standardization produced iterative recalibrations, uneven implementation and new bottlenecks, ultimately reshaping industry architecture through new API-aggregation roles.	Information asymmetry; orchestration	Future research should analyze how API standards evolve across countries and how standardization shapes competition and innovation.
Sean Stein Smith.,2021	Decentralized Finance & Accounting – Implications, Considerations,	qualitative	Open finance, DeFi, Technologies, Financial regulation	DeFi introduces major accounting, control, and compliance challenges due to volatility, smart-contract risks, and	Information asymmetry	Future research should clarify accounting standards for DeFi and assess how decentralization

	and Opportunities for Development			unclear regulatory treatment.		reshapes audit and reporting practices.
Rakesh Gupta, Reema Khurana, Anu Prashaant, 2023	Open banking on the horizon: a scientometric analysis and research agenda	quantitative	Open banking, Innovation, APIs	Research on open banking is fragmented; key themes include APIs, fintech innovation, and data governance, with major gaps in consumer behaviour and business-model impact.	-	Study regulation, regional gaps, security, and contextual products to expand Open Banking.
Federico Ferretti, Peter Petkoff , 2022	OPEN FINANCE AND CONSUMER PROTECTION: UNEASY BEDFELLOWS	theoretical	Open banking, Open finance, Innovation, APIs, Financial regulation	EU Open Finance rules risk undermining consumer protection by creating legal uncertainty and enabling opaque, data-driven business models that may foster dark patterns and weaken user control.	Information asymmetry	Develop by-design data-control models and address dark-pattern/black-box risks.
Ana ODOROVIĆ, LL.M., 2023	OPEN BANKING: BETWEEN COOPERATION AND COMPETITION	theoretical	Open banking, Open finance, Innovation, APIs, Financial regulation	Open banking reshapes bank–fintech dynamics, with cooperation driven by data access needs and regulation, and competition emerging where incumbents' advantages erode.	Information asymmetry	Study how data production, consent, and wider open-data regimes shape future competition.
Giuseppe Colangelo, 2024	Open Banking Goes to Washington: Lessons from the EU on Data-Sharing Regimes	theoretical	Open banking, Open finance, Innovation, APIs, Financial regulation	Top-down regulation in the U.S. may be unnecessary and even harmful, as market-led solutions could suffice and premature intervention risks imposing costs without solving any real market failure.	-	Assess competitive effects and costs of mandated data sharing, especially in the fragmented U.S. market.

Laura Grassi,2024	In a world of Open Finance, are customers willing to share data? An analysis of the data-driven insurance business	quantitative	Open finance, Innovation, Technologies, Financial regulation	Customers share data when financial rewards outweigh perceived privacy risks; willingness strongly depends on data type and expected benefit.	-	Future research should explore qualitative drivers of data-sharing willingness and examine how findings generalize across countries and regulatory contexts.
Piotr Łasak, Sławomir Wyciślak,2024	The dichotomy of inclusiveness and vulnerability as a consequence of banking platform development	theoretical	Open banking, Open finance, Innovation, APIs, Financial regulation	Platformization increases inclusiveness and value co-creation but simultaneously creates structural vulnerabilities and concentration risks.	-	Future research should assess how new technologies, regulatory changes, and customer behavior shape inclusiveness and risks in banking platforms.
Gorka Koldobika Briones de Araluze, Natalia Cassinello Plaza,2022	Open banking: A bibliometric analysis-driven definition	quantitative	Open banking, Innovation, Technologies, Financial regulation	Open banking is driven by four pillars—data sharing, business-model change, fintech participation, and regulation—and lacks a unified definition	-	Build a stronger multidisciplinary foundation and refine the unified definition of open banking.
Dadan Rahadian, Suriman, Astrie Krisnawati, Hasan Dincer,2023	Relationship and Impact of the Value Creation Model on Fintech and Digital Bank Collaborations in Indonesia	quantitative	Open finance, Innovation	Incremental and radical innovation both boost firm growth, but incremental innovation has a stronger impact, as radical innovation often struggles with market acceptance.	-	Future research should use broader, more diverse samples and test co-innovation models across countries and Fintech contexts.
Rim El Khoury, Muneer M. Alshater, Mayank Joshipura,2024	RegTech advancements-a comprehensive review of its evolution, challenges, and implications for financial regulation and compliance	mixed methods	Innovation, Technologies, Financial regulation and innovation	RegTech research clusters around four themes—FinTech and regulation, compliance/AML, digital governance, and data-driven technologies—revealing its strongly	-	Study RegTech scalability, tech integration, and long-term regulatory impacts.

				interdisciplinary structure.		
Jin Liu, M.H. Yahya, Saidatunur Fauzi Saidin,2023	A Bibliometric Review of FinTech's Impact on Banking Risk	quantitative	Innovation, Financial regulation and innovation	FinTech risk research has shifted from disruption fears to examining how banks use new technologies to manage risks, with COVID-era studies highlighting the systemic hazards of integrating FinTech into traditional banking models.	-	Broaden data sources and apply NLP and longitudinal/qualitative designs.
Rui Torres de Oliveira , Martie-Louise Verreyne , Sandra Figueira , Marta Indulska & John Steen,2020	How do institutional innovation systems affect open innovation?	quantitative	Innovation	Openness boosts innovation in Australian firms but reduces it in Chinese firms	-	Study other OI strategies, search depth, and multilevel institutional effects.
Chi-Chuan LEE, Lei FANG, Jinsong ZHAO, Chin-Hsien YU, Jian ZHANG,2024	HOW DOES FINTECH DEVELOPMENT DRIVE CORPORATE INNOVATION? NEW EVIDENCE FROM THE PERSPECTIVE OF FINANCIAL SUPPLY	quantitative	Technologies	FinTech development significantly increases firms' innovation output—especially invention patents—confirming FinTech's strong positive effect on technological innovation.	-	Use firm-level loan data to study FinTech's cross-regional financing effects.
Yong Xu, Ling Yuan, Hyongsuk Lee , Sabine Baire, Joanna Nakonieczny , and Xin Zhao,2024	Fintech Development and Firm Technological Innovation Efficiency: Empirical Findings in China	quantitative	Innovation, Financial regulation	FinTech development significantly <i>reduces</i> firms' innovation efficiency by accelerating financial risk transmission, with risk expansion dominating and strongly inhibiting innovation	-	Future research should test whether results hold in high-tech industries

Yuling Chen, Zhen Che, Dongqi Wan,2024	How does the financial technology innovation regulatory pilot influence financial regulation?	quantitative	Innovation, Financial regulation and innovation	The policy significantly increased financial-regulation intensity and, by supporting compliant FinTech innovation, strengthened institutions' compliance management	-	explore additional mediators beyond fintech.
Campbell R. Harvey, Daniel Rabetti,2024	International business and decentralized finance	theoretical	DeFi, Technologies, Financial regulation and innovation	DeFi leverages blockchain to enhance accessibility, transparency, and financial inclusivity, enabling global access to financial services without traditional intermediaries	-	Study how DeFi transform global business models.
Venkateswarlu Nalluri, Long-Sheng Chen,2023	Modelling the FinTech adoption barriers in the context of emerging economies—An integrated Fuzzy hybrid approach	quantitative	Technologies, Financial regulation	FinTech adoption in India is hindered by weak regulation, cultural and trust barriers, and safety concerns, but it also holds strong potential to boost financial inclusion and support rural economic development.	-	Extend analysis cross-country and apply advanced fuzzy sets.
Marco Cappai,2023	The role of private and public regulation in the case study of crypto-assets: The Italian move towards participatory regulation	theoretical	Technologies, Financial regulation and innovation	The EU Digital Financial Package (MiCA, DORA, DLT Pilot) seeks to balance innovation and protection through harmonised rules, while Italian case studies show how participatory regulation can address unresolved technological gaps.	-	Advance participatory regulation for DeFi and unresolved tech gaps

Favourate Y. Mpofu,2024	Industry 4.0 in Finance, Digital Financial Services and Digital Financial Inclusion in Developing Countries: Opportunities, Challenges, and Possible Policy Responses	qualitative	DeFi, Technologies, Financial regulation	Digital financial services bring major benefits for developing countries—financial inclusion, poverty reduction, and economic opportunity—but their impact is constrained by significant delivery and adoption challenges.	-	Study how taxes, literacy gaps, and country contexts affect digital inclusion and SDG outcomes.
Weijie Tan, Qiuyu Tang, Wanting Sun, Xuanyu Du,2024	Unintended consequences: Examining the effects of government digital regulation on corporate fintech innovation in China	quantitative	Innovation, Financial regulation and innovation	Intensive digital regulation hampers corporate FinTech innovation by increasing external risks and internal compliance burdens, while effective innovation requires regulatory–innovation synergy.	-	Use cross-country data and NLP-based policy analysis
Xavier Vives ,2019	Digital disruption in banking	theoretical	DeFi, Innovation, APIs, Financial regulation and innovation	Digital disruption can enhance efficiency and customer experience through data-driven, platform-based banking, but regulation must ensure these benefits materialize without compromising financial stability.	Information asymmetry	Study how digitalization and data rights reshape banking and systemic risk.
Eduardo Z. Milian, Mauro de M. Spinola, Marly M. de Carvalho,2019	Fintechs: A literature review and research agenda	qualitative	Technologies, Financial regulation and innovation	The study maps the evolution of fintech research, identifies its main thematic clusters—financial services, innovation, and regulation—and consolidates diverse definitions into a unified, comprehensive	-	Broaden databases, use semantic analysis, and study cross-topic fintech–blockchain links.

				understanding of fintech.		
Galyna Azarenkova, Iryna Shkodina, Borys Samorodov, Maksym Babenko, Iryna Onishchenko, 2018	The influence of financial technologies on the global financial system stability	theoretical	Financial regulation and innovation	The introduction of fintech over-complicates the global financial system, creating new interdependencies and systemic risks, which calls for stronger international prudential standards, revised licensing, sandboxes, and clearer blockchain regulation.	-	Develop global standards and cross-country regulation for fintech risks.
Marisa A. S'anchez, 2022	A multi-level perspective on financial technology transitions	qualitative	Open banking, APIs, Financial regulation and innovation	Using a Multi-Level Perspective, the study shows that fintech transitions are shaped by competition between incumbents and new entrants, platform dynamics, secondary markets, regulation, and the emergence of value-adding use cases.	-	Apply and validate the MLP framework cross-country to study fintech transitions.
Ya Bu, Hui Li & Xiaoqing Wu, 2021	Effective regulations of FinTech innovations: the case of China	theoretical	DeFi, Technologies, Financial regulation and innovation	FinTech firms' strategies depend on the gains from compliant and non-compliant innovation, while regulators' choices hinge on regulatory costs, social evaluation, and negative externalities—leading to stricter oversight when societal risks increase.	-	Quantify regulatory factors and empirically validate the game model.

Dong Yang & Min Li,2018	Evolutionary Approaches and the Construction of Technology-Driven Regulations	theoretical	Technologies, APIs, Financial regulation and innovation	RegTech enables regulators to address fintech risks more effectively by improving efficiency, reducing errors, and enabling real-time, proportionate, data-driven supervision.	-	Advance machine-readable regulation and accountability for algorithmic oversight.
Albulena SHALA, Rezarta PERRI,2022	Regulatory barriers for fintech companies in Central and Eastern Europe	qualitative	APIs, Financial regulation and innovation	FinTech regulatory development in CEE is highly uneven—Baltic states lead with full legislation and sandboxes, while countries like Albania, Bosnia, Kosovo, and Serbia lack basic frameworks and supervisory facilities.	-	Study regulatory barriers and digital-platform risks for fintech in CEE.
Laura Grassi, Davide Lanfranchi,2022	RegTech in public and private sectors: the nexus between data, technology and regulation	qualitative	Innovation, Financial regulation and innovation	RegTech offers efficiency gains but also exposes stakeholders to risks such as cyber threats, data-quality issues, and algorithmic bias, highlighting the need for a multidimensional, holistic regulatory framework.	-	Study specific RegTech applications and data-driven regulatory models.
Paolo Siciliani,2019	The Disruption of the Prudential Regulatory Framework	theoretical	Open finance, Innovation, Financial regulation and innovation	RegTech and SupTech could fundamentally reshape Basel-style prudential regulation by centralising regulatory modelling, increasing model comparability but raising macroprudential concerns, while enabling a new data-platform paradigm involving both	-	Study macroprudential risks of centralized models

				banks and fintechs.		
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3.1. Open banking and Open finance

Over the past decade, open banking and its extension into open finance have moved from niche regulatory initiatives to defining pillars of financial innovation. The phenomenon initiated from fintech and lately expanded. A comprehensive review by Milian, Spinola and de Carvalho (2019) shows that fintech captures innovative companies operating in the financial industry through the ubiquity of the internet, communication technologies and automated information processing—an umbrella conception that underpins today’s data-driven, API-enabled financial ecosystems and frames the transition from fintech to open banking and open finance (Milian et al., 2019; Puschmann, 2017). Originating as competition remedies—first in the United Kingdom and then codified in the European Union’s PSD2 (2018), Australia’s Consumer Data Right (2019), and the United States Dodd-Frank §1033 (2024) — open banking and open finance frameworks have redefined how financial data are accessed, shared, and monetised. For scholars, this shift offers an exceptional field for analysing how regulation, technology, and market design co-evolve, challenging traditional assumptions about intermediation, data ownership, and financial inclusion. As Odorović (2023) and Colangelo (2024) underline, APIs transform law into infrastructure, embedding consent, authentication, and liability directly into code—making open banking and open finance a natural experiment in “regulation by design” (Colangelo, G., 2024; Odorovic, 2023).

Open banking refers to a data-sharing paradigm in which consumers can authorize the secure portability of their financial information—typically via standardized APIs—across institutions and providers. By opening access through standardized interfaces, it reduces information frictions, invites new entrants to bundle and rebundle services, and has thus emerged as a defining force and central engine in the industry’s next wave of innovation in financial services (Gupta et al., 2024; (Colangelo, G., 2024; Łasak & Wyciślak, 2024). Developed in the UK as a competition remedy, open banking emerged as a market-opening architecture designed to reduce customer switching costs and enable new business models. While subsequently embedded in law, the idea is rooted in practitioner-led initiatives inspired by open-data principles, standardized APIs, and the broader open-innovation tradition in retail finance (Briones De Araluze & Cassinello Plaza, 2022).

As argued by Ana Odorović (2023), open banking is a regulatory construct built on the idea that customers retain sovereignty over their data—deciding who may access it and for what purposes—and that the strategic control of this data can entrench incumbents. Granting consumers the ability to permission data sharing with qualified

third parties reduces informational lock-in, encourages market entry, and should translate into sharper competition, lower prices, and greater product innovation, therefore supporting price discipline and innovation in retail financial services (Odorovic, 2023; Ferretti, F., & Petkoff, P., 2022). Moreover, as Sánchez (2022) observes, the open-banking paradigm exemplifies how fintech innovation reshapes user practices within the financial regime. Drawing on Gomber et al. (2018), she notes that open-banking platforms expand market participation by creating opportunities for third-party service providers to develop data-driven financial products, while also fostering inclusion among previously unbanked users. In the multi-level perspective she adopts, such platforms operate as a bridge between niche innovations and regime transformation—translating technological affordances into institutional and social change.

Open banking—as a regulation-mandated construct—has diffused through distinct legal instruments across jurisdictions. In the European Union, the Revised Payment Services Directive (PSD2) entered into force in 2016 with a transposition deadline of 13 January 2018, establishing the legal basis for third-party access to payment-account data (with strong-customer-authentication standards phased in thereafter). In the United Kingdom, the Retail Banking Market Investigation Order (2017) set a formal implementation roadmap and governance for open banking, complementing PSD2; the regime went live in 2018 and was operationalised via Open Banking Limited and the CMA roadmap. In Australia, open banking is delivered through the Consumer Data Right (CDR)—legislated in 2019—with live data sharing in banking commencing on 1 July 2020. In the United States, the Consumer Financial Protection Bureau issued the Personal Financial Data Rights final rule under Dodd-Frank § 1033 on 22 October 2024, published 18 November 2024 and effective 17 January 2025, with phased compliance by firm size; the rule has since been the subject of procedural reconsideration in 2025. Beyond these early adopters, open banking has gained traction across diverse jurisdictions. Brazil launched a phased, mandatory Open Finance system under the Central Bank in 2021, extending interoperability from payments to credit, insurance, and investments. India implemented its Account Aggregator Framework in 2021, enabling consent-based financial data sharing under the Reserve Bank of India's 2016 directions. Mexico's Fintech Law (2018) established a three-tier data-sharing model (open, aggregated, and transactional) now entering full implementation. In South Korea, the government launched its nationwide open-banking platform in December 2019, while Hong Kong's Monetary Authority (HKMA) introduced a four-phase Open API Framework starting in 2018. Japan's 2017 Banking

Act amendments created the category of Electronic Payment Intermediate Services, institutionalising API-based access. In Singapore, the Monetary Authority of Singapore (MAS) adopted a market-led model through its API Playbook (2016), encouraging voluntary standardisation by providing guidelines for API security, governance, and use cases. Canada followed with the Consumer-Driven Banking Act (June 2024), while New Zealand committed to full open-banking deployment by 2026 following its Commerce Commission review. Taken together, these trajectories illustrate that open banking has moved beyond a European experiment to become a globally diffused governance model—one that blends competition law, consumer data rights, and API standardisation. The diversity of approaches underscores a common direction: embedding data portability and interoperability as structural features of financial systems, while leaving open critical questions of accountability, liability, and scope as markets transition toward open finance.

Evidence from emerging markets reinforces cross-country divergences. As shown by Nalluri and Chen (2024), fintech adoption remains significantly lower in emerging economies, with 62% of financial-services firms in India not adopting fintech compared to much higher adoption rates in the US, UK, and France. The authors attribute this gap to structural barriers—including lack of trust, insufficient regulation, and inadequate digital infrastructure—which illustrate how the absence of clear and predictable regulatory frameworks can directly slow down digital-finance implementation (Nalluri & Chen, 2024).

This regulatory transformation must be situated within the broader fintech evolution, where financial innovation, digital infrastructure, and regulatory design interact dynamically. As Akyildirim, Corbet, Mukherjee and Ryan (2025) show, open banking operates as both a technological and regulatory shock, reshaping bank behaviour, data strategies, and collaboration with third-party developers (Akyildirim et al., 2025). The International Bar Association's Fintech Report (edited by Borgeat, Crabb, and Hanotiau, 2024) similarly identifies open banking as the cornerstone of national fintech strategies, serving to harmonize digital-finance licensing, payment-system modernization, and API governance (International Bar Association Banking & Financial Law Committee, 2024). From a policy perspective, Ran, Rau and Ziegler (2025) demonstrate that regulatory clarity—specifically, the degree of legal precision in digital-finance frameworks—directly correlates with fintech innovation intensity

and new-platform creation, implying that regulation can enable rather than constrain entrepreneurship (Ran et al., 2025a). Taken together, these perspectives frame open banking not as an isolated European experiment but as a core fintech policy paradigm, integrating competition law, technology governance, and innovation economics within a single regulatory architecture.

While open banking first emerged as a regulatory construct, recent evidence indicates that its evolution increasingly spans a continuum between regulation-led and market-led governance models. The Cambridge Centre for Alternative Finance (2024), in its report *The Global State of Open Banking and Open Finance* identifies two dominant archetypes: regulation-led frameworks, where participation is mandated by statute and technical standards are codified by regulators (as in the EU's PSD2, the UK's CMA Order, or Australia's CDR), and market-driven frameworks, where participation is voluntary, guided by industry coordination and commercial incentives rather than law. Under the latter, "data holders are not required by law or regulation to facilitate access," and instead data sharing "operates primarily based on agreements—either bilateral or multilateral through scheme-type arrangements—between data holders and data users" (page 26). The report situates jurisdictions such as Singapore, Hong Kong, Japan, and several Sub-Saharan African markets within this market-driven spectrum, in which regulators act as facilitators rather than mandators, providing "guided implementation" rather than compulsory access. Yet, as the report observes, 18 jurisdictions initially adopting market-led models are now transitioning toward regulation-led or hybrid regimes, demonstrating that open banking's institutional design is path-dependent and adaptive rather than binary. This finding reframes open banking as both a policy instrument and a market coordination mechanism, illustrating that the boundaries between innovation and regulation are dynamic: where regulation is absent, markets self-organise around standardisation; where regulation matures, markets rely on legal clarity to scale (CCAF, 2024).

On the other side, open finance generalizes the data-sharing architecture of open banking by extending consumer-permissioned portability and third-party access beyond payments into savings, investments, insurance, and pensions, thereby shifting from product silos to data-centric ecosystems. While retaining consent as the organizing principle, open finance relies on enhanced data sharing to enable personalisation and expand the scope of services available to consumers (Ferretti, F., & Petkoff, P., 2022; Grassi, 2024). Grassi, Figini and Fedeli, 2022, identify three

approaches to open finance. The cautious path advances only incrementally within siloed, product-centric architectures, collects a narrow set of data, extracts limited value, and exhibits uneven digital channels with a multichannel posture that remains indistinct and therefore demands a coherent data strategy. The considered path places data, data collection, and data quality at the centre, couples architectural work with internal culture-building through laboratories and cross-functional projects and seeks to valorise information for both customers and the firm, benefiting from rich historical series yet still requiring disciplined execution. The committed path aligns technology choices and corporate culture, evolves performance management toward customer-oriented metrics, sustains continuous investment and innovation, and defers sophisticated analytics until adequate data scale is achieved. Crucially, the authors argue that being a fintech is not sufficient to secure a superior position, since some incumbents adopt the considered or committed stance while some fintechs do not; market position reflects execution rather than legacy status (Grassi et al., 2022).

In the European Union, the shift toward open finance is being codified: in June 2023 the European Commission tabled the Financial Data Access (FIDA) proposal together with the Payment Services Package (PSD3 and a directly applicable Payment Services Regulation), establishing a cross-sector framework for access to and use of customer financial data and signalling a transition from open banking to open finance (Łasak & Wyciślak, 2024). Beyond the European Union, several jurisdictions have consolidated their transition from open banking to open finance through diverse governance and policy frameworks. In the United Kingdom, open banking has matured into a global benchmark of regulatory-driven innovation, with 13.3 million active users as of March 2025 and more than 23 million one-off payments processed (Financial Conduct Authority, 2025). The Financial Conduct Authority's Open Banking and Open Finance in the UK research note highlights both the institutional strengths and structural challenges of the British regime: while secure API infrastructure and variable recurring payments (VRPs) have laid strong foundations for competition and inclusion, fragmented oversight and commercial misalignment still constrain scalability. In the Asia-Pacific region, governance models are more heterogeneous. According to the Cambridge Centre for Alternative Finance and Asian Development Bank Institute, open banking and open finance have now been adopted in 16 jurisdictions, with eight APAC countries—including Australia, India, Indonesia, Japan, the Republic of Korea, New Zealand, Thailand, and the Philippines—progressing toward regulation-led or hybrid frameworks. Australia and Korea fall under “mandated and standardised data sharing,” whereas India and Indonesia employ “standardised only” regimes that require harmonised APIs without imposing mandatory participation. Market-driven models prevail in Singapore, Hong Kong, Malaysia, and Japan, where regulators

promote interoperability through non-binding guidelines and “guided implementation,” blending soft regulation with industry self-coordination. This diversity reflects differing policy priorities: in advanced economies such as Australia, New Zealand, and Korea, the emphasis lies on competition and efficiency, whereas in India and Indonesia the dominant objective is digital and financial inclusion. Regulation-led frameworks tend to yield broader data-type coverage and faster extension into adjacent verticals such as open insurance and open lending. Hong Kong’s Project Aperta, coordinated with the BIS Innovation Hub, illustrates cross-border ambitions: it connects domestic open-finance infrastructures in the UK, UAE, Brazil, and Hong Kong to enable secure, encrypted data portability for small and medium-sized enterprises (SMEs).

Taken together, these developments suggest that open finance is evolving through a dynamic continuum of governance—ranging from regulator-mandated ecosystems in the UK and EU to guided-implementation frameworks in APAC. While the regulation-led archetype correlates with greater standardisation, data quality, and consumer protection, market-driven approaches foster agility and innovation, particularly in fintech-dense economies such as Singapore and Japan. Both trajectories, however, converge on the same strategic horizon: embedding secure, consent-based data mobility across sectors as the foundation for an inclusive digital financial ecosystem (Cambridge Centre for Alternative Finance, University of Cambridge and the Asian Development Bank Institute, 2025). At the macro level, *The Cost of Fragmentation Report* by Economist Impact connects open-finance architectures to interoperability and standardization, arguing that open APIs and shared data stacks mitigate market fragmentation and promote cross-border financial inclusion (Economist Impact, 2025). Nonetheless, the transition to cross-sector data mobility is not without trade-offs: the same interoperability that fosters inclusion also expands the perimeter of risk, demanding governance mechanisms and consumer-protection safeguards that remain effective regardless of where the data reside (Ferretti, F., & Petkoff, P., 2022).

Open finance is framed as a response to the economics of data-driven markets in which control over large, individual-level data pools confers advantage through powerful network effects and economies of scale and scope. The policy case is pro-competition and pro-efficiency: left unchecked, data concentration can yield dominant platforms that prioritise growth over profit, use below-cost pricing when rational, and leverage

privileged information gathered from dependent businesses to undercut them—dynamics long familiar to antitrust scholars in the United States, the European Union, and China. Treating data as a product is therefore proposed to discipline market power and sustain innovation. Against this backdrop, open banking and open finance aim to democratise finance by enabling people to transmit their raw financial data swiftly and safely to rival providers, widening the range of offerings and lowering the structural advantages of incumbents. At the technological frontier, decentralised infrastructures—especially distributed ledger technology—are presented as complements to open-data norms: by decentralising access and governance of data, they can reduce concentration by both state and techfins or bigtechs, with DLT-based open-data rails envisaged as a core layer of DeFi. Adoption to date has been led by the EU, the UK, and Australia, while many other jurisdictions are assessing similar strategies, as argued by Zetzsche, Arner and Buckley (2020).

Conceptually, the open-finance agenda moves from theory to infrastructure: it operationalises the competition and inclusion goals of data portability through the redesign of core financial functions. Open banking and open finance reconfigure the architecture of financial intermediation, progressively extending the reach of data mobility across products and markets. The diffusion of open banking first reconfigures payments and retail banking, where account-information and payment-initiation capabilities enable aggregation, personal financial management, and account-to-account payments, as documented by Vives and developed further in regulatory analyses by Colangelo and Odorović (Colangelo, G., 2024; Odorovic, 2023; Vives, X., 2019). Through these infrastructures, data portability becomes an active competitive lever: in credit and lending, granular transaction histories support more accurate underwriting, personalised pricing, and alternative credit scoring models, as argued by Ferretti and Petkoff (Ferretti, F., & Petkoff, P., 2022). On the distribution side, bank-fintech connectivity and API-based platforms enable ecosystem orchestration, with data-centric practices and modular partnerships associated with improvements in credit origination and allocation (Briones De Araluze & Cassinello Plaza, 2022; Grassi et al., 2022). As the perimeter expands to open finance, consent-based flows extend into insurance and pensions, supporting risk assessment and product tailoring (Ferretti, F., & Petkoff, P., 2022; Grassi et al., 2022), while investments and wealth see API-enabled bundling and rebundling of services with broader reach to underserved users (Check ; Łasak & Wyciślak, 2024). The same rails materially affect RegTech and onboarding, where APIs facilitate KYC/AML automation and richer supervisory data (Shala & Perri, 2022; Buckley et al., 2020; (Zetzsche et al., 2020). At the technological frontier, decentralised finance extends open-data logic to trading, lending and settlement on programmable infrastructures (Zetzsche et al., 2020). Mapping studies reinforce this diffusion pattern—payments first, adjacent verticals next (Chan et al., 2022; Dinçkol et al., 2023; Gupta et al., 2024).

For practitioners, open banking and finance represents both a threat and an opportunity: it disrupts incumbent business models while enabling new fintech and data-driven ecosystems that broaden access, improve efficiency, and personalise services (Łasak & Wyciślak, 2024; Sánchez, 2022). Yet, despite policy enthusiasm, the literature highlights persistent uncertainty over how regulatory clarity, interoperability, and API governance affect firm performance, competition, and consumer welfare (Akyildirim et al., 2025; Ferretti, F., & Petkoff, P., 2022; Ran et al., 2025). Studying open banking and open finance therefore provides a timely opportunity to understand how data portability, technological standardisation, and regulatory experimentation reshape both financial innovation and institutional boundaries, with implications that extend from micro-level business models to macro-level financial stability. Evidence from the open-innovation literature further reinforces this point. Torres de Oliveira et al. (2020) show that the benefits of openness—defined as the breadth of external knowledge sources accessed by firms—are strongly conditioned by national institutional systems: the same openness that enhances innovation in liberal, well-coordinated environments may even have negative effects in contexts where institutional complementarities, enforcement and market coordination mechanisms are weaker (Torres De Oliveira et al., 2022).

Yet, despite conceptual maturity, several empirical and analytical gaps persist. First, there is limited causal evidence linking regulatory design and API standardisation to firm-level performance and innovation outcomes, leaving unclear how data-mobility frameworks affect profitability, efficiency, and inclusion. Second, comparative studies describe regulation-led versus market-led regimes but lack cross-country metrics capturing the quality of design—clarity, reciprocity, liability, and interoperability. Third, while ecosystem and orchestration studies emphasise collaboration between banks and fintechs, the distributional effects on SMEs and consumers remain underexplored. Finally, risk assessments—profiling, fairness, data concentration, and RegTech dependency—are still predominantly qualitative, as standardized quantitative metrics remain limited. In emerging economies, these vulnerabilities are exacerbated by structural weaknesses. Nalluri and Chen (2024) identify cybercrime exposure, unreliable digital infrastructures, and risks for digitally excluded populations as major obstacles to fintech adoption, illustrating how insufficient regulatory safeguards can magnify systemic vulnerabilities within open-finance environments (Nalluri & Chen, 2024). Advancing the field therefore requires a shift from conceptual typologies to measurement and causal inference, connecting regulatory architecture, technological design, and observable market outcomes.

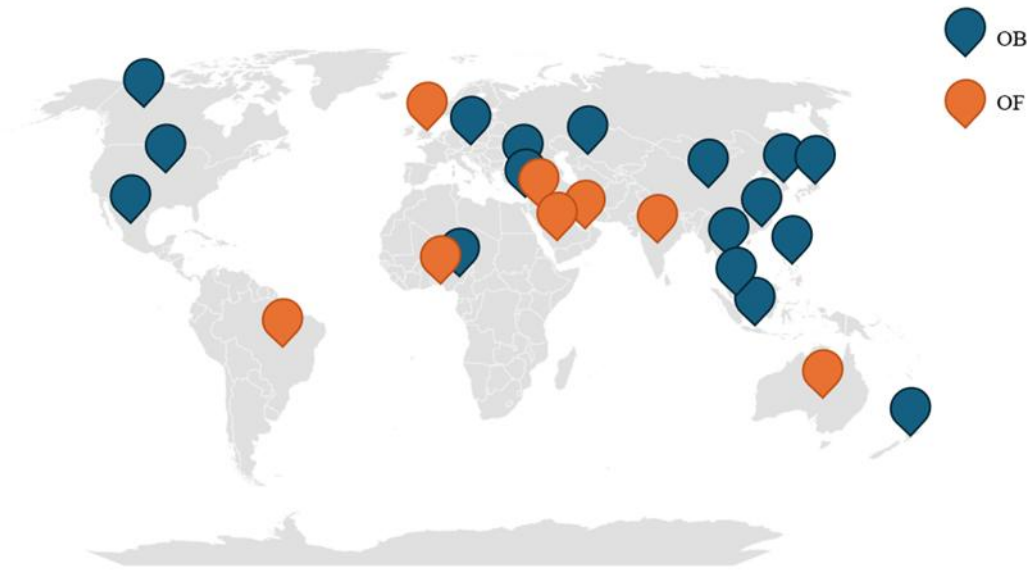


Figure 2 Worldwide coverage map of open banking and open finance

3.2. Innovation

Following 2008 crisis, regulators have launched several initiatives to promote innovation (Puschmann, 2017), lately reinforced post the pandemic emergency of Covid-19 from 2019 onwards (Bonvino & Giorgino, 2026). Open banking and open finance emerged as policy-driven responses to structural inefficiencies and limited innovation in traditional banking, where informational asymmetries and market concentration constrained competition. To stimulate technological progress and competition, regulators promoted data-sharing frameworks that open access to consumer information under secure and standardised conditions. In this context, open banking is framed as a pro-competition architecture that, once operationalised, enables more personalised and timely financial services through the use of customer data (Dinçkol et al., 2023), while data-sharing regimes reduce informational lock-in and enhance market contestability (Colangelo, G., 2024). Yet, as the experience of emerging economies shows, innovation does not diffuse automatically. Despite extensive digitisation initiatives, only 10% of financial-service firms in India actively employ fintech tools, largely due to trust deficits, security concerns, and regulatory gaps (Nalluri & Chen, 2024). This suggests that technological availability alone is insufficient: innovation depends critically on regulatory capacity, institutional support, and infrastructural readiness. Reviews of the field highlight its evolution from early debates on competition and consumer welfare toward broader themes of

collaboration, interoperability, and data governance (Gupta et al., 2024). Meanwhile, co-innovation research distinguishes incremental and radical innovation trajectories and examines how platform-based collaboration can support both (Rahadian et al., 2023). Tan et al. (2025) further demonstrate that the innovation effects of digital regulation are sector-specific: regulatory tightening reduces innovation in payments and insurance, yet stimulates it in investment, lending, and securities. These heterogeneous effects indicate that the relationship between regulation and innovation is not linear but mediated by risk profiles, data-dependencies, and business-model structures (Tan et al., 2025).

A complementary strand interprets innovation through the lens of democratisation and inclusion: open-data rails and fintech regulation broaden access and intensify competition, creating opportunities for third-party providers and previously unbanked users (Bu et al., 2022; Sánchez, 2022; Vives, X., 2019). At the technological frontier, decentralised and programmable infrastructures—when coupled with permissioned data mobility—are viewed as enablers of broader participation and more transparent markets, though they equally introduce novel challenges of governance, accountability, and consumer protection (Harvey & Rabetti, 2024; Zetzsche et al., 2020).

The same forces driving open finance innovation require regulators themselves to innovate. RegTech has become a core locus of process innovation, using automation, artificial intelligence (AI), and data analytics to lower the cost and latency of regulatory reporting while aligning supervisory requirements with firm-side data architectures (El Khoury et al., 2025; Liu et al., 2023). SupTech (supervisory technology) transforms financial supervision by integrating automated data collection, real-time analytics, and anomaly detection into supervisory processes, allowing authorities to monitor market conduct, systemic exposures, and compliance breaches dynamically rather than retrospectively (Shala & Perri, 2022). As Buckley, Arner, Zetzsche and Weber (2020) observe, RegTech and SupTech form complementary pillars of regulatory digitalisation: the former serves regulated entities, enabling real-time compliance, while the latter empowers regulators to enhance oversight through digital infrastructures. Through these tools, supervisors can analyse vast data sets at granular levels, improving the timeliness and precision of intervention and shifting from a reactive to a predictive regulatory stance. However, the digitalisation of supervision also introduces new governance and operational challenges. As Ferretti and Petkoff (2022) highlight, algorithmic decision-making and AI-driven oversight raise questions of explainability, accountability, and due process—particularly when supervisory decisions rely on models trained on opaque or biased data (Ferretti, F., & Petkoff, P., 2022). Moreover, as El Khoury et al. (2025) caution, the dependence on external

technology vendors and cloud-based infrastructures may expose regulators themselves to concentration risk, data-sovereignty issues, and cyber-vulnerabilities (El Khoury et al., 2025). These developments show that while SupTech enhances regulatory efficiency and transparency, it simultaneously extends the regulatory perimeter of risk into the technological domain.

Technologically, innovation operates as the core engine of open finance: data-driven architectures and interoperable APIs enable near-real-time service creation, personalised product design, and continuous rebounding of financial offerings (Ferretti, F., & Petkoff, P., 2022). These technological affordances redefine the speed and scope of value creation across payments, credit, and wealth, turning data mobility into an input for dynamic innovation. Institutionally, the emergence of bank–fintech partnerships reflects a pragmatic adaptation to the governance and compliance complexity inherent in open ecosystems (Odorovic, 2023). Collaboration becomes a means to balance regulatory obligations with innovation imperatives, as firms restructure internal processes and data strategies to align with evolving supervisory expectations and interoperability requirements (Grassi et al., 2022). Milian et al. (2019) identify technology adoption, network externalities, blockchain and security as the core thematic clusters in fintech innovation. Their analysis shows that these technological drivers shape both product innovation and new financial arrangements, underscoring that digital-finance innovation emerges from the interaction between technological infrastructures, regulatory conditions and evolving business models.

The review synthesises the technologies driving innovation in the open banking and open finance context. Platforms are restructuring the financial intermediation into modular and data-driven ecosystems where APIs define the governance layer of open finance. APIs determine who may access and share financial data under enforceable standards, and under what conditions such access occurs. Yet, access alone does not explain how those data are processed, verified, and transformed into financial services. To understand this second dimension, the literature turns to the technological stack underpinning digital finance, where execution and programmability take place. Zetsche, Arner and Buckley (2020) describe this infrastructure through the “ABCD stack”—AI, Blockchain (or broadly distributed ledgers technologies or DLT), Cloud computing, and Data—a mutually reinforcing set of technologies that enable decentralised processing, automation, and scalable service delivery. Whereas APIs operationalise governance and interoperability, the ABCD stack provides the technological substrate through which financial transactions are executed, validated, and composed into programmable services. The interaction between these two layers—governance through APIs and execution through the ABCD stack—frames the current frontier of innovation in open finance (Zetsche et al., 2020).

3.2.1. Platforms

Platforms are restructuring the financial intermediation into modular and data-driven ecosystems. Łasak and Wyciślak (2024) show that platformisation expands market participation beyond traditional banks, assigning modular roles to non-bank actors and complementors who leverage standardised APIs to deliver niche or embedded financial services. Similarly, Briones De Araluze and Cassinello Plaza (2022) map how business-model clusters evolve as data access deepens, illustrating the emergence of hybrid configurations in which incumbents, fintechs, and technology providers co-create value through shared infrastructures. Extending this logic, Rahadian et al. (2023) examine how co-innovation platform models shape firms' development along both radical and incremental innovation paths. They adopt a two-fold typology of innovation—incremental versus radical—and conclude that “co-innovation platforms can facilitate both categories of innovation,” underscoring how openness and collaborative architectures underpin diverse trajectories of organisational learning and technological change.

3.2.2. Application Programming Interfaces

In the open-banking and open-finance literature, APIs are consistently identified as the core technological infrastructure that transforms legal data-access rights into operational and contestable markets. As Łasak and Wyciślak (2024) and Odorović (2023) emphasise, APIs do more than connect systems: they embody a governance layer where consent, authentication, and liability intersect with product design, making consent-based data mobility technically enforceable (Łasak & Wyciślak, 2024; Odorovic, 2023). Colangelo (2024) traces how policy and market practice have shifted from scraping websites to developer interfaces, replacing insecure data extraction with secure, auditable channels that grant accredited third parties controlled access. In the retail domain, Vives (2019) documents how APIs have become the standard for data sharing in open banking, enabling real-time aggregation and payment initiation that improve service quality and competitive edge. Strategically, APIs act as catalysts of platformisation in financial services. They enable nonfinancial complementors to integrate modular offerings and create hybrid business models that expand participation and bundle financial services (Briones De Araluze & Cassinello Plaza, 2022; Łasak & Wyciślak, 2024; Sánchez, 2022). API-driven transition supports a structural shift from firm-centric innovation to collaborative and co-innovation ecosystems, where incremental and radical trajectories coexist under organisational enablers such as cross-functional initiatives and experimentation platforms (Gupta et al., 2024; Rahadian et al., 2023).

The governance of API standards is a recurring concern. Colangelo (2024) highlights the policy trade-off between mandated and market-led standards, noting that the

degree of standardisation determines interoperability, liability clarity, and entry costs. Similarly, Yang and Li (2018) emphasise that policy objectives in digital finance can only be achieved through compatibility and standardisation at the interface layer, including shared protocols and developer guidelines that ensure consistent implementation across ecosystems. On the compliance frontier, APIs enable RegTech and SupTech. By automating reporting and monitoring, they allow firms to comply with regulatory obligations more efficiently and at lower cost, while regulators experiment with machine-readable rules, sandbox environments, and data-driven supervision (Buckley et al., 2020; El Khoury et al., 2025; Shala & Perri, 2022). As Chan et al. (2022) note, such infrastructures shorten reporting cycles and strengthen transparency across the regulatory value chain.

The literature positions APIs as the backbone of open finance, a technology that operationalises consent, enables interoperability, and embeds governance within digital infrastructure. Their effectiveness in fostering innovation and competition ultimately depends on the clarity of regulatory standards, the consistency of implementation across jurisdictions, and the capacity of both firms and supervisors to align automation with accountability.

3.2.3. Artificial intelligence

In the open-finance literature, AI allow to process data to reproduce human cognitive functions such as learning and problem solving, with machine learning improving iteratively through data-driven feedback loops; as the data corpus expands, so does the accuracy of inferences and predictions (Zetzsche et al., 2020). Within financial services, AI supports credit scoring, fraud detection, anti-money laundering (AML) monitoring, and dynamic risk assessment, translating vast data sets into actionable supervisory and business insights (El Khoury et al., 2025; Shala & Perri, 2022). Ferretti and Petkoff (2022) note, however, that algorithmic decision-making challenges long-standing principles of fairness and accountability, as profiling and predictive analytics may embed bias or opacity into automated outcomes. As a result, explainability and auditability have emerged as core preconditions for the responsible deployment of AI within both RegTech and SupTech frameworks (Buckley et al., 2020), and would probably require a broader regulatory scope as open finance integrates nonfinancial players.

3.2.4. Blockchain

In the open-finance literature, blockchain and DLTs are framed as the foundational infrastructure for programmable, tamper-resistant, and data-rich financial systems. A distributed ledger is a database consensually shared and synchronized across networks, in which transaction integrity is ensured through multi-node consensus rather than central verification. This structure distributes trust, reduces single points

of failure, and enables real-time visibility across participants. Within this architecture, blockchain protocols link records into immutable, time-stamped blocks that secure transaction history and allow verifiable sequencing of financial operations (Zetzsche et al., 2020). These infrastructures offer extensions to the tokenization of value, transforming financial or real-world assets into programmable digital representations that can be transferred, fractionalised, and traded seamlessly across networks (Lehman College & Stein Smith, 2021; Harvey & Rabetti, 2024). Tokenization extends data portability into value portability, bridging the informational and transactional layers of open finance. From an innovation standpoint, tokenization expands financial accessibility and efficiency by embedding ownership and transfer rules directly into code. Smith (2021) interprets tokenization and smart contracts as mechanisms that collapse the distance between rule and execution, automating transfers, collateralisation, and settlement. Harvey and Rabetti (2024) add that tokenized infrastructures alter market dynamics by reducing intermediation and enhancing transparency, potentially shifting competitive advantage toward more agile participants able to integrate programmable assets into new financial services. These effects align with the pro-competition and inclusion objectives of open finance, as token-based systems lower operational costs, support fractional participation, and facilitate cross-border transactions (Lehman College & Stein Smith, 2021; Harvey & Rabetti, 2024; Zetzsche et al., 2020).

Decentralized Finance (DeFi) represents the most experimental layer of this transformation: a network of programmable and composable financial services built on non-custodial architectures and on-chain settlement (Lehman College & Stein Smith, 2021; Zetzsche et al., 2020). Viewed alongside consent-based data portability, DeFi and tokenization are complementary to open-finance frameworks: while open finance regulates who may access and share data, DLTs and tokens redefine how those data and assets are stored, exchanged, and governed. In this sense, tokenization is both a technological enabler and a conceptual bridge. It operationalises the shift from digital information to digital value, extending interoperability from the informational to the transactional domain.

Yet, as the literature makes clear, programmability introduces new governance and legal challenges. The same features that remove intermediaries—immutability, autonomy, and global reach—also complicate enforcement, liability, and consumer protection. Smith (2021) and Zetzsche et al. (2020) highlight persistent vulnerabilities in smart-contract logic, oracle manipulation, and governance capture, while Ferretti and Petkoff (2022) underscore the tension between algorithmic decision-making and due process in automated systems. Moreover, as El Khoury et al. (2023) note, the growing reliance on external technology providers and cloud infrastructure to support

blockchain operations reintroduces concentration risk within supposedly decentralised systems. These risks suggest that DLTs and tokenization, while expanding efficiency and inclusion, require tailored governance frameworks to ensure accountability, interoperability, and resilience within open-finance ecosystems.

Taken together, the literature situates DLT and tokenization as the technological and economic core of open-finance innovation: infrastructures that translate data mobility into value mobility, automate the enforcement of financial logic, and enable new forms of participation. Their impact, however, depends on the alignment between programmable architectures and regulatory design—whether governance can evolve to reconcile decentralisation with consumer protection, innovation, and systemic stability (Buckley et al., 2020; Lehman College & Stein Smith, 2021; El Khoury et al., 2025; Ferretti, F., & Petkoff, P., 2022; Harvey & Rabetti, 2024).

3.2.5. Cloud

Cloud computing supplies elastic compute and storage across data centres and time zones, enabling node operations, indexing, analytics, and front ends to scale globally. As El Khoury, Alshater and Joshipura (2023) observe, cloud-based architectures enhance efficiency and resilience but introduce tech-dependency and concentration risk when critical infrastructures are dominated by a few global providers. This dependence challenges the ideal of decentralisation, creating what Harvey and Rabetti (2024) describe as a “paradox of scale,” where distributed logic relies on centralised service provision. In open-finance contexts, Grassi, Figini and Fedeli (2022) highlight that cloud integration is crucial for data interoperability and customer-centric analytics, yet also demands rigorous governance to ensure data protection, service continuity, and regulatory compliance across multi-tenant environments. Shala and Perri (2022) add that regulators increasingly rely on cloud-enabled RegTech and SupTech tools for real-time monitoring and automated reporting, expanding supervisory reach but also creating new vectors of operational risk (El Khoury et al., 2025; Grassi et al., 2022; Harvey & Rabetti, 2024; Shala & Perri, 2022; Zetsche et al., 2020). Cloud infrastructures provide scalability and computational elasticity, becoming essential as their blackouts or cyber-attacks compromise business and society. Cloud computing extends the regulatory perimeter: concentration risk in cloud ecosystems become central to the policy debate on how open finance can balance innovation, accountability, and resilience (Colangelo, G., 2024; El Khoury et al., 2025; Ferretti, F., & Petkoff, P., 2022; Grassi et al., 2022; Harvey & Rabetti, 2024; Zetsche et al., 2020).

3.2.6. Data

Data is essential within the evolving open data economy (Bonvino & Giorgino, 2026). Data act as the flywheel driving both intelligence and governance. In Zetsche et al.

(2020), data form the raw material that powers AI-based learning loops, predictive analytics, and algorithmic decision-making. Within open finance, data flows from telemetry (off-chain or on-chain ledgers, oracles) and consumer-permissioned sources, fuelling pricing, liquidation, and product personalisation.

Yet, as Ferretti and Petkoff (2022) underline, such pervasive datafication raises critical concerns about profiling, fairness, and accountability, particularly when shared across sectors without effective safeguards. Colangelo (2024) and Gupta et al. (2024) both note that fragmented API standards and inconsistent data formats limit the potential of data mobility to deliver full interoperability; standardisation and data-quality governance are thus preconditions for scalable innovation. Furthermore, Grassi et al. (2022) emphasise that firms need to develop internal data strategies and cultural capabilities to extract value responsibly from expanding datasets, aligning technological affordances with ethical and regulatory imperatives. Governance of cross-sector data flows has become central to the policy debate on how open finance can balance innovation, accountability, and resilience (Colangelo, G., 2024; El Khoury et al., 2025; Ferretti, F., & Petkoff, P., 2022; Grassi et al., 2022; Harvey & Rabetti, 2024; Zetzsche et al., 2020), especially within an open finance ecosystem (Bonvino & Giorgino, 2026).

3.3. Risks

The literature converges on a nuanced interpretation: innovation and risk in open finance are two sides of the same coin. The rapid diffusion of open banking and open finance introduces a range of operational, compliance, market, systemic, and reputational risks. The same technological infrastructures that enable innovative and competitive opportunities, also multiply the points of vulnerability within financial ecosystems.

The operational risk covers data and algorithm issues. Open finance relies on the continuous, real-time sharing of granular consumer and transactional data, a process that magnifies exposure to profiling, personalised pricing, and dark-pattern manipulation. Ferretti and Petkoff (2022) note that such risks cannot be mitigated by consent alone, since data analysis and profiling travel beyond the user's control once shared across sectors. Algorithmic decision-making amplifies these vulnerabilities: machine-learning solutions (e.g., credit scoring) or fraud detection can embed bias, drift, and opacity, producing discriminatory outcomes that are difficult to contest (Grassi et al., 2022). Without explainability and auditability requirements, AI-driven innovation risks undermining fairness, the very principle it aims to enhance (Ferretti & Petkof, 2022; Grassi et al., 2022). Siciliani (2020) emphasises that also supervisory

processes become increasingly data driven and automated, thus model dependency, real-time data exposure and the possibility of systemic vulnerabilities needs to be accounted and mitigated. However, Lee et al. (2025) show that big data, AI and real-time transaction monitoring allow financial institutions to evaluate firms' creditworthiness more accurately and to channel funds toward innovative projects. Data and technologies reduce information asymmetry and significantly increase firms' innovation output, highlighting how data-governance conditions and information infrastructures directly influence innovation dynamics (Lee et al., 2024).

The compliance risk covers identity and cybersecurity issues. Mpofu (2024) highlights that privacy risks emerge in financial ecosystems, where personal data are often handled under weak protection regimes and low digital literacy, increasing exposure to misuse, unauthorised disclosure and exploitation. Transitioning from screen scraping to secure APIs reduces one class of vulnerability but creates new ones: weak tokenization, poor consent management, and ambiguous liability allocation across banks, third-party providers, and infrastructure vendors (Colangelo, G., 2024; Odorovic, 2023). As data exchange broadens across jurisdictions, inconsistent standards introduce cross-border gaps in authentication and encryption, multiplying entry points for attacks. For example, API misuse can generate denial-of-service or data exfiltration cascades across interconnected financial ecosystems.

Despite increased transparency and standardizations, there is an emerging market risk brought by decentralised solutions. The reliance on public, permissionless blockchains improves immutability but complicates auditability and assurance; regulators, but auditors struggle to reconcile on-chain activity with off-chain financial statements in the absence of crypto-specific accounting standards (Lehman College & Stein Smith, 2021). Decentralized solutions introduce a less visible accounting, valuation, and disclosure. Smith (2021) and Vincent and Wilkins (2020) report that the sector lack of global consistency in how crypto assets are treated, accounted for, and reported, across jurisdictions. This inconsistency affects both valuation and regulatory capital treatment, hampering comparability and investor confidence. Volatility and over-collateralization further compound these exposures where sharp price movements can trigger automatic smart-contract liquidations, producing balance-sheet losses without human oversight. Thus, this intersection of accounting uncertainty and technological design underscores the need for new reporting frameworks and attestations capable of translating programmable finance into verifiable disclosure.

The systemic risk relies to the increase of global interconnectedness. Open-finance ecosystems increasingly depend on a small number of cloud and API-service providers, creating technological concentration that erodes the intended resilience of

decentralization. Łasak and Wyciślak (2024) describe the trade-off between inclusiveness and vulnerability, noting that excessive platformisation can increase dependency on large intermediaries and reduce switching capacity for smaller actors. Colangelo (2024) and Chen, Che & Wan (2024) add that heterogeneous national API standards and fragmented supervision create enforcement asymmetries, heightening the potential for regulatory arbitrage and jurisdictional gaps (Azarenkova et al., 2018; Xu et al., 2024).

The increase of data and technology vulnerabilities produces a new type of reputational risk. Open finance in whatever form increases technological security risks due to tech dependency and connectivity (Zetzsche et al., 2020). Concentration in cloud and cybersecurity providers creates turns interdependence into contagion risk (Lehman College & Stein Smith, 2021). Distributed ledgers multiply access points and link nodes producing an enormous potential attack surface. Zetzsche, Arner and Buckley (2020) explicitly warn that decentralized system vulnerability, because of the absence of support points of recovery.

Overall, open finance redistributes rather than eliminates risk. Managing these risks requires embedded safeguards across worldwide jurisdictions. Few studies quantify how regulatory clarity, complexity, or fragmentation affect innovation outcomes, firm competitiveness, or cross-border interoperability, showing a essential gap for scholars and practitioners.

3.4. Regulation and Innovation

In the open-finance landscape, regulation functions not only as an enabling architecture for innovation and competition but also as the principal mechanism through which governance, data protection, and multi-stakeholder coordination are standardised (Colangelo, G., 2024; Łasak & Wyciślak, 2024; Odorovic, 2023; Yang & Li, 2018). The literature emphasises that this enabling role is contingent on the design quality of regulatory frameworks: the extent to which rules provide clarity about rights and obligations, manage the complexity arising from overlapping governance layers, and minimise fragmentation across jurisdictions and sectors. Standardised governance measures, clear controls over data usage, and orchestrated mechanisms that align diverse actors across shared infrastructures (Cappai, 2023; Colangelo, G., 2024; Odorovic, 2023) form the foundation upon which open-finance ecosystems can mature. How regulation performs along these dimensions—clarity, complexity, and

fragmentation—critically shapes firms’ incentives, market entry conditions, and the trajectory of innovation. These three pillars therefore provide a structured lens through which to assess how regulatory architecture enables or constrains open-finance development.

3.4.1. Clarity

In the open-finance literature, regulatory clarity is consistently identified as a key enabler of innovation, market entry, and firm-level competitiveness. Clarity operates along two fronts: legal clarity—the precision and stability of rights, obligations, and liability rules—and technical clarity, namely predictable API standards, accreditation criteria, and consent architectures. When these elements are well-defined, firms face lower uncertainty and can allocate resources to product development rather than defensive compliance (Colangelo, G., 2024; Odorovic, 2023). Empirical studies reinforce this view: Ran, Rau and Ziegler (2025) show that higher legal precision in digital-finance frameworks correlates with greater fintech creation, faster adoption cycles, and deeper third-party integration. Similarly, Akyildirim et al. (2025) demonstrate that regulatory clarity improves innovation intensity by reducing ambiguity around data rights and standard-setting mechanisms. Evidence from emerging economies further underscores the role of clarity. Tan et al. (2025) show that clearly articulated digital-regulation frameworks in China—covering data sharing, rights protection, security and market competition—significantly stimulate corporate fintech innovation, particularly in investment, lending and securities services. Clear regulatory boundaries reduce firms’ uncertainty and enable them to allocate resources to innovation rather than defensive compliance. Nalluri and Chen (2024) find that in India the lack of regulatory clarity—particularly around security, liability, and API governance, acts as a direct barrier to fintech adoption, increasing uncertainty and discouraging firms from investing in digital capabilities.

Policy analyses by the International Bar Association (2024) and industry mappings (Gupta et al., 2024) reach comparable conclusions: jurisdictions with clearly articulated API governance, liability allocation, and data-sharing rules attract more investment, experience broader ecosystem participation, and move more rapidly from open banking toward open finance. Clear, predictable and proportionate regulatory environments enable FinTech providers to expand financial supply, reducing financing constraints, financing costs and information frictions, and thereby amplify firms’ innovation output (Lee et al., 2024). In this sense, clarity is not simply

administrative hygiene—it is a competitive asset that shapes the strategic environment for firms (Akyildirim et al., 2025; Gupta et al., 2024; Ran et al., 2025). Milian et al. (2019) show that issues of regulation and local legislation constitute one of the largest thematic clusters in fintech research. Their review highlights how the expansion of fintech into markets traditionally dominated by banks has intensified regulatory scrutiny, raising questions about licensing, competitive neutrality and the adequacy of existing supervisory frameworks. This suggests that regulatory clarity and proportionality are not only enablers of innovation but prerequisites for ecosystem stability (Milian et al., 2019).

Clarity reduces legal uncertainty by defining consent scope, secondary use, reciprocity of access, and liability allocation when APIs fail or third parties mishandle data, thereby lowering partnering risk and accelerating diffusion (Odorovic, 2023). Mapping studies show that predictable, well-structured regimes crowd in co-innovation, ecosystem participation, and product rebounding, reinforcing the enabling role of clarity in open-finance adoption (Briones De Araluze & Cassinello Plaza, 2022; Dinçkol et al., 2023; Gupta et al., 2024).

3.4.2. Complexity

While clarity supports innovation, regulatory complexity introduces friction by increasing compliance costs, slowing implementation, and creating uncertainty about obligations across overlapping regimes. Complexity arises from the interaction of multiple regulatory layers—financial-services conduct rules, data-protection frameworks, cybersecurity mandates, API technical standards, and sector-specific requirements. In open finance, this leads to what Odorović (2023) describes as governance overload: firms must navigate consent requirements, authentication standards, cross-sector reuse rules, and risk-management obligations that do not always align. This institutional dimension is crucial. Torres de Oliveira et al. (2020) show that the effectiveness of openness, understood as the breadth of external knowledge a firm can access, depends heavily on the coherence and complementarities of the institutional environment. In contexts where institutional arrangements are fragmented or weakly coordinated, openness can impose additional burdens rather than generating innovation, reinforcing how institutional strength shapes firms' ability to navigate regulatory and organisational complexity (Torres De Oliveira et al., 2022). Evidence from adjacent regulatory domains reinforces this dynamic. Cappai (2023), analysing the European regulatory response to crypto-assets,

shows that technologically complex environments expose the limits of traditional command-and-control regulation. Siciliani (2020) similarly argues that the increasing technological sophistication of prudential regulation, particularly the integration of predictive analytics into supervisory processes, intensifies institutional complexity. The transition toward algorithmically mediated supervision requires synchronisation between regulators, firms and technology providers, increasing the organisational burden of compliance and the coordination costs of adapting rulebooks to data-driven infrastructures. Several scholars highlight how profiling, fairness, and accountability duties under data-protection law can conflict with financial-innovation objectives, particularly as machine-learning models become central to credit scoring and fraud detection (Ferretti, F., & Petkoff, P., 2022; Odorovic, 2023).

Complexity also burdens regulators: Chen, Che and Wan (2024) note that divergent supervisory mandates and inconsistent technical expectations complicate enforcement and delay ecosystem maturation (Chen et al., 2024). Consistent evidence comes from Lee et al. (2025), who show that excessive regulatory intensity can dampen FinTech's capacity to support innovation. In their analysis, stringent or uncoordinated financial-regulation regimes constrain the ability of fintech firms to alleviate financing frictions, thereby weakening the innovation-enhancing effects of digital financial development (Lee et al., 2024).

For firms, this translates into higher integration costs and delayed time-to-market, especially when internal governance structures are not fully aligned with data-driven operations (Grassi et al., 2022). Although RegTech and SupTech tools promise to streamline compliance (Buckley et al., 2020; El Khoury et al., 2025; Shala & Perri, 2022), they also introduce second-order risks—model opacity, vendor dependency, and operational bottlenecks—that interact with rather than eliminate complexity. As a result, regulatory complexity functions as a drag on innovation, disproportionately affecting smaller actors and cross-sector entrants. On the user side, excessive consent interactions generate “consent fatigue”, undermining the legitimacy and usability of permissioned data sharing, thereby weakening the intended consumer-empowerment effect (Odorovic, 2023). Tan et al. (2025) provide complementary evidence: in China, complex or excessively stringent digital-regulation requirements dampen fintech innovation in payment and insurance services, where firms face high compliance costs and uncertain supervisory expectations. This confirms that regulatory complexity acts as a frictional force that can distort innovation incentives across different verticals (Tan

et al., 2025). Where complexity grows unchecked, firms increasingly rely on bespoke integrations and defensive compliance, slowing diffusion and raising integration friction, especially for smaller actors.

3.4.3. Fragmentation

Regulatory fragmentation across jurisdictions, sectors, and technical standards is the most structurally constraining barrier to open finance. Fragmentation occurs when API standards, consent artefacts, authentication procedures, supervisory expectations, or liability rules diverge across markets, creating friction at the points where data and services should flow most freely. The systematic review by Milian et al. (2019) documents substantial cross-country variation in fintech regulation, noting that divergent national approaches and inconsistent supervisory expectations limit the possibility of harmonised oversight. This regulatory fragmentation complicates the development of scalable fintech and open-finance models, reinforcing the need for coordinated frameworks across jurisdictions (Milian et al., 2019). As Łasak & Wyciślak (2024) show, fragmentation undermines interoperability, raises entry barriers, and reinforces the dominance of large incumbents able to absorb integration costs. Colangelo, G. (2024) and Chen et al. (2024) similarly warn that heterogeneous national API standards create enforcement asymmetries, enable regulatory arbitrage, and limit scalability of cross-border financial products. Empirical mappings from Dinçkol et al. (2023) and Gupta et al. (2024) find that ecosystems characterised by fragmented standards progress more slowly along the open-finance maturity curve, with fewer adjacent-sector extensions (e.g., insurance, pensions, wealth). Consistent with this evidence, Nalluri and Chen (2024) show that in India inconsistent regulatory practices, uneven security requirements, and heterogeneous technological baselines generate differentiated adoption costs across firms, discouraging interoperability and slowing the formation of cohesive digital-finance ecosystems (Nalluri & Chen, 2024).

Fragmentation also affects supervisory coordination: divergent interpretations of data-protection rules, cybersecurity baselines, and algorithmic-governance expectations hinder information sharing and crisis response. This is consistent with broader evidence from the open-innovation literature: Torres de Oliveira et al. (2020) show that when institutional arrangements lack coherence or complementarity, firms face higher coordination costs and reduced ability to process and integrate diverse knowledge inputs. In such environments, openness imposes friction rather than generating innovation, reinforcing the idea that fragmented institutional systems can transform

the expected benefits of open finance into additional burden for firms (Torres De Oliveira et al., 2022). Lee et al. (2025) similarly find that institutional fragmentation weakens FinTech's role in supporting corporate innovation: when regulatory frameworks are misaligned across banking, financial supervision and regional authorities, FinTech firms face limits in expanding financial supply, and the innovation benefits are substantially reduced (Lee et al., 2024). Siciliani (2019) notes that regulatory misalignment between bank-regulated entities and non-bank fintech lenders can create competitive imbalances and systemic blind spots. Bringing non-bank digital lenders within the regulatory perimeter—via shared data platforms and harmonised supervisory expectations—is presented as essential to preventing fragmentation that would undermine prudential objectives and distort incentives for innovation (Siciliani, 2020).

Evidence from developing countries confirms these structural constraints. Tan et al. (2025) show that coherent, multi-layered digital regulation—where competition, data rights, and security policies are aligned—enhances firms' capacity to innovate, while fragmented or inconsistently applied frameworks generate uncertainty that suppresses investment in digital capabilities. Their evidence highlights how institutional coherence, rather than regulatory volume, is the determining factor for fintech development (Tan et al., 2025). Mpofu (2024) shows that inconsistent regulatory frameworks, weak coordination among public authorities, and the absence of national digital-finance strategies significantly impede the rollout of digital financial services. In fragmented environments, providers face heterogeneous compliance expectations, while users experience uneven protection and limited trust, slowing ecosystem formation and widening adoption gaps (Mpofu, 2024). This multiplicity of frameworks transforms the promise of open finance, interoperability and contestability, into a patchwork of incompatible infrastructures, where firms must build bespoke connections market by market. As a result, regulatory fragmentation acts as a structural bottleneck, suppressing the network effects that make data-driven finance efficient (Chen et al., 2024; Colangelo, G., 2024; Dinçkol et al., 2023; Gupta et al., 2024; Łasak & Wyciślak, 2024).

Taken together, the literature shows that the trajectory of open-finance innovation is critically shaped by the design quality of regulation. The evidence links clarity to contestability and speed, acting as an accelerant, complexity to higher compliance and

integration costs, acting as a frictional force, and fragmentation to coordination failures, introducing structural constraints. These just mentioned are key determinants of how, and how fast, open-finance innovation diffuses. Despite the conceptual richness of this literature, important gaps remain. Empirical evidence on how regulatory clarity, complexity, and fragmentation translate into firm-level innovation, product velocity, partnership formation, or competitive outcomes is sparse and addressing these gaps is essential to understand to what extent regulatory architecture shapes innovation and competitiveness in open finance.

3.5. Theories

The literature review does not rely on a single explanatory paradigm; rather, it draws on a set of established theoretical frameworks that illuminate different aspects of data-driven financial transformation. These frameworks span information economics, platform theory, dynamic capabilities, orchestration theory, institutional and governance theory, and co-evolutionary systems thinking, providing a multidimensional explanation of how regulation and technology jointly reshape the financial sector.

3.5.1. Information asymmetries

At the foundation lies information economics, where asymmetric information (Akerlof, G., 1970) is treated as a structural source of market power. Open banking is conceptualized as a regulatory remedy to information asymmetries, lowering entry barriers by mandating data portability and reducing incumbents' informational advantage (Colangelo, G., 2024; Dinçkol et al., 2023; Ferretti, F., & Petkoff, P., 2022; Odorovic, 2023; Vives, X., 2019). Under this view, data access becomes a pro-competition instrument: the consumer right to share transaction data weakens lock-in and increases contestability. Sánchez (2022) reinforces this logic by showing how open-banking platforms expand participation among third-party providers and underserved users, consistent with the idea that removing informational bottlenecks widens market reach (Sánchez, 2022).

3.5.2. Multi-sided markets

A second theoretical anchor is platform economics, which interprets open banking as the transformation of banks into multi-sided market orchestrators (Rochet, J.-C., &

Tirole, J., 2003). Technologies become interfaces that connect data providers, fintech complementors, and end-users, shifting competition from balance-sheet size to interface quality (Briones De Araluze & Cassinello Plaza, 2022; Łasak & Wyciślak, 2024; Sánchez, 2022). APIs reduce transaction costs and enable modular innovation, reflecting core platform-theory principles, so: lower marginal costs of adding complementors, network effects that amplify participation and value creation through interoperability rather than vertical integration. This aligns with the empirical mapping of open-finance business-model clusters (Gupta et al., 2024).

3.5.3. Dynamic Capabilities

Dynamic-capabilities theory (Teece, D. J., Pisano, G., & Shuen, A., 1997) explains how firms adapt to technological and regulatory shocks, offering a useful lens for understanding why open finance requires banks and fintechs to develop new sensing, seizing and reconfiguring capabilities. In this context, firms must sense emerging data-driven opportunities, seize them through technological partnerships and reconfigure legacy architectures into modular digital infrastructures capable of supporting interoperability and continuous innovation (Grassi & Lanfranchi, 2022; Odorovic, 2023). Grassi, Figini and Fedeli (2022) show explicitly that banks' approaches to open finance, whether cautious, considered or committed, depend on internal cultural and architectural capabilities, reflecting the resource-based and dynamic-capabilities view. This perspective helps explain why regulatory clarity accelerates innovation: by reducing environmental uncertainty, it enables firms to deploy these capabilities more effectively (Grassi et al., 2022).

3.5.4. Resource orchestration

Open finance operates not as a linear value chain but as an ecosystem, making resource orchestration theory (Sirmon et al., 2011) central. Banks, fintechs, and regulators act as orchestrators who coordinate complementary actors through standards, technologies, governance protocols, and liability frameworks (Briones De Araluze & Cassinello Plaza, 2022; Łasak & Wyciślak, 2024).

Often, the APIs serve as coordination mechanisms, and regulators shape participation through accreditation, reciprocity rules, and interoperability requirements (Colangelo, G., 2024; Odorovic, 2023). In this sense, orchestration theory explains why fragmentation of standards suppresses network effects and why regulated interoperability is essential to ecosystem scaling (Dinçkol et al., 2023; Gupta et al., 2024) showing evidence of the need to understand how regulatory frameworks impact the

structuring, bundling, and leveraging of resources to achieve innovation and competition.

3.5.5. Innovation-diffusion and co-innovation

Open finance is also framed through innovation-diffusion (Rogers, E. M., 1962) and co-innovation theories. Technology-enabled openness allows both incremental and radical innovation, depending on organisational enablers such as cross-functional teams and experimentation platforms (Gupta et al., 2024; Rahadian et al., 2023). Banks and fintechs act as complementary innovators, where collaboration and competition coexist, a dynamic consistent with co-innovation models and Schumpeterian creative destruction. Regulators, in turn, become learning institutions, adjusting rules iteratively through guidance, experimentation, or sandboxes (Briones De Araluze & Cassinello Plaza, 2022; El Khoury et al., 2025).

3.5.6. Institutional theory

The DeFi literature introduces network theory and institutional technology perspectives. Zetzsche, Arner & Buckley (2020) conceptualise decentralised finance alter coordination, trust, and risk propagation. Smith (2021) and Harvey & Rabetti (2024) show how programmable finance can complement, but not replace, regulated data portability, creating hybrid architectures that blend decentralised execution with permissioned access governance (Lehman College & Stein Smith, 2021; Harvey & Rabetti, 2024; Zetzsche et al., 2020).

3.6. Future Research

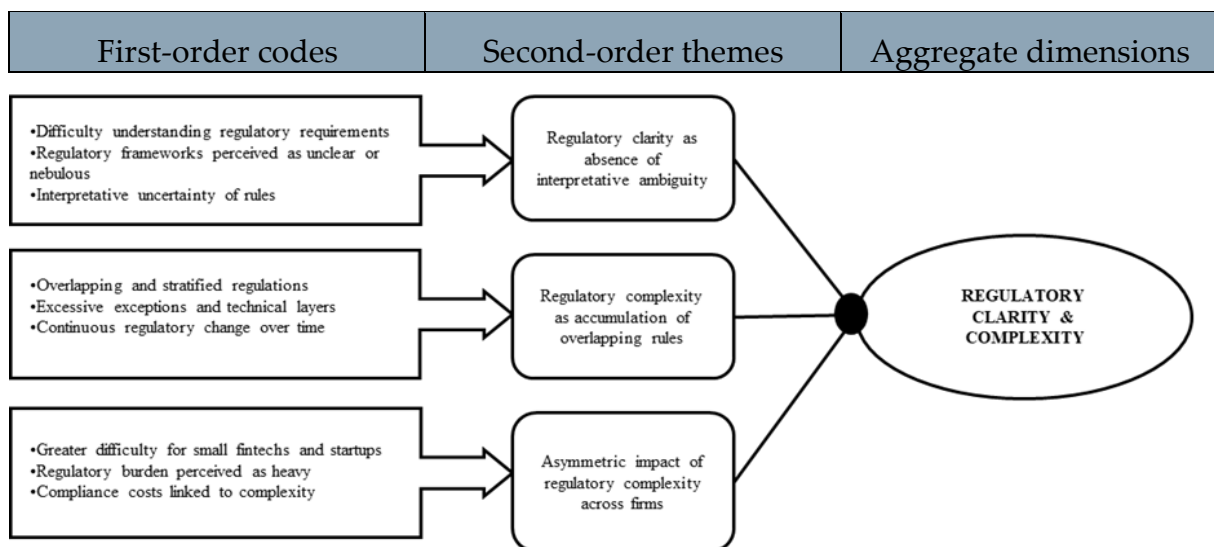
Across the reviewed contributions, several recurring future research directions are explicitly identified. A first stream calls for cross-country and cross-jurisdictional analyses to examine how regulatory standards, including API frameworks, evolve differently across institutional contexts and how fragmentation affects implementation and supervision. A second set of studies highlights the need to investigate embedded and cross-jurisdictional regulatory models, particularly in emerging domains such as decentralised finance, where supervisory coordination remains underdeveloped. Third, scholars emphasise the importance of analysing how RegTech ecosystems can be purposefully designed and how experimental governance mechanisms, including regulatory sandboxes and participatory regulatory approaches, can balance innovation and risk. Finally, multiple contributions call for empirical assessment of the

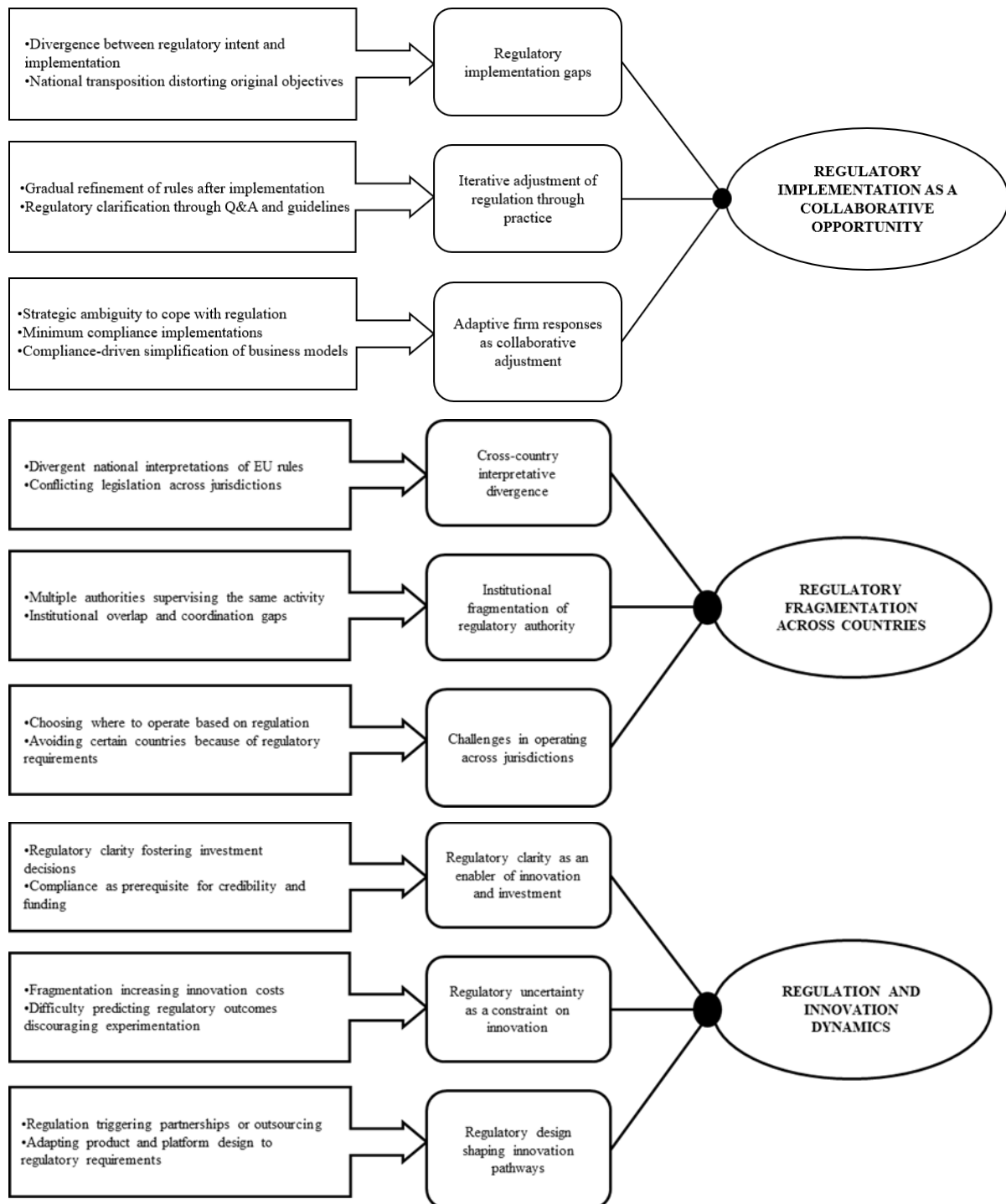
competitive effects and economic costs associated with mandated data sharing regimes.

Taken together, these research directions point to the need for systematic frameworks capable of linking regulatory design choices, coordination mechanisms, and innovation and competition outcomes across jurisdictions.

4 Findings

This section presents the main empirical findings emerging from the qualitative analysis of the interview data. Building on the data structure illustrated in Figure 2, the findings are organised around six aggregate dimensions that capture how regulatory and data governance frameworks shape the development of open banking and open finance initiatives. These dimensions reflect recurring patterns in how actors interpret regulatory requirements, manage data-related resources, and respond to regulatory clarity, complexity, and fragmentation in practice. Together, the findings highlight the mechanisms through which regulation influences the design, implementation, and scaling of data-sharing initiatives across different institutional and organisational contexts.





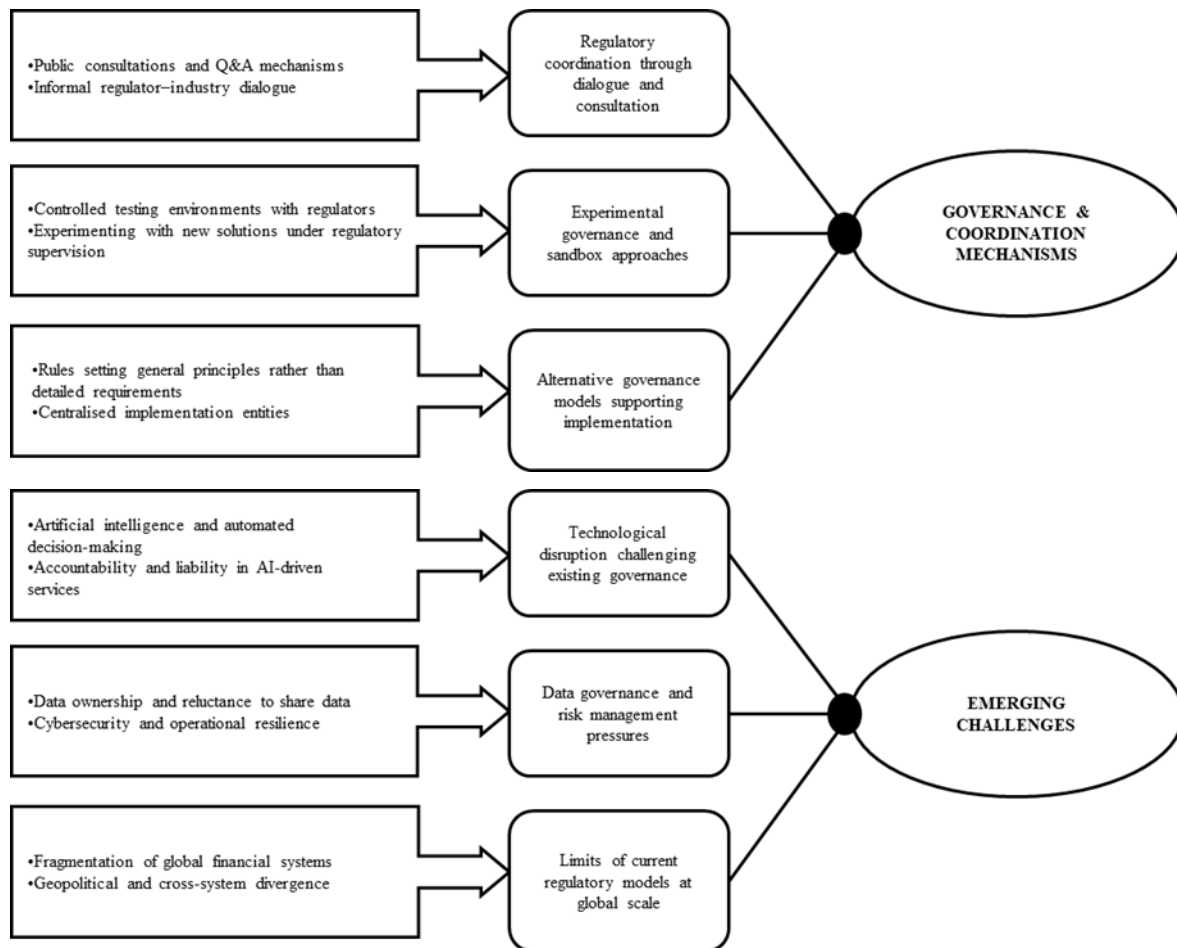


Figure 3 Data structure of the qualitative analysis

4.1. Regulatory clarity & complexity

This aggregate dimension captures how interviewees perceive and experience regulatory clarity and regulatory complexity as foundational conditions shaping open banking and open finance initiatives. Across interviews, clarity and complexity consistently emerged as intertwined characteristics of the regulatory environment, influencing how actors understand regulatory requirements, assess compliance risks, and allocate resources to data governance and implementation activities. Rather than being treated as purely formal attributes of regulation, clarity and complexity were described in operational terms, reflecting how rules are interpreted, applied, and managed in day-to-day practices.

The findings show that regulatory clarity is primarily associated with the absence of interpretative ambiguity and the ability of actors to anticipate how rules will be enforced, while regulatory complexity is linked to the accumulation of overlapping requirements, technical layers, and frequent regulatory changes.

When discussing regulatory clarity and complexity, interviewees often implicitly referred to jurisdictional context, even when not explicitly comparing countries. Rather than framing clarity and complexity as fixed properties of regulation, respondents described them as dependent on how regulation is interpreted and operationalised in specific contexts. From this perspective, jurisdictions are not experienced merely as legal boundaries, but as environments characterised by different degrees of predictability, flexibility, and coordination.

4.1.1. Regulatory clarity as absence of interpretative ambiguity

Across interviews, regulatory clarity is consistently associated with the absence of interpretative uncertainty, rather than with the simplicity of the rules themselves. Several interviewees emphasised that difficulties arise not from the existence of regulation per se, but from unclear or ambiguous interpretation of regulatory requirements. One respondent explicitly defined clarity as “the extent to which people understand the rules of the financial system they are working in” (Interviewee A).

Similarly, regulatory clarity was described as the ability of regulation to be translated unambiguously into operational and technological requirements. In this sense, clarity refers to the extent to which regulatory provisions can be directly mapped onto concrete technical solutions, system architectures, and implementation choices. As one interviewee stated, clarity means an “unequivocal translation into technologies” (Interviewees G, L), highlighting that unclear rules create uncertainty at the level of system design and slow down implementation efforts.

Others highlighted that the core issue is “not the rule itself, but the interpretative uncertainty” (Interviewee C), stressing that ambiguity generates costs and slows down implementation efforts.

In several cases, respondents explicitly characterised existing frameworks as unclear or nebulous, noting that “saying that it is still quite nebulous is an understatement” and that “we still have not understood a whole series of things” (Interviewee H). Overall, clarity emerges as a condition in which regulatory expectations are stable, understandable, and applicable in a coherent manner.

4.1.2. Regulatory complexity as accumulation of overlapping rules

Regulatory complexity is primarily described as the result of overlapping, stratified, and continuously evolving regulations. Interviewees repeatedly referred to the presence of multiple regulatory layers, technical standards, and exceptions that accumulate over time. One respondent described the regulatory environment as “formed by different layers that over the years have become more technical and more complicated” (Interviewee G, L), while another referred to a “storm of regulation” (Interviewee G, L) that market operators struggle to follow.

Complexity was also associated with the proliferation of exceptions and technical specifications. As one interviewee explained, “regulatory complexity is when there are too many exceptions to one rule” (Interviewee H), highlighting how difficult it becomes for firms to navigate regulatory requirements in practice. Multiple interviewees emphasised that regulatory complexity increases over time as new rules, technical standards, and clarifications are added to existing frameworks.

Several respondents stressed that even when individual rules may be understandable, their interaction generates frictions, as “they intersect and create layers of friction” (Interviewee J). This accumulation of overlapping requirements contributes to implementation difficulties and increases the overall burden on firms.

4.1.3. Asymmetric impact of regulatory complexity across firms

The interviews reveal that regulatory complexity has a highly asymmetric impact across firms, particularly affecting smaller fintechs and startups. Multiple respondents observed that understanding and complying with regulation is “quite difficult, especially for smaller fintechs” (Interviewee E), and that compliance efforts tend to weigh more heavily on organisations with limited resources.

Several interviewees linked complexity directly to higher compliance costs, noting that firms are often forced to “focus more on hiring legal advisors or lawyers” (Interviewee A). Others highlighted that complexity translates into significant investments in resources and capabilities, with one respondent stating that “a complex regulation requires significant investments in resources and competences” (Interviewee B).

This asymmetry was also framed in terms of market structure, with interviewees describing the fintech ecosystem as “a two-speed market” (Interviewee C), where larger or more established firms are better positioned to absorb regulatory burdens, while smaller players struggle to scale. Overall, regulatory complexity emerges as a factor that disproportionately constrains smaller firms, reinforcing unequal competitive conditions within the ecosystem.

4.2. Regulatory implementation as a collaborative opportunity

This aggregate dimension captures the space for collaboration that emerges between regulatory design and regulatory implementation in open banking and open finance. Interviewees consistently described how the practical application of regulation requires ongoing interaction between market participants and regulators in order to translate regulatory intent into effective operational practices. Rather than representing a misalignment, this dynamic was framed as an opportunity for joint learning and adaptive refinement. Through structured collaboration, feedback loops,

and continuous dialogue with regulators, market actors can contribute to clarifying standards and improving implementation processes, ultimately supporting the shared objective of a more effective and resilient regulatory framework.

4.2.1. Regulatory implementation gaps

Interviewees frequently described divergences between regulatory design and practical implementation, particularly in relation to national transposition of European rules. One interviewee observed that “the PSD2 has an objective of simplicity, but the Italian transposition goes against this,” describing implementation as “a cumbersome, complex transmission, sometimes impossible” (Interviewee H). Similarly, another respondent noted that “every country has declined it in a slightly different way” (Interviewee J), pointing to variability in how regulation is operationalised across jurisdictions.

These divergences were often associated with uncertainty and operational difficulties. One interviewee explained that “deviations between the normative text and practical application are frequent in the initial phases of implementation,” adding that “after consultation some parts of the technical standards were changed” (Interviewee B). Another respondent stated that “a regulation that is uncertain generates difficulties and associated costs” (Interviewee C).

Taken together, these accounts highlight a persistent gap between regulatory intent and implementation practices. While interviewees primarily described the existence and consequences of this misalignment, their experiences suggest that reducing interpretative uncertainty requires mechanisms of ongoing interaction and clarification between regulators and market participants. In this sense, the implementation gap can be interpreted as a space in which collaborative alignment becomes necessary to preserve regulatory objectives and improve practical applicability.

4.2.2. Iterative adjustment of regulation through practice

A second recurring theme concerns the iterative nature of regulatory implementation, whereby rules are progressively refined after being introduced. Interviewees described regulation as evolving through continuous interaction between regulators and market participants, rather than being fully defined *ex ante*. One respondent highlighted that industry actors “contribute to the EBA Q&A” (Interviewee G, L), while another explained that regulators “work with guidelines, Q&A and recommendations to clarify these requirements” (Interviewee B).

Several interviewees emphasised that regulation evolves after its initial introduction. As one respondent stated, “whatever comes initially from a regulator gets refined after some time” (Interviewee I). In this sense, implementation itself becomes a source of regulatory learning, with rules being adjusted in response to emerging issues and

market feedback. This iterative refinement was associated with the technical complexity and novelty of open banking and open finance initiatives, requiring firms to remain flexible and continuously update their compliance approaches.

4.2.3. Adaptive firm responses as collaborative adjustment

The interviews reveal that firms respond to regulatory implementation gaps through adaptive organisational strategies aimed at navigating uncertainty and maintaining effective compliance. Rather than positioning themselves in opposition to regulators, companies were described as adjusting their practices to operate within evolving regulatory environments. One interviewee noted that “many operators, to contain costs, implement minimal solutions” (Interviewee G, L), highlighting how firms calibrate their implementation efforts in response to compliance requirements.

At the same time, adaptation was frequently linked to the development of dialogue with regulatory actors. One respondent emphasised the importance of “promoting a dialogue between the market and regulators,” advocating for “a dialogue that can be informal, simple, direct” and capable of providing operational support (Interviewee E). Another interviewee stressed that “there’s a constant dialogue between the regulators and the firms” (Interviewee D), suggesting that firm adaptation occurs within an ongoing process of interaction rather than in isolation.

From a regulatory perspective, collaboration with firms was also recognised as valuable. One respondent explained that “the contribution of firms is relevant to calibrate requirements and avoid disproportionate effects on innovation” (Interviewee B). These accounts indicate that adaptive responses are embedded in a broader ecosystem of mutual adjustment, where firms refine their strategies while contributing to the practical shaping of regulatory implementation.

4.3. Regulatory fragmentation across countries

This aggregate dimension captures how regulatory fragmentation across countries emerges as a salient feature of open banking and open finance governance. Across interviews, respondents consistently described fragmentation as the result of differences in how regulatory frameworks are interpreted, applied, and supervised across jurisdictions. Rather than being limited to formal divergences in legislation, fragmentation was experienced in practical terms, affecting coordination among authorities and firms’ ability to operate across national boundaries.

4.3.1. Cross-country interpretative divergence

Interviewees repeatedly highlighted that a key source of regulatory fragmentation lies in divergent national interpretations of the same regulatory frameworks, particularly

at the European level. One respondent noted that “every country has declined it in a slightly different way” (Interviewee J), while another emphasised that interpretative differences emerge “when you leave room for interpretation” (Interviewee G, L).

This divergence was often linked to inconsistencies across jurisdictions. One interviewee explicitly referred to the existence of “conflicting legislations between the countries” (Interviewee D), while another observed that regulatory approaches are “not uniform across the board” (Interviewee D). Similarly, one respondent explained that “in some countries regulation is applied very rigidly, in others a bit less” (Interviewee K).

Taken together, these accounts suggest that firms operating across borders face uncertainty regarding how rules are interpreted and enforced in different national contexts, reinforcing perceptions of regulatory fragmentation even within formally harmonised regimes.

4.3.2. Institutional fragmentation of regulatory authority

Beyond interpretative differences, interviewees also associated regulatory fragmentation with institutional overlap among supervisory authorities. One respondent observed that “there can be multiple authorities under one umbrella” and referred to the involvement of “SAMA, royal police, ministry of commerce” in supervising related activities (Interviewee I). Similarly, another interviewee described fragmentation as arising from “numerous pieces of legislation covering the same subject matter” (Interviewee K).

Interviewees also pointed to variation in supervisory approaches. One respondent highlighted “different interpretations and different levels of severity from supervisory authorities” (Interviewee K), while another noted that “there are spaces of autonomy for individual authorities” (Interviewee E). These accounts suggest that firms must navigate a complex institutional landscape in which overlapping mandates and autonomous supervisory practices contribute to perceived regulatory fragmentation.

4.3.3. Challenges in operating across jurisdictions

The interviews further reveal that regulatory fragmentation translates into concrete challenges for firms operating across jurisdictions. Several respondents explained that firms make strategic decisions about market presence based on regulatory conditions. One interviewee noted that “there can be jurisdictions that are more favourable than others” and that “firms take these evaluations into account” (Interviewee E).

In some cases, fragmentation leads firms to avoid specific markets. As one respondent stated, “companies simplify their life by cutting off citizens from certain countries” (Interviewee D). Operating across borders was also described as requiring differentiated organisational arrangements, with one interviewee observing that

fragmentation “leads firms to structure themselves differently even just to provide services a few hundred kilometres away” (Interviewee K).

Overall, respondents stressed that such frictions generate “a limitation to internationalisation” (Interviewee G, L), reinforcing the idea that regulatory fragmentation complicates seamless cross-border activity within the open banking and open finance ecosystem.

4.4. Regulation and innovation dynamics

This aggregate dimension captures how regulation shapes innovation dynamics in open banking and open finance. Across interviews, respondents described regulation as playing a dual role: on the one hand, regulatory clarity and compliance were associated with credibility, investment readiness, and the ability to attract funding; on the other hand, regulatory uncertainty and fragmentation were described as factors increasing costs and discouraging experimentation. In addition, interviewees highlighted how regulatory design directly influences firms’ innovation pathways, affecting organisational choices, partnerships, and product or platform configurations.

4.4.1. Regulatory clarity as an enabler of innovation and investment

Several interviewees emphasised that regulatory clarity plays a critical role in enabling innovation and investment by reducing uncertainty for investors and firms. One respondent noted that “investors are very attentive to compliance” (Interviewee E), while another stressed that “compliance has become a fundamental requirement to be credible in the eyes of investors” (Interviewee C).

Regulatory clarity was also directly linked to investment decisions. As one interviewee observed, “clarity switches an investment on or off” (Interviewee G, L), while another explained that “regulatory clarity reduces uncertainty and fosters innovation” (Interviewee B). Together, these accounts frame regulatory clarity not as a constraint, but as a condition that supports innovation by enabling trust, legitimacy, and access to financial resources.

4.4.2. Regulatory uncertainty as a constraint on innovation

In contrast, interviewees also described how regulatory uncertainty constrains innovation, particularly when outcomes are difficult to anticipate. One respondent observed that “if every six months a new interpretation comes out it becomes a problem for innovation” (Interviewee J). Similarly, another interviewee emphasised that “an uncertain regulation generates difficulties” and that “regulatory complexity is perceived as the main obstacle” (Interviewee C). Additional uncertainty was reflected in the perception that “we still haven’t understood a whole series of things” (Interviewee H), highlighting the challenges firms face in interpreting evolving requirements.

Fragmentation across jurisdictions was described as further amplifying these constraints. One interviewee noted that highly fragmented and complex regulation leads to “higher costs and disincentives to investment” (Interviewee G, L), while another explained that “complexity and fragmentation increase compliance costs” (Interviewee B). Regulatory unpredictability was also linked to the continuous issuance of guidance, with one respondent observing that “every authority sends continuous guidelines that effectively function as rules” and that “this generates complexity and uncertainty” (Interviewee J).

Together, these accounts suggest that regulatory uncertainty and fragmentation require firms to dedicate substantial resources to compliance management, reinforcing more cautious and risk-aware approaches to innovation.

4.4.3. Regulatory design shaping innovation pathways

The interviews further show that regulatory design actively shapes how firms organise and implement innovation. Several respondents described how regulatory requirements influence organisational choices and collaboration strategies. One interviewee referred to firms that “wanted to develop an activity in house” but “decided to create collaborations with other actors” (Interviewee E), suggesting that regulatory considerations can redirect how innovation activities are structured.

Regulatory design was also described as directly affecting operational and technological configurations. One respondent noted that regulatory requirements can be “extremely time-consuming and economically burdensome” (Interviewee K), while another observed that “the requirements on reserve of assets directly influence how companies invest deposits” and that “this choice directly affects the business strategies of issuers” (Interviewee B).

Together, these accounts indicate that regulation does not merely influence whether firms innovate, but shapes how innovation is organised in practice, affecting organisational arrangements, investment strategies, and the structure of business models.

4.5. Governance & coordination mechanisms

This aggregate dimension captures the governance and coordination mechanisms through which regulatory requirements are discussed, tested, and operationalised in open banking and open finance. Across interviews, respondents described governance not only as a formal set of rules, but also as a collection of interaction mechanisms between regulators and market participants. These mechanisms include dialogue and

consultation practices, experimental approaches such as sandboxes, and alternative governance models aimed at facilitating implementation.

4.5.1. Regulatory coordination through dialogue and consultation

Interviewees frequently referred to dialogue and consultation mechanisms as important tools for coordinating regulatory interpretation and implementation. One respondent observed that “there are many public consultations now for the introduction of new regulations” and that “the market and trade associations are listened to” (Interviewee C). From a regulatory perspective, another interviewee explained that “when we develop a law we publish it for consultation and banks can signal aspects that require clarification” (Interviewee B).

In addition to formal consultations, interviewees emphasised the relevance of direct interaction with regulators. One respondent advocated “promoting a dialogue between the market and regulators” and described the need for “a dialogue that can be informal, simple, direct” (Interviewee E). Similarly, another interviewee stressed that “there’s a constant dialogue between the regulators and the firms” (Interviewee D).

Together, these accounts indicate that ongoing interaction between regulators and market participants plays a central role in clarifying expectations and supporting regulatory implementation, particularly in complex and evolving innovation contexts.

4.5.2. Experimental governance and sandbox approaches

A second recurring theme concerns the use of experimental governance mechanisms, particularly regulatory sandboxes and controlled testing environments. One interviewee described how “we create a sandbox, a controlled environment with real data” and explained that “if it is working fine, the regulator will include that into their policies” (Interviewee I). This perspective highlights how testing environments function as spaces where experimentation and regulatory learning occur simultaneously.

The relevance of supervised experimentation was also reflected in references to institutional initiatives designed to support innovation. One respondent referred to “Milano HUB (an incubator of projects in which fintech operators test and define projects)” (Interviewee G, L), emphasising the role of structured environments in facilitating the practical development of innovative solutions.

Together, these accounts frame experimental governance as a pragmatic response to uncertainty, enabling gradual learning and supporting the operationalisation of regulatory frameworks in innovation-intensive contexts.

4.5.3. Alternative governance models supporting implementation

Interviewees also referred to alternative governance models that support regulatory implementation, particularly those based on higher-level principles or more centralised coordination. One respondent contrasted different regulatory styles by observing that “the United Kingdom sets principles rather than regulations” and that “your law system is stricter than the United Kingdom” (Interviewee A), highlighting differences between principle-based and more prescriptive approaches.

Other interviewees emphasised the role of coordination and centralisation in reducing implementation divergence. One respondent explained that “we are moving towards harmonisation and centralisation to avoid different approaches” (Interviewee G, L). Similarly, another interviewee referred to the United Kingdom, noting that “in the United Kingdom there was an entity managing the implementation of open banking” (Interviewee J), suggesting that dedicated coordinating bodies can facilitate more consistent implementation.

Together, these accounts indicate that alternative governance arrangements, whether principle-based or centrally coordinated, are perceived as mechanisms that can reduce ambiguity and support more coherent regulatory implementation.

4.6. Emerging challenges

This aggregate dimension captures the emerging challenges that interviewees expect to become increasingly relevant for open banking and open finance in the near future. Across interviews, respondents pointed to technological developments, data-related risks, and broader systemic transformations as sources of pressure on existing regulatory and governance frameworks. These challenges were described not as distant or abstract, but as issues already affecting current practices and decision-making.

4.6.1. Technological disruption challenging existing governance

Interviewees frequently referred to artificial intelligence as a major emerging challenge for current governance arrangements. One respondent described AI as “a game changer” (Interviewee C), while another emphasised that “the AI has changed the cards completely” (Interviewee H), highlighting the transformative impact of automated technologies on financial services.

A recurring issue concerns responsibility and accountability in AI-driven environments. One interviewee explicitly raised the question of “who is responsible for what and who is accountable” (Interviewee I), while another referred to “the theme of responsibility when advisory services will be delivered through AI” (Interviewee G, L). These concerns were echoed by respondents who pointed to the growing

centrality of “big data and artificial intelligence” in shaping future financial systems (Interviewee J).

Together, these accounts frame AI-driven decision-making as a technological shift that introduces new governance challenges and raises unresolved questions about responsibility, oversight, and regulatory adaptation.

4.6.2. Data governance and risk management pressures

A second emerging challenge concerns data governance and risk management, particularly in relation to data ownership, data sharing, and operational resilience. One interviewee explicitly raised the issue of “who is owning the data” (Interviewee I), highlighting persistent uncertainty around data governance responsibilities. Related concerns were also reflected in observations that “banks are reluctant to share their data” (Interviewee I), suggesting that ambiguity around data control affects openness and collaboration.

Respondents further pointed to growing attention to operational and security risks. One interviewee emphasised the importance of “operational resilience and data security” (Interviewee C), while another referred to “silent infrastructural innovation” (Interviewee H), pointing to the need for underlying infrastructure capable of supporting secure and resilient systems.

Together, these accounts indicate that challenges in data governance are closely intertwined with broader concerns about operational robustness and risk management in increasingly data-intensive financial ecosystems.

4.6.3. Limits of current regulatory models at global scale

Interviewees also pointed to broader systemic challenges affecting financial regulation at a global level. One respondent referred to “the separation or the creation of alternative systems of global finance” (Interviewee D), while another noted that “country to country, it depends on that particular jurisdiction” and that “there is not a set of standard rules applied everywhere” (Interviewee I), highlighting the fragmented structure of global regulatory environments.

Some interviewees emphasised the pace of technological and systemic change. One respondent observed that “technological development will dramatically change the environment” (Interviewee D), suggesting increasing pressure on regulatory systems to adapt. In a more cautious perspective, another interviewee added that “I don’t see major revolutions” (Interviewee F), pointing to uncertainty regarding how global governance frameworks will evolve.

Together, these accounts suggest perceived limits of existing regulatory models when confronted with global fragmentation and rapid technological transformation, raising open questions about the future governance of open banking and open finance.

5 Discussion

This discussion integrates the empirical findings with Resource Orchestration Theory to develop a conceptual framework for regulatory design in open banking and open finance. Resource Orchestration Theory, as developed by (Sirmon et al., 2011), explains how managers structure, bundle, and leverage firm-level resources to achieve competitive advantage. While the theory has primarily been applied to managerial action within firms, it provides a powerful logic for understanding how actors intentionally coordinate and deploy resources to generate performance outcomes.

Building on this foundation, the present study extends the orchestration perspective beyond the firm level to the regulatory ecosystem. Rather than focusing on managers as resource orchestrators, the framework conceptualises regulators as ecosystem-level orchestrators who shape the institutional and infrastructural conditions under which firms innovate and compete. In this view, regulatory standards, governance mechanisms, interpretative practices, and collaborative infrastructures function as orchestrated resources that influence ecosystem-level innovation dynamics. The framework synthesizes the main dimensions emerging from the analysis and translates them into a structured model that explains how regulatory action can support incremental and sustainable innovation and strengthen ecosystem competitiveness. The resulting Regulatory Resource Orchestration Framework is presented in Figure 4 and serves as the analytical structure guiding the discussion that follows.

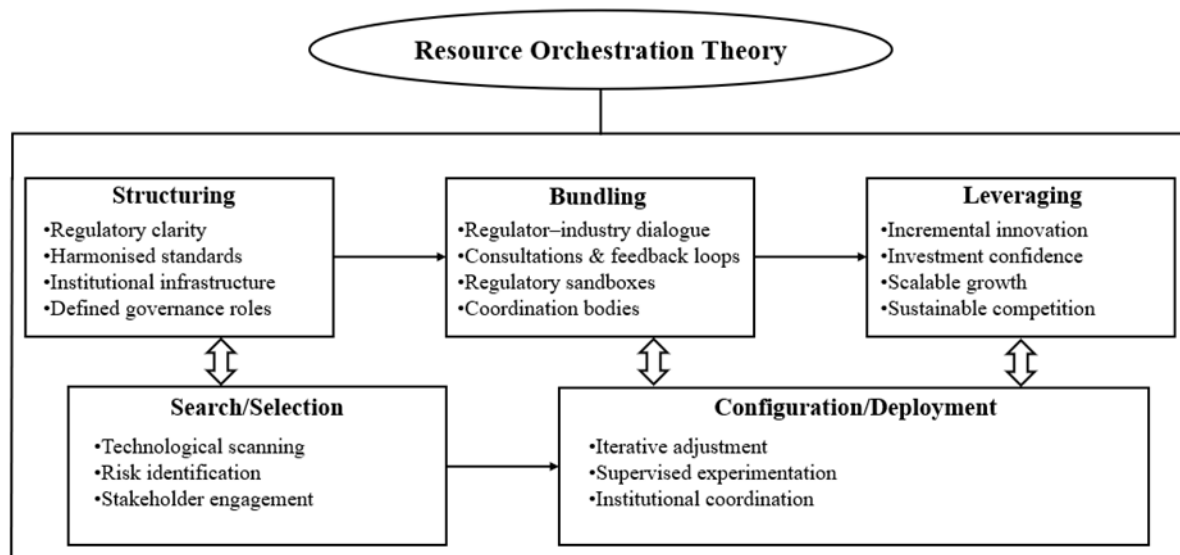


Figure 4 Innovative Framework

5.1. Structuring

The structuring phase concerns the design of a regulatory infrastructure capable of reducing uncertainty and enabling coordinated innovation. This dimension directly builds on the aggregate findings related to regulatory clarity, fragmentation, and implementation gaps. The results show that ambiguity and divergent interpretations create uncertainty and increase compliance costs, while clearer and more harmonised frameworks support investment and innovation. Structuring therefore involves the intentional creation of simplified and interpretable regulatory architectures, coordinated standards, and clearly defined governance roles. In line with the findings on regulatory implementation and fragmentation, this phase emphasises the importance of institutional infrastructures, such as shared interpretative mechanisms and experimental environments, that stabilise expectations and create a predictable foundation for ecosystem development.

5.2. Bundling

Bundling refers to the integration of regulatory and market actors through collaborative governance mechanisms. This phase is grounded in the aggregate dimension highlighting regulatory implementation as a collaborative opportunity. The findings consistently emphasise the central role of dialogue, consultations, sandboxes, and coordination platforms in aligning regulatory intent with practical implementation. Bundling therefore captures how regulators actively connect diverse stakeholders, transforming fragmented governance elements into an integrated

system. Through structured interaction and mutual learning, bundling reduces interpretative divergence and supports adaptive refinement of regulatory frameworks, as observed in the empirical evidence on iterative implementation processes.

5.3. Leveraging

Leveraging represents the stage at which orchestrated regulatory resources translate into observable ecosystem-level outcomes. This dimension builds directly on the empirical findings linking regulatory clarity and coordinated governance to investment confidence, credibility, and incremental innovation. The results show that well-structured and collaboratively governed regulatory environments reduce perceived risk, stabilise expectations, and enable firms to pursue scalable innovation strategies. In this sense, leveraging conceptualises regulation not as a constraint, but as an enabling mechanism that channels entrepreneurial activity toward sustainable growth.

Importantly, the leveraging phase also captures how regulatory orchestration shapes ecosystem competitiveness. Here, competitiveness does not refer to firm-level rivalry, but to the capacity of regulatory ecosystems to attract innovation, investment, and entrepreneurial activity. The findings indicate that regulatory clarity, coordinated standards, and collaborative governance mechanisms lower uncertainty and reduce entry and scaling barriers for firms. Jurisdictions that provide clearer and more predictable regulatory environments therefore become more attractive locations for experimentation and growth. Through this process, regulatory orchestration strengthens ecosystem competitiveness by shaping the structural conditions that allow firms to innovate and scale more effectively. Rather than directly regulating competition between firms, the framework highlights how regulatory design influences the competitive positioning of entire ecosystems relative to one another, generating cumulative innovation effects that reinforce long-term ecosystem development.

5.4. Search and selection

Search and selection concern the continuous identification of emerging technological and systemic challenges requiring regulatory attention. This phase is grounded in the aggregate findings on emerging risks and future governance challenges, including artificial intelligence, data governance, and global fragmentation. The results highlight how rapid technological evolution and geopolitical dynamics create areas of uncertainty that demand proactive regulatory scanning. Search and selection therefore

involve structured engagement with innovation trajectories and stakeholder perspectives, enabling regulators to prioritise interventions that support incremental and sustainable ecosystem development.

5.5. Configuration and deployment

Configuration and deployment refer to the practical translation of regulatory strategies into operational governance arrangements. This dimension builds on findings related to iterative implementation, adaptive learning, and experimental governance. The results show that regulatory frameworks evolve through practice, feedback loops, and supervised experimentation. Configuration therefore emphasises flexible implementation mechanisms that allow continuous adjustment and coordination across institutions. By sustaining alignment between regulatory objectives and market realities, this phase supports the long-term effectiveness and resilience of the governance ecosystem.

5.6. Academic implications

This study contributes to the literature by addressing several empirical and conceptual gaps identified in prior research on open banking and open finance. Existing scholarship repeatedly highlights the importance of regulatory clarity, complexity, and fragmentation, yet provides limited empirical evidence on how these dimensions translate into firm-level innovation outcomes and ecosystem dynamics. As noted in the literature review, empirical evidence linking regulatory architecture to innovation, partnership formation, and competitive performance remains limited, leaving a significant gap in understanding how regulatory design shapes managerial behaviour.

The Regulatory Resource Orchestration Framework developed in this thesis responds directly to this gap by offering an integrative model that connects regulatory design features to resource orchestration processes and observable innovation outcomes. By framing regulators as ecosystem orchestrators, the framework applies Resource Orchestration Theory beyond its traditional firm-level focus to explain how regulatory design shapes entire innovation ecosystems. This perspective helps bridge the gap between regulatory studies and management research by showing how governance structures influence firms' strategic behaviour and innovation outcomes, particularly in explaining why different jurisdictions develop distinct innovation trajectories.

Furthermore, prior systematic reviews acknowledge that existing research has only limitedly examined how regulatory design features influence firms' strategic behaviour and competitive dynamics in open-finance ecosystems. The framework

proposed here addresses this limitation by mapping empirical findings onto the orchestration processes of structuring, bundling, leveraging, search, and configuration. In doing so, it provides a structured explanation of how regulatory infrastructures, collaborative governance mechanisms, and adaptive implementation practices shape ecosystem-level innovation.

More broadly, the study advances academic debates by reframing regulation as an active design variable rather than a passive constraint. While much of the literature treats regulation primarily in terms of risk mitigation or compliance burdens, this research demonstrates how regulatory architectures can be deliberately orchestrated to foster incremental and sustainable innovation. This perspective opens new avenues for research on ecosystem governance, platform regulation, and institutional design, encouraging scholars to examine regulation as a dynamic component of innovation systems rather than as an external boundary condition.

5.7. Practitioner implications

The framework offers practical guidance for both firms and regulators seeking to enhance innovation and competition in open banking and open finance ecosystems.

For firms, the findings suggest that regulatory engagement should be treated as a strategic capability rather than a purely compliance-driven function. Prior research shows that fragmented and unclear regulatory environments create uncertainty and suppress investment in digital capabilities. The framework therefore provides a structured approach for firms to navigate this environment by actively contributing to regulatory clarification through collaborative governance mechanisms, such as participation in Q&A processes, consultations, and ongoing dialogue with supervisory authorities.

In practical terms, firms can use the framework to embed regulatory interaction into their innovation processes, participate actively in sandboxes and consultations, and align product development with evolving governance priorities. By engaging in collaborative bundling processes with regulators, firms can reduce interpretative uncertainty, accelerate experimentation, and co-develop standards that support scalable growth. This approach transforms regulatory interaction from a defensive necessity into a proactive source of competitive advantage.

For regulators, the framework provides a roadmap for designing governance architectures that actively enable innovation and strengthen ecosystem competitiveness. The literature and empirical findings show that fragmented and

poorly coordinated regulatory systems increase uncertainty and weaken both innovation capacity and cross-border scalability. The framework translates these insights into actionable principles: creating clear and interpretable regulatory foundations, harmonising standards and interpretations, reducing institutional fragmentation, and institutionalising collaborative governance mechanisms.

Crucially, the framework emphasises the role of adaptive and experimental governance. By embedding continuous feedback loops, using supervised experimentation, and iteratively refining regulatory frameworks, regulators can align policy objectives with rapidly evolving technological landscapes. These practices support learning on both sides of the ecosystem and reduce the risk that regulation lags behind innovation.

Ultimately, sustainable ecosystem development emerges when firms and regulators operate within a shared orchestration logic. Continuous dialogue, joint experimentation, and coordinated deployment of regulatory tools enable both sides to co-create resilient, innovation-friendly, and competitive ecosystems. This collaborative model is particularly relevant in environments characterised by rapid technological change and global fragmentation, where isolated regulatory action is insufficient to support long-term ecosystem growth.

6 Conclusions

This thesis set out to investigate how regulatory clarity, complexity, and fragmentation in open banking and open finance shape innovation and competition across different regulatory frameworks. Building on a systematic literature review and a qualitative analysis of expert interviews, the study contributes to ongoing academic and policy debates by clarifying the mechanisms through which regulatory design affects the orchestration of data resources in data-driven financial ecosystems.

The literature review highlighted that open banking and open finance have evolved from narrowly defined competition remedies into broader data-governance infrastructures that reshape financial intermediation, platform dynamics, and innovation trajectories. While existing research extensively documents technological enablers, API architectures, and ecosystem roles, it remains fragmented in explaining how specific regulatory design features translate into firm-level innovation incentives and competitive outcomes. In particular, regulatory clarity, complexity, and fragmentation are frequently invoked in the literature but rarely integrated into a coherent analytical framework capable of explaining how regulation shapes managerial and organisational choices in practice.

To address this gap, the thesis adopted resource orchestration theory as its central interpretive lens. This perspective conceptualises value creation not as the mere possession of resources, but as the outcome of deliberate actions aimed at structuring, bundling, and leveraging resources over time. In the context of open banking and open finance, data emerge as a strategic resource whose value depends critically on how regulatory and governance frameworks shape access, interoperability, liability, and coordination among ecosystem actors. Regulation, therefore, is not treated as an exogenous constraint, but as a constitutive element of the resource environment that conditions how firms and regulators orchestrate data, technologies, and partnerships.

The empirical findings provide a clear answer to the research question by showing that regulatory design directly shapes innovation and competition through its impact on resource orchestration processes.

First, findings demonstrate that regulatory clarity functions as an enabling condition for effective resource structuring bundling and leveraging. Interviewees consistently associated clarity not with the absence of regulation, but with the absence of interpretative ambiguity and the ability to anticipate how rules will be enforced. When regulatory expectations are clear and stable, firms can structure their data resources, technological architectures, and organisational capabilities with confidence, allocating investments toward product development, partnerships, and scaling rather than defensive compliance. In resource orchestration terms, clarity lowers uncertainty around resource deployment and enhances firms' ability to leverage data across use cases and markets. This mechanism explains why regulatory clarity is repeatedly linked to credibility, investor confidence, and innovation readiness in open banking and open finance ecosystems.

Second, the analysis shows that regulatory complexity operates as a friction in resource bundling processes. Complexity arises from the accumulation of overlapping rules, technical layers, and continuous regulatory change, which increase coordination costs and slow implementation. Firms must bundle data resources with legal expertise, compliance infrastructures, and risk-management capabilities, often diverting resources away from innovation activities. Importantly, the findings reveal that this burden is asymmetric: smaller fintech and startups face disproportionately higher costs, limiting their ability to compete and scale. From a resource orchestration perspective, complexity constrains firms' capacity to recombine resources flexibly and efficiently, thereby dampening competitive dynamics and reinforcing incumbent advantages.

Third, the findings highlight that regulatory implementation gaps represent a key opportunity to strengthen cross-border resource orchestration through collaboration. Differences in national interpretations, institutional overlap among authorities, and inconsistent supervisory practices reveal areas where greater coordination and interaction can enhance interoperability and enable firms to leverage data resources more effectively across jurisdictions. Rather than being treated solely as structural constraints, these gaps create spaces for joint learning in which regulators and market participants can progressively clarify standards and improve operational practices. By promoting shared interpretative mechanisms, coordinated governance, and collaborative implementation processes, regulatory systems can support more integrated ecosystem-level orchestration.

In response to implementation gaps, firms and regulators engage in adaptive and collaborative adjustment processes that generate opportunities for mutual learning. Through ongoing dialogue, feedback loops, and iterative refinement, firms contribute practical insights while regulators adjust interpretative guidance to improve feasibility and proportionality. When supported by structured collaboration mechanisms, these interactions facilitate more effective cross-border coordination, accelerate the diffusion of implementation knowledge, and strengthen ecosystem maturity. In this sense,

implementation gaps function not only as challenges to be managed, but as collaborative arenas through which ecosystem actors continuously improve how resources are orchestrated and how regulatory frameworks evolve over time.

Beyond these structural features, the findings also show that regulatory implementation is an iterative and adaptive process, rather than a linear translation of regulatory intent into practice. Misalignments between regulatory design and implementation generate uncertainty, prompting firms to adopt conservative strategies such as minimum compliance, simplification of business models, or strategic ambiguity. At the same time, governance mechanisms such as dialogue, consultation, and sandbox environments emerge as critical coordination tools that partially mitigate these gaps. These mechanisms enable collective learning and incremental adjustment, illustrating how regulation itself becomes an object of orchestration through interaction between regulators and market participants.

Finally, the analysis identifies emerging developments, such as AI-driven decision-making, evolving data governance models, and shifts in the global financial landscape, that call for more advanced and adaptive regulatory approaches. Rather than merely stressing existing regulatory models, these dynamics highlight the increasing relevance of effective resource orchestration in technologically complex and interconnected ecosystems. As questions of accountability, liability, and resilience become more prominent, they create opportunities to refine governance structures and strengthen coordination mechanisms.

The findings indicate that adaptive governance arrangements, capable of aligning technological innovation with regulatory objectives through feedback loops, experimentation, and continuous dialogue, can ensure that open banking and open finance fulfil their pro-competitive and innovation-enhancing potential. In this perspective, emerging technological and systemic challenges act not only as pressures on regulation, but as catalysts for more sophisticated, resilient, and forward-looking orchestration of financial ecosystems.

Taken together, this thesis demonstrates that innovation and ecosystem competitiveness in open banking and open finance are not determined by regulation *per se*, but by how regulatory design orchestrates institutional, technological, and data-related resources at the ecosystem level. Building on Resource Orchestration Theory, the study extends the orchestration logic beyond the firm to conceptualise regulators as ecosystem-level orchestrators who structure, bundle, and leverage governance mechanisms to shape innovation outcomes.

In doing so, the thesis contributes to the literature by bridging regulatory analysis and managerial theory, showing how regulatory infrastructures influence firms' strategic behaviour, investment decisions, and scaling capabilities across jurisdictions. By reframing regulation as an enabling and orchestrated resource rather than a static constraint, the framework helps explain why similar technological opportunities

generate divergent innovation trajectories and levels of ecosystem competitiveness in different regulatory environments.

For regulators, the findings highlight the importance of designing governance architectures that foster clarity, coordinated standards, collaborative implementation, and adaptive learning mechanisms. Embedding feedback loops, supporting supervised experimentation, and reducing institutional fragmentation are not merely compliance improvements, but strategic levers for strengthening ecosystem-level innovation and competitiveness.

For firms, the study underscores the value of treating regulatory engagement as a strategic capability. Integrating continuous dialogue with supervisory authorities, participating in experimental governance environments, and developing adaptive orchestration capabilities allow firms to navigate uncertainty more effectively, scale innovation across jurisdictions, and contribute to the co-evolution of regulatory frameworks.

Ultimately, the success of open banking and open finance depends not only on opening access to data, but on orchestrating governance, institutional coordination, and organisational capabilities in a structured and collaborative manner. As financial ecosystems continue to globalise and digitise, the ability to align technological evolution with adaptive regulatory orchestration will become an increasingly decisive factor in shaping sustainable and competitive innovation ecosystems.

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A Appendix A

A.1. Interview protocol

This appendix presents the semi-structured interview protocol adopted for the qualitative phase of the study. The protocol was designed to ensure consistency across interviews while allowing sufficient flexibility to explore context-specific insights related to regulatory clarity, complexity, fragmentation, governance mechanisms, and innovation dynamics in open banking and open finance ecosystems.

The questions were grounded in the theoretical framework of Resource Orchestration Theory and aimed at capturing how regulatory design influences the structuring, bundling, and leveraging of data-related resources in practice. The protocol included open-ended questions covering regulatory interpretation, implementation challenges, cross-border coordination, innovation strategies, governance mechanisms, and emerging risks.

Each interview was recorded and subsequently transcribed to ensure accuracy in the qualitative analysis, with the exception of one interview, which was not recorded but documented through detailed contemporaneous notes.

Below, the full list of questions used during the interviews is reported.

Professional role and operational context

1. Could you please describe a time you worked on an initiative or project involving the sharing of financial data, third-party access, or interoperability across financial services?
2. Based on your experience, how would you define open banking? And open finance?
3. If any, in your day-to-day work, which parts of the regulatory framework do you deal with most often?

Regulatory clarity

4. In the initiatives you mentioned, how easy was it to understand the regulatory requirements? And what could be done to make them clearer?
5. How might these initiatives have unfolded if firms had taken the lead in shaping solutions and standards, rather than mainly responding to regulatory

requirements, or if there had been closer collaboration with regulators from the outset?

6. In your experience, how would you define regulatory clarity

Regulatory complexity

7. When you think about the current regulatory environment, which aspects do you find most difficult (e.g.,) for industry actors to navigate in practice?
8. Have you come across situations where the way regulation is meant to work differs from how it actually plays out in the market? What factors do you think contribute to these gaps?
9. In your experience, how would you define regulatory complexity

Regulatory fragmentation

10. From your perspective, do differences in how regulatory authorities interpret, coordinate, or enforce regulatory requirements create frictions for firms? How do these differences tend to shape firms' behaviour?
11. Do you notice meaningful variation across countries or segments of the financial industry in how regulatory frameworks are put into practice? What do you see as the main reasons behind these differences?
12. In your experience, how would you define regulatory fragmentation

Impact on innovation and competition

13. Based on your experience, how do these regulatory features (clarity, complexity, fragmentation) influence firms' incentives to innovate?
14. Could you describe a concrete episode or example where regulatory design affected a firm's innovation decisions or market interactions?
15. In your view, under what conditions does have you seen real cases of innovation or edge or revenue increase or cost reduction ?
16. Conversely, what conditions tend to limit or distort its impact?

Implementation frameworks across jurisdictions

17. Would you consider other governance models for inspiration e.g., from other countries? Why?

Emerging challenges

18. What emerging challenges do you expect to become more relevant in the next 2–3 years?

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