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Fintech framing financial ecologies: Conceptual and policy-related implications

Marta Gancarczyk[1], *Óscar Rodil-Marzábal*[2]

Abstract

PURPOSE: *Financial ecologies (FEs) are place-based governance forms of financial services provision, currently undergoing a transformation through financial technologies (Fintech). The idea of FEs is socially and economically relevant, since they reach toward underserved or excluded market segments and intermediate for territorial development across industries and sectors of private and public entities. At the same time, the FE remains at the early stage of conceptualization and empirical corroborations, in particular regarding how Fintech affects its core elements and related policy implications. In response to the theoretical and practical relevance, and early stage of theorizing the recent Fintech developments in the FE, this article aims to identify how Fintech frame FEs and to propose the resulting conceptual and policy-related implications.* ***METHODOLOGY:*** *To frame the FE concept, we used the methodological lens of construct clarity principles and the concept reconstruction. The research method includes a systematic literature review of 48 publications selected from Scopus and WoS databases.* ***FINDINGS:*** *We have analyzed the concept of FE according to its major elements and related concepts. The FE remains at the intersection of other outcome-oriented ecosystems that focus on territories, but it can also be treated as an independent phenomenon and research object. The idea of FE has been shaped by Fintech-driven developments in all its constituent elements with conceptual and policy consequences formulated as a set of propositions.* ***IMPLICATIONS:*** *The findings are relevant for future theory development and empirical corroborations of the FE. They can also enhance the integration of research communities of practice to accumulate knowledge. Despite standardization brought about by technological innovations, the availability, usefulness, and effects*

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of financial ecosystems depend on the multiscalar spatial contexts that differ in socio-economic and institutional dimensions. ***ORIGINALITY AND VALUE:*** *First, the article frames the understanding of FE as financial services governance based on technological advancements and focused on territorial projects and communities. Second, the FE concept was clarified according to major properties and relationships to other adjacent ideas of spatial networking for socioeconomic development. Third, propositions and research areas were formulated for further investigations.*
Keywords: *financial ecologies, financial ecosystems, Fintech, financial technologies, policy-related implications*

INTRODUCTION

Financial technologies are understood as ICT-based financial innovations and business entities based on these innovations (Lai & Samers, 2021; Langley & Leyshon, 2021; Wójcik, 2021b). Like other technological innovations, Fintech not only influences technical parameters of products and services, but also transforms the economic organization of firms and industries (Baldwin, 2020; Sanchez & Mahoney, 2013). ICT solutions in the financial sector complement the existing services (e.g., payment platforms), substitute human work and tangible assets (e.g., robo-advisers), and generate new solutions (e.g., mobile wallets). Furthermore, Fintech transcends borders and geographical frontiers, as exemplified by crowdfunding in financial centers accessible to start-ups and growth firms from peripheral locations (Bonini & Capizzi, 2019; Spigel, 2022). However, the ongoing digital transformation of financial services has a strong spatial and multiscalar dimension and takes various forms and outcomes, depending on the socioeconomic and institutional specifics (Leyshon, 2020; Baranauskas, 2021; Coe, 2021).

The financial sector has recently been conceptualized as a financial ecosystem to reflect its exposition to dynamics and occasional disruptive change (Leyshon, 2020). Within a broadly defined financial ecosystem, two interrelated structures can be identified according to spatial characteristics (Gancarczyk, Łasak, & Gancarczyk, 2022; Lai, 2020). The first comprises global networks of financial centers and large investment banks, that is, global financial networks (GFNs), largely spanning over the borders of countries and regions (Coe, Lai, & Wójcik, 2014; Coe, 2021). The other forms are financial ecologies as segments of the financial ecosystem that are delimited by particular territories (Lai, 2016; Leyshon et al., 2004; Leyshon et al., 2006; Langley & Leyshon, 2020).

Being subunits of the financial ecosystem, FEs represent interrelated financial intermediaries and other economic agents, focused on the provision and access to financial services in particular territories (Beaverstock et al.,

2013; DawnBurton, 2020; Lai, 2016; Leyshon et al., 2004; Leyshon, 2020). In this vein, FEs can be considered as governance modes comprising private and public entities, such as banks, Fintech, BigTech, public agencies, enterprises, and customers, and relationships among these entities. The actors and relationships are delimited by a given location, such as a region or city (Langley, 2016; DawnBurton, 2020; Chen & Hassink, 2021; Appleyard, 2020).

The relevance of the FE concept is based on the disproportionate outcomes that small ecologies may raise for comprehensive systems, as evidenced by the subprime market failure in the USA, affecting the subsequent financial and economic crisis of 2007-2009 (Leyshon, 2020), with relevant effects on many economies such as the European economy (Rodil-Marzábal & Menezes-Ferreira-Junior, 2016). Therefore, investigating small but critical points within the larger financial ecosystem is crucial for policy. It is also theoretically justified since the financial ecosystem has been predominantly studied as a general abstraction of the financial sector. Subsystems remain less explored, especially in the granularity of the spatial context.

Since FEs are context-specific and undergo co-evolutionary dynamics with this context, they also transform as a phenomenon and a concept (Lai, 2020; Wójcik, 2021a). One of the main influences comes from the recent technological developments raised by Fintech. The growing empirical evidence in this area calls for understanding consequences for the FE construct (Welch, Rumyantseva, & Hewerdine, 2016) and adequate policy responses. Resonating with the said research gaps and an early stage of the development of the FE idea, this article aims to identify how Fintech frames FEs and propose the related conceptual and policy implications.

To frame the FE concept, we use the methodological lens of construct clarity principles (Suddaby, 2010; Simsek et al., 2017) and concept reconstruction (Welch et al., 2016). The method includes a systematic literature review, which represents a unique approach, since the existing theorizing of FEs has been either in the form of conceptual papers or narrative reviews (Lund et al., 2016).

Our findings raise conceptual and policy-related contributions. First, the article conceptually reframes the understanding of FE as financial services governance enhanced by technological advancements and focused on territorial projects and communities. Second, the concept of FE was clarified according to its main elements and its relationships with other adjacent ideas of spatial networking for socioeconomic development. Third, research propositions and areas for further investigation were proposed.

In the following, we present the literature review to justify our aim and research questions. The methodology section presents the conceptual lens for our discussion of the FE as a construct shaped by Fintech; it also

specifies the method of a systematic literature review. Results, discussion, and conclusion proceed in the next sections.

CONCEPTUAL FOUNDATIONS

Financial ecosystems were institutionally introduced to the policy framework and gained widespread recognition in research since the Federal Reserve Bank of New York conference in 2006 (Leyshon, 2020). FEs have become a new theoretical abstraction of the financial services sector as an alternative to the neoclassical equilibrium-based doctrine (Leyshon, 2020). The main difference was in acknowledging radical dynamics within the sector treated as an ecosystem with a diverse and flexible set of financial intermediaries, institutional investors and supporting entities, such as exchanges, data providers, and regulators (Bose, Dong, & Simpson, 2019). The abstraction of complex adaptive systems has often been recalled as a broad framework to understand the functioning and change in the financial sector. Consequently, theoretical perspectives of evolution and coevolution, and in particular, the network governance concept to cope with complex coordination issues, demonstrate explanatory power in studying FEs (Chen & Hassink, 2021; Ponte & Sturgeon, 2014; Chen & Hassink, 2021, 2020; Coe & Yeung, 2019).

The lens of the financial ecosystem was intended to provide concepts and methods that would address environmental and regulatory shocks and prepare for future breakthrough changes to the financial system (Leyshon, 2020; Fasnacht, 2018). Furthermore, within this idea, the classical goals set for the financial sector, such as optimizing capital allocation, matching savers and investors, and signaling scarcity and abundance, were expanded by sustainability and social responsibility goals that go beyond purely economizing (Bose et al., 2019; Fasnacht, 2018).

The focus on the financial ecosystem as a model or abstraction of the financial sector predominated over what is the core of ecosystems, the interrelated actors embedded in particular socio-economic and institutional environments (Strumeyer & Swammy, 2017; Bose et al., 2019; Lai, 2020; Wojcik, 2021). Although the legal frameworks of financial ecosystems are intensely studied, the remaining context, such as socioeconomic environment and informal institutions, remain much less explored (Gancarczyk et al., 2022). These contextual factors are specific to individual territories within the financial ecosystem (Ponte & Sturgeon, 2014; Chen & Hassink, 2021, 2020; Coe & Yeung, 2019).

Since the systemic approach assumes interrelations and mutual influences among its parts, changes or weaknesses in a subsystem affect the

whole. A painful recognition for this gap happened just after the indicated 2006 turn to the financial sector as an ecosystem, with the shock of the 2007-2009 crisis. The latter originated in the smaller subunit of the ecosystem of the US subprime market. The following pandemic and political breakthroughs, as well as technological developments, raised new challenges, adaptations, and structural changes to the financial ecosystem (Leyshon, 2020). However, they were implemented differently in different spatial contexts, which stimulated a more granular approach of the financial ecosystem as a collection of place-based subsystems, that is, financial ecologies (Lai, 2016). Another justification for the more place-based perspective is that localized supply chains might require localized financial systems or ecologies (Sarawut & Sangkaew, 2022). Wójcik and Iannou (2020) argue that local and regional financial centers are expected to lose their position, and that the territories outside the core regions and financial centers will have to rely on retail banking and the public sector to fund investment and sustainable development. These smaller ecologies will coexist with global financial networks, which are worldwide networks of financial centers and investment banks (Lai, 2020).

The concept of FE originated in the field of economic geography to reflect the spatial specifics and uneven distribution of financial ecosystems, and to address the crucial issues in financing for the particular territorial populations, such as inclusion, financialization, surveillance, and over-indebtedness (DawnBurton, 2020). Consequently, the FE concept *recasts the financial system as a coalition of smaller constitutive ecologies, such that distinctive groups of financial knowledge and practices emerge in different places with uneven connectivity and material outcomes* (Lai, 2016). The relevance of the FE phenomenon and concept consists of a more fine-grained approach to understanding uneven access to financial services and uneven connectedness to the financial system (DawnBurton, 2020; Leyshon, 2020). Furthermore, research on FEs signals weak and strong points in subsystems that can affect the efficiency of the entire financial system.

FEs represent interrelated financial intermediaries and other economic agents focused on the provision of and access to financial services in particular territories (Leyshon, 2020). As systemic phenomena, they comprise both actors and their relationships, in which actors form various configurations of private and public entities, such as banks, public agencies, enterprises, and customers. The actors and relationships are delimited by a given location that forms a spatial context, that is, a set socioeconomic conditions of a territory, be it a region, city, or a country, and acknowledging multiscalar contexts (Langley, 2016; DawnBurton, 2020; Chen & Hassink, 2021; Appleyard, 2020). The context of a particular ecology should also be considered in a wider, multiscalar perspective. Multiscalarity of the context

is an idea that advocates a multilevel analysis of a spatial unit (Chen & Hassink, 2021). The example of this approach is a regional financial ecology that should be analyzed in the context of the region, country, and relevant international environments. Due to the multiscalar perspective, spatially focused FEs do not lose a broader framework of the financial system in larger units and globally (Chen & Hassink, 2020).

Taking into account the nature of the FE presented above, the main elements of this construct include actors, relationships among actors, outcomes, and contexts. While the scope of actors and contexts has been outlined above, the systemic relationships and outcomes of the FE require further explanation. The FE relationships are often captured as governance, whereby governance represents the sets of institutions (rules, norms) that affect the functioning of a particular socioeconomic system and its efficiency (Colombo, Dagnino, Lehmann, & Salmador, 2019; Ostrom, 1986; Williamson, 2000). In this vein, governance can be described according to the rules of collaboration and competition, and power relations (Lai, 2018). Types of governance range from the firm to hybrids, such as networks, and to markets (Gereffi, Humphrey, & Sturgeon, 2005; Williamson, 2000). The outcomes of FE represent the terms of and access to financing, with a more general effect on financial inclusion or exclusion and on the overall territorial development.

With the wider financial systems, FEs share such constitutive elements as actors and their relationships centered around financial services supply and demand (Bose et al., 2019; Fasnacht, 2018; Lai, 2020). Moreover, they similarly focus on the coordination of the system through the lens of governance (DawnBurton, 2020; Langley & Leyshon, 2021). However, FEs also demonstrate some unique characteristics in relation to wider financial ecosystems, such as clear delimitation of a territorial space, be it a city, region, or country, and acknowledgment of an associated socioeconomic and institutional context (DawnBurton, 2020; Leyshon et al., 2004).

The focus on a particular territory does not ignore the systemic nature of economic relationships in the globalized world, since FEs are considered in a multiscalar context (Chen & Hassink, 2020; Leyshon, 2020). Connectivity of given populations to a broader financial system becomes one of the major issues to ensure the infusion of external sources (Coe et al., 2014). The focus on relationships between commercial banks and retail customers, as well as underserved and unbanked individuals or enterprises, differentiates FEs from GFNs (Beaverstock et al., 2013; Coe et al., 2014; DawnBurton, 2020). The latter consider global networks of investment banks and financial centers liaising over peripheral and noncore territories (Coe et al., 2014; DawnBurton, 2020; Lai, 2018). This global perspective is also related to the governance approach

in the framework of global value chains, which extends to financial activity (Milberg, 2008; Coe et al., 2014; Seabrooke & Wigan, 2017).

The emphasis on socioeconomic effects for disadvantaged market segments and particular industries and projects represents an additional feature of FEs as outcome-oriented systems. While financial ecosystems are primarily targeted at economic efficiency and stability of the system itself, FEs emphasize territorial target groups and projects (Langley, 2016; Langley & Leyshon, 2017). Regarding governance, the focus of FEs has been on network governance of a complex and multi-actor adaptive system (Leyshon, 2020). Network governance is considered not only from the perspective of power relations and resource allocation, but also from learning and financial practices (Lai, 2016).

As evolutionary and dynamic phenomena, financial ecosystems and FE undergo substantive and conceptual developments. One of the ongoing breakthrough transformations stems from Fintech. Financial ecosystems are increasingly reconceptualized as the ultimate mode of financial services governance transformed by financial technologies (Wójcik & Ioannou, 2020; Łasak & Gancarczyk, 2022; Gancarczyk et al., 2022). Similarly, the intensive development of FEs is closely related to technological changes that enable a flexible establishment of new forms of cooperation between economic entities (Arsanian & Fischer, 2019). Fintech increase efficiency and availability of existing and launch of new financial products (Hill, 2018; Livesey, 2018; Nicoletti et al., 2017; Sabatini, Cucculelli, & Gregori, 2022; Scardovi, 2017). However, negative effects are also reported, such as over-indebtedness of risky customers, Fintech surveillance, and exclusion of some customers due to computer illiteracy (Kong & Loubere, 2021; Łasak & Gancarczyk, 2021; Brooks, 2021). The economic and social outcomes of the emerging FEs transformed by Fintech have not been fully understood and systemized (Langley & Leyshon, 2021; Wójcik, 2021b).

Given technological influences, the FE undergoes developments in its core elements, i.e., actors, governance, and outcomes, acknowledging spatial contexts. Despite the increasing stock of empirical findings that describe the impact of Fintech on the functioning of FEs, we lack a synthesis reflection to reconsider FEs from this perspective. Therefore, we formulate the following research questions:

RQ1) How does Fintech affect the FE phenomenon in the area of its actors, governance, and outcomes in various spatial contexts?

RQ2) What are the conceptual and policy-related implications of Fintech influencing FEs?

METHODOLOGY

Our methodology follows the principles of construct clarity (Suddaby, 2010; Simsek et al., 2017; Mazzei, 2018) and reconceptualization of existing constructs (Welch et al., 2016). Construct clarity principles are intended to ensure that a given concept is well formed and described. Since this research aims to explain how Fintech frames the FE phenomenon and concept, we need to acknowledge all the constitutive dimensions of FE affected by Fintech comprehensively. Welch et al. (2016) propose that the review of extant case-based studies informs own research to reconsider the concept. We adapt this approach to form a synthesis from the review of empirical research on FEs that is by nature case-based, since delimited by the contexts of particular locations.

According to Suddaby (2010), the principles of concept clarity are as follows.

i) The definition of the concept should properly reflect the essential properties of the phenomenon. Guided by this principle, we will check whether and how the core elements of FE have been affected by Fintech. We will consider the following elements of FE described in the Conceptual Foundations. Namely, we will focus on the actors (entities forming FEs), governance (rules of competition and cooperation, public and private involvement, governance modes of market, hybrid, and the firm), as well as outcomes (financial inclusion or exclusion, territorial development), and contexts (spatial units defining FEs).

ii) Clear constructs are coherent, not only in their definitions but also per logical relationships among their elements or dimensions. Consistent with this recommendation, we describe the relationships among the FE elements affected by Fintech. Thus, we follow the systemic approach by embracing the elements of the system (actors) and their interrelationships captured as governance.

iii) The scope conditions of the concept need to be acknowledged, such as temporal and spatial aspects. Following this principle, we will recognize the socioeconomic contexts of FEs transformed by Fintech and derive policy implications.

iv) Clear constructs should explicate relationships with other adjacent constructs relevant to understanding the phenomenon. Consequently, we explore how the Fintech transformation of FEs is described through adjacent concepts.

The principles of clarifying how Fintech affects the FE are coherent with the RQs. Namely, principles (i), (ii), and (iii) will directly guide the exploration of RQ1 that focuses on the impact of Fintech on the actors, governance,

outcomes, and contexts of FEs. The exploration of RQ2 will follow principle (iv) regarding conceptual implications and principles (i)-(iii) regarding policy implications of Fintech transforming FEs.

Based on the above assumptions, a systematic literature review was designed (Lund et al., 2016; Tranfield, Denyer, & Smart, 2003). The review was performed in Scopus and WoS, widely used as comprehensive and complementary data sources. The search was done in the period from 2000 till the present, since the first conceptualizations of the FE were published after 2000. The selection of sources was not limited to journal articles, but also included books and conference papers due to the early phase of the research on FEs.

The search embraced the following expression: *"finan* ecosystem*"* or *"finan* ecolog*"* or *"Fintech* ecosystem*"* or *"Fintech* ecology,*"* sought in the title, abstract, and key words of Scopus, and in the abstracts of WoS. The rationale for choosing this search key was to cover not only the term of FE, but also spatially defined financial ecosystems, since the initial screening revealed the studies applying these terms interchangeably or as synonymous with the delimitation of FE through a clearly defined territory (Lai, 2020). A similar conjunction of the meaning can be found with Fintech ecosystems or Fintech ecologies. As territorially bounded, they are equivalent to industrial clusters of Fintech businesses' agglomerations in particular territories, thus forming an ecology of financial services provision backed by territorial socioeconomic structures (Wójcik, 2021a). Since we sought to study systemic relationships and not merely the occasional presence of Fintech, the keywords of Fintech ecosystems or Fintech ecologies were chosen.

The search in Scopus yielded 359 results, which were later refined to 153 by excluding the subject areas beyond the core fields of social sciences, such as medical, computer, chemistry, or a pharma sciences. We found that publications beyond social science do not address our research purpose and the search criteria that seek understanding of transformation of FEs as social systems rather than the technical side of financial innovations. After removing reviews, notes, erratum and retracted papers, and limiting the sample to English-language publications, we obtained a set of 136 sources. The search in WoS produced 83 results, which were fully filtered according to the same criteria and limited to 70 relevant references. In the next step, the two sets of Scopus and WoS were merged to remove repetitions, which resulted in the intermediate sample of 128 items for a comprehensive analysis (Hiebl, 2021).

The initial four key terms were useful to possibly expand the number of relevant references. When selecting the intermediate sample, we followed the four keywords as alternative and necessary but still not sufficient to address the nature of the phenomenon we were studying. Therefore, the

ultimate selection sought to retain those empirical studies that comprise the core properties of FE, including the focus on financial services provision and absorption in a given spatial context and with a variety of stakeholders involved. Given the focus of this research, the recognition of Fintech as technologies or businesses was also a necessary selection criterion. Therefore, the final selection embraced empirical studies that are best suited to reflect the core of the FE concept or can be treated as 'most likely' manifestations of FEs affected by financial technologies (Welch et al., 2016). Based on this procedure, we accomplished the final sample of 48 items, including 41 peer-reviewed journal articles, two books, two book chapters, and three conference papers.

In the next step, we performed theoretical (selective) coding, based on the coding themes originating from the principles of construct clarity and the crucial elements of FEs (Villiger, Schweiger, & Baldauf, 2021). The coding was manual; we tabulated quotes and paraphrases according to the main coding themes (Locke, Feldman, & Golden-Biddle, 2022). The coding themes included the actors, outcomes, governance, and spatial context described as affected by Fintech. We separately analyzed the results for each theme and, ultimately, by the iterative process of matching theory and empirical findings, we formulated analytical generalization as a set of propositions (Piekkari & Welch, 2018; Silverman, 2015; Yin, 2018).

RESULTS

Fintech framing actors in financial ecologies

Actors are considered the core of FEs, since their power and interests determine types of governance and outcomes from these systems. Fintech affects both the number (density) and composition of actors in FEs and their roles (Table 1). Regarding density, we observe an increase in the number of players in ecosystems (Alijani & Karyotis, 2019; Lai, 2020; Senyo et al., 2022). Taxonomies of FE participants include banks, nonbank financial institutions (venture capital, hedge funds, asset managers), Bigtech, Fintech startups, state entities, industry partners, financial regulators, investment community, B2B, social entrepreneurs and non-profit organizations, and customers (Alijani & Karyotis, 2019; Dalal, 2022; Grafe, 2020; Lehner, 2021; Moskalenko et al., 2022; Purkayastha, Tripathy, & Das, 2020; Zhang-Zhang, Rohlfer, & Rajasekera, 2020). The increased number of actors is due to new, ICT technology-based entrants and a broadened opportunity to participate in financing projects by established entities using technology means, such as incumbent banks offering online services or mobile banking, and international development institutions.

Table 1. Fintech and actors in financial ecologies

Spatial context	Findings	Selected references
Global reach with the emphasis on spatial differences	Complex interactions among stakeholders with opposing objectives and antagonistic assets; the role of social enterprises in the concurrent pursuit of social objectives and sustainable business	(Alijani & Karyotis, 2019)
London, UK, retail services for elites	A prime segment of financial services market: investment bankers, corporate lawyers, senior employees in finance-related advanced producer and professional service firms, and private equity and hedge fund partners who have played a significant role in shaping processes of financialization	(Beaverstock et al., 2013)
Food entrepreneurs operating less than three years in the USA	Actors perform decision-making within a dense web of relationships, including buyers and sellers, and non-human actors (algorithms).	(Carolan, 2019)
Financial ecologies of urban infrastructure provision in London (UK) and Mumbai (India)	'Avatars' are a colony from one ecology within another. Avatars represent a new financial market expertise that evaluates and abstracts local projects to standardized metrics; the latter determines a viability and financing of the project. Information among actors is not equal and transparent, leading to power asymmetries.	(Grafe, 2020)
The cases of the ecologies generated by the Singaporean bank DBS and the British bank RBS	Critically evaluated the potential of Fintech to banks' disintermediation; banks continually setting the rules of competition and collaboration. Five main types of actors in Fintech ecosystems: banks, non-bank financial institutions (venture capital, hedge funds, asset managers), Bigtech, Fintech startups, state entities	(Lai, 2020)
Ecosystem of microfinance institutions (MFIs) in India	Lax regulations and ill competition among MFIs led to the microfinance crisis that spilled over from the local level to the entire India.	(Purkayastha et al., 2020)
Mobile money in Ghana	The relationships between the new and old actors, as well as the actors at the meso-level and macro-level determine financial inclusion; the state should provide incentives for these actors to collaborate.	(Senyo et al., 2022)
Development finance ecosystems for the countries of the Global South	Private non-profit and for-profit actors in development financing and the change of the role of governments from providers of global public goods to brokers of private financing.	(Tan, 2022)

Spatial context	Findings	Selected references
Fintech start-ups and Quebec's financial cluster	Comfort zoning by incumbent banks and Fintech, who refuse collaboration hinder innovation and mutually supportive ecosystem.	(Turcan & Deák, 2022)
Financial ecosystem in the Middle East and North Africa	Regulators constraining Fintech; the call for the support of Fintech expansion by regulators	(Zalan & Toufaily, 2017)
China ecosystems centered around Alibaba and Tencent	Financial industry transformed not only by Fintech startups, but also BigTech as cross-sector players.	(Zhang-Zhang et al., 2020)

Regarding the composition of actors, the research reports old or incumbent actors, such as banks and financial advisors (Lai, 2016), and new ones, including Fintech, Bigtech and individuals or peers acting as crowd suppliers of financing (e.g., crowdfunding or P2P lending platforms) (Alijani & Karyotis, 2019; Grafe, 2020; Purkayastha et al., 2020; Zhang-Zhang et al., 2020). Another taxonomy of actors includes human and nonhuman entities, with the latter exemplified by algorithms and robo-advisors (Carolan, 2019). The latter embody Fintech and perform some decision-making functions, such as credit rating and assessment, and standard advisory. Nonhuman actors impose standardized rules of finance provision, which are often abstracted from human and spatial specifics (Carolan, 2019). Their entry into the ecosystem enhances the financialization of everyday lives for both the prime and subprime markets (Beaverstock et al., 2013; Lai, 2016). Among the new topics, Bigtech is a cross-sector actor, expanding from its high-tech business sector to financial services (Zhang-Zhang et al., 2020). The roles of Fintech entrants include being suppliers of outsourced services by banks, e.g., payment platforms, subjects to acquisitions by banks, or independent competitors (Lai, 2020). Bigtech has the power to establish their roles as leaders in the sector, in addition to traditional bank organizations (Zhang-Zhang et al., 2020).

Regarding old or incumbent actors, banks underwent outsourcing to Fintech and thus shortening the scope while concentrating on the core activities. The shortened scope and the challenge of new players have undermined the exclusive position of banks. They became a part of the wider network and multisided platforms engaged in partnerships for service delivery (Turcan & Deák, 2022). However, despite the claims of disintermediation and democratization of FE, banks are expected to maintain their dominant position, even though sharing this dominance with Bigtech (Lai, 2020; Zhang-Zhang et al., 2020).

Fintech not only expands the number of actors, but also increases their multiscalar participation. Actors from one financial ecology work in collaboration with other relevant ecologies (Grafe, 2020). The participants of local funding projects are often meso- or macrolevel organizations (e.g., from regions or countries) using electronic platforms for microcredits and loan provision (Senyo et al., 2022). The latter act as 'avatars' of external goals that are reinforced in particular communities (Grafe, 2020). This can lead to a displacement of local missions by more general goals, such as gender or environmental issues (Senyo et al., 2022; Tan, 2022).

The changing roles are observed among private and public actors, with the increasing involvement of private enterprises (e.g., Fintech platforms providing microfinance for small firms and farmers in developing countries) (Tan, 2022). Private enterprises enhanced by dedicated Internet websites take over some of the financing functions that were previously performed by governments and public entities (Grafe, 2020; Senyo et al., 2022). Global platforms of Fintech, banks, and Western enterprise link local ecologies with global financial networks, while displacing some of the earlier traditional and local networks, such as those of agrarian communities (Tan, 2022). Fintech-enhanced ecosystems can also be effective in the supply of finance for startups and early-stage projects that would otherwise apply for government funding (Festa et al., 2022; Owen et al., 2019; Spigel, 2022). P2P lending and crowdfunding platforms are also a friendly and opportunistic venue for established players, such as business angels and venture capital finds (Konhäusner et al., 2022).

Overall, on the supply side, actors' configurations are increasingly open and not bound to territories, going through different spatial, sectoral, and ownership dimensions (Beaverstock et al., 2013; Grafe, 2020; Senyo et al., 2022; Zhang-Zhang et al., 2020). On the demand side, actors are still defined by their spatial contexts and place-based heterogeneous needs (Carolan, 2019; Purkayastha et al., 2020; Senyo et al., 2022). Consequently, the observation of FE is often pessimistic with respect to conflicting goals and interests among banks, Fintech and Bigtech, as well as between territorial communities suppliers of financing that impose private efficiency goals and external interests (Grafe, 2020; Soloviev, 2018; Tan, 2022; Turcan & Deák, 2022).

Fintech also frame target groups on the demand side of FE, which are rarely prime and elite customers, and predominantly belong to the disadvantaged by traditional institutions, such as startups, social entrepreneurs, non-profit actors, and precarious retail customers (Langley & Leyshon, 2017). This resonates with an emphasis on the spatial context of the Global South, developing countries, and peripheral or rural territories (Carolan, 2019; Purkayastha et al., 2020; Zalan & Toufaily, 2017). Fintech

opens the opportunities for these market segments and territories; however, they also induce standardization and de-contextualization. This may cause a disparity between place-based goals and the interests of external finance providers. Based on the above considerations and related policy implications, we formulate Proposition 1.

Proposition 1. *Fintech changes the density and composition of actors in the FE, with the demand side being largely decontextualized and less focused on the specificity of territorial communities. In addition to broadening the financing opportunities, this results in a gap between the needs of the places and the development objectives and the financing suppliers' goals.*

Resonating with the argument in Proposition 1, the reviewed research includes recommendations towards more active government involvement as a regulator. Policymakers are called to facilitate the integration of Fintech into FEs to broaden financing opportunities and, at the same time, to protect the interests of territorial communities (Grafe, 2020; Purkayastha et al., 2020; Senyo et al., 2022; Zalan & Toufaily, 2017). One of the key challenges for policymakers is to resolve conflicts of interests and ensure the entrance and expansion of Fintech balanced with the protection of consumers.

Fintech framing governance in financial ecologies

In conjunction with the Fintech-driven reconfigurations of FE actors, the research reports on technological advancements affecting the governance of financial ecologies (Table 2). The entrance of new powerful players, such as Bigtech and growing Fintech businesses, causes the shift from public governance to private governance in the financial sector (Łasak & Gancarczyk, 2022). This process not only includes crowdfunding opportunities that replace public support for commercial start-ups, but also for development goals in poorer countries (Green, 2022; Tan, 2022). Tan (2022) calls emerging private governance a 'contractual governance', since it largely follows private standards, indicators, and audit systems, substituting for legal and public policy frameworks, and thus undermines political accountability of financial aid providers.

Another profile of Fintech-enhanced governance captures the impact of external international entities as '*club-like* governance,' dominated by a transnational policy elite of donor states, private investors, and transnational civil society actors from the Global North (Tan, 2022). This 'hybrid transnationalism' is constituted less by spatial location and political

framework and more by thematic goals (infrastructure development, microfinance, gender equality) (Green, 2022; Tan, 2022).

Table 2. Fintech and governance in financial ecologies

Spatial context	Findings	Selected references
P2P lending platforms in Chinese market	Platforms run by the state-owned entities, banks, and private equity capital demonstrate a higher net cash inflow rate; private platforms have lower cash inflows. The impact of the regional Fintech ecosystem on P2P lending platforms (geographical, policy and environmental factors)	(Chen, Hu, & Ben, 2021)
Financial ecological environment and internal audit outsourcing in China	The influence of the financial ecological environment on the corporate governance of internal audit and thus collaborative networks.	(Du, Li, Lin, & Wu, 2021)
Financing agrarian change; credit and debt in the Global South	Agrarian finance, inherently rooted in rural relationships and practices, increasingly shaped by global finance governed by entities at multiple scales The power of the state limited and depending on the position within the global financial system	(Green, 2022)
Mobile money adoption in five countries of the sub-Saharan Africa	To advance the digital financial ecosystem, mobile money regulators and standard setting bodies should engage with stakeholders.	(Koomson, Bukari, & Villano, 2021)
Practices of financial advisors in the UK	The professional practices of financial advisors affected by governance structures; both practices and governance territorially defined by national regulations and cultural norms	(Lai, 2016)
North vs Global South	Trends from public governance to private governance; evolutionary transition from hierarchical to heterarchical to hierarchical governance	(Łasak & Gancarczyk, 2022)
The UK setting for crowdfunding	Crowdfunding structures and processes can replicate rather than change institutional arrangements and practices of funding; crowdfunding questioned to be open and egalitarian	(Langley & Leyshon, 2017)
The Chinese financial ecology of expertise	A technocratic financial governance that reduces the government administrative and fiscal functions; precarious knowledge of investors who call for the state to intervene and safeguard their actions; Conflicts among formal and informal financial experts, state institutions, local banks, and individual investors	(Maso, 2021)

Spatial context	Findings	Selected references
Vizag Fintech Valley in India	The stages of ecosystem emergence as a complex adaptive system; from the *Envisioning* stage, the *Enacting* stage and finally to the *Enlivening* stage The need for a dynamic, agile and proactive regulation that would acknowledge market conditions, consumer demands and complex stakeholder relationships	(Muthukannan, Tan, Gozman, & Johnson, 2020)
The context of Global South and developing countries	The shift to private from public governance in the development finance; 'contractual governance' (private agreements of standards, indicators, audit systems) replacing law and policy-making; abstracted from political contestation (depoliticized). 'Club-like' governance dominated by a transnational policy elite of Western donor states, private investors, Northern bureaucrats and transnational civil society actors 'Hybrid transnationalism' constituted less by spatial location and political framework and more by thematic goals (infrastructure development, microfinance, gender equality)	(Tan, 2022)
Financial ecology of strategic emerging industries in China	The internal financing ecology has a regulating effect on the external financing ecology; internal and external financing ecology as alternative forms of governance in strategic emerging industries The role of central government in maintaining regional economic stability; local government should support scientific and technological innovation.	(Xu, Geng, & Wei, 2019)

The FE governance revolves both around market segments, such as rural communities, startups, retail customers, and social enterprises, and around particular projects (Green, 2022; Lai, 2016; Muthukannan et al., 2020; Tahiri Jouti, 2019). Therefore, we observe networks of local and international origins focused on retail customers and projects delimited by geographical contexts (Tan, 2022).

Studies emphasize the importance of a financial, ecological environment for the internal governance of companies and their efficiency, as well as the professional practices of financial agents, such as advisors (Chen et al., 2021; Du et al., 2021; Lai, 2016). In the Chinese context, private digital platforms demonstrate lower efficiency than those led by institutional actors (e.g., state agencies, banks, and private equity). On the other hand, Xu (2019) reports that internal governance efficiency acts as a substitute for a less developed FE.

Despite the importance of efficient internal corporate governance, most studies demand more government involvement to ensure stability, efficiency,

and implementation of place-based objectives (Koomson et al., 2021; Langley & Leyshon, 2017; Maso, 2021; Muthukannan et al., 2020; Tan, 2022; Xu et al., 2019). The state is recommended to act as a facilitator of information flow to reduce information asymmetry among investors, reconcile conflicting objectives of stakeholders. It is also called to establish development processes for the FE, by linking regulation with the provision of infrastructures and the support for innovations (Koomson et al., 2021; Kotarba, 2016; Maso, 2021; Muthukannan et al., 2020; Xu et al., 2019). On the other hand, when pursuing public procurement and friendly legislation for financial innovation, policy-makers should avoid the dominance of increasingly powerful and global Fintech businesses over consumers in particular ecologies. These claims signal a tension between the privatization processes of FE and the desired role of the government. This role should be performed acknowledging the nature of FEs as complex adaptive systems of numerous actors undergoing evolutionary and gradual development, and affected by existing formal and informal institutions, that is, path dependent (Lai, 2016; Łasak & Gancarczyk, 2022; Muthukannan et al., 2020). Based on the FE governance characteristics driven by Fintech, we formulate Proposition 2.

Proposition 2. *The Fintech-driven governance dynamics of FEs features the tension between the increased role of global private governance and a demanded public governance to ensure the advancement of FEs and reconcile efficiency with social objectives. These processes follow an evolutionary pattern determined by the interactions of FE actors and adaptations to the FE contexts.*

Fintech framing the outcomes of FEs

The selected research sample allows one to extract the range of outcomes from and roles of Fintech in FEs rather than identify tendencies or determine their unequivocal impact (Table 3). Here, we can discriminate between the ultimate impact and intermediate effects. The ultimate impact is discussed as financial inclusion or exclusion, microeconomic efficiency, and wealth generation. Intermediate or side effects include financialization of retail customers, learning, organizational practices, and influence on social networks (Coppock, 2013; Koomson et al., 2021; Muralidhar et al., 2018; Okello Candiya Bongomin & Munene, 2021).

In a cross-country and quantitative study, Lyons et al. (2022) found a strong and positive effect of Fintech on financial inclusion, understood as access to financial services. However, they admit that the availability of financing is not equal to using this opportunity. Fintech links households

and large socioeconomic with the global financial system (Coppock, 2013; Koomson et al., 2021; Mejia-Escobar, González-Ruiz, & Duque-Grisales, 2020). They also have a positive effect on income increase and industrial integration (Ge, Li, Tang, Xu, & Boamah, 2022; Ge, Tang, Zhou, Tang, & Boamah, 2022; He, 2013), financial support, and resilience to external shocks within family and social networks (Koomson et al., 2021).

Table 3. Fintech and the outcomes of FEs

Spatial context	Findings	Selected references
Retail financial services for London elites	New financial technologies drive financialization and stratify customers within the wealth management ecology The super-rich transnational class ecology reproduced through the governance performed by financial service providers	(Beaverstock et al., 2013)
Financialization of individuals and households in rural England	Fintech expanded the availability of financial products to diversified customers and stronger linked households with the global financial system; distinct ecologies of financial inclusion and exclusion within and outside of the mainstream finance	(Coppock, 2013)
Digital financial technologies changing the consumer debt industry in UK	The new Fintech debt ecology threatening with financial exclusion; the time and place convenience and individualization of digital debts, but also manifestation of financial exclusion and dependence on an algorithm assessment; differential pricing of debt collection disfavoring the poorer	(DawnBurton, 2020)
Rural China	The development of digital financial inclusion and rural tertiary industry integration from the perspective of policy impact; regional differences in the financial inclusion	(Ge, Li, et al., 2022)
Rural China	Digital inclusive finance enhancing the income of local farmers and their neighboring farmers; the speed up the of the inclusive finance development and stronger government supervision proposed	(Ge, Tang, et al., 2022)
City infrastructures, digital debt provision for agrarian sector in the Global South	Standardized metrics of customer and project assessment imposed by external financing institutions, which promote own efficiency goals and thematic missions over individual and place-based needs of particular ecologies.	(Grafe, 2020; Green, 2022)
Worldwide country-level analysis of Fintech ecosystems	Rather than spatial dispersion, the Fintech sector spatial agglomeration in few centers increases this sector's competitiveness.	(Jiao, Shahid, Mirza, & Tan, 2021)

Spatial context	Findings	Selected references
Mobile money in five sub-Saharan countries	The adoption of mobile money associated with an increase in financial support transfer within the family and social communities as a response to external shocks; female-headed and rural households benefit from mobile money adoption in the face of idiosyncratic shocks	(Koomson et al., 2021)
Fintech in the context of demand for financial services in 16 the world's largest emerging economies	Strong and positive relationship between the Fintech development and financial inclusion (access to finance); the access not necessarily translated to a greater usage of financial services; heterogeneities of effects across population groups and regions	(Lyons, Kass-Hanna, & Fava, 2022)
Brazil, Columbia, Argentina	Private financial institutions of Brazil, Colombia, and Argentina leading the development of social and green financial products, based on regulatory and government mechanisms; the Brazilian Fintech ecosystem featuring a greater financial inclusion and digitalization of financial services, as well as products for agricultural sector	(Mejia-Escobar et al., 2020)
Auto-rickshaw drivers in Karnataka, India	Learning and organizational efficiency outcomes; intended and unintended consequences of the digital application (platform) adoption: enhanced workflows, but reduced field agents' flexibility	(Muralidhar et al., 2018)
Entrepreneurial ecosystem for females in Northern Ireland	The financial entrepreneurship ecosystem highly gendered; the role of the financial eco-system in promoting or limiting female entrepreneurship	(Ogunjemilusi, Johnston, & Boyd, 2021)
Taizhou in China	Credit availability for SMEs not dependent on financial ecosystems but on the enterprise characteristics; policy-based credit guarantee is not among the major determinants as well.	(Xu et al., 2020)

There are also negative effects reported. Digital debt financing can lead to stratifying customers according to impersonal metrics and dividing them according to gender or wealth, to either exclude from financing or increase debt pricing, ultimately resulting in the debt loop and over-indebtedness (DawnBurton, 2020; de la Cuesta-Gonzalez, Paredes-Gazquez, Ruza, & Fernandez-Olit, 2021; Ogunjemilusi et al., 2021). These mixed evaluations of Fintech impact are even more complex when considering the evidence by Xu et al. (2020), who did not find any relationships between the quality of the financial ecosystems and SME financing in Taizhou, China.

Evaluation of the outcomes from the Fintech transformation of FEs should also acknowledge the influence of spatial contexts and government intervention (Mejia-Escobar et al., 2020). Studies point to strong spatial

heterogeneities and uneven distribution of inclusion and exclusion within and outside mainstream finance (Coppock, 2013; Gün, 2019). Empirical evidence is primarily focused on the ecologies of the Global South and retail, often precarious or disadvantaged individuals and organizations in Western countries. Although some claims were made regarding the location of Fintech ecosystems in other than financial centers, they still enhance spatial polarization by concentrating in technological knowledge centers (Jiao et al., 2021; Mejia-Escobar et al., 2020; Pollio & Cirolia, 2022). A unique feature is attention to wealth elite segments of financially literate individuals, particularly in Anglo-American economies, who benefit from new financial products and availability of funding within the international financial system (Beaverstock et al., 2013).

Based on the above considerations of the mixed socio-economic effects of Fintech in FEs, we formulate Proposition 3.

Proposition 3. *The outcomes of FEs transformed by Fintech are dependent on the characteristics of the spatial context of particular ecologies, as well as on the government intervention in setting out the rules of Fintech expansion and the enhancement of socio-economic objectives of territorial communities.*

Fintech framing the concepts related to FEs

By attracting other concepts that can be explanatory of the financial ecology phenomenon, the understanding of the FE and its theoretical message increase (Wójcik, 2021a). This results in a more comprehensive knowledge of the FE and enables profiling it from different thematic angles (Mazzei, 2018; Simsek et al., 2017; Suddaby, 2010). The related concepts are treated in a wider sense as both those ideas and constructs that are the approximations of the phenomenon in focus and those acting as theoretical explanations of this concept (Suddaby, 2010) (Table 4).

Regarding the concepts acting as approximations, they tend to be used as synonymous, that is, equivalent ideas, or umbrella concepts, that is, wider ideas embracing the FEs as one of their dimensions. Theoretical approximations are also used as theoretical explanations of Fintech-driven processes in FEs. These double-role concepts include financial ecosystems, entrepreneurial ecosystems, Fintech ecosystems, networks, open innovation systems, digital platforms, and complex adaptive systems. The financial ecosystem acts as an umbrella concept for FEs when delimited by the focus on particular market segments, such as the science ecosystem, and by particular territories (Junfang & Mu, 2022; Lai, 2020; Leyshon, 2020; Muthukannan et al., 2020).

Table 4. Fintech and the concepts related to FEs

Approximation or a synonym of the FE	Theoretical explanation	Concepts and their application	Selected references
X	X	Financial ecosystem as an umbrella concept with thematic scopes or spatial focus, such as science ecosystem or/and financial ecosystem defined by particular territories; the use of taxonomies of financial ecosystems	Lai, 2020; Muthukannan et al., 2020)
X	X	Entrepreneurial ecosystems as an umbrella concept; the use of the outcome-oriented and relationship-focused approach	(Spigel, 2022; Ogunjemilusi et al., 2021)
X	X	Fintech ecosystems as synonymous but not sufficient coverage of the FE; spatial agglomerations or clusters of the Fintech industry; the use of agglomeration economies	(Jiao et al., 2021; Wójcik, 2021a)
X	X	Networks as a form of ecosystem relationships; the use of the network economies concept	(Alijani & Karyotis, 2019; Lai, 2020; Wójcik, 2021b)
X	X	Open innovation systems defined by spatial contexts; the focus on the innovative output from FEs	(Fasnacht, 2018)
X	X	Complex adaptive systems; the use of complexity theory and multi-actor approach; actors jointly adapting to external environments	(French et al., 2011; Muthukannan et al., 2020)
X	X	Digital platforms organizational form based on relationships between the platform and the ecosystem of firms; the use of digital platform economies (digital financial economies); the platform political economy of Fintech as a new governance of achieving efficiency	(DawnBurton, 2020; Langley & Leyshon, 2021; Lyons et al., 2022; Muralidhar et al., 2018; Wójcik, 2021b)
	X	Coopetition as a form of governance targeted at win-win strategies through a combination of competition and collaboration; the explanation of the desired outcomes of and relationships in FEs	(Zhang-Zhang, Rohlfer, & Rajasekera, 2020)

Approximation or a synonym of the FE	Theoretical explanation	Concepts and their application	Selected references
	X	Stakeholder approach to understand a variety of actors with conflicting interests; the explanation of relationships among the actors in FEs	(Alijani & Karyotis, 2019; Mejia-Escobar et al., 2020)
	X	Evolutionary perspective as a gradual development in time, from less to more organized ecosystems and ecologies, explaining the emergence and decline, and associated structural differences in the FE	(Dragos & Wilkins, 2014; Zhang-Zhang et al., 2020)
	X	Governance denoting power relations among entities and influencing the outcomes of the FE (finance availability, meeting social objectives, roles of private and public actors)	Wójcik, 2021a)

Considering the use of financial ecosystems as a theoretical background, FEs adopt a large part of related taxonomies, with their own focus on particular groups of actors entering the system due to technological advancements.

Another umbrella concept used both as an approximation and a theoretical approach is the entrepreneurial ecosystem (Leyshon, 2020; Ogunjemilusi et al., 2021; Spigel, 2022). FEs are, in principle, one of its dimensions, but also defined as synonymous or equivalent ideas, namely, a financial entrepreneurial ecosystem (Ogunjemilusi et al., 2021). FEs buy from entrepreneurial ecosystems an outcome-oriented approach, relevant for pragmatic policymaking, and a relationship lens.

Fintech ecosystems are often synonymous, but certainly do not have sufficient coverage of the FE. Their spatial focus invokes the cluster theoretical approach and related agglomeration economies to explain the competitive advantage of FE (Jiao et al., 2021; Pollio & Cirolia, 2022; Wójcik, 2021b). FEs are also treated as a type of network, and the concept of network economies is adopted to explain the benefits of actors organized around a given ecology (Alijani & Karyotis, 2019; Lai, 2020; Wójcik, 2021b). The network approach resonates well with the framework of complex adaptive systems that capture FEs through the lens of the complexity theory and multi-actor adaptations to external environments (French et al., 2011; Muthukannan et al., 2020).

Ultimately, the concept of digital platforms is adopted as an approximation of FEs. This concept denotes an organizational form aggregating and analyzing data, and using ICT infrastructures to capture value from intermediation (DawnBurton, 2020; Langley & Leyshon, 2021;

Lyons et al., 2022; Muralidhar et al., 2018; Wójcik, 2021a). A related idea of digital platform economies describes network and scale efficiencies from Fintech (Langley & Leyshon, 2021).

The adjacent concepts that serve as a theoretical background are used to explain the relationships among the actors in FE, FE dynamics, and outcomes. The explanations of the relationships among FE actors stem from the stakeholder approach (Alijani & Karyotis, 2019; Mejia-Escobar et al., 2020) and a game-theoretic perspective of coopetition (Zhang-Zhang et al., 2020). FE dynamics are captured through an evolutionary approach that describes the emergence and decline, and associated structural differences in FEs (Dragos & Wilkins, 2014; Zhang-Zhang et al., 2020). The outcomes of FEs are derived from approaches such as coopetition (Zhang-Zhang et al., 2020) and governance (Tan, 2022; Wójcik, 2021b).

FEs represent the multiactor and multidimensional object of study, therefore, it would be difficult or even simplistic to search for only one explanatory theory. Therefore, we deal with a plethora of adjacent concepts that profile the nature and outcomes of FEs as transformed by Fintech. This profiling reflects the complexity of the phenomenon and it can be considered as a relevant approach, at least at this early stage of the FE idea development.

DISCUSSION

In accordance with the aim, this research has identified how Fintech frames FEs and proposed the resulting conceptual and policy-related implications. Recently, Leyshon (2020), Lai (2020), and Wójcik (2021a, 2021b) have synthesized the origins of the FE and pointed to their relationships with the adjacent frameworks of financial ecosystems and entrepreneurial ecosystems. The current contribution expands the theorizing on FEs by an explicit recognition of their dynamics in response to technological transformations. We have organized the accomplishments of the extant research around a consistent framework that follows the principles of construct clarity (Suddaby, 2010). This ensured a theory-informed guidance over the systematic literature review. A systematic literature review is unique in the research on FEs since existing reviews are narrative syntheses to define the FE concept (Lai, 2020; Leyshon, 2020; Wójcik, 2021a, 2021b). The rigorous approach and analyzed evidence allowed us to address two research questions and derive a set of assumptions as research propositions.

In response to RQ1, we have described how Fintech affects the FE phenomenon. The literature review shows that financial technologies exert the impact on all constitutive elements of FE, namely, the actors,

their relationships captured as governance, and outcomes, acknowledging spatial contexts. Technological advancements allowed for the increased density and various configurations of FE participants. In particular, financing providers broadened their reach to FEs in various spatial locations, peripheral communities, and unbanked or previously excluded participants. This expansion required standardization of procedures, such as credit assessment, and Fintech offered adequate tools in this regard. The demand side of FEs featured an expansion of financing opportunities; however, their needs and financial capacity remained heterogeneous and less prone to standardization by Fintech-driven algorithms. Overall, the customer side remained rooted in the spatial context, while financing suppliers tend to decontextualize their markets. This general observation was reflected in Proposition 1, assuming a gap between place-based needs and development objectives and the targets of the finance suppliers. Proposition 1 reflects mixed results of existing research in terms of customization and meeting the heterogeneous needs of customers through Fintech, and calls for a more granular and cautious approach between enthusiastic and pessimistic views on the interests and benefits of the actor (Lai, 2020; Lyons et al., 2022; Wójcik, 2021b).

The changing composition and roles of actors in FEs and the gap between place-based and decontextualized interests raise direct consequences for the FE governance, which was summarized in Proposition 2. The latter assumes a tension between the increased role of global private governance and a demand for public governance to ensure the advancement of FEs and reconcile efficiency with social objectives. Moreover, it asserts that the observed processes follow an evolutionary pattern, determined by the interactions of FE actors and the adaptations to the FE contexts (Chen & Hassink, 2021; Gong & Hassink, 2019).

Following the logical relationships among the major elements of FEs, governance is assumed to affect the efficiency and broader outcomes of financial ecologies. The reviewed evidence allowed the formulation of Proposition 3 that intends to resolve the equivocal results reported from Fintech-driven FEs. According to this proposition, the ambiguous results can be justified and explained by the heterogeneity of spatial contexts and socioeconomic differences among FEs, as well as by various policy responses (Chen & Hassink, 2020; Zhang-Zhang et al., 2020).

RQ2 explored the conceptual and policy-related implications of Fintech that influences FE. The conceptual implications were addressed through the review of how the technological transformation has been captured by concepts related to FE. Compared to existing theorizing on FEs, our research is unique in a comprehensive systemization of relevant conceptual frameworks (Lai, 2020; Lai & Samers, 2021; Leyshon, 2020). This was done

according to theories and constructs that are approximations or synonyms and those acting as theoretical explanations of the phenomenon in focus. In general, the FE concept remains at the intersection of other outcome-oriented ecosystems that focus on territories, but it can also be treated as an independent phenomenon and research object.

Our results justify the FE as a clearly defined concept and unit of analysis. This allows scientific validity in capturing the dynamics of this concept in response to external developments, such as Fintech expansion. However, as a complex phenomenon and early stage idea, it does not have a unique theoretical framework but is rather profiled or theoretically explained through other adjacent frameworks. With an advancement of the knowledge of the phenomenon and its empirical corroborations, we can expect a tailored and unique theoretical approach to Fintech-driven FEs. However, it is also possible that the profiling approach will remain dominant, as in the case of other complex constructs (Mazzei, 2018; Simsek et al., 2017; Suddaby, 2010).

The results also address RQ2 with regard to policy implications, as reflected in Propositions 2 and 3. According to Proposition 3, in addition to the overall socioeconomic context, a particular explanatory factor for the outcomes of the FE is the participation of the government. The public intervention demanded includes the establishment of rules and resources for economic stability and technological infrastructure, collaboration among the actors of FE and protection of place-based interests. Proposition 3 also establishes a research program in which context specifics and government involvement are juxtaposed with the outcomes of particular FEs. The policy implication of Proposition 2 is the evolutionary logic in government intervention. The policy design and implementation should follow evolutionary logic, determined by the interactions of FE actors and adaptations to the FE contexts. The proposed logic is a novel approach to government intervention, predominantly viewed as unidirectional and top-down rather than open to interactions with stakeholders to both design and implement policy objectives (Gong & Hassink, 2019, 2020).

CONCLUSION

This research provides conceptual and policy-related contributions. First, it conceptually reframes the understanding of FE as financial services governance focused on territorial projects and communities and enhanced by Fintech. The research community can benefit from the accumulation and synthesis of knowledge regarding the recent dynamics of the FE phenomenon and

concept. Profiling of FE from the angle of adjacent concepts can be a useful approach, at least at this early stage of idea in focus (Wójcik, 2021a, 2021b).

Second, the concept of FE was clarified according to its main elements and its relationships with other adjacent ideas of spatial networking for socioeconomic development. This contribution is relevant for the theoretical validity and methodological rigor of future studies (Suddaby, 2010). The benefits include a transparent delimitation of FEs as study objects, as well as the usefulness of the systemized adjacent concepts in addressing particular research aims.

Third, research proposals and areas for further investigation were proposed. The referred set of propositions not only tackles the crucial elements of FEs, but also points to their logical relationships, making the assumptions derived a coherent framework. Furthermore, the propositions can be further specified in evidence-based hypotheses (Breslin & Gatrell, 2020; Silverman, 2015; Yin, 2018).

Our results are not free from limitations that require justification and explanation of how they were tackled and alleviated. First, our research sample is not homogeneous according to the types of sources. These should preferably be peer-reviewed articles (Lund et al., 2016; Tranfield et al., 2003). At this early stage of research on FEs, we had to source both from peer-reviewed journals and other reliable formats, such as conference proceedings, books, and book chapters. The quality of the research sample was ensured through a thoughtful selection process, with theory-driven and transparent criteria for inclusion and exclusion (Hiebl, 2021). As empirical corroborations grow, future studies can rely on consistent samples of peer-reviewed articles. Second, the research sample is not uniform in terms of the method, since it includes the papers addressing territorially delimited FEs with both qualitative and quantitative approaches. This does not allow for meta-analysis and statistical generalization. However, the assumed focus on spatially defined FEs ensures case-based insights and analytical generalization of socioeconomic processes (actors, their relationships, and resulting outcomes) (Piekkari & Welch, 2018; Yin, 2018).

FEs are emerging constructs and economic phenomena; therefore, we need both further conceptualizations and studies that would put these ideas to empirical testing (Lai & Samers, 2021; Wójcik, 2021b; Kleibert, 2020). In terms of conceptual challenges, the FE idea deserves more in-depth and sympathetic criticism to refine its understanding. The ecosystem approach in social science is a promising lens. However, it also raises concerns reported in discussions of more mature ecosystem concepts, such as entrepreneurial ecosystems. The critics include blurred delimitation versus adjacent concepts, complexity, and multivariate nature, whereby the issues of target groups and

outcomes often remain unclear (Aguilar, 2021; Spigel, 2022; Stam, 2015; Wurth, Stam, & Spigel, 2021). Further studies of FE should face and resolve similar conceptual challenges.

Moreover, the idea of FE should be supported with a relevant theoretical background and clarified with respect to the relationships with other business and enterprise ecologies and ecosystems. The promising theoretical lens might include evolutionary and institutional theories, as well as governance theories (Chen & Hassink, 2020, 2021; Williamson, 2005; 2010; North, 2005; Ostrom, 2010; Hodgson, 2015). Moreover, the important research gaps refer to the mechanisms of the FE governance, such as regulatory frameworks, e.g., financial reporting and sandboxing, types of involved entities and their relationships, power relations, types of contracts, value and intellectual property sharing, as well as learning and adapting by FE participants. Since FEs are focused on territories, their idiosyncrasies should be acknowledged by exploring FEs in variegated socio-economic and institutional contexts of countries and regions (Ponte & Sturgeon, 2014; Chen & Hassink, 2021, 2020; Coe & Yeung, 2019).

In terms of empirical challenges, future research can focus on place-based qualitative and quantitative studies. These would enable qualitative analytical generalization on the mechanisms of FEs affected by Fintech, and metaanalytical reports for statistical generalization in this area.

This issue contains articles, selected through a rigorous peer-review process, which contribute to our understanding of how Fintech frames the financial ecosystem and its particular ecologies. As detailed in the following, the content addresses diverse but complementary topics, providing a comprehensive and updated view of the central theme.

Kutera (2022) is the author of the article entitled ***'Cryptocurrencies as a subject of financial fraud'***, which aims to review the current scope of research on this topic by examining current trends, the most popular crimes related to cryptocurrencies, and identifying potential opportunities for further research. The findings of the detailed bibliometric and descriptive analysis reveal that cryptocurrencies as a subject of financial fraud are an emerging area of scientific research. Moreover, this work finds that money laundering and financial pyramids – based on the Ponzi scheme – are currently the most common frauds.

The article entitled ***'The interplay of entrepreneurial ecosystem actors and conditions in Fintech ecosystems,'*** authored by Avarmaa et al. (2022), focuses on the growing role that financial technology (Fintech) plays in the process of expanding financial ecosystems. In this sense, this paper is an original approach that aims to contribute to the emerging research on this specific topic within the needs of analysis that justify this special issue.

The work by Bartolacci et al. (2022), entitled ***'An analytical framework for strategic alliance formation between incumbent banks and Fintech start-***

ups: theoretical proposals and empirical findings,' analyses the conditions of strategic alliance formation between incumbent banks and Fintech start-ups. Specifically, it seeks to fill the research gap in the literature and identify the explanatory factors of successful strategic alliances by examining two specific entities as case studies: the *Banca Popolare di Cortona* and the *NetFintech start-up*. The findings allow improving the knowledge about the best conditions for incumbent banks and Fintech start-ups strategic alliances, serving as a basis for further research in this area.

The research entitled ***'Heterogeneity of motivations among crowd investors: Evidence from the football industry',*** authored by Kosciolek (2022), takes as its starting point the controversy surrounding the motivations of crowd investors. This work focuses specifically on the study of the heterogeneous motivations of crowd investors in football clubs by using a survey research method, segmenting them according to their investment motivations. Although no cluster with a predominance of extrinsic motivations was found, this research provides evidence that a homogeneous group in terms of crowd investment activity can still be heterogeneous in terms of crowd investment motivations. The results can be useful for sports managers as they provide information on the market segments of crowd investors to make crowdfunding campaigns more effective.

Finally, the work by Khan (2022), entitled ***'How funding matters: Reinitiating of New Product Development and the moderating effect of extramural R&D,'*** aims to analyze the effect of financial obstacles on the innovative behavior of firms. In particular, this article examines the effect on the probability of undertaking previously suspended (or abandoned) innovation projects for new product development by focusing on selected South Asian economies. It also analyzes whether extramural R&D and R&D collaboration mitigate the relationship between financial constraints and the probability of restarting this innovative activity. The findings corroborate that the optimization of innovation outcomes by firms requires the maintenance of a balance between their internal knowledge base and extramural R&D. Meanwhile, extramural R&D has positive effects, such as reducing the financial dependence of firms, improving access to finance, and increasing R&D productivity in new product development.

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Abstrakt

CEL: *Finansowe ekologie (FE) stanowią formy koordynacji nastawione na podaż usług finansowych oraz skoncentrowane na określonym terytorium. Obecnie, formy te podlegają transformacji pod wpływem technologii finansowych (Fintech). Idea FE jest istotna pod względem społecznym i ekonomicznym, gdyż zwraca uwagę na segmenty rynku słabo obsługiwane przez rynki finansowe lub z nich wykluczone. FE stanowią platformy łączące branże oraz podmioty z publicznego i prywatnego sektora. Jednocześnie, finansowe ekologie pozostają na wczesnym etapie rozwoju jako koncepcja i przedmiot badań empirycznych. Słabo zbadane pozostają wpływ Fintech na ekosystemy finansowe oraz związane z tym implikacje dla polityki gospodarczej. W odpowiedzi na teoretyczne i praktyczne znaczenie oraz wczesny etap badań nad transformacją FE pod wpływem Fintech, artykuł ma na celu określenie, w jaki sposób Fintech kształtują FE oraz wskazanie związanych z tym implikacji koncepcyjnych oraz dotyczących polityki gospodarczej.* ***METODYKA:*** *Podejście badawcze odwołuje się do zasad spójności koncepcji oraz rekonstrukcji koncepcji. Zastosowano metodę systematycznego przeglądu literatury 48 publikacji, wyselekcjonowanych z baz Scopus i WoS.* ***WYNIKI:*** *Zanalizowano główne elementy koncepcji FE oraz perspektywy teoretyczne pokrewne wobec tej idei. FE stanowią element innych ekosystemów zorientowanych na wyniki a zarazem koncentrowanych na określonym terytorium. Mogą być także traktowane jako niezależne zjawisko i przedmiot badań. Wskazano, że idea FE podlega rozwojowi pod wpływem Fintech w zakresie wszystkich elementów tworzących to zjawisko. Sformułowano zestaw zało-*

żeń co do wynikających z tej transformacji konsekwencji dla rozumienia zjawiska finansowych ekosystemów i dla polityki gospodarczej. ***IMPLIKACJE:*** *Wyniki systematycznego przeglądu literatury są istotne dla rozwoju podstaw teoretycznych oraz badań empirycznych nad FE. Mogą także sprzyjać integracji środowiska naukowego wokół rozwoju i akumulacji wiedzy w tej dziedzinie. Mimo standaryzacji wywołanej innowacjami technologicznymi, dostępność, użyteczność oraz efekty ekosystemów finansowych zależą od kontekstów geograficznych, które różnią się pod względem społeczno-ekonomicznym i instytucjonalnym.* ***ORYGINALNOŚĆ I WARTOŚĆ:*** *Artykuł pogłębia rozumienie FE jako form koordynacji usług finansowych, opartych na innowacjach technologicznych oraz zorientowanych na terytorialne projekty i społeczności lokalne. Usystematyzowano główne element koncepcji FE oraz relacje z pokrewnymi ideami sieciowej współpracy dla rozwoju społeczno-gospodarczego. Określono zestaw założeń i wskazano obszary przyszłych badań nad zjawiskiem FE.*
Słowa kluczowe: *finansowe ekologie, finansowe ekosystemy, Fintechy, technologie finansowe*

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Conflicts of interest

The authors declare no conflict of interest.

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Cryptocurrencies as a subject of financial fraud

Małgorzata Kutera[1]

Abstract

PURPOSE: *The main purpose of this paper was to identify the current scope of research on cryptocurrencies as a subject of fraud. Detailed research questions related to the determination of contemporary trends of the conducted research and the definition of potential opportunities for further investigation of this topic. One of the questions also concerned identifying the most common crimes committed using cryptocurrencies.* ***METHODOLOGY:*** *The study is based on a systematic literature review (SLR) of 57 publications available on the Scopus database. A bibliometric and descriptive analysis of selected literature items was carried out. Then, vital thematic clusters were separated, and an in-depth content analysis was performed.* ***FINDINGS:*** *The detailed bibliometric and descriptive analysis showed that cryptocurrencies as a subject of financial fraud are generally a new area of scientific research, although it is developing quite intensively. The relatively small number of publications, compared to other similar areas, also indicates that this topic has not yet been explored widely by scientists, and many different research trends can be created in it. Ultimately, the following key research areas were identified: types of cryptocurrency fraud, crime detection methods, risks related to blockchain technology, money laundering, and legal regulations regarding cryptocurrencies. It was also possible to identify that money laundering is currently the most common fraud. However, it has been pointed out that the second most frequent fraud is financial pyramids based on the Ponzi scheme.* ***IMPLICATIONS:*** *The paper clearly presents the main research trends on using cryptocurrencies in criminal activities. At the same time, it was emphasized that, compared to other research areas, this topic is relatively new. Therefore, there is a wide possibility of exploring not only existing but also undiscovered research trends. In addition, key types of fraud in economic practice have been identified, which is particularly important for financial market participants. It was clearly indicated which transactions bear the highest risk. It is also worth paying attention to the critical timeliness of the topic, as the scale of crimes involving cryptocurrencies has recently*

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been growing rapidly. The study confirms the insufficient scope of legal regulations, which are not able to strengthen the security of economic transactions adequately. Therefore, it can be a clear indication for the governments of individual countries or international institutions for further efficient changes to the law. ***ORIGINALITY AND VALUE:*** *The contribution of this study is threefold. It is one of the first research papers showing the results of a systematic literature review (SLR) combined with a bibliographic and in-depth analysis of the content of publications in this field. During the work, the VOSviewer software was also used, which enabled objective identification of the main thematic clusters based on the occurrences and link strength of keywords included in the publications. Secondly, the key types of fraud have been identified that, at the same time, cause the most significant financial loss. This allowed for the establishing of directions for further research, which have profound practical implications for market participants. Some of them relate to the need to develop and implement modern computer applications, allowing for the detection of a wider range of emerging abuses.*
Keywords: *cryptocurrency, bitcoin, blockchain, financial frauds, economic crime, money laundering, Ponzi scheme, financial pyramid, systematic literature review*

INTRODUCTION

Bitcoin was the first cryptocurrency to be created by Satoshi Nakamoto in 2009. Its introduction to the economic market completely revolutionized many existing mechanisms related to the financial market. Some changes related to entire foundations, i.e., defining new economic concepts or changing the current perception of selected macro- and microeconomic processes. The key terms in this context are "cryptocurrency" and "blockchain" related to new technologies. In short, it can be concluded that the first is a generic term for a virtual or digital currency that takes the form of coins or tokens. Cryptocurrencies use blockchain technology (Al-Saqaf & Seidler, 2017). In turn, blockchain is defined as a chained data structure that combines blocks of data and information in chronological order and records the blocks in encrypted form as a distributed ledger that cannot be tampered with or forged. It uses timestamps to identify and record each transaction, so the data are traceable, thereby preventing irreversible modifications to data or information (Lu, 2019). So cryptocurrencies do not require a central authority to validate and settle transactions. Instead, they use only cryptography (and an internal incentive system) to control transactions and manage the supply. Payments are validated by a decentralized network (Gandal, Hamrick, Moore, & Oberman, 2018).

From the very beginning, the essence of blockchain and related cryptocurrencies has been the subject of research by scientists. It is possible to identify many research trends by analyzing the potential application areas of the new technology. Blockchain can be used to decentralize the

financial system (Chen & Bellavitis, 2020; Patel, Migliavacca & Oriani, 2022; Sánchez, 2022), to create new forms of nonfungible token (NFT) investments (Regner, Schweizer, & Urbach, 2019), and finally to implement smart contracts (Cong & He, 2019; Hughes, Park, Kietzmann, & Archer-Brown, 2019; Rozario & Vasarhelyi, 2018), which are systems that automatically control digital assets according to arbitrary prespecified rules. There is also an increasing trend of its mass application in accounting and financial reporting of enterprises (Schmitz & Leoni, 2019; Pimentel & Boulianne, 2020; Kokina, Mancha, & Pachamanova, 2017). Therefore, further intensive changes in economic systems caused by this invention should be expected.

Particularly noteworthy is distributed, decentralized, and reliable mechanism of cryptocurrencies, thanks to which they have become a global trading platform (Lin, Wu, Hsu, Tu & Liao, 2019). Unfortunately, these same features have also become attractive to criminals (Fletcher, Larkin & Corbet, 2021). In addition, it is worth mentioning the lack of appropriate legal regulations and related supervisory activities on the part of domestic or international institutions (Irwin & Dawson, 2019; Al-Tawil & Younies, 2020; Lui & Ryder, 2021). All this contributes to the growing use of the cryptocurrency market by criminals financing terrorism, money laundering, and other economic abuses. Cryptocurrencies are under constant threat of attack. Numerous researchers have conducted studies to document and combat crimes, such as:

- Ponzi schemes (Vasek & Moore, 2015; Esoimeme, 2018; Bartoletti, Pes, & Serusi, 2018; Zhang, Kang, Dai, Chen, & Zhu, 2021; Wang, Cheng, Zheng, Yang, & Zhu, 2021);
- money laundering (Levin, O'Brien, & Zuberi, 2015; Rivera, 2019; Hendrickson & Luther, 2022; Bartoletti et al., 2018; Barth, Herath, & Xu, 2020; Broadhead, 2018; van Wegberg, Oerlemans, & van Deventer, 2018; Dupuis & Gleason, 2021; Wronka, 2022);
- mining botnets (Huang et al., 2014; Konoth et al., 2018) and the theft of "brainwallets" (Vasek, Bonneau, Castellucci, Keith, & Moore, 2016).

Thousands of new cryptocurrencies have been introduced in recent years. It is estimated that over 5,100 such assets are currently in operation (Goforth, 2021). The scale and variety of abuses related to it are also growing. The US Federal Trade Commission published a report that presented the latest data on the scale of fraud in the cryptocurrency market (FTC, 2021). It shows that from October 2020 to the end of March 2021, almost 7,000 people fell victim to virtual currency fraud, which resulted in a total loss of more than $ 80 million. For comparison, this sum is nearly 1000% higher than the amount

recorded in the corresponding period a year earlier. The report presented by FTC also shows that the median value of the losses suffered was $ 1,900. Global data on the topic can be found in Chainanalysis reports. According to the latest information, the value of frauds and scams in the crypto-assets market in 2021 amounted to $ 14 billion, i.e., almost twice as high ($ 7.8 billion) as the year before (Chainanalysis, 2022). It is also worth paying attention to the scale of money laundering by use of this market. Cybercriminals laundered $ 8.6 billion worth of cryptocurrency in 2021. That represents a 30% increase in money laundering activity over 2020. Cybercriminals have laundered over $ 33 billion worth of cryptocurrency since 2017.

As presented above, the problem is beginning to grow and it significantly affects the security of economic transactions on a global scale. This has been pointed out by both ordinary market participants as well as the governments of individual countries. We are seeing a dynamic increase in global financial flows that are not under any effective control. In connection with the above, it is highly desirable to identify the degree of development and the scope of the current research on the cryptocurrency market in the context of their use for criminal activities. A preliminary analysis of the literature on the subject indicates an existing research gap. There are some studies that present an analysis of the literature on the subject to date (Trozze et al., 2022). The authors have made a scoping review of academic research and grey literature on cryptocurrency fraud. When selecting scientific positions, the Google Scholar search engine was used, and for the remaining publications – the Google search engine. The main purpose of the study was to identify the types of crimes committed with the use of cryptocurrencies. Hence, only those items that contained a description of at least one example of fraud (as of November 2020) were analyzed. As a result of this work, 29 different types of cryptocurrency fraud included in scientific publications and 32 types discussed in the grey literature were distinguished. However, it should be mentioned that only the identification of the types of fraud using cryptocurrencies is insufficient. It is worth making a broader analysis of the literature on the subject in order to define also other areas of research in this field. This article takes that perspective.

The main purpose of the study is, therefore, to identify the current scope of research on cryptocurrencies as a subject of fraud. It will also allow the definition of potential opportunities for further investigation of this topic. To the best of the author's knowledge, it is one of the first studies showing the results of a systematic literature review (SLR) combined with a bibliographic analysis and an in-depth analysis of the content of publications in this field. Detailed research questions are presented later in the study.

This article is structured as follows. The next part deals with the general theoretical background of the subject, with particular emphasis on research conducted in similar areas. Then the research methodology is presented. In this section, research questions are posed. The process of selecting publications for their systematic review is explained in detail, as well as the approach to bibliometric and descriptive analysis. The basic parameters used to distinguish thematic clusters are also presented in this part of the study. The following section shows the results of a systematic review of the literature, including the findings of an in-depth analysis of the content of individual publications. They provide the basis for a discussion on the context of the specific research questions. The last part contains conclusions and presents potential directions for further research in this field.

METHODOLOGY

This study adopted a systematic approach to conducting a literature review to minimize bias and lend scientific value to its results. Systematic literature review (SLR) is a widely recognized scientific method used in social sciences, including management, economics, and finance (Hiebl, 2021; Simsek, Fox, & Heavey, 2021; Sharma & Bansal, 2020). According to the guidelines included in the literature on SLR, the study was divided into the following stages (Jesson, Matheson & Lacey, 2011; Booth, Sutton, & Papaioannou, 2016):

- defining research questions;
- searching for the literature;
- selection of publications using exclusion and inclusion criteria;
- preparation of the final database;
- bibliometric analysis;
- content analysis;
- discussing the results.

At the beginning, three main research questions were defined that set the direction and scope of the systematic literature review, especially in content analysis. The following questions were asked:

RQ1) What are the current state and the primary considerations of research relating to cryptocurrencies as a subject of fraud?
RQ2) What are the most common crimes committed with the use of cryptocurrencies?
RQ3) What could be the future research trends related to cryptocurrencies and financial fraud?

A systematic literature review is crucial in responding to RQ1 and RQ3. In turn, RQ2 is also related to the practical implications of the subject of the study. From the methodological point of view, one of the essential elements of a systematic literature review is an appropriately conducted process of selecting a research sample. The individual steps of eliminating and including in the final set of publications should be based on clear criteria and performed in the correct order. Selected literature items indicate different sampling activities (Sharma & Bansal, 2020; Denyer & Tranfield, 2009; Gaur & Kumar, 2018). However, as a rule, three standard main stages can be distinguished in them:

- identification – it consists in determining a potential group of publications relating to a predefined research problem (Vassar et al., 2017; Booth et al., 2016);
- screening – application of various criteria for inclusion and exclusion of selected items to the final research sample, relating mainly to the substantive content, including also the qualitative assessment of the publication based on content analysis (Booth et al., 2016; Pussegoda et al., 2017; Briner & Denyer, 2012);
- final review sample – determining the definitive set of literature items on the subject being the basis for a detailed analysis from the point of view of the research questions posed. In this respect, there are several guidelines for the minimum dataset size. In the context of the analyzed issue, the minimum sample size should be 50 items (Short, Sharma, Lumpkin & Pearson, 2016; Hiebl, 2021).

A diagram of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used to present the different stages of determining the final set of scientific publications covered by the analysis. This model is one of the most frequently used tools that regulates the sequence of actions performed during the sampling process (Pussegoda et al., 2017; Page et al., 2021; Liberati et al., 2009). Scopus was selected as the key database for the systematic literature review. Before deciding on the choice of the final database, trial tests were also carried out for other databases of scientific publications, especially the Web of Science and ProQuest. However, preliminary results of searching these databases using comparable criteria indicated a smaller number of publications and they included many duplicates. Therefore, it was decided to use Scopus, where the scope of the publication was the largest. The time range of the published scientific items was not limited due to the relatively new subject of scientific research, i.e., cryptocurrencies. An interesting aspect was also the identification of the oldest publications in this field.

The first stage of searching the database and selecting items was determining the keywords appropriate for the research subject. This collection includes cryptocurrencies and crypto assets (crypto *), bitcoin, Ethereum, fraud, crime, scam, and abuse. The first four keywords generally refer to cryptocurrencies and their two most popular and longest-functioning types in the market. The following four keywords are a combination of the most common terms related to financial fraud in the literature. The "Article title, abstract, keywords" area was selected as the reference database for the search. As a result of the database search, 841 publications meeting these criteria were identified.

Then, the subject area had to be narrowed down due to its substantive nature. In this regard, two sites were selected: "business, management, and accounting" and "economics, econometrics, and finance." The scope of the publication was 106 items. Another criterion was to narrow the area of analysis to four types of documents: "article," "conference paper," "book chapter," and "book." The database identified 102 publications. Of these, all articles still in print were discarded, and the focus was solely on the completed items. As a result of the database search, 95 scientific publications were finally included in the collection, and the full search criteria were as follows:

(TITLE-ABS-KEY (crypto*) OR TITLE-ABS-KEY (bitcoin) OR TITLE-ABS-KEY (ethereum) AND TITLE-ABS-KEY (fraud) OR TITLE-ABS-KEY (crime) OR TITLE-ABS-KEY (scam) OR TITLE-ABS-KEY (abuse)) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "bk")) AND (LIMIT-TO (PUBSTAGE , "final")).

The next stage was verifying the titles and abstracts of all 95 bibliographic items to determine which of them relate to the research questions posed. The mainstream research was supposed to concern cryptocurrencies in the context of fraud committed. At this stage, a complete double analysis of titles and abstracts was performed to eliminate the risk of confusion. Thirty-eight publications were rejected. For research purposes, the final collection was 57 literature items. The eliminated publications mainly concerned the possible innovative applications of blockchain technology related to the cryptocurrency market in other areas of life (medicine, education).

The summary of the entire process of selecting the research sample is the following PRISMA diagram presenting the various stages of the elimination of bibliographic items (Figure 1).

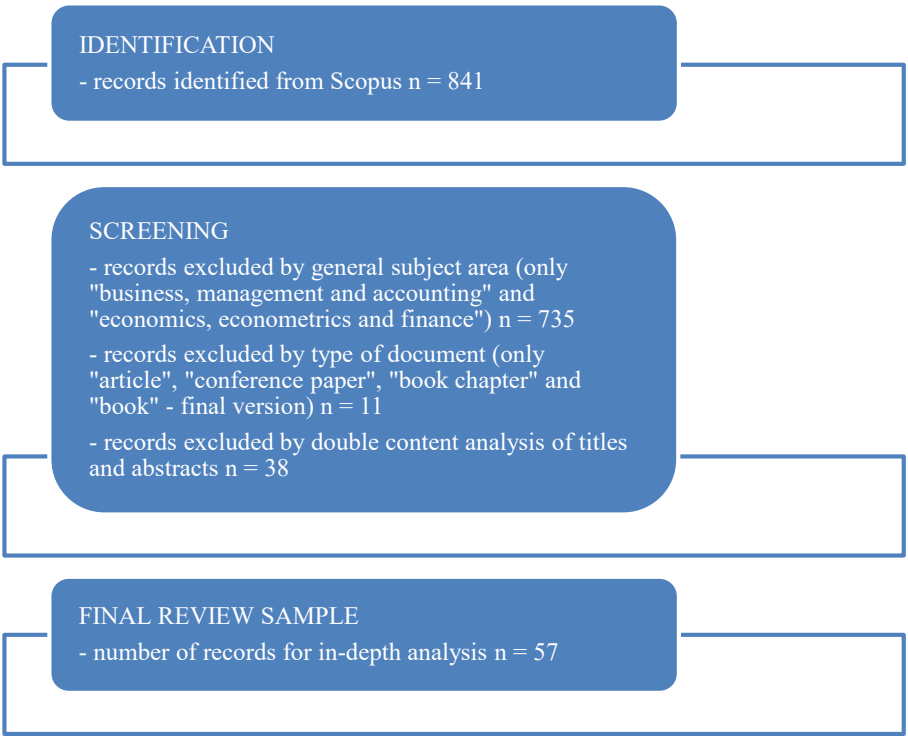

Figure 1. PRISMA diagram – selection of the research sample

In the next stage, bibliometric and descriptive analyses were made to present the primary data on the literature on this subject. The key verification criteria concerned publication trends in particular years, types of these publications, the most popular journals, authors, their affiliation, and countries of origin. The publications were also analyzed in terms of their levels of citation. Using the tools built into the Scopus database, a ranking of the most frequently cited literature items from the collection included in the final analysis was prepared. In this way, it was possible to identify critical publications that were most often included by other authors dealing with similar issues.

The last element was the in-depth content analysis. The starting point for organizing the substantive criteria of this analysis was the verification of potential clusters. Therefore, a network analysis was performed using the VOSviewer 1.6.18 Software. The data was extracted directly from Scopus, including all necessary information (author, title, abstract, keywords, publication year, affiliation, etc.), and then imported to VOSviewer to create

the co-occurrence network to identify the main aspects of the discussion. The most crucial element in this respect was the analysis of the co-occurrence network of keywords to distinguish clusters. The key parameters used to define the network of connections are presented in Table 1.

Table 1. Essential parameters for identifying the co-occurrence network of keywords

Parameter	Settings
Type of analysis	Co-occurrence
Unit of analysis	All keywords
Counting method	Full counting
Minimum number of occurrences of a keyword	5
Number of keywords to be selected	10

Subsequently, each literature item within the individual clusters was read, and an in-depth content analysis was performed. A narrative approach was used during this verification, and significant substantive findings relating to the research questions were presented.

RESULTS

The first element is a detailed bibliometric and descriptive analysis. The subject of cryptocurrencies in the context of crime is relatively new compared to other research areas related to management, economics, and finance. Figure 2 presents the evolution of the number of publications in this field. As mentioned above, no filters related to time constraints were assumed when searching the Scopus database. The results, therefore, present the full range of literature on the subject.

One of the analysis's most interesting elements was identifying the oldest publications on cryptocurrencies used as a potential fraud tool. The above chart shows that in 2014 one such item was published. After that, only individual publications were identified over the next several years. It was only in 2018 that higher growth dynamics can be observed – eleven such items were published then. A similar trend continued in the following years (12, 15, and 12 publications in 2021). The chart does not present data from 2022, as the information does not include the whole year and it would distort the conclusions from the comparative analysis. This implies that after the first cryptocurrency was introduced to the market, at least a few years had to pass before it became the object of interest to scientists. It is also clear that in the early years, cryptocurrencies were not identified as potential financial crime tools.

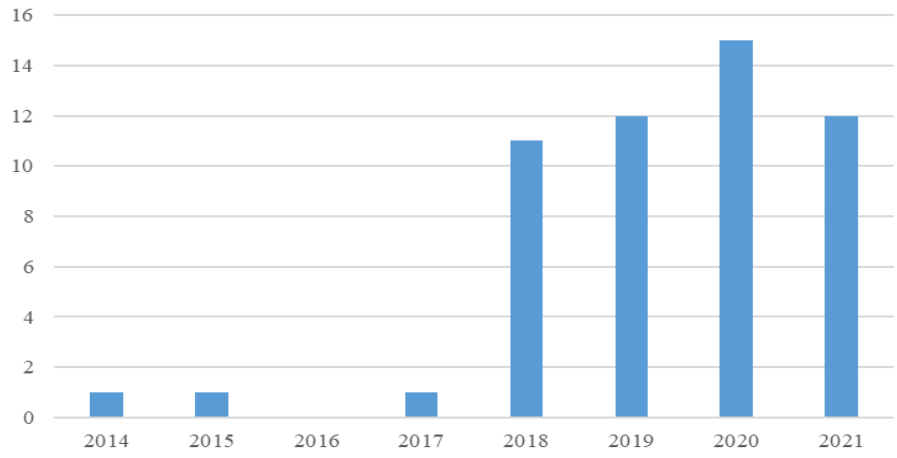

Figure 2. Number of publications in respective years

Another aspect of bibliometric verification is the publication type and the most famous journals. The data show that among the entire group of 57 literature items, the most significant number is of scientific articles (36) and publications in conference materials (14). Trace amounts refer to chapters in books or complete monographs. A summary of these data is presented in Figure 3.

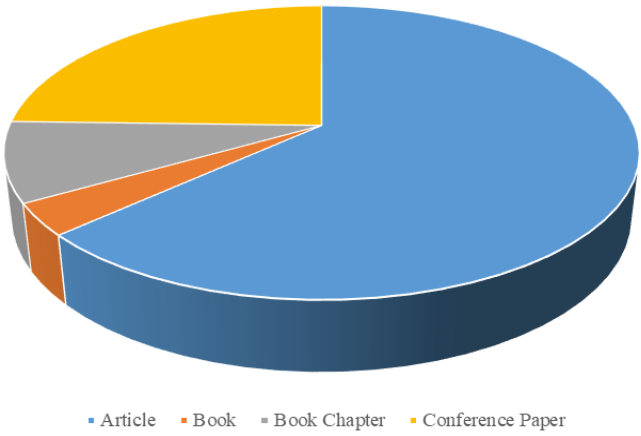

Figure 3. Types of publications

The publications appeared in a total of 42 different journals and conference materials. The analysis showed that articles in this field are most often published in the Journal of Money Laundering Control, which immediately suggests the essence of the research issue and the most common type of fraud in the context of cryptocurrency trading. A total of 10 publications were identified in this journal. The following items are publications in conference materials relating to the IEEE International Conference on Blockchain and Cryptocurrency, ICBC 2020, and four more journals. Two elements of the literature on the subject were identified. The rest are single publications in 36 different journals. It is immediately noticeable that there is one top place dealing with the issue of cryptocurrencies in the context of economic fraud. Table 2 presents the primary sources of publications in this field.

Table 2. Most common journals

Title	Number of articles
Journal of Money Laundering Control	10
IEEE International Conference on Blockchain and Cryptocurrency, ICBC 2020	3
Research in International Business and Finance	2
Journal of Financial Crime	2
Journal of Advanced Research in Law and Economics	2
International Journal of Recent Technology and Engineering	2

Considering the number of publications issued by individual authors, it is difficult to identify a leading scientist specializing in this subject. Only five people with two publications on using cryptocurrencies in financial frauds can be distinguished – Esoimeme, Falker, Moore, Teichmann, and Wronka. It is worth pointing out that all of their scientific articles are about money laundering with crypto-assets and have been published in the Journal of Money Laundering Control. Most researchers dealing with this subject come from the United States, Great Britain, and China. Due to the large dispersion of publications issued by individual authors, it is also impossible to indicate specific research centers related to the affiliation that would play a leading role in scientific research on this subject.

Table 3 presents the ranking of publications from their citation point of view. It includes all items for which more than 10 citations were identified. In total, for the entire set of 57 items, 921 citations were established in other scientific publications, of which 11 articles did not receive any citations in the analyzed period of 2018-2022.

Table 3. Most cited publications

Title	Authors	Number of citations
Price manipulation in the Bitcoin ecosystem	Gandal N., Hamrick J.T., Moore T., Oberman T.	259
Blockchain technology innovations	Ahram T., Sargolzaei A., Sargolzaei S., Daniels J., Amaba B.	227
Data mining for detecting bitcoin Ponzi schemes	Bartoletti M., Pes B., Serusi S.	109
Bitcoin money laundering: mixed results?: An explorative study on money laundering of cybercrime proceeds using bitcoin	van Wegberg R., Oerlemans J.J., van Deventer O.	32
News sentiment in the cryptocurrency market: An empirical comparison with Forex	Rognone L., Hyde S., Zhang S.S.	28
An Evaluation of Bitcoin Address Classification based on Transaction History Summarization	Lin Y.J., Wu P.W., Hsu C.H., Tu I.P., Liao S.W.	25
Multi-Class Bitcoin-Enabled Service Identification Based on Transaction History Summarization	Toyoda K., Ohtsuki T., Mathiopoulos P.T.	24
Bitcoin, life coin, name coin: The legal nature of virtual currency	Kirillova E.A., Pavlyuk A.V., Mikhaylova I.A., Zulfugarzade T.E., Zenin S.S.	24
Underpricing in the cryptocurrency world: evidence from initial coin offerings	Felix T.H., von Eije H.	22
The contemporary cybercrime ecosystem: A multi-disciplinary overview of the state of affairs and developments	Broadhead S.	13
Is bitcoin a waste of resources?	Williamson S.	12
Tracing Cryptocurrency Scams: Clustering Replicated Advance-Fee and Phishing Websites	Phillips R., Wilder H.	12
Pricing Efficiency and Arbitrage in the Bitcoin Spot and Futures Markets	Lee S., Meslmani N.E., Switzer L.N.	11
Countering money laundering and terrorist financing: A case for bitcoin regulation	Fletcher E., Larkin C., Corbet S.	10

When analyzing the above results, three leading items of the most significant substantive importance with more than 100 citations should be identified. They mainly relate to manipulating the bitcoin exchange rate or its use to build a financial pyramid (Ponzi scheme).

The next stage of the systematic literature review is the in-depth content analysis of the collection of publications from the point of view of achieving the main goal and the research questions posed. The starting point for this analysis was the identification of potential substantive clusters. As mentioned earlier, VOSviewer Software was used to create the co-occurrence network using all keywords to identify the main aspects of the publications.

As part of the selection process presented in the methodology section, a total of 322 keywords were identified, of which only 10 met the assumed criteria. The number of occurrences and total link strength for the most important keywords are presented in Table 4.

Table 4. Occurrences and link strength of keywords

Keyword	Occurrences	Total link strength
bitcoin	30	53
blockchain	19	52
cryptocurrency	21	44
crime	11	30
chromium compounds	5	18
Ethereum	6	18
money laundering	10	16
block - chain	5	15
electronic money	5	13
cryptocurrencies	6	7

Generally, three clusters focused on the following keywords were identified:

- bitcoin – electronic money, cryptocurrencies;
- blockchain – crime, chromium compounds, Ethereum, block – chain;
- cryptocurrency – money laundering.

The results are presented in Figure 4, which shows network visualization. In addition, the density visualization in Figure 5 was also included to provide a complete presentation of the selected clusters.

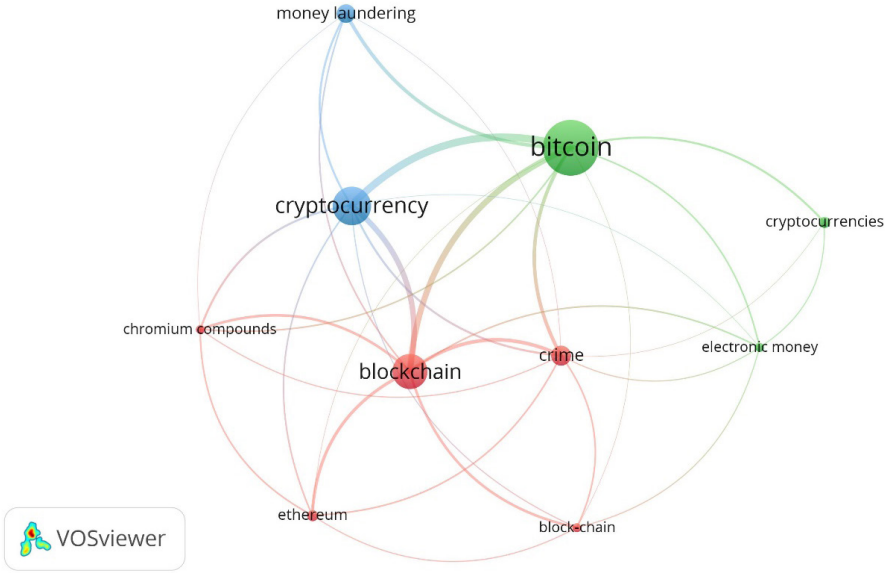

Figure 4. Co-occurrence analysis of the authors' keywords

Source: own study using VOSviewer 1.6.18.

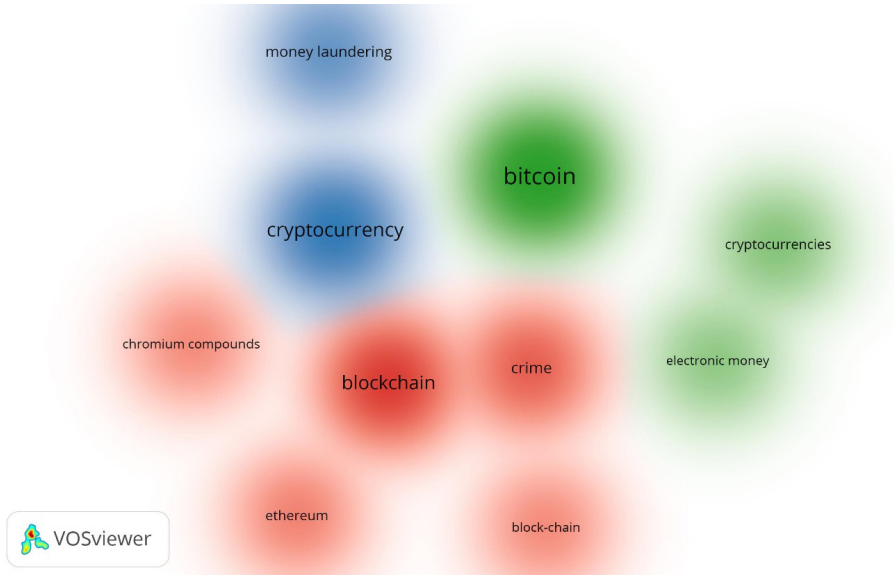

Figure 5. Clusters of the authors' keywords

Source: own study using VOSviewer 1.6.18.

Cluster "Bitcoin"

Bitcoin as the oldest cryptocurrency and various aspects related to its functioning, is by far the most frequently discussed topic in the literature on the subject. Many authors emphasize that the perception of bitcoin has significantly evolved and is now a normally functioning asset in financial markets. Therefore, Teo and Low (2018) pointed out that it is necessary to redefine the concept of "money" as an asset and define its protection principles. They showed various legal aspects related to defining this concept and the resulting risks in investment practice. It was especially emphasized that the main threat in this regard is hacking.

A large part of the publication shows examples of possible illegal use of bitcoin for various crimes, including money laundering (Esoimeme, 2018; Bartoletti et al., 2018; Barth et al., 2020; Broadhead, 2018, van Wegberg et al., 2018). Esoimeme (2018) indicates that bitcoin creates hitherto unknown opportunities for marketing funds from illegal sources, much more significant than traditional money transfers. For example, the Mavrodi Mondial Movement (MMM) pyramid scheme operating in recent years in Nigeria and the risks associated with new payment methods are given.

Ponzi scheme-based financial pyramids are one of the most commonly used frauds in the context of bitcoin, with the longest tradition in the market. It is noted by Bartoletti, Pes, and Serusi (2018), Zhang, Kang, Dai, Chen, and Zhu (2021), Wang, Cheng, Zheng, Yang, and Zhu (2021). They build a network of investors, where the profits paid to the first participants of the system come from payments made by subsequent investors and not from the funds generated by the system. The authors emphasize that immediately after the introduction of bitcoin in 2009, there were signs of building financial pyramids with its use. At the same time, they proposed various techniques for detecting bitcoin addresses directly related to Ponzi schemes, allowing early identification of this type of fraud. The method involves experimenting with different machine learning algorithms and evaluating their effectiveness using standard validation protocols and performance metrics. In turn, Wang, Cheng, Zheng, Yang, and Zhu (2021) proposed a method for detecting pyramid schemes based on oversampling Long Short-Term Memory. Account features and code features are extracted from contract call information and contract codes, and the two components are combined to detect Ponzi scheme smart contracts.

Analyzing bitcoin addresses and their associated transaction types is also of interest to Lin, Wu, Hsu, Tu, and Liao (2019). They point out that the ability to identify addresses associated with criminal activities is becoming the most critical issue in the cryptocurrency network. They experimented

with building a classification model for detecting abnormality of bitcoin network addresses. These features include various high orders of moments of transaction time, which summarizes the transaction history in an efficient way. This allows the addresses associated with the scams to be identified. A modern tool for detecting suspicious bitcoin accounts was also proposed by Sun, Xiong, Yiu, and Lam (2019), who developed the BitVis system. With it, cryptocurrency investors can easily filter transactions on demand, interact with trading networks to find helpful information, and analyze the behavior of bitcoin accounts. The mechanism may also be successfully used by authorities regulating financial markets.

A tool popularly known as honeypot (Torres, Baden & State, 2020) can also play a similar role. This particular trap is aimed at detecting attempts at the unauthorized use of the system or obtaining data. Most often, it consists of a computer, data, and a separate area of the local network, which pretends to be a real network but are isolated from it and adequately secured. From the outside, this construction looks like it contains information or a resource that could be a potential target of a cybercriminal. Another publication that presents the potential possibilities of preventing fraud with bitcoin is the study on the innovative solution proposed by Toyoda, Ohtsuki, and Mathiopoulos (2018). Scientists implemented a multi-faceted scheme for identifying services based on bitcoin addresses by analyzing the history of transactions. It allows distinguishing seven significant services: regular exchange, faucet, gambling, investment scam, marketplace, mining pool, and mixer. The model provides 72% accuracy and it has been tested on over 26,000 bitcoin addresses. In turn, Lorenz, Silva, Aparício, Ascensão, and Bizarro (2020) conducted experiments to detect illegal activity in a set of bitcoin transactions. They studied the detection ability of the machine learning model and proved that unsupervised anomaly detection methods have poor results.

Interesting research in the context of bitcoin has also been presented by Barth, Herath, and Xu (2020). These scientists were looking for answers as to whether, and to what extent, ethical aspects affect the valuation of cryptocurrencies. To this end, they measured the intensity of the use of ethical and unethical words in the discussion of bitcoin on Twitter and its valuation. They discovered that the frequency of an unethical discussion about bitcoin is negatively associated with its price. In contrast, the frequency of an ethical debate is positively associated with its price.

Cluster "Blockchain"

The publications belonging to this cluster mainly concern blockchain as a new technology covering, among other things, the cryptocurrency market and they draw attention to various associated risks. It is assumed that this solution completely revolutionized the existing digital world and brought an entirely new perspective on its security, flexibility, and efficiency (Srivasthav, Maddali, & Vigneswaran, 2021). On the one hand, it is emphasized that blockchain allows for a completely different dimension of transactions or exchange of goods and services. However, its further development depends to a large extent on regulatory changes protecting against cybercrimes and financial frauds (Ahram, Sargolzaei, Daniels & Amaba, 2017).

The WannaCry ransomware attack that took place in May 2017 was given as an example of a new type of crime involving blockchain-based cryptocurrency payment transactions (Turner, McCombie, & Uhlmann, 2019). It was a global hacking attack that involved computers running the Microsoft Windows operating system by encrypting data and demanding ransom payments in the bitcoin cryptocurrency. At the same time, the authors developed a model for collecting and analyzing data related to inflows and outflows of bitcoin-related ransomware transactions. Bitcoin transactions form graph networks and enable the construction of a target network model for collecting, analyzing, and sharing intelligence with multiple stakeholders. It would therefore be possible to counter such attacks more quickly and effectively in the future.

Karapapas, Pittaras, Fotiou, and Polyzos (2020) draw attention to the increased risk of hacker attacks using blockchain technology. The authors clearly showed how technology could be used to launch ransomware campaigns as a service. They proved that criminals could transact with related parties and victims without revealing their identity and with multiple privacy guarantees. The scale of cyber-attacks in cryptocurrency trading and the use of technology was also the subject of research by Caporale, Kang, and Spagnolo (2020). They thoroughly analyzed hacking attacks on the four most popular cryptocurrencies. They confirmed their significant negative financial consequences and, at the same time, pointed to the need to increase research in this field. They considered the precise understanding of the mechanisms of cyber-attacks to be crucial in the fight against this phenomenon.

With the development of blockchain and the cryptocurrency market, the scale of abuse related to the simple theft of these assets has also increased. Only the tools used by criminals have changed. These scams operate on visually similar but seemingly unrelated websites advertised by malicious social media accounts. With the help of such websites and social media accounts, they

often perpetrate fraud or act as phishing sites. For example, Phillips and Wilder (2020) analyzed selected data online and based on blockchain technology. Using the clustering technique, they developed a typology of prepayment and phishing scams. It turned out that the same entities carried out very similar scams in their online activities and using blockchain.

Cluster "Cryptocurrency"

The vast majority of publications in this field see the problem of using cryptocurrencies for various crimes, including primarily money laundering. Levin, O'Brien, and Zuberi (2015) explicitly point out that until recently, the bitcoin market was considered a "virtual Wild West for drug dealers and other criminals." At the same time, they pointed out that the support for this currency is constantly growing, and it has become a global virtual asset. The regulations governing this market do not keep up with the practice and seem unclear. The authors cite examples of American administrative proceedings against operators of platforms on which cryptocurrency trading is carried out and analyze the current state of legal regulations in this field in the USA.

The issue of appropriate regulation was also raised by Irwin and Dawson (2019), who specifically dealt with the law of payment methods. The authors identified the current legal status in Australia, Europe, and America and, at the same time, indicated potential limitations in their application on a global scale. In addition, they highlighted the ineffectiveness of the implemented solutions, which also have a negative impact on the possibility of prosecuting criminals. One of the reasons they mentioned is the lack of a legal, universally binding definition of bitcoin.

It is also emphasized that countries that give up cash transactions entirely are not much less vulnerable to money laundering crimes (Rivera, 2019; Hendrickson & Luther, 2022). In this case, virtual transactions, including those related to cryptocurrencies, are used on a larger scale. After all, popular cryptocurrencies like bitcoin are close substitutes for cash. In addition, they offer a higher level of financial anonymity and thus allow transactions with a lower risk of detection than traditional digital payments. Consequently, all efforts to eliminate cash from circulation strongly drive criminals towards cryptocurrencies.

Experts indicate that a substantial restriction of trading in cryptocurrencies is not the solution for the future either, because they appeared as a natural consequence of the intensive development of technology. However, it is essential to introduce global legal regulations limiting their criminal use (Al-Tawil & Younies, 2020). Liechtenstein is quite an active country in this context (Teichmann & Falker, 2020; 2021). Particular guidelines have recently

been introduced regulating this market ("The Liechtenstein Blockchain Act"), preventing money laundering above all. New regulations were also introduced relatively quickly in Malta (Buttigieg & Sapiano, 2020). Teichmann and Falker (2020) also presented specific methods used by people involved in money laundering using crypto assets. The qualitative research included 10 presumed money-laundering people and 18 anti-money-laundering experts.

Quite an exciting publication was prepared by Dupuis and Gleason (2021). The authors presented the possibilities and limitations of the cryptocurrency market as a place for money laundering. They performed an in-depth analysis of the currently available exchange mechanisms of these assets in light of the existing legal regulations. The illegal use of cryptocurrencies was investigated through Kane's regulatory dialectical paradigm and it eventually identified six potential tools used by criminals.

A similar topic was taken up by Lui and Ryder (2021). They classified the mechanisms of using cryptocurrencies in financial crimes and analyzed the relevant legal provisions in Great Britain. There has also been an attempt to identify the current loopholes in the regulatory systems that are most often exploited by fraudsters. The authors emphasized that, despite the efforts of the Financial Action Taskforce, the legal system does not keep up with the development of technology, and harmonized global actions are needed in this regard.

Potential money laundering techniques using cryptocurrencies were also presented by Wronka (2022). He classified the most common fraud mechanisms and patterns and highlighted the changing cryptocurrency market that brings new opportunities for fraud. The author also analyzed the extent to which EU and national regulations can counteract this phenomenon, bearing in mind the security of the financial market. In verifying domestic law, he dealt mainly with the legal provisions in force in Germany, Great Britain, and Switzerland. Findings suggested that relatively lenient laws exist in Switzerland and Germany, while Great Britain has the most stringent regulations.

The directions of changes in the law in the context of the security of cryptocurrency trading were also presented by Fletcher, Larkin, and Corbet (2021). They performed an in-depth analysis of the regulations in the American market. The authors distinctly indicated that bitcoin and other crypto-assets should be classified as a technology with financial components and regulated as a part of the growing FinTech industry. In turn, Riley (2021) reviewed current Chinese law, with particular emphasis on the new Chinese Cryptography Law.

DISCUSSION

The bibliometric and descriptive analysis summary presented above made it possible to partially answer the first research question regarding the state of scientific publications on cryptocurrencies as a subject of fraud. There has been an increased interest in this topic for several years.

The detailed content analysis of the literature items made it possible to indicate the main research trends, identify the most frequently committed frauds with the use of cryptocurrencies and define future research directions, which are closely related to the research questions posed. The starting point was the identification of three keyword-based clusters. The verification of the publications included in individual groups indicated some thematic specialization.

Within the bitcoin cluster, the most significant number of studies presenting various types of crimes committed with its use and possible techniques for detecting these abuses were identified. Some publications also referred to the need to redefine critical concepts related to cash turnover or ethics. Cluster "blockchain" clearly focuses on new technology and the resulting risks. On the other hand, the group of studies in the field of cryptocurrencies mainly refers to issues related to money laundering and changes in international and national legal regulations regarding cryptocurrency trading. Figure 6 summarizes the identified vital research trends.

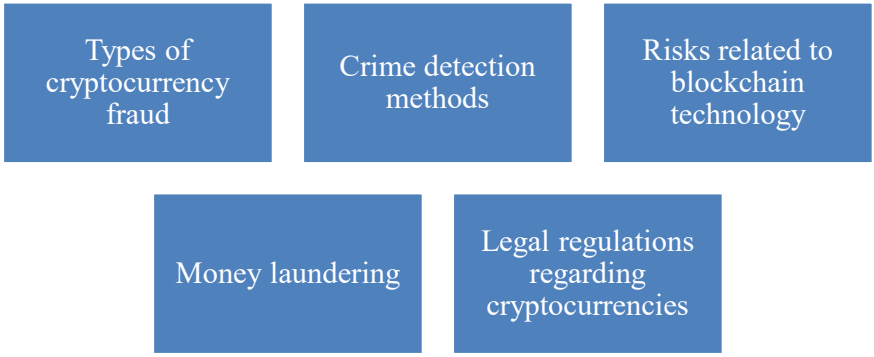

Figure 6. Main research areas in scientific publications

The two main types of economic crime related to the cryptocurrency market are money laundering and financial pyramids based on the Ponzi scheme. All authors point out that this market offers new and unprecedented possibilities for transferring funds from illegal sources. This is facilitated by

certain anonymization of transactions and the lack of clear legal regulations. As soon as the formalized framework for the organized cryptocurrency trading market, including mainly bitcoin at first, emerged, criminals found new opportunities for money laundering. This type of abuse is by far the most common in the cryptocurrency context (Esoimeme, 2018; Levin et al., 2015; Rivera, 2019; Hendrickson & Luther, 2022; Bartoletti et al., 2018; Barth et al., 2020; Broadhead, 2018; van Wegberg et al., 2018; Dupuis & Gleason, 2021; Wronka 2022).

However, attention should be paid to the second, quite a strong trend of publications on the use of the cryptocurrency market to build Ponzi schemes (Esoimeme, 2018; Bartoletti et al., 2018; Zhang et al., 2021; Wang et al., 2021). The crimes of the financial pyramid have been known in the market for many years and they have always aroused a lot of emotions, mainly due to the scale of actions of selected fraudsters and the wide range of victims. The very name of the type of fraud comes from Charles Ponzi, an Italian immigrant living in the United States. In 1920, he built the first financial pyramid (based on the international reply coupons IRC). Since then, this type of fraud has systematically appeared in the market. One of the largest frauds of this type in the economic history of the world is the financial pyramid of Bernard L. Madoff, a well-known American stock exchange player. The number of victims exceeded fourteen thousand people and the losses were estimated at tens of billions of dollars (Kutera, 2016). The cryptocurrency market offers new opportunities in this regard, although the essence of the crime has remained unchanged. It was presented in detail by Wang, Cheng, Zheng, Yang, and Zhu (2021), who described the fraud mechanism using the example of PlusToken. However, there are more examples: the OneCoin-based pyramid operating in 2014-2017 or BitConnect (2016-2018).

Another area of research is the methods of detecting cryptocurrency scams. Most researchers here focus on various ways of verifying bitcoin addresses and identifying those that bear the hallmarks of criminal activity (Bartoletti et al., 2018; Lin et al., 2019; Toyoda et al., 2018). Other proposals relate to machine learning models (Wang et al., 2021; Lorenz et al., 2020) or completely original solutions (Sun et al., 2019; Torres et al., 2020). In this context, everyone emphasizes that the capabilities of blockchain technology can also contribute to a more effective fight against economic crime related to cryptocurrencies. This trend of research also applies to the IT sector, where you can see a growing number of publications describing the use of so-called smart contracts. Therefore, it seems that the subject of creating various application tools supporting fraud detection in the blockchain environment will be a separate and stringent research stream.

The analysis of the content of publications regarding various risks arising from the use of blockchain technology and their potential impact on the cryptocurrency market showed that the main problem is hacker attacks. Selected studies presented examples of such situations and identified the scale of financial losses (Turner et al., 2019; Broadhead, 2018). The most significant illegal acquisitions of cryptocurrencies as a result of imperfect information systems took place, for example, on Mt. Gox, where the size of the financial damage was estimated at $ 473 million. Other examples include the hacking attacks on the Bitfinex exchange in August 2016 (total losses amounted to $ 72 million), PolyNetwork in August 2021 ($ 600 million), and Zaif in September 2018 ($ 62 million). Some publications in this area also presented more technical aspects related to the actual carrying out of attacks and analyzed the main IT tools used in the crime (Karapapas et al., 2020; Caporale et al., 2020; Phillips & Wilder, 2020).

The last highlighted research area is that of legal regulations regarding cryptocurrencies and their impact on the security level of this market. The analysis covers both global and national levels. The authors identified the current state of the law and the desired directions of its changes. The regulations applied in the United States (Levin et al., 2015; Fletcher et al., 2021), Great Britain (Lui & Ryder, 2021; Wronka, 2022), China (Riley, 2021), Australia (Irwin & Dawson, 2019), Germany and Switzerland (Wronka, 2022) and in smaller countries such as Liechtenstein (Teichmann & Falker, 2020; 2021) and Malta (Buttigieg & Sapiano, 2020). In some cases, broader international comparative analyzes were carried out, which allowed for more profound conclusions. In general, attention was drawn to the urgent need to develop and implement some global standards regulating the cryptocurrency market. The rules applied at the national level are insufficient to protect investors fully. Crypto-asset transactions, by their nature, involve transnational cash flows.

CONCLUSION

The main purpose of this paper was to identify the current scope of research on cryptocurrencies as a subject of fraud. Ultimately, 57 publications were selected for the systematic review of the literature. The detailed bibliometric and descriptive analysis showed that it is generally a new area of scientific research, although it is developing quite intensely. The relatively small number of publications compared to other similar areas also indicates that this topic is not yet explored widely by scientists, and many different research trends can be created within it.

In turn, an in-depth analysis of the content made it possible to find answers to the specific research questions. They mainly referred to identifying the most critical trends in the current research on cryptocurrencies in the context of financial fraud and the definition of potential opportunities for further investigation of this topic. The starting point in this part of the study was the identification of three thematic clusters and more detailed areas of analysis within them. Ultimately, the following key research trends were identified: types of cryptocurrency fraud, crime detection methods, risks related to blockchain technology, money laundering, and legal regulations related to cryptocurrencies. One of the questions also concerned the practical implications of the research area, namely identifying the most common crimes committed with the use of cryptocurrencies. These include money laundering and financial pyramids based on the Ponzi scheme.

The contribution of this study is threefold. It is one of the first research papers showing the results of a systematic literature review (SLR) combined with a bibliographic and in-depth analysis of the content of publications in this field. This is all the more important as the scale of crimes involving cryptocurrencies is growing yearly, which is also mentioned in this study. Secondly, the key types of fraud have been identified that, at the same time, cause the most significant financial loss. This allowed for the establishing of directions for further research, which have profound practical implications for market participants. The most important issues that should be included are:

- desired changes in the field of international and national legal regulations regarding cryptocurrency trading, which on the one hand, would increase the security of investors, but at the same time, would not inhibit the natural development of new solutions emerging along with the dynamic technological development;
- in-depth research on identifying possible types of fraud committed using cryptocurrencies, mainly to build effective mechanisms to combat these phenomena. In this respect, cooperation of specialists in various fields, for example, financiers and IT specialists, would be desirable;
- creating and analyzing various application tools supporting fraud detection in the blockchain environment.

However, there are also limitations to this study. Regarding the research methodology, the Scopus database does not allow the analysis of all available publications related to the topic (including studies only in paper form). Moreover, only items published in English were taken into account during the selection of articles. Various reports prepared by organizations dealing with the analysis of the cryptocurrency market or institutions responsible for

shaping legal regulations in this field were also not taken into account. The main goal of the article was closely related only to scientific publications. It is also worth mentioning the time limit. The selection of the items in the literature on the subject was made as of July 2022. Therefore, the analysis did not cover the latest publications, which may be important in the context of the dynamic development and changes that have taken place on the cryptocurrency market in the recent period of time. Despite this, the author believes the study will be a helpful resource for current and future scholars interested in addressing the most critical connections between cryptocurrencies and financial crimes.

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Abstrakt

CEL: *Celem głównym niniejszego opracowania jest identyfikacja aktualnego zakresu badań dotyczących kryptowalut jako przedmiotu nadużyć finansowych. Szczegółowe pytania badawcze odnosiły się do prezentacji najważniejszych kierunków tematycznych prowadzonych badań oraz zdefiniowania potencjalnych możliwości dalszej analizy tego tematu. Jedno z pytań wiązało się również z identyfikacją najbardziej popularnych oszustw przeprowadzanych z użyciem kryptowalut.* ***METODYKA:*** *Artykuł opiera się na systematycznym przeglądzie literatury (SLR) przeprowadzonym dla 57 publikacji dostępnych w bazie Scopus. Dokonano bibliometrycznej oraz opisowej analizy wybranych pozycji literatury przedmiotu. Następnie wydzielono główne klastry tematyczne i dokonano pogłębionej analizy ich treści.* ***WYNIKI:*** *Szczegółowa analiza bibliometryczna i opisowa pokazała, że tematyka kryptowalut jako przedmiotu nadużyć finansowych jest generalnie nowym obszarem badań naukowych, choć rozwija się dość intensywnie. Relatywnie mała liczba publikacji w porównaniu z innymi podobnymi obszarami pokazuje również, że ten temat nie jest jeszcze tak mocno eksplorowany przez naukowców i można w nim rozwijać wiele różnych trendów badawczych. Ostatecznie zidentyfikowano następujące kluczowe obszary badawcze:*

rodzaje oszustw kryptowalutowych, metody wykrywania nadużyć, ryzyka związane z technologią blockchain, pranie brudnych pieniędzy oraz regulacje prawne dotyczące kryptowalut. Udało się również ustalić, że obecnie najczęściej występującym przestępstwem jest pranie pieniędzy. Zwrócono jednak uwagę, że drugim dość częstym oszustwem są piramidy finansowe oparte na schemacie Ponziego. ***IMPLIKACJE:*** *W artykule wyraźnie przedstawiono główne trendy badawcze dotyczące wykorzystania kryptowalut w działalności przestępczej. Jednocześnie podkreślono, że w porównaniu do innych obszarów badawczych niniejsza tematyka jest stosunkowo nowa. Powstaje zatem szeroka możliwość eksploracji nie tylko istniejących, ale również nie odkrytych do tej pory nurtów badawczych. Ponadto zidentyfikowano kluczowe rodzaje oszustw w praktyce gospodarczej, co jest szczególnie istotne dla uczestników rynków finansowych. Wyraźnie wskazano bowiem, które transakcje są obarczone największym ryzykiem. Warto również zwrócić uwagę na istotną aktualność tematu, gdyż skala przestępczości z udziałem kryptowalut ostatnio gwałtownie rośnie. Opracowanie potwierdza niedostateczny zakres regulacji prawnych, które nie są w stanie odpowiednio wzmocnić bezpieczeństwa obrotu gospodarczego. Może być zatem jasnym wskazaniem dla rządów poszczególnych państw, czy też instytucji międzynarodowych do dalszych sprawnych zmian przepisów prawa.* ***ORYGINALNOŚĆ I WARTOŚĆ:*** *Naukowy wkład niniejszego opracowania jest potrójny. Po pierwsze, jest to jeden z pierwszych artykułów badawczych prezentujący wyniki systematycznego przeglądu literatury (SLR) połączonego z analizą bibliograficzną oraz pogłębioną analizą treści publikacji. Podczas pracy zastosowano również oprogramowanie VOSviewer, które umożliwiło obiektywną identyfikację głównych klastrów tematycznych opartą na occurrences and link strength of keywords ujętych w publikacjach. Po drugie, zidentyfikowano kluczowe rodzaje oszustw, które jednocześnie powodują największe straty finansowe. Wyznaczono również kierunki dalszych badań, które mają głębokie praktyczne implikacje dla uczestników rynku. Niektóre z nich dotyczą bowiem konieczności opracowywania i wdrażania nowoczesnych aplikacji komputerowych, pozwalajacych na wykrywanie szerszego zakresu pojawiających się nadużyć.*

Słowa kluczowe: *kryptowaluta, bitcoin, blockchain, nadużycia finansowe, przestępstwa gospodarcze, pranie brudnych pieniędzy, schemat Ponziego, piramida finansowa, systematyczny przegląd literatury*

Biographical note

Małgorzata Kutera is an assistant professor in the Institute of Economics, Finance and Management at the Jagiellonian University in Krakow, Poland. She is also a certified public accountant (CPA) and has many years of experience in auditing financial statements. The critical areas of her research include accounting, auditing, and corporate financial reporting. Most of the publications focus on theoretical and practical aspects of auditing financial statements, the activity of statutory auditors, the organization of the audit services market, and the methodology of verification processes. In this context, fraudulent financial reporting and the role of auditing in detecting

such crimes are of particular importance. Other scientific interests include the financial reporting system, creative accounting, and issues related to the tax optimization of enterprises from national and international perspectives.

Conflicts of interest

The author declares no conflict of interest.

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The interplay of entrepreneurial ecosystem actors and conditions in FinTech ecosystems: An empirical analysis

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Abstract

PURPOSE: *The purpose of this study is to investigate the role of actors and ecosystem conditions in the development of the FinTech ecosystems in Tallinn and Moscow.* ***METHODOLOGY:*** *The study develops a framework for investigating entrepreneurial ecosystems, combining ecosystem actors with ecosystem conditions. The framework is implemented through a comparative case study of FinTech ecosystems in Tallinn and Moscow, with data drawn from 35 semi-structured interviews and processed by means of thematic analysis. The primary data is supplemented with data from secondary sources.* ***FINDINGS:*** *The findings show how the ecosystem conditions and actors are interdependent in the FinTech ecosystems. Tallinn is an example of a strong entrepreneurial culture with its small market, advanced technological infrastructure, and talent, which leads to the dominance of the FinTech start-ups and the emergence of an active FinTech cluster organization. In Moscow, the institutional context, concentration of financial capital, and its large home market with a loyal customer base limit start-ups' ability to grow and form the ecosystem.* ***IMPLICATIONS:*** *The study contributes to the literature on entrepreneurial ecosystems and emerging technologies by integrating the streams of research on entrepreneurial ecosystems and FinTech ecosystems, combining FinTech actors with entrepreneurial ecosystem conditions. It also highlights the implications of variations of entrepreneurial culture,*

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characteristics of the domestic demand and formal institutions in the development of ecosystems. It demonstrates that ecosystem conditions are likely to contribute to the emergence of the dominant actor in a particular ecosystem. Our results also suggest that when aiming to develop the FinTech ecosystem in a city, the support given to FinTech cluster organizations is essential. Facilitating university–industry cooperation through the cluster organizations or direct partnerships can contribute to the development of FinTech ecosystems. ***ORIGINALITY AND VALUE:*** *To our knowledge, this is the first study to illustrate how specific entrepreneurial ecosystem conditions lead to configurations with different types of ecosystem actors, and to illustrate how specific ecosystem conditions impact the way in which actors develop and operate and how the ecosystem configuration is structured. These have been notable omissions in extant entrepreneurial ecosystem research until now. The present study also illustrates sectoral variations in entrepreneurial ecosystems while highlighting the distinct features of emerging ecosystems. It also contributes to the emerging literature on FinTech ecosystems through a comparative empirical perspective, thereby enhancing understanding of local conditions necessary for developing and maintaining FinTech ecosystems in different contexts.*

Keywords: *FinTech, financial technology, entrepreneurial ecosystem, FinTech actors, ecosystem elements*

INTRODUCTION

The 2008 global financial crisis, accompanied by mistrust of the banking industry, the rapid evolution of technology, and the related general shift of consumer behavior, paved the way for the emergence of FinTech (Arner, Barberis, & Buckley, 2015; Mohan, 2020; Wójcik, 2021). The term "FinTech" encompasses a combination of finance and technology, carrying a broad range of definitions in academic and popular literature (see reviews by Giglio, 2022; Milian, Spinola, & Carvalho, 2019; Sun, Li, & Wang, 2022). It is often understood as applying modern technologies, such as the Internet, mobile computing, and data analytics, to enable, innovate, or disrupt financial services. (Gimpel, Rau, & Röglinger 2018; Gomber, Koch, & Siering 2017) Some authors treat FinTech as a whole sector – a new financial industry that applies technology to improve financial activities (Schueffel, 2016). Alternatively, the term is used to denote companies, mainly start-ups, combining finance and modern technology (Dorfleitner, Hornuf, Schmitt, & Weber, 2017; Pushmann, 2017). To encompass the mentioned definitions, in the current paper FinTech is defined as "*a set of innovations and an economic sector that focus on the application of recently developed digital technologies to financial services*" Wójcik (2021, p. 3). A FinTech ecosystem is a combination of FinTech actors

and entrepreneurial ecosystem[5] elements or ecosystem conditions, in line with Stam (2015).

The emergence of the FinTech phenomenon has brought along a remarkable amount of research (for literature review, see Iman & Tan, 2020; Kavuri & Milne, 2019; Milian et al., 2019; Takeda & Ito, 2021). As digitalization has enabled FinTech start-ups to penetrate the financial services market, it is necessary for scholars to clarify the competitive and collaborative dynamics of the various actors in FinTech (Alaassar, Mention, & Aas, 2021; Gazel & Schwienbacher, 2021; I. Lee & Shin, 2018). As a response, the FinTech ecosystem concept has recently been introduced to FinTech studies. Efforts to conceptualize FinTech ecosystems started with the model suggested by I. Lee and Shin (2018), concentrating on FinTech actors and their interrelations that has been used as a basis for several empirical studies (Castro, Rodrigues, & Teixeira, 2020; Svensson, Udesen, & Webb, 2019; Zhang-Zhang, Rohlfer, & Rajasekera, 2020). However, the mentioned model lacks a theoretical basis and is limited to describing the actors of a FinTech ecosystem. While the promise of the entrepreneurial ecosystem (EE) framework for studying Fintech has been noted lately (Wójcik, 2021), studies on the topic have also focused mainly on actors rather than the contextual elements of the ecosystem (Alaassar et al., 2021) or on single events such as Brexit (Sohns & Wójcik, 2020). While Alaassar et al. (2021) used the EE concept to observe the interactions between FinTech start-ups and other ecosystem actors, the interplay between ecosystem conditions and actors still requires further scrutiny (Iman & Tan, 2020). As calls have been made for international comparative case studies on FinTech (Kavuri & Milne, 2019), and emerging FinTech ecosystems (Muthukannan, Tan, Gozman, & Johnson, 2020) specifically, the purpose of this study is to investigate the role of actors and ecosystem conditions in the development of the FinTech ecosystem in Tallinn and Moscow. Although the study maps the status of these FinTech ecosystems in 2020, the analysis reflects developments over a longer time period leading up to that moment.

The findings show how EE conditions of domestic demand, entrepreneurial culture, talent, knowledge, institutions, and infrastructure, are interrelated with the role of FinTech actors, fostering or inhibiting the development of ecosystems. Through these results, the present study contributes to the emerging EE and FinTech literature in several ways. First, while extant literature has focused on start-ups (e.g., Alaassar et al., 2021), we show how specific ecosystem conditions can lead to configurations where

5 An entrepreneurial ecosystem is "a set of interconnected entrepreneurial actors, entrepreneurial organisations, institutions and entrepreneurial processes which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment" (Mason & Brown, 2014, p. 5).

other types of actors are dominant. Second, we illustrate how EE conditions, such as culture, demand and institutions, impact how certain actors develop and operate and how the ecosystem configuration is structured. Third, the present study adds to the understanding of sectoral variations in EEs while highlighting distinct features of emerging ecosystems, such as insufficient finance, minor role of universities and accelerators. Fourth, the present study develops a framework for investigating ecosystems merging the two lines of research on FinTech ecosystems, combining FinTech actors with EE conditions. We also contribute to the empirical studies of FinTech ecosystems (Alaassar et al., 2021; Hendrikse, van Meeteren, & Bassens, 2020; Muthukannan, Tan, Chian Tan, & Leong, 2021; Muthukannan et al., 2020; Sohns & Wójcik, 2020) through comparative empirical analysis with data from Estonian-Russian perspectives, thereby enhancing the understanding of local conditions necessary for increasing the likelihood of developing and maintaining an emerging FinTech ecosystem.

The rest of the paper is organized as follows. The second section explores the literature on entrepreneurial ecosystems and the FinTech phenomenon, leading to the analytical framework for the current study. The third section of the paper proceeds to explain the design of the study, research methods of data collection and analysis. The fourth and fifth sections summarise and discuss the findings of the comparative case study.

LITERATURE REVIEW

Literature has defined an ecosystem as "*an interdependent network of self-interested actors jointly creating value*" (Bogers et al., 2019, p. 1). Originating from natural sciences, the ecosystem concept has a growing significance in the field of business studies (Audretsch, Cunningham, Kuratko, Lehmann, & Menter, 2019; Tsujimoto, Kajikawa, Tomita, & Matsumoto, 2018; Vlados & Chatzinikolaou, 2019), considering it from a wide range of perspectives, such as networks (Rosenbloom & Christensen, 1994), platforms (Cusumano & Gawer, 2002) or multi-sided markets (Evans, 2003). The EE perspective provides a theoretical framework for analyzing the underlying dynamics of how new venture formation occurs and is more plentiful and growth-oriented in certain geographical locations than others (Brown & Mason, 2017). Some of the main characteristics of the EE concept is the centrality of the entrepreneur as the key actor (Auerswald & Dani, 2017; Spigel & Harrison, 2018; Stam, 2015), the focus on networks and linkages (Auerswald & Dani, 2017), the importance of entrepreneurial processes and ability to access resources (Sarma & Marszalek, 2020; Spigel & Harrison, 2018), the

cross-industry nature (Auerswald & Dani, 2017; Spigel & Harrison, 2018), and the role of social and economic contexts surrounding entrepreneurial processes (Nicotra, Romano, Del Giudice, & Schillaci, 2018). Application of the EE concept to FinTech is useful in acknowledging the broader ecosystem where FinTech actors belong and paying attention to the influence of the ecosystem elements. However, due to the centrality of venture creation, there might not be a sufficient focus on the dynamics related to other actors, such as financial institutions.

Empirical research on FinTech ecosystems has emerged only recently and remains in its infancy (Basole & Patel, 2018; Zhang-Zhang et al., 2020). Most studies have focused on a single ecosystem, investigating a specific aspect or component of the ecosystem (Wójcik, 2021). There is a set of studies investigating the impact of certain policy initiatives or political events on a FinTech ecosystem (Hendrikse et al., 2020; Muthukannan et al., 2020; Sohns & Wójcik, 2020). Another stream of empirical research focuses on FinTech ecosystems built around one or two companies (Leong, Tan, Xiao, Tan, & Sun, 2017; Zhang-Zhang et al., 2020). Some research (Basole & Patel, 2018; Muthukannan et al., 2020) also deals with FinTech ecosystems that operate on a global scale. The geographical scope of studies has often been limited to a single ecosystem, e.g., Singapore, Brussels, London, or Sweden (Alaassar et al., 2021; Hendrikse et al., 2020; Sohns & Wójcik, 2020; Svensson et al., 2019). There are also a few studies on FinTech ecosystems relying on empirical data from several countries (e.g., Castro et al., 2020; Palmié, Wincent, Parida, & Caglar, 2020). While these developments in empirical research on FinTech ecosystems are promising, they tend to focus on a single ecosystem, a specific component, intervention or initiative, without paying sufficient attention to its overall composition and interactions.

Two main types of frameworks have been used in the studies on FinTech ecosystems. One set of studies (Castro et al., 2020; Hendrikse et al., 2020; Svensson et al., 2019; Zhang-Zhang et al., 2020) focuses on FinTech actors and their roles and interrelations, relying on the prominent FinTech ecosystem model proposed by I. Lee and Shin (2018) or creating similar models of their own. While such focus on actors is crucial to understand the functioning and specifics of a FinTech ecosystem, earlier models tend to both neglect the context in which the actors operate and lack a theoretical foundation. The second set of studies (Alaassar et al., 2021; Sohns & Wójcik, 2020) applies frameworks utilized in entrepreneurship research (Brown & Mason, 2017; Isenberg, 2011; Spigel, 2017; Stam, 2015), where an ecosystem refers to a set of interdependent actors and factors that are governed in such a way as to enable productive entrepreneurship (Stam, 2015). This approach enables to

observe not only FinTech actors but also contextual elements, such as culture, market, infrastructure, and human capital.

In developing our framework, we combine the FinTech ecosystem models consisting of actors with the ecosystem elements provided by the literature on EEs (Brown & Mason, 2017; Isenberg, 2011; Spigel, 2017; Stam, 2015). The approach of linking FinTech actors and EE conditions is supported by the findings of Spigel (2022) that well-developed FinTech ecosystems tend to benefit from linkages with the general EE, and the results of Harris (2021) that the FinTech ecosystem has emerged from the broader EE and is heavily interlinked with the latter, with actors benefiting from both ecosystems. Our framework (see Figure 1) is constructed as follows: ten main actors constitute the core of the FinTech ecosystem model, surrounded by nine EE conditions. We adapt and extend the model proposed by I. Lee and Shin (2018) as the basis for constructing our ecosystem framework, to achieve comparability with previous FinTech ecosystem studies and to consider a broad set of core actors Figure 1.

Following Castro et al. (2020) and Alaassar et al. (2021) we consider *investors* placed under financial institutions by I. Lee and Shin (2018) as a separate actor due to their strategic role. For clarity, we refer to the traditional financial institutions as "*banks*" and to the item "*government*" as "*regulator*," as FinTechs need to be in close dialogue with regulators to ensure the survival and sustainable development of their services. The "*regulator*" component also encompasses the role of the financial supervisory authority in the framework. In addition to FinTech-specific regulations, there are general elements of legislation, such as the tax incentives or procedures for starting a business that form the policy conditions for all start-ups (Nicotra et al., 2018). We consider the general role of government under "*institutions*," which is one of the conditions of EE.

We include four additional actors compared to the model of I. Lee and Shin (2018). Sheriff and Muffatto (2018) include *universities* in their model of high-tech ecosystems as those provide the talent pool, develop technologies, and transfer knowledge beyond academic borders, confirmed by empirical results of Lai and Vonortas (2019) on China. *Accelerators* are added based on the empirical results of Alaassar et al. (2021), who find accelerators to serve as intermediaries for various actors in the FinTech ecosystem in Singapore, and Harris (2021) documenting the significant role of accelerators in the development of the FinTech ecosystems in London and Singapore. In line with Berg, Novak, Potts, and Thomas (2018), we include *cluster organizations* and, following Zhang-Zhang et al. (2020), we include *cross-section FinTechs* among the actors. Relying on the EE literature (Alvedalen & Boschma, 2017) and previous studies on FinTech (Harris, 2021; Zhang-Zhang et al., 2020), we

place FinTech start-ups, banks and cross-section FinTechs in the centre of the framework as the main providers of FinTech services.

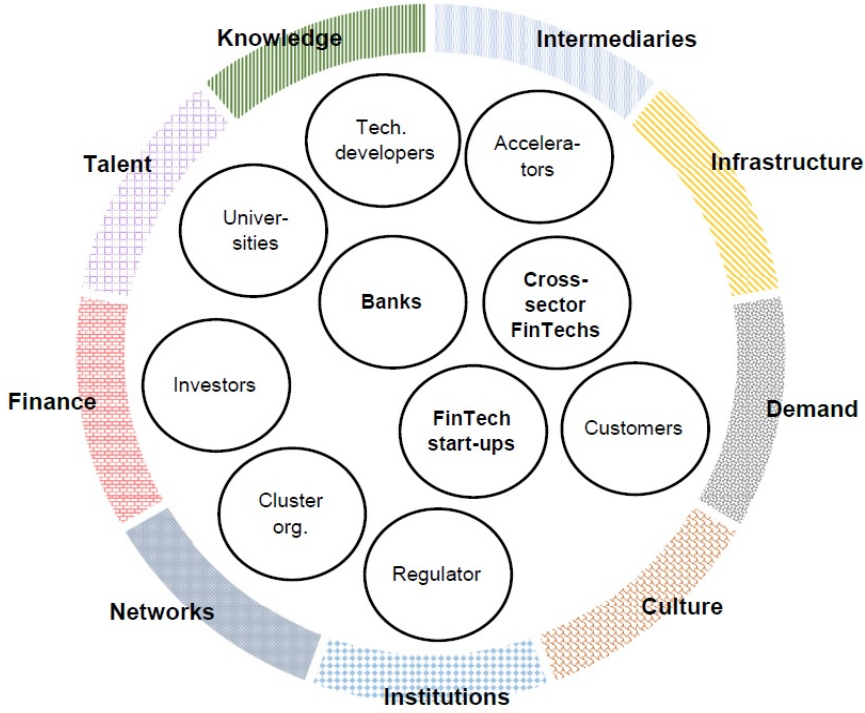

Figure 1. A framework of FinTech actors and ecosystem conditions developed based on literature

EE *conditions* are introduced from EE frameworks by Stam (2015) and Stam and van de Ven (2021), which have been used in several recent empirical works (e.g., Laidroo, Koroleva, Kliber, Rupeika-Apoga, & Grigaliuniene, 2021; Leendertse, Schrijvers, & Stam, 2021). We include the nine conditions of the latter framework – infrastructure, demand, intermediaries, talent, knowledge, finance, institutions, culture, and networks. We merge the element of leadership with culture due to the strong interrelation of role models, visible entrepreneurial leaders and the degree to which entrepreneurship is valued in a society. While Sohns and Wójcik (2020) incorporate the four EE elements most relevant in the context of Brexit in their study, we chose to cover all elements to provide a more comprehensive framework. In what follows, we apply the framework to two ecosystems, examining the interaction between actors and conditions.

METHODOLOGY

Research design

The case study method has been prevalent in prior studies of FinTech ecosystems (Hendrikse et al., 2020; Muthukannan et al., 2020; Sohns & Wójcik, 2020). This research approach is apt when investigating understudied phenomena (Halinen & Törnroos, 2005; Siggelkow, 2007), such as the FinTech ecosystem, its components and their interrelations. Case studies are particularly useful in understanding contextual conditions (Yin, 2018) and necessary to use a variety of lenses, such as the ones of entrepreneurs, bankers, representatives of government institutions, and other organizations, which allow the phenomenon's multiple facets to be revealed (De Massis & Kotlar, 2014).

Most authors tend to take the view that ecosystems should be analyzed on a regional or local level (Audretsch & Belitski, 2017; Hakala, O'Shea, Farny, & Luoto, 2020; Leendertse et al., 2020; Velt, Torkkeli, & Saarenketo, 2018). In line with extant empirical works on FinTech ecosystems (Hendrikse et al., 2020; Sohns & Wójcik, 2020; Spigel, 2022), we investigate the FinTech ecosystem on the city level. The cities of Tallinn and Moscow provide a suitable setting for the comparative analysis. Despite their similar history, the countries that the capital cities represent (Estonia and Russia, respectively) present distinct contexts: while Estonia scores above EU averages in the quality of institutions (reflected in indices for the corruption perception, rule of law, government effectiveness, voice and accountability), Russia is somewhat behind (Laidroo et al., 2021). The different size of the countries serves as a good basis for observing the ecosystems geared towards serving one's home market as opposed to going after the international customer base. The regulative frameworks are also different, as the EU financial regulatory framework applies in Estonia and developments in the area are driven by EU-wide initiatives (for a more detailed overview see Tirmaste, Voolma, Laidroo, Kukk, & Avarmaa, 2019). In Russia, the Central Bank carries out the role of both the regulator and supervisor (Claeys, 2005), initiating and supporting the main directions of the development of FinTech (Bank of Russia, 2018).

Based on the literature review and our preliminary framework of the FinTech ecosystem, a case study protocol was developed using the guidelines of Yin (2018). It contained objectives and research aims, data collection procedures, protocol questions, and the tentative outline of the analysis. Details on the data collection and analysis methods used are provided in the next section.

Data collection and analysis

Data collection occurred in two main phases—the preparatory phase and the fieldwork phase. The preparatory phase started in 2019 as a part of a project focusing on the analysis of the FinTech landscape in Estonia and the neighbouring countries. In the preparatory phase, data from macroeconomic and industry reports, articles in the press, and legislative documents concerning Estonia and Russia were analyzed to understand the background of the countries. We then concentrated on mapping the factors influencing the development of the FinTech sector in the two cities as well as getting an initial understanding of the level of development, composition and the main participants of the ecosystems. In this process, we also compiled a list of all FinTech companies in Tallinn and Moscow. The final list for Tallinn consisted of 111 start-ups identified, based on a critical review of data provided in Crunchbase, Funderbeam, Key Capital[6], and FinanceEstonia databases as of the end of 2019. The list of FinTech companies in Moscow was collected from the official websites of banks, accelerators, associations, and RusBase[7], and, after corrections, included 272 companies. All corrections to the initial lists were made to ensure that the companies fell under the definition used in this paper, and this list was used to select some of the interviewees in the fieldwork phase.

The fieldwork phase was based on semi-structured interviews to collect data specific to our research aims and explore the two FinTech ecosystems in depth. This approach enables us to gain an insight into opinions, attitudes, experiences, and predictions of ecosystem participants where existing knowledge of the subject is inadequate, and was also preferred since our potential interviewees are likely to be more receptive to interviews than other data collection methods (Rowley, 2012). The semi-structured interviews were performed with the representatives of the ecosystem actors, the list of interviewees is illustrated below in Table 1.

The interviewees were selected via purposive sampling. Interviewees from FinTechs were selected from the list of FinTechs, keeping in mind the diversity of respondents and the variety of FinTech types, sizes, and business models. Non-entrepreneur interviewees were selected based on input from secondary data sources. The interviewees were contacted via emails or social media accounts. Several respondents were added through the snowball method via referrals because of their expertise and involvement in the FinTech ecosystem. Out of 32 interview requests, 11 resulted in an interview in the case of “cold” contacts, while all 24 requests through referrals or personal contacts got a positive response.

6 https://www.keycapital.eu/fintechcompaniesinestonia

7 https://rb.ru/fintech/; http://list.FinTech-lab.ru/; https://www.fintechru.org/; https://www.sberbank.ru/ru/; https://alphaccelerator.ru/ ; https://startup.vtb.ru

Table 1. List of interviewees

	Actor Category	Position	Participant Code
Tallinn	Start-up	Founder/CEO	E1
	Start-up	Founder/CEO	E2
	Start-up	Founder/CEO	E3
	Start-up	Manager	E4
	Start-up	CEO	E5
	Start-up	Founder/CEO	E6
	Start-up	Founder/CEO	E7
	Start-up and Bank	Industry expert	E8
	Start-up	Founder/COO	E9
	Start-up	Founder/COO	E10
	Start-up	Founder/CEO	E11
	Bank	Head of Department	E12
	Bank	Head of Department	E13
	Regulatory/Supervisory Authority	Specialist	E14
	Regulatory/Supervisory Authority	Specialist	E15
	Regulatory/Supervisory Authority	Head of Department	E16
	Cluster organization	Board Member	E17
	Non-profit FinTech association	Board Member	E18
	Venture Capital network	Board Member	E19
Moscow	Start-up	CIO	R1
	Start-up	HR business partner	R2
	Start-up	Deputy of CEO	R3
	Start-up	CIO	R4
	Start-up	Founder/CEO	R5
	Start-up	CEO	R6
	Start-up	CEO	R7
	Start-up	COO	R8
	Start-up	Founder/CEO	R9
	Start-up	CFO	R10
	Bank	Manager	R11
	Bank	Head of Department	R12
	Accelerator/ Venture Capital fund	Head of Department	R13
	Cluster organization	Head of Department	R14
	Cluster organization	Head of Department	R15
	Regulatory/Supervisory Authority	Head of Department	R16

In total, 35 interviews (19 in Tallinn and 16 in Moscow) were performed between May and September 2020. The age of the interviewees ranged from 24 to 59, with 26% of the respondents being female. Interviews took place either online or in person, depending on the availability of the interviewees, and lasted from 27 to 105 minutes. Several interviewees had multiple current or previous roles in banking, start-ups, regulatory bodies and/or representative organizations and were thus able to see the ecosystem from multiple perspectives.

A detailed interview guide following the guidance from Yin (2018) and relying on the example of Cukier and Kon (2018) was applied. The interview questions presented in Table 2 were developed based on our research aims and the developed framework. The interview questions were asked in a flexible order to allow for a higher level of detail and responsiveness. Interviews were carried out in Estonian, Russian or English, depending on the native language of the interviewee. All interviews were digitally recorded and transcribed. Thematic analysis was performed according to the guidelines of Braun and Clarke (2006) and Nowell, Norris, White, and Moules (2017), using the software package Nvivo. Interview transcripts were read, and sections of text from the informants coded based on our research aims and the elements of our initial ecosystem framework, resulting in first-order codes. Patterns within the first-order codes were then identified through an iterative process, which led to the development of broad second-order themes that were on a higher level of abstraction than the first-order codes. The coding was performed independently by two of the authors and differences were discussed and modified until a consensus was reached. The broad themes included the composition of the ecosystem, its level of development, cooperation and connectivity within the ecosystem, the role of the local demand, entrepreneurial culture, FinTech regulation, and human and financial capital in its development.

Table 2. Interview questions

The interview starts with warm-up questions on the background of the person and institution/company, followed by questions on the FinTech ecosystem:
1. What are the drivers and reasons for the establishment of FinTech companies in our city? 2. What are the factors in Tallinn/Moscow that foster/promote the development of FinTech companies? What are the factors in Tallinn/Moscow that discourage/ create barriers for FinTech companies? 3. In your opinion, does the FinTech ecosystem exist in Tallinn/Moscow? Why?
If the answer to question 3 is “no,” ask what is missing to create a FinTech ecosystem, and continue with questions on Entrepreneurship Ecosystem (4-7)

4. What are the institutional mechanisms in place in the region that promote entrepreneurship?
5. What is the culture in your region with respect to entrepreneurship? How does it contribute to the establishment of FinTechs?
6. How do the existing firms (banks, technology companies, others) contribute to the establishment and development of FinTechs?
7. How does the development of the local financial services market/customers contribute to the establishment and development of FinTechs?

If the answer to question 3 is "yes," continue with questions 8 and forward:

8. How does the FinTech ecosystem look like? How would you describe it?
9. If you were requested to draw a FinTech ecosystem map/chart/schema, how would it look like?
10. What is the role of the FinTech ecosystem? Why does it exist? Why is it important?
11. How is the ecosystem led? Is there a leader of the FinTech ecosystem? Who?
12. What role do actors play in the ecosystem? If some actors in our preliminary model are not discussed, ask for additional input on their presence and roles.
13. How has the emergence of FinTech transformed your industry dynamics and the position of actors?
14. How do resources (knowledge/info, talent, funds, etc.) flow in the ecosystem?
15. To what extent is the FinTech ecosystem a geographical phenomenon, present in a specific location as opposed to a virtual phenomenon? Spatial concept or not?
16. If you had to name three key elements of a healthy FinTech ecosystem in a region, what would they be? What are the key success factors for FinTech ecosystems?
17. How successful is the FinTech ecosystem in your city , in your opinion? What are the reasons? What are the problems?

RESULTS

The FinTech ecosystem in Tallinn: Actors and configuration

Overall, the FinTech ecosystem of Tallinn is seen as being present and functioning: "*I truly believe that we are a part of the FinTech ecosystem, I really do. There are so many FinTech companies operating here, we participate in Money2020 and use the slogan "Join the Estonian FinTech revolution*"" (E5); "*I believe it exists, as there are some participants. Not hundreds, but several dozens for sure, some more and some less ambitious*" (E6). The dominating view among the informants occurs to be that the FinTech ecosystem exists

in some form, described as "unconscious," "abstract," "uncoordinated," "personal" or "in its infancy."

Several representatives of start-ups (E2; E8) likened the FinTech ecosystem to the EE as for them, it constitutes an informal network of technology-oriented entrepreneurs. When the interviewees were asked to bring out the leader of the ecosystem, most of them described the FinTech ecosystem in Tallinn as self-organizing rather than led by any particular actor. At the same time, *FinTech start-ups* are considered the most central participant in the ecosystem (see Figure 2). Some respondents say explicitly that the ecosystem is needed mainly for start-ups in their early stages of development (E12; E7; E9). The focus on start-ups is also confirmed by the view of bank representatives, who do not perceive the existence of a local ecosystem due to the smallness of the economy (E12; E13) or are not considering themselves as part of the ecosystem (E8).

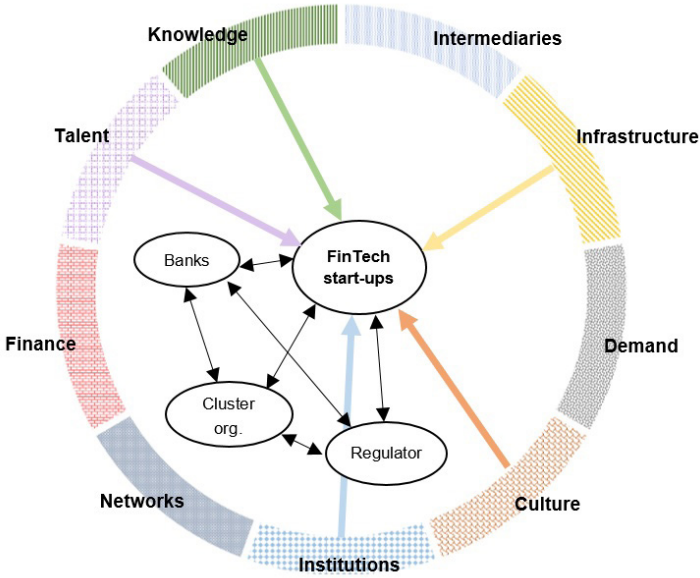

Figure 2. Tallinn FinTech ecosystem

According to most non-bank actors, *banks* participate in the Tallinn ecosystem, but their role is rather secondary. Some start-ups perceive the largest foreign-owned banks as uninterested in developing the ecosystem due to their monopolistic position and foreign background (E1). Their restrictive banking practices, often dictated by the headquarters, are believed to pose a major obstacle to foreign founders establishing start-ups in Estonia (E11).

On the contrary, one bank representative explains that although they initially saw FinTechs as a threat, they have opened up to cooperation over the past five years, welcoming FinTechs under their roof and providing venture capital (E12). Both bankers (E12) and start-ups (E3) pointed out that incumbent banks tend to be dependent on their legacy systems and time-consuming procedures that might limit their ability to cooperate on minor add-on applications. The major locally owned bank LHV was regarded as the most open to cooperation, for instance, through a well-functioning API and the integration of ready-made FinTech solutions (e.g., payments, verification) to their customers (E13; E10).

Data suggest that Tallinn has a strong FinTech section under FinanceEstonia, a *cluster organization* of the financial sector, facilitating connectivity in the ecosystem. Some respondents liken it to an ecosystem since it includes the main actors, such as banks, FinTechs, financial supervisor, regulator, and providers of support services; a few others consider it the leader of the FinTech ecosystem. Run and financed by its members, the main function of FinanceEstonia is representing participants' interests towards regulators, as well as coordinating efforts to enter foreign markets. According to its members, the organization is necessary to ensure that the voices of the many small players can be heard, gain visibility and have negotiation power (E9).

Participants consider regulatory and supervisory authorities, marked as "*regulator*" in our framework, a crucial actor in the local FinTech ecosystem. The interviews showed that the role of regulators in creating a supportive environment while securing transparency and protection of participants' rights is key to the development of the ecosystem. As one entrepreneur (E1) stressed, you cannot perform any innovation in the financial sector without coordinating this with the regulator, as regulation is the main shaper of the FinTech ecosystem. There are contradictory views on the impact of the regulatory and supervisory activities in Estonia. Some participants do not see regulation as a major obstacle (E17), while others consider it a major barrier. "*In general, the Estonian financial sector regulation is a copy-paste from the EU, while in our country there is a tendency to be stricter in its enforcement and this limits abilities to innovate and take some business risks*" (E3).

According to ecosystem actors, stronger cooperation between the regulator, supervisor and other market participants would speed up the alleviation of regulatory challenges of start-ups and enable Estonia to be the forerunner of FinTech internationally. "*So, it's kind of like all the pieces are there, but it seems to me that there is proximity with everybody, except with the Finance Minister's office, the Financial Intelligence Unit, the Financial Supervisory Authority (FSA) and the banking sector. For some reason, they*

cannot communicate with each other, but everybody else can. I think they need to break down those walls" (E11).

The findings also suggested that several of the actors of our initial FinTech framework were not considered to be a part of the Tallinn ecosystem or were viewed to be loosely connected with the rest of the ecosystem. *Technology developers* were omitted since FinTech services tend to be built on relatively mainstream technologies, *universities* were mainly viewed as a provider of human capital, *investors* and *accelerators* lack specialization in FinTechs. Some interviewees pointed out the current underutilization of opportunities for industry–university cooperation and the related knowledge transfer (E12, E4). FinTechs expect universities to take a more proactive role in proposing marketable technologies to the industry as well as in the communication of research results.

The FinTech ecosystem in Tallinn: Ecosystem conditions and interplay with actors

According to the findings, the FinTech ecosystem in Tallinn is rooted in the *entrepreneurial culture* in Estonia, triggering the dominant role of start-ups in the ecosystem. The emergence of FinTech start-ups has been driven by the general entrepreneurial spirit and acceptance of risk-taking in society, as well as some early success stories and role models (E3; E8; E10). Success stories both inspire start-ups and help pave their way internationally. As an interviewee (E8) illustrated, "*You constantly need success stories for the ecosystem to be successful, otherwise you are like the Eagles who plays Hotel California thirty years in a row and are still happy.*" The interviewee also explained that successful entrepreneurs wish to invest capital in similar ventures where they understand the business and are ready to take high risks. The early success of technology start-ups has underpinned the creation of technological *knowledge* that is a key component in the development of FinTech services (E10; E13; E17).

Talent was also a key condition contributing to the development of FinTech start-ups in Tallinn. As several interviewees explained, strong technological skills, high financial literacy, as well as the availability of specialists and leaders with financial experience have supported the establishment and development of FinTech ventures. Hansapank, a local bank established in the early 1990s, now foreign-owned, has been a source of knowledge, talent, and capital (E8; E17). While Estonia has produced high-quality technological talent through serial entrepreneurship and the country stands out with its financial and IT literacy (Trabskaja & Mets, 2019), it has reached the stage where some start-ups face scarcity and an increasing cost of talent and struggle with

bringing in key specialists, such as developers, engineers, product managers and designers from abroad (E2; E7*)*. To overcome the shortage, some start-ups also use remote employees (FinanceEstonia, 2020).

Estonia's small size is viewed as both an advantage and liability of the FinTech ecosystem in Tallinn. The liability of smallness is characterized by the limited domestic demand and scarcity of resources (Yamamura & Lassalle, 2020). As several participants explained, FinTech services, such as payments or crowdfunding, require a large scale to succeed (E1). Due to the limited local *demand* and a concentrated banking sector, most start-ups have the scalability to other markets in mind from the very beginning and therefore focus on adaptability in the early stages of development. Start-ups with a substantial home market might learn about the different needs and requirements of international markets at a later stage when it is costlier to modify and adapt. As several participants (E4; E17) explained, with its small scale and financially and technologically savvy customers, Estonia is a suitable platform for experimentation and a direct passage to the entire EU market. To access large multinational companies, one generally needs to have good connections in the US (E9). Due to the centrality of international markets, start-ups see a need for strengthening coordinated international sales efforts (E3, E10).

Despite the strong international focus, start-ups mostly consider the FinTech ecosystem in Tallinn a location-specific phenomenon due to the importance of interactions, interpersonal ties, and concentration of knowledge. The relatively small capital market is associated with the limited availability of *financing* for FinTechs**.** The small circle of venture capital investors is approached by almost every start-up founder (E3) and opportunities for raising capital are much broader elsewhere, for instance, in London (E7). Thus, while Tallinn is considered a good location to establish a FinTech, several entrepreneurs highlighted the need to move to a major financial hub in the next phases to be closer to the capital and earn credibility. Several start-ups have experienced pressure from foreign investors to move the legal headquarters to the US or UK after a successful round of funding due to legislative reasons (E4) or to eliminate country risk (E17). The lack of a critical mass of start-ups was also mentioned as a limitation in the context of establishing a regulatory sandbox (E16).

Most participants highlighted the central role of the general digital and technological leadership with its advanced *infrastructure* and *institutions* in Estonia as one of the drivers for the establishment of FinTechs and success of the ecosystem in Tallinn. Residents' digital identity and e-government solutions were often mentioned as distinctive elements of the infrastructure (E12; E15, E16). Also, the ease of doing business and a relatively simple tax system

attract entrepreneurs (E1; E6; E15). While developing and enforcing legislation to support and facilitate innovation is considered a general challenge for the financial sector in Europe (E3, E4), start-ups in Tallinn see a need to consider how rigorously the legislation needs to be enforced locally (E3). Due to its small size, Estonia could be the forerunner in the regulation to support the development of the FinTech sector (E2). Several participants (E6, E12) have raised the need to proceed with the regulatory sandbox initiatives, yet, in its discussions with market participants, the FSA has experienced low interest towards the classical sandbox as a testing environment (E16).

All in all, there is a start-up-centric FinTech ecosystem, relying on a strong entrepreneurial culture, talent, and technologically advanced infrastructure and institutions present in Tallinn, facilitated by an active cluster organization. The small size of the economy enforces networking and agility of the ecosystem, while putting strong pressure on internationalization and calling for coordinated policy efforts.

The FinTech ecosystem in Moscow: Actors and configuration

Since 2015, the participants of the financial sector in Russia, based mainly in Moscow, have aimed to establish a joint FinTech ecosystem through a constructive dialogue. Initiatives have been reflected in numerous negotiations and forums (Bankir.Ru, 2015; Finnopolis, 2016; Banking Review, 2016) and in the foundation of associations and innovation centres operating in Moscow. According to our study, the efforts to create a FinTech ecosystem have not succeeded due to the unaligned interests of the main actors. The data suggest that there is a loosely formed general FinTech ecosystem as well as two alternative configurations of nested ecosystems observed in Moscow (see Figure 3).

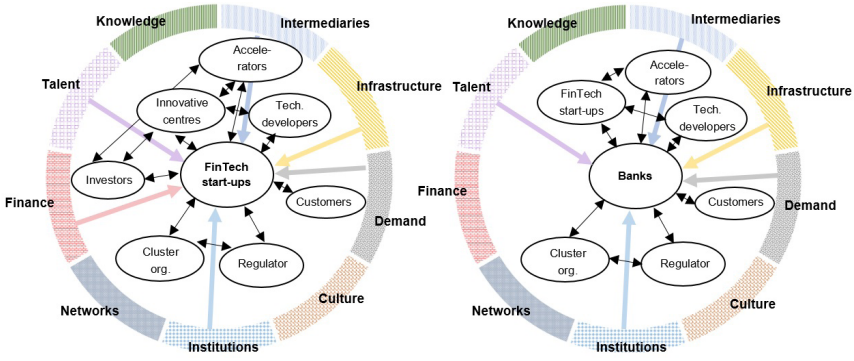

Figure 3. Moscow FinTech ecosystem: the nested ecosystem supporting FinTech start-ups (left) and banks' private ecosystem (right)

First, the "private" ecosystems of most of the systematically important banks (Sber, VTB Bank, Tinkoff), consisting of start-ups, accelerators, and technology developers. The major banks acknowledge the need to provide state-of-the-art services to their consumers and therefore invest in start-ups. In the case of facing obstacles to entering the market and having limited development opportunities, start-ups benefit from participating in a bank-centred ecosystem by accessing the necessary resources. According to the opinion of the representative of start-ups (R1), "*banks ensure the reliability of the start-up and thereby attract new consumers to its services.*" The position of banks can be described as the Appleisation of finance (Hendrikse, 2018), whereby incumbents aim to transform legacy systems into integrated platforms, cultivating ecosystems where start-ups are "free" to compete whilst effectively being locked into the bank's orbit. The configuration contrasts with the empirical findings of Hornuf, Klus, Lohwasser, and Schwienbacher (2021), indicating that banks in Canada, France, the UK, and Germany tend to cooperate with FinTechs through alliances rather than acquisitions. Second, the nested ecosystem gathered around the innovation cluster that supports start-ups established without the involvement of a major bank. There is a special competence centre of FinTech and blockchain in the Skolkovo innovation centre near Moscow. Start-ups observe a stronger trust of consumers in the members of Skolkovo in comparison with other start-ups (R2).

The dominance of bank-driven nested ecosystems is considered a reason for the lack of a well-functioning FinTech ecosystem in Moscow. As one respondent put it: "*Start-up founders in Moscow tend to take a short-term view – creating a FinTech, attracting a bank, and selling the start-up to the bank*" (R2). The position of banks is believed to hinder cooperation in the ecosystem: "*It is extremely difficult to establish a constructive dialogue due to the importance of banks in the FinTech ecosystem in Moscow. This allows banks to impose their policies*" (R9).

Most of the respondents consider the *Central Bank,* who acts both as a regulator and supervisor, not only a part but also the driver of the general FinTech ecosystem in Moscow. There are diverse views towards the activity of the Central Bank among respondents, depending on their area of activity. There are still areas (e.g., blockchain, cryptocurrency) with no specific regulation (Ermakova & Frolova, 2019). One respondent (R10) explained: "*Innovations are usually in the grey zone of the regulator being not or poorly described in the legislation.*" Thus, it is not always clear how to implement the technologies and draw up the relevant documentation. The actors of the FinTech ecosystem take a wait-and-see attitude: they wait for someone else to test the regulatory frameworks and their enforcement first. The uncertainty of regulation leads to start-ups registering abroad (e.g., Cyprus, US) to ensure the sustainability

of their business (Remezova, 2010). One of the challenges of the FinTech ecosystem in Moscow is finding a regulatory approach that enables to intensify market competition and reduce barriers to entry to the market. Interviewees suggest directing the regulatory activities towards banks to promote healthy competition in the market and contribute to the development of the FinTech ecosystem in Moscow. The Central Bank recognizes the necessity of regulating new actors in the financial market and suggests testing possible decisions using the regulatory sandbox (Bloomchain, 2019).

The role of the FinTech *cluster organizations* reflects the bank-centred setup of the ecosystem. Cluster organizations view themselves as a part of the general FinTech ecosystem, acting as the facilitator of communication between different members of the ecosystem and the coordinator of improvements in the regulatory environment. The banks' representatives brought out the difficulty of building an equal dialogue between the members of organizations and considering the interests of each type of actor in the ecosystem.

According to our interviews, in Moscow, local *customers* are believed to play a driving role in the ecosystem, unlike Tallinn. For instance, (R1) explained: "*Well, the first reason [for the emergence of the FinTech ecosystem] is the demand of consumers for services and the further development of technologies in finance*". One respondent (R6) mentioned: "*Consumers are interested in new, more convenient functionality of applications and look forward to new offers from actors of the FinTech ecosystem*". The local customers provide the necessary demand for the development of services and fuel the evolvement of the FinTech ecosystem.

Although *technology developers* do not tend to be specialized in FinTech, start-ups consider them critical actors in the FinTech ecosystem by providing crucial developments that form a basis for products. Technology developers do not see their role in the ecosystem as FinTech is just one of the areas where their insight is used. *Universities* are not considered a part of the ecosystem since formal education is perceived as irrelevant in the FinTech area. Some respondents pointed out the low level of entrepreneurship education in Russia and emphasized the importance of obtaining additional skills for establishing start-ups through specialized courses or webinars. *Cross-sectional FinTechs* are not present in the ecosystem and not perceived by the actors.

The FinTech ecosystem in Moscow: Ecosystem conditions and interplay with the actors

As mentioned in the previous sub-chapter, the high home *demand* with relatively sophisticated customers is one of the main conditions driving the development of the FinTech services in Moscow. Due to the highly

competitive banking market, large banks have been in search of ways to lock in their customer base and the ecosystem strategy has been designed for this purpose. As a banker (R12) describers: "*It is becoming increasingly difficult for banks to compete for customers. Most players have similar rates for the same products and services. It seems that the solution was found in the ecosystem approach. We get a client, create a comfortable environment and seemingly there are endless opportunities for creativity and growth.*" Advanced physical *infrastructure* with widespread high-quality Internet is believed to be another key condition for the development of the FinTech services in Moscow, supporting the home demand (R1).

The data suggest that regulatory activities are quite effective in regard to banks while regulation lags behind when it comes to financial innovations, thus creating uncertainties for the potential investors in FinTech (R10). Most accelerators, venture funds and innovation centres in Moscow are state-owned or supported by state grants and state programs (R12, R13) to compensate for the low interest of private entities. One entrepreneur (R6) noted that the increasing role of the government in the development of the FinTech ecosystem is further eroding the private sector. This resonates with the empirical findings of Keogh and Johnson (2021) that start-ups in the US financed by a government source have the highest likelihood of failure. The institutional aspects in Moscow also inhibit international activities – according to one entrepreneur (R4), Russia has a poor political reputation abroad, reflected in various sanctions and restrictions, thus leading to negative consequences for the FinTech sector.

The central role of banks in the Moscow ecosystem is reinforced by the lack of *financial capital* available for start-ups. Only a few venture capital funds invest in FinTech start-ups (Skolkovo Ventures, Digital Horizon, Sailing Start-up, Starla Capital, and Sberb CIB). In the words of a representative of a VC fund (R13), *"the venture capital market in Russia is dead"*. Moreover, Russian investors often reorient to foreign markets due to legal insecurity (R4). Therefore, start-up founders are forced to turn to banks.

Talent is a condition functioning both as a driver and a barrier to the development of the FinTech ecosystem in Moscow. As one interviewee (R12) explained, largely thanks to the IT-skilled workforce and advanced *technological knowledge*, especially in the development of interfaces and support systems, Russia is far ahead of Europe in the diversity of financial services. According to one entrepreneur (R1), the strong IT sector in Moscow is the main source of technological knowledge for FinTechs. However, the lower salary level of IT specialists compared to some other locations in Europe poses a threat to the development of the FinTech ecosystem, and entrepreneurial skills in Moscow are lagging behind: the founders struggle with presenting

their business ideas, developing a business plan, assessing risks, attracting potential investors, registering a company, as well as making informed management decisions (R15). One respondent (R12) described the mix of skills from an interesting angle: "*In Russia, a FinTech start-up with a poorly developed idea and a beautiful interface is more likely to be launched than a FinTech start-up with a well-thought-out idea and an irrelevant interface.*" An interviewee (R2) pointed out that the lack of managerial skills and the short-term profit orientation of the founders of FinTech start-ups result in a high failure rate.[8] Thus, entrepreneurial talent might also be a condition that has enforced the ecosystem configuration where banks dominate over start-ups. Our interviews provided no evidence of the presence of entrepreneurial *culture* or role models for FinTech start-ups in Moscow, also explaining the structure of the FinTech ecosystem.

Overall, the FinTech scene in Moscow is fragmented, consisting of strong banks' ecosystems relying on a loyal customer base, ample financial resources, and institutional support, and less developed ecosystems organized around innovation centres serving FinTech start-ups. The ecosystem development is driven by a large local market and technologically skilled workforce and shaped by a dominating Central Bank.

DISCUSSION

The aim of the study was to investigate the role of actors and ecosystem conditions in the development of the FinTech ecosystems in Tallinn and Moscow. Applying our developed framework, Table 3 illustrates FinTech ecosystems in Tallinn and Moscow, showing that the composition of the FinTech ecosystem in each city is unique, with the EE conditions in each location eliciting diverging configurations and roles of actors. Tallinn is an example of an ecosystem evolving around a community of FinTech start-ups, routed in the strong ecosystem conditions of entrepreneurial culture, talent and technological infrastructure. Such entrepreneur-centred ecosystems are complex and self-organizing systems where entrepreneurs are dependent on and collaborate with many other actors (Fredin & Lidén, 2020; Sheriff & Muffatto, 2018). In Moscow, on the other hand, major banks, which relish a large local customer base, have created their own ecosystems that dominate over the ecosystem serving the FinTech start-ups, and there is no unified FinTech ecosystem observed in the city. Our evidence shows that the propositions of Alaassar et al. (2021) are valid for Tallinn but not for Moscow, probably due to different ecosystem conditions.

8 Based on our desk research, nearly 45% FinTech companies have gone bankrupt three years from their establishment.

Table 3. Observed ecosystems in comparison to the proposed framework

	Component	Tallinn	Moscow
Actors	Start-ups	Main actor, leader	Secondary actor, participating in nested ecosystems led by banks or innovative centres
	Banks	Secondary actor, not dominating or not an actor	Main actor, leading its own private ecosystems
	Cross-sector FinTechs	Not perceived as a participant	Not perceived as a participant
	Investors	Not specialized in FinTech	Not specialized in FinTech, underrepresented
	Universities	Inactive role	Inactive role
	Technology developers	Not participating	Perceived as participants by banks and start-ups
	Regulator	Key actor	Key actor, leader
	Accelerators	Not specialized in FinTech	Part of nested ecosystems of banks and innovation centres
	Cluster organizations	FinanceEstonia as a key actor	Under the control of banks and the Central Bank
	Customers	Not perceived as a participant	Key actor
Conditions	Institutions	Ease of doing business, accessible	Interlinked with large banks, insufficient support for entrepreneurship
	Culture and leadership	Entrepreneurial culture with role models and serial entrepreneurship	Entrepreneurial culture underdeveloped, no visible role models
	Networks	Informal networks facilitated by the smallness of the country	Dominated by banks and the Central bank
	Infrastructure	Digital and technological leadership	Advanced IT infrastructure
	Demand	Small home market enforces scalability to foreign markets	Large home market with loyal customers
	Intermediaries	Moderate involvement in FinTech	Mainly state-owned
	Talent	Strong finance and technology talent through serial entrepreneurship	Strong technology talent through the educational system; lack of entrepreneurial talent
	Knowledge	Knowledge base through technology entrepreneurship and advanced technology and banking sectors	Knowledge base through strong education and technology sector
	Finance	Limited availability of venture capital	Lack of venture capital, large banks have sufficient resources

In Tallinn, the entrepreneurial culture, with a high presence of role models and technologically advanced talent and infrastructure, as well as institutional support, is conducive to the rapid evolvement and dominance of FinTech start-ups, compensating for the relatively weak ecosystem condition of the local demand. In Moscow, high domestic demand and bank-friendly institutions dominate among the ecosystem drivers, and culture was not believed to support the development of the FinTech ecosystem. While other studies have placed start-ups in the centre of the ecosystem, we show that this does not always hold: certain cultural and institutional conditions lead to the dominance of other actors, as our results indicate in the case of Moscow.

In both cities, universities were mainly viewed as a provider of human capital with no active involvement in the FinTech ecosystem, which contradicts Alaassar et al. (2021). Moreover, contrary to Castro et al. (2020) and Alaassar et al. (2021), investors and accelerators were not significant actors in the FinTech ecosystem due to their lack of specialization in FinTechs in the case of Tallinn or subordination to government or banks in Moscow, a feature potentially differentiating emerging ecosystems from developed ones.

In sum, we observed a start-up-centred ecosystem in Tallinn, built on a strong culture, technologically advanced human capital, and infrastructure. In Moscow, conversely, the FinTech scene is oriented towards the local market and characterized by isolated ecosystems of banks and a relatively underdeveloped nested ecosystem servicing start-ups.

The present study contributes to the literature on EEs and FinTech in several ways. First, the study illustrates how EE conditions, such as culture, demand and institutions, impact the way individual ecosystem actors develop and operate within a structured ecosystem configuration, and thus adds to the understanding of sectoral variations in EEs while highlighting distinct features of emerging ecosystems. Extending the model of I. Lee and Shin (2018) and subsequent empirical works (Castro et al., 2020; Hendrikse et al., 2020; Zhang-Zhang et al., 2020), we have constructed the internal layer of the FinTech ecosystem actors. This enables observation of the roles and interrelations of start-ups, banks, regulators, and other players stemming from the specifics of FinTech. By combining the prior models and empirical results, we can observe a richer set of actors.

Second, the study contributes to the literature by complementing its framework on FinTech actors with the second line of literature relying on the EE research (Alaassar et al., 2021; Sohns & Wójcik, 2020), thus adding the outer layer of EE conditions. Through the framework, the present study helps to integrate the streams of research on FinTech ecosystems, combining FinTech actors with EE conditions. The role of conditions enables us to acknowledge the broader EE where FinTech actors operate and to pay attention to the

influence of the ecosystem elements on roles and interrelations of actors. While Sohns and Wójcik (2020) focus on selected actors and ecosystem conditions in the context of one specific intervention, and Alaassar et al. (2021) study interrelations of start-ups with other actors, we integrate the whole set of actors and ecosystem conditions, thus contributing to the literature by offering a holistic view of the FinTech ecosystem. We also contribute to the prior research by highlighting the potential implications of the variations of entrepreneurial culture, characteristics of the home demand and formal institutions in the development of FinTech ecosystems. Our empirical study also highlights the role of FinTech cluster organizations in building the connectivity between FinTech ecosystem actors.

Third, the present study contributes to the empirical studies of FinTech ecosystems (Alaassar et al., 2021; Hendrikse et al., 2020; Muthukannan et al., 2020; Sohns & Wójcik, 2020) with a comparative empirical analysis with data from Estonian-Russian perspectives, thereby enhancing the understanding of local conditions necessary to increase the likelihood of developing and maintaining an emerging FinTech ecosystem. Recent studies have called for comparative case studies on FinTech (Kavuri & Milne, 2019), and for more clarification on FinTech ecosystems in particular (Muthukannan et al., 2020). Our comparative case study demonstrates the existence of interdependencies between FinTech actors and conditions introduced in our framework in terms of the role of demand, culture, and institutions. This enables to explain how the roles and configurations of actors in different ecosystems emerge from specific locational conditions, and how ecosystems can potentially be developed addressing the key conditions. As FinTech services tend to be characterized by low profit margins and the need for scalability (D. K. C. Lee & Teo, 2015), we show that local demand is one of the forces shaping the configuration of FinTech ecosystems, the power of various actors and the nature of collaboration. We demonstrate that a high home demand is associated with a more polarised ecosystem configuration where incumbents have a stronger starting position. Small home markets are likely to lead to a more balanced ecosystem with multiple players, where newcomers are able to develop.

Fourth, while Sohns and Wójcik (2020) omit culture, which is considered one of the most fundamental EE conditions (Donaldson, 2021; Vedula & Kim, 2019), from their framework due to its general nature, our holistic approach enables us to capture the interplay between culture and other conditions, and FinTech actors. We show that the nature of entrepreneurial culture acts as a trigger or barrier for the evolvement of start-ups, impacting their position in the ecosystem and the overall balance in the ecosystem. We show that institutional conditions may determine the composition of the

ecosystem depending on whether the priority is on promoting general ease of doing business or supporting and prioritizing certain actors. We found that institutions also influence other ecosystem conditions, such as access to finance or intermediaries. Finally, we also demonstrate that ecosystem conditions are likely to contribute to the emergence of a dominant actor in a particular ecosystem. While prior studies attribute the central role in entrepreneurial ecosystems to start-ups, we show that certain conditions may result in a different configuration where some other actors, for instance, incumbent banks, take leadership.

CONCLUSION

Building on the two lines of prior research on FinTech ecosystems, we have developed a comprehensive entrepreneurial ecosystem framework for FinTech and illustrated the interplay of ecosystem actors and conditions. Our multiple-case study of Tallinn and Moscow demonstrates the interdependence of ecosystem conditions and FinTech actors. The status of ecosystem conditions is likely to guide FinTech actors to take certain roles, and stronger cooperation between the main ecosystem actors, such as start-ups, regulatory and supervisory authorities, and banks is needed for the further development of the entrepreneurial ecosystem, both in informal and structured forms.

Our empirical research highlights the strengths and weaknesses of the studied FinTech ecosystems. The approach taken by banks with the support of the institutions in Moscow enables them to achieve rapid digitalization. On the other hand, according to our findings, the private ecosystems of banks are believed to inhibit the evolvement of the financial sector and a more comprehensive FinTech ecosystem in Moscow. The results emphasize the crucial role of regulators and supervisors in the FinTech ecosystems as the development of the sector is driven by regulation. High transparency and up-to-date regulations help to attract new participants and support the development of the existing ventures. It is crucial to facilitate cooperation between regulators and other participants. The newly established Innovation unit of the Estonian FSA is a good example of such an initiative.

When aiming to develop the FinTech ecosystem in a city, supporting FinTech cluster organizations might be one practical option, provided they have built a strong reputation among the ecosystem participants. At the same time, it is crucial to keep in mind the inclusiveness criterion of the ecosystem, ensuring that the cluster organization would not be dominated or governed by a couple of major market players or the state. Facilitating

university–industry cooperation, either through cluster organizations or direct partnerships, might be another way of helping FinTech ecosystems to move to the next level of development, as low involvement of universities seems to be an aspect that distinguishes emerging FinTech ecosystems from more mature ones.

We acknowledge that this study also has several limitations, while providing several potential areas for future research. While we incorporate the layers of actors and ecosystem conditions in our conceptual framework, an additional dimension of the institutional and economic environment that might have implications for the composition and development of the FinTech ecosystem could complement our proposed view. Also, due to the complexity of the FinTech ecosystem phenomenon, our conceptual approach does not encompass the evolutionary aspect of ecosystems with its stages of development from nascence to resilience. A limitation of our empirical approach is that the results of the analysis cannot be considered generalizable to all FinTech ecosystems, as each ecosystem is the product of the unique historical and economic processes of the location.

Several of the actors of our initial framework were not considered active participants of the FinTech ecosystem in the two cities. In contrast to the prominent model of I. Lee and Shin (2018), technology developers play a modest role, probably since FinTech services tend to be built on relatively mainstream technologies. Future research should address if closer integration of the technology development into the FinTech ecosystem would influence its success.

As the research on FinTech ecosystems continues to evolve, frameworks are needed to study the interplay between the evolutionary dynamics of the ecosystem, roles of actors and ecosystem conditions. In addition, the implications of the potential invasion of Big Tech companies into the area of FinTech, requires a systematic approach in respect to the ecosystem configurations and related implications. While case studies are the first step in gaining knowledge on the emerging phenomenon of FinTech ecosystems, it is also necessary to quantify the presence and strength of FinTech actors, ecosystem conditions, and their interactions in various locations, and measure the impact of possible configurations on ecosystem success.

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Abstrakt

CEL: *Celem tego artykułu jest zbadanie roli aktorów i warunków w rozwoju ekosystemów FinTech w Tallinie i Moskwie.* ***METODYKA:*** *Badanie rozwija ramy ekosystemów przedsiębiorczych, łącząc podmioty ekosystemowe z warunkami ekosystemowymi. Ramy są wdrażane poprzez porównawcze studium przypadków dotyczących ekosystemów FinTech w Tallinie i Moskwie z danymi pochodzącymi z 35 częściowo ustrukturyzowanych wywiadów i przetwarzanymi za pomocą analizy tematycznej. Dane pierwotne uzupełniane są danymi ze źródeł wtórnych.* ***WYNIKI:*** *Wyniki pokazują, w jaki sposób warunki ekosystemu i podmioty są współzależne w ekosystemach FinTech. Tallin jest przykładem silnej kultury przedsiębiorczości z małym rynkiem, zaawansowaną infrastrukturą technologiczną i talentami, co prowadzi do dominacji start-upów FinTech i powstania aktywnej organizacji klastrowej FinTech. W Moskwie kontekst instytucjonalny, koncentracja kapitału finansowego oraz duży rynek macierzysty z bazą lojalnych klientów ograniczają zdolność start-upów do rozwoju i tworzenia ekosystemu.* ***IMPLIKACJE:*** *Badanie wnosi wkład w literaturę na temat ekosystemów przedsiębiorczości i nowych technologii poprzez integrację strumieni badań nad ekosystemami przedsiębiorczości i ekosystemami FinTech, łącząc podmioty FinTech z warunkami ekosystemu przedsiębiorczości. Podkreśla również implikacje zmienności kultury przedsiębiorczości, charakterystyki popytu krajowego i instytucji formalnych w rozwoju ekosystemów. Pokazuje, że warunki ekosystemowe prawdopodobnie przyczynią się do pojawienia się dominującego aktora w danym ekosystemie. Nasze wyniki sugerują również, że przy dążeniu do rozwoju ekosystemu FinTech w mieście niezbędne jest wsparcie udzielane organizacjom klastrów FinTech. Ułatwienie współpracy uczelni z przemysłem za pośrednictwem organizacji klastrowych lub bezpośrednich partnerstw może przyczynić się do rozwoju ekosystemów FinTech.* ***ORYGINALNOŚĆ I WARTOŚĆ:*** *Według naszej wiedzy jest to pierwsze badanie ilustrujące, w jaki sposób określone warunki ekosystemu przedsiębiorczego prowadzą do konfiguracji z różnymi typami aktorów ekosystemu oraz ilustrujące, w jaki sposób określone warunki ekosystemowe wpływają na sposób, w jaki podmioty rozwijają się i działają oraz jak konfiguracja ekosystemu jest ustrukturyzowana. Niniejsze badanie ilustruje również różnice sektorowe w ekosystemach przedsiębiorczości, podkreślając jednocześnie odrębne cechy nowych ekosystemów. Wnosi również wkład do powstającej literatury na temat ekosystemów FinTech poprzez porównawczą perspektywę empiryczną, zwiększając w ten sposób zrozumienie lokalnych warunków niezbędnych do rozwoju i utrzymania ekosystemów FinTech w różnych kontekstach.*

Słowa kluczowe: *FinTech, technologia finansowa, ekosystem przedsiębiorczości, aktorzy FinTech, elementy ekosystemu*

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Conflicts of interest

The authors declare no conflict of interest.

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An analytical framework for strategic alliance formation between a cooperative bank and a fintech start-up: An Italian case study

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Abstract

PURPOSE: *The paper aims to identify the characteristics of the entities involved, the motivations and the processes of forming strategic alliances between a small cooperative bank and a fintech start-up. The paper bridges the research gap in the literature and explains the success factors of strategic alliance between considered entities.* ***METHODOLOGY:*** *We applied a typical qualitative research approach that consists of two steps. The first step was to develop an analytical framework to understand the critical success factors for the strategic alliance formation between banks and fintech start-ups. In the second step, we applied the analytical framework for a case study analysis, considering the strategic alliance between the Banca Popolare di Cortona and the NetFintech start-up.* ***FINDINGS:*** *Our research shows that there are different motives for strategic alliance formation for banks and fintech start-ups. From a theoretical point of view, banks' motivations are based on outsourcing, innovation, the evolution of the business model, competitive advantage, saving costs, improving service quality, and learning. The main motives for fintechs include access to customers, loans, banking license, economies of scale, trust, and credibility. In the empirical part, we found that the crucial success factors are strategic alignment and hybridization, competence and experience, cultural value and territorial closeness, and professionalism.* ***IMPLICATIONS:*** *The results develop the knowledge about the best conditions for cooperative banks and fintech start-ups strategic alliances. The*

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main limitation is that the paper is based only on one case study and it is related to cooperative banks and does not embrace other groups of banks. For this reason, it can be a basis for further research in this area. The described case study can be a good example to compare other cases of such alliances. Cooperative banks and fintech start-ups involved in a strategic alliance should share the commitment at the governance level. Critical are also the procedures of the alliance formation. ***ORIGINALITY AND VALUE:*** *This article provides two main contributions to the literature on the technology-driven transformations of the banking sector. First, we elaborated a theoretical framework of the critical success factors for the bank and fintech start-up strategic alliance formation. Second, we applied the framework with the bank–fintech start-up cooperation in the local market in Italy. Contrary to previous research, which focuses mainly on commercial banks, this article presents the relationship between cooperative banks and fintech start-ups.*
Keywords: *incumbent bank, cooperative bank, fintech start-up, strategic alliance, success factors*

INTRODUCTION

The integration between banks and fintech start-ups belongs to an important topic in the financial ecosystem innovation and development (Zachariadis & Ozcan, 2017). The latest innovative processes show that we are in a time of profound digital transformation in banking. The traditional model of hierarchical dominance of banks has ceased to prevail in finance activity. The existing hierarchical structure is being replaced by heterarchical networks of banks and non-banking entities (Chiu, 2017; Nicoletti, Nicoletti & Weis, 2017). During such transformations, various hybrid forms (arm's length transactions) are more common and innovative ecosystems are created, such as digital platforms (Pedersen, 2020; Sironi, 2021). In this context, the strategic alliances between banks and fintech start-ups represent a pivotal partnership to realize competitive business activities.

In this article, an incumbent bank is recognized as a regulated financial institution that focuses on accepting deposits and making loans. We distinguish incumbent banks, a general category of banks, from cooperative banks, a special group that have particular importance in some countries (Angelini, Di Salvo & Ferri, 1998). Moreover, when referring to incumbent banks, we consider traditional institutions that normally do not apply digital solutions (main determinants of challenger banks and neobanks creation). Following the literature, a fintech start-up is defined here as non-bank institution that uses technology to provide a financial service (Łasak & Gancarczyk, 2021; Zavolokina, Dolata, & Schwabe, 2017).

Banks and fintech start-ups try to overcome the difficulties they encounter by operating as single entities and seek to gain competitive advantage through long-term cooperation. Among these, one of the most frequently made management decisions is the strategic alliance (Inkpen & Tsang, 2016), which has influenced the development of scientific research over time (Gomes, Barnes & Mahmood, 2016). A significant body of literature focuses attention on strategic alliances as an essential source of critical knowledge and other important resources to gain and maintain a competitive advantage (Davies, 2009; He, Ghobadian & Gallear, 2021). Although many studies analyse this kind of collaboration, there is a lack of empirical studies that examine the determinant factors of strategic alliance success (Taylor, 2005; Varadarajan & Cunningham, 1995; Wittmann, Hunt, & Arnett, 2009) with particular attention to the formation phase, especially when a bank and a fintech start-up are involved.

Our paper is an attempt to bridge this literature gap and provides a study of strategic alliance formation between an incumbent traditional bank and a fintech start-up. We highlight the difficulty in building a successful strategic alliance and this paper aims to develop a conceptual framework for the creation of such cooperation. The problems that usually arise when realizing effective strategic alliances motivated us to research the factors that determine their success. For this purpose, we formulated a research framework, which embraces the three most essential pillars: the motivations for the alliance, the characteristics of involved entities, and the crucial requirements for alliance formation. The framework is applied with a single case study through an in-depth analysis of the strategic alliance between the two Italian entities, Banca Popolare di Cortona and the fintech start-up NetFintech. The Banca Popolare di Cortona is a cooperative bank from Cortona (Toscana, Italy) whereas the NetFintech is a local fintech start-up from Arezzo (Toscana, Italy).

This paper provides two contributions to the literature on technology-driven transformations of the banking sector. First, we elaborate a theoretical framework which enables us to identify the critical success factors of banks and fintech start-ups' strategic alliance creation. Second, we applied our model with the local businesses in the Italian banking sector. Although, many examples of cooperation between commercial banks and fintech start-ups are in the literature, there is still a lack of research on the impact of financial technology on cooperative banks, especially strategic alliances between those banks and fintech start-ups.

The remainder of this paper is organised as follows. Section 2 describes the literature review on the relations between incumbent banks and fintech start-ups. We then provide the methodology in section 3. In section 4, we

present the framework adapted to analyse the dynamic of integration and support it with the practical example of the alliance in section 5. Section 6 discusses the success factors that made the model promising and efficient. And in the last section, the conclusions and suggestions for future research are provided.

LITERATURE REVIEW

Cooperative banks and fintech start-ups

Traditional banks are institutions with a long tradition in offering banking services and they can be divided into a few groups. Apart from commercial banks and saving banks, we can distinguish cooperative banks. The main difference is that cooperative banks are owned and operated by the members for a common purpose. Their main goal is to generate value mainly for stakeholders instead of exclusively for shareholders. Cooperative banks belong to small institutions, and they usually service agriculture and small business (Angelini et al, 1998; Meyer, 2018; Migliorelli, 2018). Such principles as cooperation, democratic decision making and mutual help by the members play a significant role in this group of financial institutions. These banks play an important role in some European countries, like France, Germany, Italy, and Spain (Bülbül, Schmidt & Schüwer, 2013; Hesse & Heiko, 2007).

The term "fintech start-up" is strictly connected with the term "fintech". Fintech comes from financial technology and is understood in two ways, firstly, digital technologies and related innovations focused on financial services, secondly, the term relates to fintech-based businesses (Gomber, Koch & Siering, 2017; Puschmann, 2017). Such businesses rely on innovative solutions to improve financial performance (Tanda & Schena, 2019). To achieve this goal they use different solutions, namely, software, applications, products, processes, and services. Usually they focus on particular areas of financial services, e.g. payments (Nicoletti, 2021). Among such entities are different groups of companies, for instance, big companies having their main operations in different industries. There are also newly created entities which are called fintech start-ups (Benziane, Roqiya & Houcine, 2022; Haddad & Hornuf, 2019). Such entities exert great impact on the current business models of incumbent banks (Łasak & Gancarczyk, 2022). We separate fintech start-ups, which originally do not belong to the banking sector, from challenger banks and neobanks, whose activity is based on new technologies, but they have a banking licence and belong to the banking sector. We consider only the non-bank entities as fintech start-ups.

The impact of fintechs on incumbent banks

The last decade is defined by the rapid development of financial technologies and their entrance into the banking sector. At the beginning, traditional banks and institutional investors monopolised financial innovations based on new technology. Since the global financial crisis of 2008, the situation changed and new actors entered into traditional financial sectors. The literature highlights the positive influence of fintechs on traditional banking sectors. In the first phase of bank–fintech relations, there was an influence of financial technologies on banking activity. Among the most important aspects related to the issue include 1) an increase in the scale of the operations, 2) the introduction of new (more efficient) services, and 3) an increase in the number of customers (Campbell-Verduyn, Goguen & Porter, 2017; Gomber et al., 2017; Iman, 2018). A significant consequence of the cooperation between banks and fintech start-ups is created for developing countries, where society's access to traditional banking is limited. The relationship between banks and non-banking fintech entities enables access to banking services for those who were excluded before (Demir, Pesqué-Cela, Altunbaş & Murinde, 2020; Demirgüç-Kunt, Klapper, Singer, Ansar & Hess, 2020; Jagtiani & Lemieux, 2018).

Despite improving the banking services offered through financial technologies, the negative impact of non-banking entities on traditional banks is sometimes indicated. Some researchers even argue that the entrance of non-bank competitors and technology-driven entities have a disruptive effect on traditional banking (Coetzee, 2018; Hodson, 2021). The technology leads to the profound disintegration of the bank business model (Boot, Hoffmann, Laeven & Ratnovski, 2021). The influence of financial technologies on banks is particularly evident in banks' front offices, responsible for customer services (lending, payment, and wealth management). However, they are equally common in banks' middle and back office operations (Łasak & Gancarczyk, 2022). Boot et al. (2021) highlight that offering specialised financial services does not require a full banking licence. We observe a transformation from a bank-centred approach to a customer-centred approach in the banking industry (Chen, Li, Wu & Luo, 2017). As a consequence, a less bank-centric financial industry structure emerges. We also observe a change from traditional, bricks-and-mortar branches to virtual, online-based banking services (Coetzee, 2018). All these changes cause banks to have to offer a new dimension to their services. The need leads to a search for a new business path and opens the process of alliances between banks and fintech start-ups (Son & Kim, 2018).

The literature related to the impact of fintechs on incumbent banks is mainly associated with commercial banks. Relatively rarely is the influence of fintechs on cooperative banks analysed. Meantime, cooperative banks have become more and more important nowadays. They provide credit to households and small and medium enterprises (SMEs). Migliorelli (2018) emphasizes that the entrance of fintechs into the banking sector creates a new situation for cooperative banks. They should be able to bridge the gap with new entrants and seize the opportunity before the market moves into a new, advanced growth stage. It is important to be aware that sometimes the impact of fintechs on cooperative banks is stronger than the impact on commercial banks. Flögel & Beckamp (2020) point out that, nowadays, strong competition is observed within the digital provision of bank services, and the competition is especially difficult for small branches. The way of customer servicing has changed, and the new, digital solutions create more attractive customer interfaces than traditional banks. Moreover, digitalization offers strong economies of scale, which undermines the efficiency of smaller entities (Meyer, 2018). In such circumstances, cooperative banks respond by offering digital channels of distribution of their services. It also opens the possibility for cooperation between cooperative banks and fintech start-ups.

The impact of fintechs on banks also has a spatial dimension. Firstly, financial technology stimulates the transition from bank internal governance to network and market governance (Brown & Piroska, 2021; Langley, 2016). It has an important impact on cooperation between banks and fintech start-ups and, among others, strategic alliance creation (Clarke, 2019). Secondly, the bank and non-bank cooperation stimulates development of financial ecosystems where retail banks and place-based projects become more significant (Appleyard, 2020; DawnBurton, 2020; Lai, 2020). They have not only a global, but especially a regional and local dimension. Such development creates great opportunities for cooperation between cooperative banks and fintech start-ups, which usually is stronger in a local dimension as a consequence of the nature of cooperative banking.

The role of strategic alliance in banking

An alliance is defined as a long-term collaborative relationship between two or more independent firms (Hamel & Prahalad, 1990; McCarthy & Aalbers, 2022; Teece, 1992) in which they combine resources in an effort to achieve mutually compatible benefits that they could not easily obtain alone (Franco, 2011; Nguyen & Tran, 2017). A strategic alliance is a voluntary arrangement among firms that involves the exchange, sharing, or co-development of products, technologies, and services (Gulati, 1998). Also Eckman and Lundgren (2020)

argue that the core motivation of strategic alliances is the opportunity to access new resources and the willingness to develop innovation, with the aim to identify new products or new industry standards. A synergetic interplay, based on the exchange of technology and know-how (Fang, Francis, Hasan & Wang, 2012), may allow alliances to achieve collective commercial goals (Todeva & Knoke, 2005). For Lawrence, Hardy and Phillips (2002), strategic alliances are often a way to develop new solutions to complex problems when facing an increasingly difficult competitive arena (Gomes-Casseres, 1996). Given their importance, strategic alliances recently increased in popularity (He et al., 2021), quickly becoming a major strategic tool that few firms can afford to ignore (Rindfleisch, 2000).

The managerial literature discusses in detail the role and motivations of strategic alliances. Companies use this form of collaboration to achieve organizational flexibility, economies of scale, cost reductions, market entry, exports, competitiveness, and improve diversification through new product development (Abdollahbeigi & Salehi, 2021). Other authors indicate company growth, new technology, better quality, greater investments' efficiency, reduction of financial risk, cost sharing (Deeds & Hill, 1996; Kotabe & Swan, 1995; McCarthy & Aalbers, 2022), new markets and competitive advantages (Elmuti & Kathawala, 2001; Lütolf-Carroll & Pirnes, 2009; Zamir, Sahar & Zafar, 2014; Hussein, 2021).

Traditional banks usually had a hierarchical structure given the particularity of banking activity strictly regulated by law. The liberalization of this activity and the appearance of new fintech start-ups into the sector determined the flattening of this structure and, over time, the creation of new ecosystems (Omarini, 2018). In this context, strategic alliances are crucial forms of cooperation between banks and fintech start-ups (Drasch, Schweizer & Urbach, 2018; Oshodin, Molla, Karanasios & Ong, 2017) that have increased digitization of banking services and created added value for customers (Fonseca & Meneses, 2020). The digitalization processes and the most recent competitive dynamics have generated changes in the banking structure according to a hybridization approach (Drasch et al., 2018; Schwab & Guibaud, 2016; Zachariadis & Ozcan, 2017). Strategic alliances between banks and fintech companies are oriented toward distributing financial products and services via digital channels (Scardovi, 2017; Tanda & Schena, 2019). They appear to be hybrid structures aimed at leveraging firms' resources and enhancing their competitiveness while maintaining their independence (Akpotu, 2016; Holotiuk, Klus, Lohwasser & Moormann, 2018). The involved banks and fintech start-ups can achieve the best results from cooperation in an environment of newly created digital ecosystems (Carbó-Valverde, Cuadros-Solas & Rodríguez-Fernández, 2021). The ecosystem is

understood as the alignment structure of a multilateral set of partners who must interact for a value proposition to materialize their goals (Adner, 2017; Svensson, Udesen & Webb, 2019).

Crucial aspects to achieve the expected performance are the planning process of the collaboration (Arslan, Archetti, Jabali, Laporte & Speranza, 2020) and the selection of an appropriate partner (Amin & Boamah, 2022) with whom to create an alliance based on mutual trust and the sharing of critical information and resources (Lütolf-Carroll & Pirnes, 2009). It is, however, highlighted that it is tough to build a successful alliance and, therefore, fundamental there is proper formation and management of the main aspects of the strategic alliance (Russo & Cesarani, 2017). The critical issue is how the partners participate in the formation of the alliance and how they manage the interdependence that exists between them (Das & Kumar, 2011).

Though the strategic alliances formed are growing, because of problems such as instability and poor negotiation, these alliances may be more expensive and difficult and less efficient to manage than expected if not adequately planned (Contractor & Lorange, 2002; Jiang, 2011; Minshall, 1999). The evidence that more financial institutions are forming strategic alliances suggests the need to identify the main elements of a theoretical framework of these specific alliances' formation, which can aid their effective implementation and avoid inefficiency, conflict and instability over time.

The critical success factors of strategic alliance

The development of the research framework of a cooperative bank and fintech start-up strategic alliance formation, allowed us to identify the critical success factors for such an alliance. The following subsections highlight the critical success factors of a strategic alliance between banks and fintech startups.

Strategic alignment and hybridization

Today the dominant view in the literature is that cooperation between traditional banks and fintech start-ups is a much better solution than the competition (Elia, Stefanelli & Ferilli, 2022). In this way, each of these entities can get better results than if they were operating independently (Anand & Mantrala, 2019). As clarified in the previous parts of the paper, strategic alliances are one of these forms of cooperation between incumbent banks and fintech start-ups, which is beneficial for both parties (Hornuf, Klus, Lohwasser & Schwienbacher, 2021). This argumentation is one of the crucial drivers of strategic alliance creation. The benefits of the collaboration of banks with

fintechs are ample. Banks have a customer base and infrastructure, while fintechs excel in technology and innovation (Kyari, Waziri & Gulani, 2021). Fintechs' motivations also focus on banks' funds, networks, and reputation. The strong motivating factor for banks is cost savings, while fintechs' motivations also concentrate on banks' funds, networks, and reputation (Bömer & Maxin, 2018). Svensson et al. (2019) highlight the legitimating functions of alliances. Incumbent banks and fintech start-ups can enhance their organizational legitimacy through the joint accomplishments arising from alliances. The minority share investments are more popular than other forms of alliances and enable banks to internalize the knowledge of a fintech and obtain sole possession of its understanding. This kind of investment incorporates a relatively low level of hierarchical control of the cooperation by one of the alliance's partners. The crucial determinant of cooperation is the ability of the partners to coordinate activities across themselves. It embraces such activities as collecting and disseminating information, making decisions, resolving potential conflicts, and guiding interdependent actions. In this type of partnership, the participating entities work together without creating a new entity (Gulati & Singh, 1998).

Competence and experience in the real market and SME's financial needs

One of the crucial aspects of successful banking activity is the understanding of the needs of customers. This is more important while banking services are becoming digitized. Anand & Mantrala (2019) point out that sometimes banks lack the competence to understand millennial customers, while fintech start-ups can better understand their needs. The same opinion is presented by Nicoletti et al. (2017), who also argue that customer centricity and applying financial technologies in banking activity can enhance the customer experience. Omarini (2018) highlights the significance of synergies generated by complementary core competences and experiences possessed by banks and fintech start-ups. A significant level of competence and experience is needed especially in such markets where the services are offered to those customers who were financially excluded (Glavee-Geo, Shaikh, Karjaluoto & Hinson, 2019).

Customer needs definitely impact the success of strategic alliance when banking services become customer-centric (Acar & Çıtak, 2019; Nicoletti et al., 2017). Both banks and fintech start-ups have some advantages in this field. While banks have customer bases and loyalty, fintech start-ups have the agility to adjust to new customer needs. It is a fact that customer loyalty is a crucial aspect of the relations between banks and their customers but,

nowadays, customers' demands are changing from static and predictable to dynamic and unpredictable (Schmidt, Drews & Schirmer, 2017). In an era of digitalization, innovativeness and quality of services are the main drivers of customer satisfaction in banking services (Hornuf et al., 2021), and this exerts tremendous pressure for a change in banks' business models. Banks try to address specific customer needs, and the collaboration with fintechs enables them to improve their customer-centric orientation. Fintechs are usually quicker and more agile in providing digital services for customers. In addition, fintechs provide solutions to improve the banks' potential for digital technologies, which is why they attract new customers (Böttcher, Al Attrach, Bauer, Weking, Böhm & Krcmar, 2021). In the literature, attention is paid to the limited access of SMEs to financing via traditional channels (Vasilescu, 2014). For this reason, fintechs have become a significant source of SME financing (Cichy & Gradoń, 2016; Eldridge, Nisar & Torchia, 2021; Fasano & Cappa, 2022; Ferreira, Eça, Prado & Rizzo, 2022). Temelkov (2018) points out that the alliance between banks and fintech start-ups can be beneficial for SMEs in this area. It is especially significant in such countries where small businesses have limited access to traditional banking (Babajide, Oluwaseye, Adedoyin Isola Lawal & Isibor, 2020; Xiang, Zhang & Worthington, 2018).

Cultural value and territorial closeness to create trust and commitment at the top governance level

Apart from managerial and organizational skills, the cultural similarity or differences between alliance partners also play an important role for the success of joint cooperation. Those partners who are responsible for forming a plan of strategic alliance should be willing to compromise, when it is necessary, for their joint collaboration (Albers, Wohlgezogen & Zajac, 2016; Russo & Cesarani, 2017). Empirical research confirms that cultural consistencies and local character of cooperation (physical proximity) are important factors for building relationships between banks and fintech start-ups (Hommel & Bican, 2020). Local conditions play a significant role in the relationship between these partners and impact their cooperation in a two-dimensional way. The first dimension gives an advantage to banks as they are naturally related to the local market, have close relationships with their customers, and at the same time have extensive knowledge of this market. New entrants very rarely have such advantages. The second dimension is related to technological advancements and innovativeness. It is highlighted in the literature that some incumbent entities are characterized by a lack of in-house talent and innovative culture. Local banks sometimes operate on traditional methods and do not have the ability to modify their approach to

the extent required by the dynamically developing financial technology. The cooperation between incumbent institutions and new entrants (fintech start-ups) reduces this disadvantage (Murinde, Rizopoulos & Zachariadis, 2022).

The literature indicates that the creation of successful alliances is based on the strong commitment and trust of the participants. Such relational factors, like mutual trust and mutual commitment, are treated as a form of relational safeguard (Russo & Cesarani, 2017). While Albers et al. (2016) pay attention to the role of trust in strategic alliance creation, Teng and Das (2008) argue that trust and mechanisms of governance are strictly interrelated. They indicate that such types of risk, like relational and performance risk, influence both governance mechanisms and bilateral trust between strategic alliance partners. Trust plays an important role in explaining the coopetition relations between banks and fintech start-ups and in the success of their alliance (Eckman & Lundgren, 2020).

Professionalism in strategic assessment and contractual agreements

Proper management is important for a successful strategic alliance. Drasch et al. (2018) highlight that a strategic alliance has a greater possibility of success if the involved parties' managers are well prepared to manage alliances, have previous knowledge, and are dedicated to this form of cooperation. Managers, who understand the processes of digitalization, may significantly contribute to the success of such an alliance. Hornuf et al. (2021) make a hypothesis that banks with a chief digital officer (CDO), or with digitalization defined as an important goal of their corporate strategy, are more likely to establish alliances with fintechs. It suggests that banks with a clear digital strategy are more likely to have alliances with fintech start-ups than banks without such a strategy. Hommel and Bican (2020) emphasize the role that the relevant market experience of founders, a clear vision and a strategy, has on running an alliance successfully.

Our research process enables greater understanding of the strategic alliances between cooperative banks and fintech start-ups. More precisely, we believe that it is useful to understand:

- how banks and fintechs must deal with the formation of strategic alliances in the light of their characteristics;
- what are the main motivations and objectives pursued by these financial operators;
- whether it is possible to identify some critical factors for the success of the alliance between Banca Popolare di Cortona (BPC) and NetFintech (NF) start-up.

The answer to these questions, as well as providing a discussion in the context of the ongoing literature on the bank–fintech start-up cooperation, is our main contribution.

METHODOLOGY AND DATA COLLECTION

In our study, we applied a typical research approach that is used in qualitative research and we followed a two steps approach. The first step was to develop an analytical framework, which enables an understanding of the critical success factors for the strategic alliance formation between cooperative banks and fintech start-ups. The framework has been elaborated by considering the literature that analyses the impact of financial technologies on the operation of banks and the importance of strategic alliances in the context of the relations between cooperative banks and fintech start-ups. Particularly, we adopted a review of the literature including scientific articles, organization reports, and press releases. We used the large and recognized databases Scopus and Web of Science that cover the leading journals and book series in science. The search was limited to social sciences and related sciences, and the time period 2010-2022. We searched according to the keywords "bank*" and "fintech*". This search enabled the study of the nature of cooperation between banks and fintech start-ups. We found 988 documents related to the keywords. After the initial examination of the titles, keywords, and abstracts, we selected 121 papers for more detailed study. We focused on the parts related to the bank–fintech start-up cooperation. In the next step, we included the keyword "alliance" to our search. This search enabled us to find 11 documents on the basis of which we tried to identify the mechanisms of alliance formation. The third approach was a combination of the keywords "bank*" and "strategic alliance". Another group of 124 documents were selected. In the next stage, we reviewed the selected articles and coded the information manually, focusing on such keywords like "bank*", "cooperative bank*", "fintech start-up*", "alliance formation". In such an approach we obtained the necessary information and discussed them in the context of our research, eventually achieving consensus on the main constructs of the theoretical framework of our research. On the basis of the literature study, we firstly considered of the impact of fintech start-ups on banking activity and bank business models. After the initial consideration, we narrowed our research to strategic alliance formation between banks and fintechs. We focused on three crucial areas defining our framework, namely, 1) identification of the characteristics of the involved entities, 2) defining the motivations for the alliance, 3) identification of the process of the alliance formation.

In the second step of the research process, we applied the analytical framework for a case study analysis, considering the strategic alliance between an Italian incumbent bank and a fintech start-up. This step enables the contextualization of our previous steps with the aim to employ the analytical framework and identify the critical success factors for an alliance between a small cooperative bank and a fintech start-up. The application of the case study corresponds to the patterns described in the literature, including Baxter and Jack (2008), Dul and Hak (2007), Eisenhardt (1989), Harrison, Birks, Franklin and Mills (2017), Merriam and Tisdell (2015), and Stake (1995). In line with the assumptions for the application of the case study (Budzanowska-Drzewiecka, 2022; Yin, 2015), our goal was to focus on our analytical framework. We selected this case because the Italian banking sector belongs to the biggest banking sectors in the European Union. There is a large number of banks, the concentration of the sector is relatively low, and the five largest banks pose around 40% of the whole sectors' assets (Bilotta, 2017). Moreover, the Italian banks are relatively small, considering the value of assets or the number of employees. They are either limited companies, cooperative banks (Banche Popolari), or mutual banks (Banche di Credito Cooperativo) (De Bonis, Pozzolo & Stacchini, 2011). The cooperative banks in Italy have relatively modest market share when compared with cooperative banks in other European countries. In 2017 they were responsible for between 7-8 percent of total customer loans and customer deposits (Poli, 2019). Despite the fact that these banks are responsible for relatively small part of the Italian banking sector, two things are significant – the cooperative banks are important in Italian banking history, and they are able to meet the needs of those customers who might otherwise be excluded from accessing financial products and services (Jensen, Patmore & Tortia, 2015).

To employ the framework, we selected the case of the strategic alliance between Banca Popolare di Cortona (BPC) and NetFintech (NF) start-up. BPC is a traditional local bank, founded in Cortona in the province of Arezzo in 1881, and has the legal form of limited cooperative company. BPC is the oldest, small-sized popular bank operating in Italy which, inspired by the principles of popular credit, currently serves the communities residing in the area included between the provinces of Perugia and Arezzo, and in particular those of the Valdichiana (De Lucia Lumeno, 2011). NF is a limited liability company registered in Arezzo that operates in the development, production and marketing of innovative products and services with high technological value in sectors such as credit mediation.

This alliance has been selected as a relevant case for the following reasons. First, we found that the entities involved represent the typical actors that are now facing the challenge of promoting a strategic alliance,

emphasising the need for integration between a traditional and innovative approach in the financial ecosystem. Second, since BPC is a local bank operating in a cooperative logic, we found that this case is under investigated in the scientific literature, especially with reference to financial innovation and technology. Indeed, these subjects are usually reserved for big banks allying with fintech start-up in the financial eco-system of the most innovative financial regions and centres. Also, with regard to the fintech start-up, the case considers a reality that has developed in a traditional economic–productive district, characterized by a strong presence of SMEs and a certain distance from advanced financial districts. For these reasons, it is believed that the chosen case is adequate to prove the framework, given its high level of innovativeness and originality, filling a gap in the literature.

The case of the strategic alliance between BPC and NF was analysed using different data sources, which were used for triangulation and external and internal validation of the information (Baxter & Jack, 2008; Dul & Hak, 2007; Eisenhardt, 1989; Harrison et al., 2017; Merriam & Tisdell, 2015; Stake, 1995). In particular, we have collected information through the following sources (Table 1):

Table 1. Data sources

Details	Organization (Role)	Contents	Date	Reference
Conference material				
Ivan Pellegrini	Italia Fintech (Director)	Introduction to the event	17 September 2021	CM1
Laura Grassi	Fintech Observatory – Politecnico di Milano (Professor)	The collaboration between incumbent banks and fintech start-ups	17 September 2021	CM2
Tiziano Cetarini	Agile Laboratory Ecosystem (CEO)	Change Capital development in the Agile Laboratory Ecosystem	17 September 2021	CM3

Details	Organization (Role)	Contents	Date	Reference
Conference material				
Roberto Calzini	Banca Popolare di Cortona (General Manager)	The strategic objectives of strategic alliance with Change Capital	17 September 2021	CM4
Francesco Brami	NetFintech - Change Capital (CEO)	Change Capital business model and strategic plan	17 September 2021	CM5
Semi-structured interviews				
Roberto Calzini	Banca Popolare di Cortona (General Manager)	The framework for strategic alliance formation: Banca Popolare perspective	July 2022	IS1
Francesco Brami	NetFintech - Change Capital (CEO)	The framework for strategic alliance formation: NetFintech perspective	July 2022	IS2
Internal documents				
Financial Statement as at 31st Dec 2021	Banca Popolare di Cortona	-	May 2022	ID1
Financial Statement as at 31st Dec 2021	NetFintech - Change Capital	-	May 2022	ID2
Business Plan	NetFintech - Change Capital	-	May 2021	ID3
Advisor analysis and assessment	KPMG	-	April-May 2021	ID4
Contractual Agreement	Banca Popolare di Cortona-NetFintech		July 2021	ID5

RESULTS

An analytical framework for strategic alliance formation between cooperative banks and fintech start-ups

The problems that usually arise when creating effective strategic alliances motivated us to identify the factors determining the creation of successful strategic alliances in the banking sector, addressing the question in the specific context of the process of strategic alliance creation between cooperative banks and fintech start-ups. For this purpose, we formulated our research framework, which embraces the three most essential pillars: defining the motivations for the alliance, providing characteristics of involved entities, and expressing the crucial requirements for alliance formation (Figure 1). The research framework should answer the question of the critical success factors for strategic alliance creation in bank–fintech cooperation. The detailed description of the three pillars, which constitute our theoretical research framework, is based on desk research. The motivations for the alliance explain why banks cooperate with fintechs in such a form of cooperation. The characteristics of involved entities provide a more detailed description of the banks and fintechs' features. The alliance formation describes the first stage of the "alliance lifecycle", defined by Russo and Cesarani (2017). In our research framework, we have omitted the next steps that embrace the "alliance operational phase" and "alliance evaluation".

Characteristics of involved entities

Banks play a unique role in economies as they are financial intermediaries between savers, investors, and institutions responsible for money creation (Bertocco, 2004; Schooner & Taylor, 2009). They are strictly regulated institutions which create their special status and constitute a barrier to the entrance of other, non-bank entities into the sector (Carletti & Hartmann, 2003; Murinde et al., 2022). Many banks have long-term relationships with their customers, creating a unique environment for closer cooperation and giving a natural advantage over other entities (Jakšič & Marinč, 2019). However, the existing advantages of banks are gradually losing their importance. Greater digitalization of the processes and activities in the banking industry means that, nowadays, banks cannot rely only on their internal competencies. They must complement their competencies with those provided by other non-bank companies if they want to stay in the market (Schmidt, Drews & Schirmer, 2018).

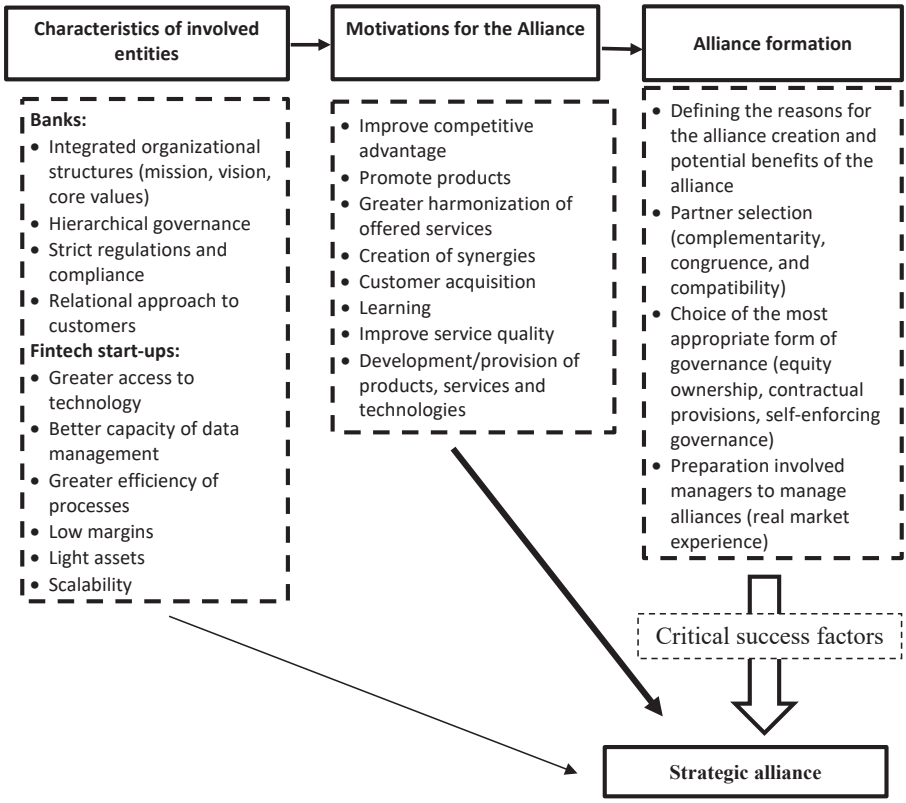

Figure 1. The research framework of the cooperative bank and fintech start-up strategic alliance formation

Fintech start-ups have different characteristics. Greater access to new technologies and the use of new technologies gives their customers greater availability than traditional banks (Bhagat & Roderick, 2020). They have advantages over banks because they can accomplish many activities faster and achieve greater economies of scale and scope. Fintechs can enhance the speed, transparency, access and security of services (Murinde et al., 2022). They also offer the possibility of faster and more convenient data processing, which can optimize and innovate banking services (Schmidt et al., 2018). Among other features of fintechs are low-profit margins, light assets, scalability, greater innovativeness, and lower regulatory restrictions (Bömer & Maxin, 2018; Lee & Teo, 2015). The low profit margins stem from more significant economies of scale and an appropriate costs structure (low share of fixed costs). There are also advantages coming from greater scalability

of the business (fintechs can increase the scale of their activity without drastically increasing in costs).

The successes of fintechs in offering banking services are not only from the use of technology *per se*. There are also some other critical aspects contributing to the growing role of fintechs. Among the most important are enumerated: delivered product (service), customer base, management and high organizational culture, and also the possibility of cooperation with other entities (Karmańska, 2021).

Motivations for the bank–fintech start-up alliance

The contemporary financial ecosystems are different from structures that operated in the past. They consist of the entire range of market players together with their processes, products and new entities entering the financial market and the transmitters enabling contact with their customers. There are also many supporting actors, like data providers, exchanges and regulatory agencies (Bose, Dong & Simpson, 2019). Moreover, the current financial ecosystems are subjects of dynamic changes (Hacioglu & Aksoy, 2021; Somin, Altshuler, Gordon, Pentland & Shmuel, 2020). The digitalization of banking services triggers the creation of such digital ecosystems where incumbent banks and fintech start-ups work closely together (Dapp, Slomka & Hoffmann, 2015; Liu, Kauffman & Ma, 2015). Financial ecosystems development is the crucial dimension of coupling between traditional banks and fintech companies (Arslanian & Fischer, 2019; Hendrikse, Van Meeteren & Bassens, 2020). In such an environment, banks and fintechs have many motivations to build strategic alliances (Drasch et al., 2018).

Among the most popular forms of cooperation are VC or direct investment, collaboration via platforms, in-house development of products based on fintech solutions, or M&As (Gharrawi, 2018; Murinde et al., 2022). Strategic alliances belong to the crucial forms of responses of the traditional institutions as a reaction to the entrants with disruptive business models (Anand & Mantrala, 2019).

The reasons why banks cooperate with fintechs and form alliances can be considered from numerous points of view. Banks fail to serve today's digital savvy customers (Eckman & Lundgren, 2020) and they can improve their value through the implementation of financial innovations. Hornuff et al. (2021) highlight that fintechs can obtain access to the broader customer base, and learn how to deal with financial regulations and access to banking licences. According to Drasch et al. (2018), only 2% of fintechs have a banking license. Banks enable market entry for fintechs by providing regulatory infrastructure, products, know-how, and funds (Bömer & Maxin, 2018; Drasch et al., 2018).

Another aspect is to catch up with the new opportunities, which is essential for both banks and fintechs. The latter realised that the partnership with banks is necessary for them to grow and have access to a large base of banks' customers (Bömer & Maxin, 2018; Drasch et al., 2018; Carbó-Valverde et al., 2021). Furthermore, fintechs want to access economies of scale, build user networks, and balance risks (Hommel & Bican, 2020). On the other hand, banks acknowledged that strategic alliances with fintechs are an opportunity to improve the digital services they offer (Hornuff et al., 2021).

Another group of motives for an alliance between banks and fintechs embrace the better adjustment to customer expectations, cost reduction, and the possibility of creating new services (Holotiuk et al., 2018). Hommel and Bican (2020) emphasize that making new services is connected with risk reduction, privacy, and data security. They also indicate a positive influence on bank performance and profitability, processes that are more convenient, higher efficiency and improvement in service quality, as the motives for banks to partner with fintechs. A strategic alliance supports bank efforts to save costs, reduce workload and focus on core activities (Klus et al., 2019). Hornuff et al. (2021) reveal that another reason for banks is to secure a competitive advantage. They indicate fintechs have developed as a better way to provide financial services. Furthermore, fintechs can give banks exclusive rights to use a specific application (or licence), which helps protect core businesses in banks. According to Klus et al. (2019), banks are afraid of the speed of change and are ready on business model evolution.

The strategic alliance between banks and fintechs can generate competitive advantages for both parties (Svensson et al., 2019). Holotiuk et al. (2018) and Klus et al. (2019) emphasize the role of learning as motivations for this kind of alliance. Incumbent banks and fintechs know that cooperation can help develop products and services, as well as being an opportunity for growth innovation (Hornuff et al., 2021). Sometimes, however, there are also some additional motives.

Alliance formation

It is highlighted in the literature that there are possible different forms of alliances between banks and fintech start-ups. Usually, a strategic alliance is based on an agreement between the involved parties and are distinguished different types of arrangements that may be based on: an ownership agreement, a contractual agreement or a licensing agreement (Lin & Darnall, 2015). Sometimes the term "alliance" is being used in a very lax way, and it defines many types of interactions between banks and fintech companies, like minority or majority investments, product-related

collaborations, or other forms of cooperation between these two types of entities (Carbó-Valverde et al., 2021; Hornuf et al., 2021).

According to Russo & Cesarani (2017), strategic alliance formation should embrace three crucial phases: defining the reasons for the alliance creation, selecting the partners, and choosing the most appropriate form of governance. The motives for alliances might be different for every participating entity, and it is crucial that every partner achieves some benefits from the alliance. For example, banks support fintechs financially and help them overcome regulatory boundaries (Klus et al., 2019). Fintechs, on the other hand, help improve the efficiency of the banking services and raise the level of innovations of incumbent banks (Bömer & Maxin, 2018).

The second important aspect of alliance formation is the selection of partners. All participants must be attractive to the other participants. The criteria that must be fulfilled to become a suitable partner in a strategic alliance are presented in several research papers. Svensson et al. (2019) describe the detailed conditions of being seen as a legitimate strategic alliance partner. They create a list of necessary conditions partners must meet and highlight that organizational legitimacy is crucial for a successful strategic alliance. They also describe a framework of legitimating functions of alliances between a fintech start-up and an incumbent to meet the organizational legitimacy needs of each partner. Whipple and Frankel (2000) also highlight the need to meet partner expectations as a key factor of a strategic alliance. According to them, the critical success factors of strategic alliance can be enumerated: trust, senior management support, clear goals, ability to meet performance expectations, and partner compatibility (Whipple & Frankel, 2000). Russo and Cesarani (2017) demonstrate that the partner selection process for a strategic alliance should be considered through three criteria: complementarity, congruence, and compatibility. They argue that partners should provide complementary resources and be committed to achieving common, clear, compatible goals.

The third phase of alliance formation is choosing the most appropriate form of governance, the choice of which is connected with the alliance structure. The main decision is whether the alliance involves equity stakes or is without equity investment. Elmuti and Kathawala (2001) argue that the purpose behind alliance formation significantly decides on the choice of governance structure. Alliance objectives are generally treated as the crucial determiner of the governance structure. Sometimes, aspects like alliance management objectives and international partners prevail (Teng & Das, 2008). Another important aspect of alliance formation is having well-prepared and aware managers to manage alliances (Anand & Khanna, 2000;

Drasch et al., 2018), as they can better provide the process from legitimation to hybridization.

The case of Banca Popolare di Cortona and NetFintech

In July 2021, Banca Popolare di Cortona (BPC) acquired a 9.99% stake in NetFintech (NF), an Italian fintech start-up founded two years before, operating under the Change Capital brand (ID3). This investment represented a fundamental step for the strategic alliance formation between an incumbent bank and a fintech start-up, with a deep impact in the financial eco-system of the two entities. Contextualizing the case in the framework previously elaborated, the different components of the strategic alliance formation are represented in the figure below (Figure 2).

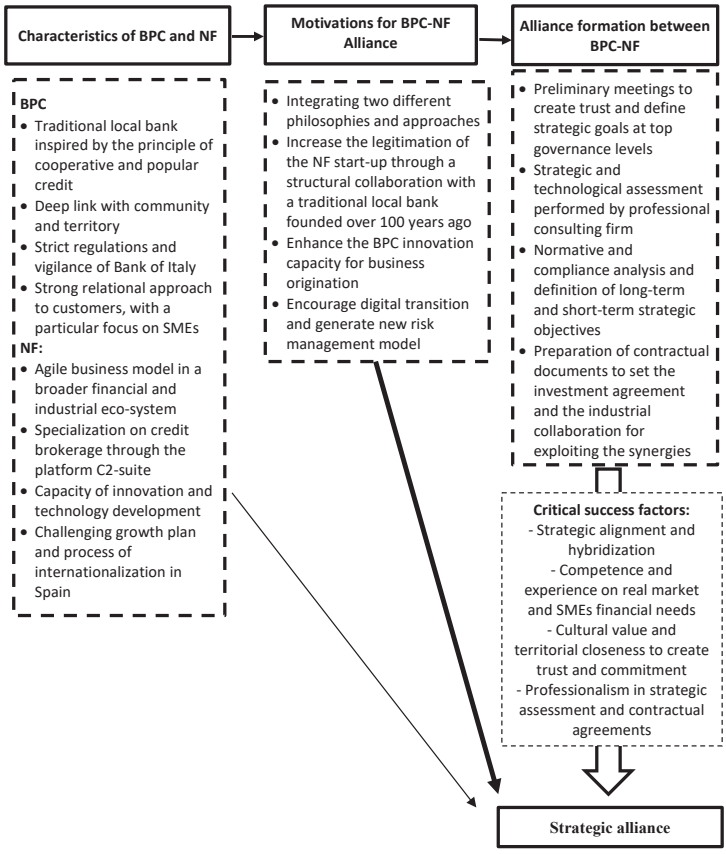

Figure 2. The framework of strategic alliance formation between Banca Popolare di Cortona (BPC) and NetFintech (NF)

Characteristics of BPC and NF

Banca Popolare di Cortona S.c.p.a. (BPC) is a traditional local bank, founded in Cortona in Arezzo in 1881, that has legal form of limited cooperative company. It is the oldest, small-sized Banca Popolare operating in Italy which, inspired by the principles of popular credit, currently serves the communities residing in the area included between the provinces of Perugia and Arezzo and in particular those of the Valdichiana. Today, Banca Popolare di Cortona represents an important resource for the economy of the entire area on the border between Tuscany and Umbria, a solid resource with a capitalization ratio (TIER 1) close to 16% (ID1), above the minimum requirement required by the supervisory authorities. The bank is operating with 74 employees, total assets of over 500 million euros, customer loans for just under 300 million euros, and deposits of over 350 million euro (ID1). The Bank collects savings and exercises credit in its various forms, inspired by the principles of community credit. The cooperative base is composed by around 3000 shareholders, while the distribution network consists of ten branches, of which nine are in the province of Arezzo and one in the neighbouring province of Perugia (ID1). Within its evolutionary path, the Bank has grown by following its main goal to "be a bank serving the territory", even maintaining a local company profile aimed to preserve a distinct role and identity in the community in which it operates, to satisfy customer needs and produce wealth in the reference area. It has a distribution network, which pays particular attention to small and medium-sized enterprises and cooperatives (ID4).

NetFintech S.r.l. (NF) is a limited liability company registered in Arezzo that operates in the development, production and marketing of innovative products and services with high technological value in sectors such as credit mediation (ID2). The Company has a lean organizational structure inspired by an agile business model framework, with no hierarchical levels among managers and an on-going process of open innovation, networking and technological advancements (CM1, CM3). NF represents a digital financial network, with an advanced approach as compared to traditional credit activities. The Company is a credit broker, operating under the Change Capital brand, which has developed an integrated digital services platform for corporate finance, to reduce the information asymmetry between supply and demand. Particularly, it has developed a digital platform (C2-Suite) equipped with a CCC (Cash Conversion Cycle) predictive algorithm, which allows access to multiple market solutions (fintechs, banks, insurtechs, etc.). Through a digital platform, the Company manages a virtual marketplace that enables the interconnection between SMEs and banks, intermediaries and other fintechs, focused on short and medium-long term lending (ID3). Today, the

platform represents the crucial element of the business model, as it allows to get, by entering the VAT number, the company's financial statement data and carry out an analysis of the financial profile and consequent funding needs (CCC) and the risk profile of the company.

NF has prepared a challenging growth plan that should operate in the main industrial and financial centres of the country, through an innovative organization, which uses coworking and peripheral hubs (ID3). In 2021, the Company established a Spanish branch, Change Capital Spain, a credit brokerage company wholly controlled by Change Capital.

Motivations for BPC–NF alliance

The BPC bank adopts a traditional business model, focused on credit intermediation with the aim to realize specific customer targets represented by small and medium-sized enterprises (SMEs) and families. The strategic motives that encouraged the bank to carry out the alliance were mainly referred to as several synergies related to the business opportunities origination and organizational hybridization. Particularly, the strategic goals refer to creating new distribution channels, through the introduction of new integrated solutions to promote a more personalized and effective offer for customers (ID4). Additionally, the alliance would encourage the digital transition, following the innovation changes in lifestyles and business processes and developing partnership with digital operators to integrate business approaches and philosophies (CM4, IS1). Finally, the alliance would serve to generate a new risk management model implementing the integration between the commercial area of the bank and other emerging crucial areas such as, finance, advanced data and analytics, and artificial intelligence. A potential extension of the banks' geographical coverage in new territorial areas is also probable, through the creation of digital financial shops. The fintech model is capable of supporting significant growth in business volumes by benefiting from a flexible costs structure. Furthermore, it offers access to a synergistic context based on digitization and new ways of interacting, with the possible attraction of new talents (CM4, IS1).

The NF fintech start-up actually proposes the most suitable solutions in terms of product and partner originator that are present on the financial platform (ID2). In perspective, the intention is to allow the use of the platform by banking and financial operators, in order to directly manage the pre-investigation phase, offering value-added digital services such as, digital marketing, customs intelligence, legal tech solutions, business intelligence solutions, payment services (PISP), and currency exchange management (ID3). It also plans to offer corporate insurance solutions, through a digital platform

(IVASS). Considering the investment plan and the expected results, the strategic alliance has been considered by NF to be a formidable opportunity to gain legitimacy, raising financial support for growth, accelerating its presence on the market, and integrating their innovative services with traditional channels (CM2, CM5, IS2). Indeed, one of the main objectives of the partnership for the start-up was to collaborate with a bank with more than 100 years of history, an important brand and a strong presence on the territory. From an industrial and commercial point of view, the alliance would allow an extension on territorial diffusion, gaining real market experience. For NF, the possibility of contacting the bank's customers and exploiting the relationships has been evaluated as extremely important. The incumbent bank can offer a highly valuable lead qualification that can easily be transformed into turnover and thus economic efficiency of the Company. The branch manager has the information and historical knowledge of the customers, and this facilitates the Company in making profitable financing and, therefore, favouring its growth (CM5, IS2).

Alliance formation between BPC–NF

The process of alliance formation started with several informal meetings between the top management teams of BPC and NF, accompanied by the continuous involvement and increasing commitment of the respective board of directors that finally approved the strategic alliance (IS1, IS2).

As reported from the interviewees, a fundamental step in designing the alliance and evaluating the entities' characteristics and alliance motivations was the involvement of an external, professional consulting firm, appointed by the incumbent bank to assess the strategic value of the fintech development plan and the level of technology innovation embedded in the digital solutions proposed (IS1, IS2).

The alliance formation was also influenced by the regulation conditions and the relevant institutional characteristics of the two entities. More specifically, two regulations have conditioned and bound the collaborations. From the BPC side, the alliance has been evaluated in compliance with the regulations issued by the Bank of Italy, the fundamental regulatory and control organism for all less significant Italian banks (IS1). From the NF side and its character of a credit brokerage institution, it has been the OAM regulations. According to these rules, the shareholding that can be assumed by banks in credit brokerage companies cannot exceed the limit of 9.99% (IS2). Additionally, there is a limit of participation in the credit brokers' capital imposed on banks, in order to avoid a significant influence and maintain

independence among entities, according to the new discipline of financial agents and credit brokers.

Another relevant step in alliance formation was the involvement of professional legal consultants that supported the two entities in designing the most appropriate contractual agreements. Particularly, the process of formal definition of the collaboration required several meetings with the top management teams and was structured to value at their best the joint strategic objectives of industrial and commercial long-term alliance, not limiting to the typical provisions of investments agreements (ID4, ID5). The business plan elaborated by NF has been considered a central part of the agreement, together with the protocol of collaboration aimed to assure a continuous interaction between BPC and NF for the hybridization of the organizational cultures and the optimal exploitation of the industrial and commercial partnership (ID5).

DISCUSSION AND CONCLUSION

Critical success factors

The conducted research enables a discussion of the identified critical success factors in the context of former literature study. They are presented in the same order as considered in the framework of strategic alliance formation between Banca Popolare di Cortona (BPC) and NetFintech (NF).

Strategic alignment and hybridization

The analyzed case between BPC-NF demonstrates that a successful alliance requires deeper integration in many aspects. One of the fundamental success factors in this alliance formation was the mutual knowledge and respect of the partners' mission, vision and core values that were analysed through informal communication between the fintech founders, the banks' top management teams and the board of directors (CM2, CM4, CM5). Since the beginning, the shared mutual commitment for an alliance has not been limited to a financial partnership, valuing the presence of the bank on the territory and the consolidated relationships with its customers that support the commercial and industrial growth of Change Capital (IS1, IS2). Also, the regulations influenced positively the strategic alignment, especially with reference to the limit of 9.99% of the investment share. Limiting the equity investment and the power of influence of the incumbent bank on fintech start-ups created a greater possibility of respecting the partners' characteristics without losing the nature of each entity (CM2). As reported by the interviewees, the main

challenge was to bring together two worlds characterized by very different speed and business models to create new business proposals, increase long-term profitability and exploit the innovation opportunities. This was consistent with the shared strategic objective to activate a process of hybridization (CM4, IS1), making the two organizations coexist, collaborate and contaminate the respective organizational cultures. The BPC General Manager was highly focused on this strategic goal, specifying during the presentation of the alliance at the Fintech district located in Milan (CM4):

"We are now transforming into hybridizing geneticists, who have to combine pieces of DNA from the most unthinkable areas. Our mission impossible is the creation of a bank model that does not exist, that knows how to wisely combine the tradition inherent in the universal values - today of great relevance - elaborated in the 19th century by strongly inspired minds, such as Luigi Luzzatti; the values of cooperation, of the community, of that social engineering laboratory that led to the birth in Europe and in Italy of popular credit, with the positive and evolutionary values of digital transformation. Always, and in any case, remember that the governance of things must belong to the human race and never to machines, which are only an expression of it. Our commitment to Change Capital goes in this direction".

Additionally, as reported during the interview, the alliance must be instrumental with respect to the objectives of both counterparties. It is necessary to create the right degree of alignment and overlap of needs that must be sought (IS1, IS2). For the bank, it is a question of meeting new technological and managerial processes, the fintech world needs the stability and solidity of the banking world, which represents the most physical part of the collaboration project. Each needs the other (CM4, IS1). The fintech start-up offers good ideas and technologies, and the bank a good business model to implement them, with the shared aim to have profitable market prospects.

Competence and experience in the real market and SME's financial needs

Our research contributes to the current literature on this subject by defining the importance of competence and experience of the bank and fintech decision makers in relations with their customers (IS2). We also confirmed the significance of relationships in creating successful strategic alliances. As reported in the interview, the BPC General Manager found that one of the most valuable characteristics of making the mutual understanding and commitment to the alliance was the competence and experience in the traditional market held by the NF founders (IS1). Quite paradoxically, an innovative project based on disruptive technologies has to be supported by an expertise in real market

dynamics, effective customer relationship and physical interaction. Only these conditions can realize the goal of offering access to a specialized digital platform through which the traditional bank products can be conveyed, as well as the possibility of accessing new forms and methods of lending (digital factoring, instant lending, etc.) and consultancy for SMEs (advisory, mini-bond, etc.), with positive effects for both partners (CM4, CM5, IS1, IS2). On the one hand, the incumbent can offer fintech products to its customers; on the other hand, the fintech marketplace can expand the customer base and achieve geographical diversification. A potential extension of the incumbents' geographical coverage in new territorial areas is also included in the strategic goals through the creation of digital financial shops. The fintech model is capable of supporting significant growth in business volumes by benefiting from a flexible costs structure. Furthermore, it offers access to a synergistic context based on digitization and new ways of interacting, with the possible attraction of new talents. In such a context, the key strategic objective is to integrate digital and physical, as clearly reported by the fintech CEO during the event at the Fintech district (CM5):

"*The Bank's entry into the capital of our Company, as well as being a reason for personal pride and great trust in our customers and business partners, is the concrete sign of the synergy and collaboration that can arise from the combination of digital and traditional, all in support and to the advantage of Italian SMEs".*

Cultural value and territorial closeness to create trust and commitment at the top governance level

The research provides deeper practical knowledge about cooperation between a bank and a fintech start-up in a given territory (CM3, IS1, IS2). The two entities involved in the alliance operate in the same province, characterized by a traditional productive system mainly formed by SMEs and operating with a deep link with cultural values and territory, quite far from the most innovative financial centres of Italy. As emerged from the interviewees (IS1, IS2), the territorial proximity of people involved in the alliance formation accelerated the mutual trust and created a positive commonality of intents, especially at top governance level. As specified by the banks' General Manager, the realization of the partnership mostly depends on the organizational level that plans the collaboration project (IS1). The higher the level of the organization, the more it is possible to have a broad and complete vision of the integration, both in terms of staff commitment and for the involvement of the technological and market management components, both indispensable.

A fundamental aspect concerns the contamination of the two worlds. On the one hand, collaboration cannot stop at the purely technological aspect as the success of these collaborations occurs when the right mix is created between tradition (bank) and innovation (fintech), because neither one nor the other going it alone is able to guarantee success (CM2, IS2). The main issue is to find the right combination, putting two worlds in relation that normally do not speak. On the one hand, the traditional world is structured and constrained based on complaints and regulations and has a mentality that is not always up-to-date, but it is orderly and stable. On the other hand, there is a fintech that is more flexible, innovative, dynamic and faster, but also less stable. At least it is important to approach them from a cultural point of view and to speak the same language (albeit with different dialects) (IS1).

Professionalism in strategic assessment and contractual agreements

The former literature highlighted the role of internal commitment, but the success of strategic alliances also depends on external factors. The case demonstrates that the alliance formation required a professional intervention from external consultants holding the suitable expertise in fintech strategic evaluation and corporate regulatory issues (ID4, ID5). As emerged from the interviewees, the technology assessment and the contractual formation of the alliance represented two fundamental aspects for the strategic planning of the partnership and the regulation embedded in the contractual agreements (IS1, IS2). Particularly, not limiting the formal setting to an investment agreement created the right premise to translate the mutual commitment on strategic alignment in an operational agenda to realize the hybridization of organizational cultures and innovation of financial services (CM4). Some strategic areas of the two entities have been involved in the alliance regulations, concerning the common initiatives to be implemented: digital marketing and strategic marketing, fintech lending, staff training and digital open banking initiatives (ID5). Also, the development of in-depth sessions on specialized topics in the field of fintech/digital banking were explicitly mentioned in the agreements, as well as planning meetings with the main players of the Italian financial and banking system, organization of thematic meetings with local SMEs, potential initiatives for specific industries (i.e. agri-food, textile, wine, etc.), with the aim of creating a value financial eco-system integrated with the real economy needs of the territory (ID5).

The case confirms the previous theoretical analyses that the trust in people and the professionalism with which the contractual agreements were made, supported by professional consultants, who did not neglect the formal and substantive aspects of the agreement, is fundamental.

Research implications

The research can be treated as a contribution to the financial ecosystem related literature. It describes the situation where traditional industry boundaries have been broken down leading to interdependence and symbiotic relationships. Our research provides three main contributions. The first contribution of the article to the literature on technology-driven transformations of the banking sector and bank–fintech start-up cooperation is the research framework. The framework bridges the research gap in the literature and explains the motivations of a strategic alliance between banks and fintech start-ups. The second contribution is the unification of the research framework with the alliance between BPC-NF. The performed verification finds reference to the literature on the research subject. The third contribution comes from the fact that our research is related to cooperative banks. Most of the research related to the *incumbent banks – fintech start-ups* are connected with commercial banks, whereas we focused on cooperative banks, which play an important role in the Italian banking sector. All of these areas require further, in-depth research in the future.

The research suffers some limitations related to the difficulty to generalize the results derived from the contextualization of the strategic alliance implemented, as usually highlighted for the case study research. First of all, the case considers a cooperative bank, whose governance and management processes are influenced by the need to safeguard and value the territory and the shareholder base in a collaborative logic. Geographical diversification can bring new dimensions of the strategic alliance cooperation. It is also important to compare the strategic success factors identified for cooperative banks with the same factors identified for commercial banks. Secondly, the entities involved in the alliance are characterized by relatively small and local dimensions. This may have impacted on the particular attention and care the governance and management of the two entities invested in the alliance design and implementation, confirming the particular value of the integration between the theoretical pillars of the framework elaborated. However, as Yin (2014, p. 48) counters, case studies are not designed to provide statistical generalizations but instead deliver analytical generalizations that offer theoretical explanations that researchers can apply to similar cases.

Managerial implications

The research has some managerial implications about the strategic alliance between incumbent banks and fintech start-ups. In fact, when the entities decide to form a strategic alliance, they should take into account several

aspects that are treated as the critical success factors. Some of them were discussed in this study. However, they lead to two crucial managerial implications. Firstly, when defining a strategic alliance between incumbent banks and fintech start-ups, not only technological exchanges should be considered. Designing an alliance should also involve such factors as top levels of governance of the participating entities. In turn, the governance is a derivative of their mission, culture, processes, and proper commitment at the governance level. Secondly, the process of alliance formation is very important. Managers have to be very sensitive to define the collaboration and create a good agreement. Self-regulation is a challenge and it is essential for all participating parties to create a good strategic agreement. A properly defined agreement will decide on the success of their alliance.

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Abstrakt

CEL: *Celem artykułu jest identyfikacja cech charakteryzujących analizowane podmioty, motywacje oraz procesy tworzenia aliansów strategicznych pomiędzy małym bankiem spółdzielczym a start-upem typu fintech. Artykuł wypełnia lukę badawczą w literaturze dotyczącej tej tematyki oraz wyjaśnia czynniki sukcesu aliansu strategicznego zawieranego pomiędzy badanymi podmiotami.* ***METODYKA:*** *Zastosowano jakościowe podejście badawcze, które składa się z dwóch etapów. Pierwszym krokiem było opracowanie ram analitycznych, umożliwiających zrozumienie kluczowych czynników sukcesu w tworzeniu aliansów strategicznych między bankami i start-upami typu fintech. W drugim kroku zastosowano ramy analityczne do analizy studium przypadku, którym był alians strategiczny pomiędzy Banca Popolare di Cortona i start-upem NetFintech.* ***WYNIKI:*** *Z przeprowadzonych badań wynika, że istnieją różne motywy tworzenia aliansów strategicznych między bankami i start-upami typu fintech. Z teoretycznego puntu widzenia motywacje banków opierają się na outsourcingu, innowacjach, ewolucji modelu biznesowego, przewadze konkurencyjnej, oszczędnościach, poprawie jakości świadczonych usług oraz uczenia się. Główne motywy fintechów to dostęp do klientów, pożyczki, licencja bankowa, ekonomia skali, zaufanie i wiarygodność. W części empirycznej ustalono, że głównymi czynnikami sukcesu są strategiczne dopasowanie i hybrydyzacja, kompetencje i doświadczenie, wartość kulturowa i bliskość terytorialna oraz profesjonalizm.* ***IMPLIKACJE:*** *Wyniki poszerzają wiedzę na temat aliansów strategicznych między bankami spółdzielczymi i start-upa-*

mi typu fintech. Głównym ograniczeniem jest to, że artykuł opiera się tylko na jednym studium przypadku i dotyczy wyłącznie banków spółdzielczych, pomijając inne rodzaje banków. Może on być punktem wyjścia do dalszych badań w tym obszarze. Opisane studium przypadku może być dobrym przykładem do porównywania innych przypadków takich aliansów. Banki spółdzielcze i fintechy typu start-up zaangażowane w alianse strategiczne powinny dzielić swoje zaangażowanie na poziomie zarządzania. Istotne są również procedury tworzenia aliansów strategicznych. ***ORYGINALNOŚĆ I WARTOŚĆ:*** *Artykuł wnosi istotny wkład do dotychczasowych badań na temat transformacji sektora bankowego pod wpływem technologii finansowych w dwóch obszarach. Po pierwsze opracowaliśmy teoretyczny model kluczowych czynników sukcesu podczas budowania aliansów strategicznych między bankami a start-upami typu fintech. Po drugie, zastosowaliśmy nasz model w kontekście kształtowania aliansów strategicznych między bankami i startupami na lokalnym rynku we Włoszech. W przeciwieństwie do wcześniejszych badań, które dotyczą głównie banków komercyjnych, nasz artykuł dotyczy relacji między bankami spółdzielczymi i start-upami typu fintech.*
Słowa kluczowe: *banki tradycyjne, start-up fintechowy, alians strategiczny, czynniki sukcesu*

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Conflicts of interest

The authors declare no conflict of interest.

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Heterogeneity of motivations among crowdinvestors: Evidence from the football industry

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Abstract

PURPOSE: *As the issue of the motivations of crowdinvestors is still heavily debated, empirical research has come to focus on specific industries and the heterogeneity of motivations within specific crowdfunding models. This study combines these two perspectives and considers the research question of the heterogeneous motivations of football club crowdinvestors. The aim of the study is to segment the football club crowdinvestors according to investment motivations.* ***METHODOLOGY:*** *In this study, the survey research method was used for a sample (n = 793) of crowdinvestors from the Wisla Krakow football club, and a two-step motivation-based segmentation approach was applied. The convenient sampling method was used as the club distributed the surveys electronically among all its crowdinvestors in July 2021. A cluster analysis, including Ward's method with Euclidian distance and the non-parametric k-means method, was applied to segment the market. Differences between segments were assessed with chi-square tests for qualitative variables and Kruskal-Wallis H tests with Dunn's post hoc tests for quantitative variables. A discriminant analysis successfully validated the segmenting procedure.* ***FINDINGS:*** *The crowdinvestors of football clubs were divided into three market segments: benefit-oriented (50.7%), club-oriented (45.3%), and goal-oriented (4.0%). This clustering solution was influenced by all of the previously identified motivations: fan identification, supporting a campaign's cause, status of football club owner, rewards, and return on investment. The segments were also differentiated according to consumption-related behaviors (media consumption, word-of-mouth marketing, merchandise purchases, match attendance, and social media engagement) and socio-demographic profiles (age, marital status, income, and place of residence). With the exception of the goal-oriented niche, crowdinvestors of football clubs are fans who are highly identified with the club and focused on supporting the cause of the campaign. However, some of them ("benefit-oriented")*

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are more sensitive than others to the return on investment, rewards, and status that comes along with club ownership ("club-oriented"). Benefit-oriented crowdinvestors consume the club's products to the greatest extent, while goal-oriented crowdinvestors are on the opposite side of the spectrum. ***IMPLICATIONS:*** *Based on self-determination theory, no cluster with a predominance of extrinsic motivations was found. These results are in opposition to most crowdfunding studies, but are in line with sport management literature. Importantly, evidence was found showing that groups that are homogenous in terms of crowdinvestment activity can still be heterogeneous in terms of crowdinvestment motivations. This insight shows that crowdinvestment motivations should be considered in more detail than they have been in the past. The assumptions of the multi-needs-meeting phenomenon of crowdinvesting in football clubs were also confirmed. These outcomes provide sports managers with information about market segments of crowdinvestors that they can use to communicate their crowdfunding campaigns more effectively.* ***ORIGINALITY AND VALUE:*** *This study is the first to present the research-tested heterogeneity of investment motivations among football club crowdinvestors. It shows the instability of research results that focus on entire crowdfunding models and ignore the industry-related specificities and internal diversity of crowdinvestors. Moreover, it extends the area of research on fan investors in the football industry, which has, until this point, focused on investment motivations without taking their internal heterogeneity into account.*

Keywords: *equity crowdfunding, fans investors, market segmentation, self-determination theory (SDT), sports clubs, team identification.*

INTRODUCTION

Crowdfunding has partially filled the capital gap faced by small and micro-sized enterprises, particularly start-ups, which find it challenging to have their projects funded by traditional sources such as bank loans, venture capitalists, or their own savings (Gierczak et al., 2016). By financing risky technological projects as well as ambitious cultural and social ventures, crowdfunding has created a market that is estimated to reach USD 1.3 billion by 2028 (Bloomberg, 2022). What is less obvious is that interest in crowdfunding is also growing immensely among sports managers of professional European football clubs (Huth, 2018a, 2018b), who have to face the structural problem of financial instability of the units managed by them (Ahtiainen & Jarva, 2022; Nessel, Havran, & Máté, 2022; Perechuda, 2020).

Football clubs with fans' crowds perfectly fit the opportunities offered by the crowdfunding ecosystem, which is based on the acquisition of funds for projects by means of amassing usually small amounts from a number of persons, chiefly via electronic trading platforms (Belleflamme, Lambert, & Schwienbacher, 2014). In contrast to technological start-ups, traditionally considered the main beneficiaries of crowdfunding (Kozioł-Nadolna, 2016;

Leboeuf & Schwienbacher, 2018), football clubs have the advantage of a recognizable brand for an existing group of customers to whom they can easily target their campaigns. However, considering the specificity of sports consumers' behavior (Mullin, Hardy, & Sutton, 2014), the investment behaviors of this particular group differ from those of other sectors (Huth, 2020; Prigge & Tegtmeier, 2020; Weimar & Fox, 2021). It turns out that the fans investors, the main target group for football club shares, are primarily motivated intrinsically by the psychological connection to the sport entity they support without expecting profitable financial returns. Therefore, their motivations for crowdfunding are also the subject of separate studies (Kościółek, 2021, in press). As with other forms of investment, it was noticed that football clubs' campaigns mainly attracted their fans, who were motivated primarily by the will to support "their" team and support the campaign's goal.

However, concerning the sports perspective, no consensus has been reached among researchers concerning the motivations for participation in crowdfunding campaigns. To achieve the most consistent results, the authors tend to limit their empirical research to specific crowdfunding models, but their results remain inconsistent with each other (see for instance, multiple research focus on equity model of crowdfunding: Bretschneider & Leimeister, 2017; Cholakova & Clarysse, 2015; Estrin, Gozman, & Khavul, 2018; Gerber & Hui, 2013; Lukkarinen, Wallenius, & Seppälä, 2018). The solution to this challenge could be to focus on projects within a particular model in specific thematic areas, as was done in the football industry, or to divide crowdfunding participants into multiple homogeneous, motivation-based market segments (Feola et al., 2019; Ryu & Kim, 2016).

Considering the abovementioned two captures, in this study, we combine both and state the research question about the heterogeneity of motivations while limiting our insights to the football industry. Hence, this study aims to segment the football club crowdinvestors using investment motivations. To achieve it, the research procedure was based on surveying crowdinvestors of one of the Polish football clubs (Wisla Krakow) and a two-step motivation-based market segmentation technique.

To the best of the author's knowledge, this is the first crowdfunding-related research that combines the two perspectives presented above. Consequently, the findings contribute to the literature by applying a more fragmented approach to crowdinvestment motivations than that presented. This leads to the verification of the extent to which, in relation to a specific sector, we can find superiority of a given category of motivation, and the extent to which, even in such a strictly defined group, their prioritization will be different. Additionally, the findings provide sports and crowdfunding platform managers with information on the general patterns of football

club crowdinvestor-segmentation procedures and outcomes. Based on this study, they could obtain information on who invests in football clubs through crowdfunding campaigns and why they do so. The results presented allow to design marketing communication in a way that the published content corresponds to the values sought by crowdinvestors (resulting from their motivation) as well as to profile who the message should reach (based on segment profiling).

LITERATURE REVIEW

Crowdfunding – the concept, typology, and context of sport

In general, crowdfunding is an open invitation to provide, primarily through the Internet, financial resources to support a project's campaign as a donation or in exchange for some form of reward (Schwienbacher & Larralde, 2010). In contrast to other forms of financial support, crowdfunding reduces the risk exposure for funders, as they are a large group of individuals providing small amounts of money. In this way, crowdfunding produces the 'long tail' of financial services (Haas, Blohm, & Leimeister, 2014), linking the ideas of crowdsourcing and microfinancing together (Mollick, 2014). Consequently, it increases the availability of capital for projects that are often perceived as too risky or not profitable to receive not only a bank loan but also support from business angels or venture capital (Gierczak et al., 2016).

Depending on the reward that the funder receives in return, we can categorize four main crowdfunding models: donation-based, reward-based, lending-based, and equity crowdfunding (Agrawal, Catalini, & Goldfarb, 2013). In donation-based crowdfunding, no material reward is provided. In reward-based, backers received some kind of product, lending-based (crowdlending) is a form of borrowing, while equity crowdfunding (crowdinvesting) provides returns in the form of shares or assets similar to shares.

Regardless of the crowdfunding model, sports projects belong to the most popular thematic category of campaigns (Gałkiewicz & Gałkiewicz, 2018). According to Ratten and Jones (2020), crowdfunding fulfills the second stage of the entrepreneurial ecosystem of sports organizations, such as the *start-up* stage (the others are: *stand up* and *scale up*; Autio et al., 2018), which transforms the initial idea into the potential sports business project. However, the scope of sports crowdfunding campaigns is highly varied and, therefore, it is distinguished into two branches: the crowdfunding *of* sports, when the creator of the campaign is a sports provider, and sports-*related* crowdfunding, when a non-sports entity raises money for a sports product

(Kościółek, 2021). In crowdfunding *of* sports, sports clubs are identified as, on the one hand, one of the most common creators of campaigns (Leroux-Sostenes & Bayle, 2019), and on the other hand, objects often included in sports crowdfunding projects (Adam, 2018). Nevertheless, the systematic elaborations on what are the factors that influence the crowdfunding model, as well as what industrial conditions affect the need for crowdfunding in sports organizations, are still lacking.

For professional football clubs, crowdfunding models, such as crowdlending and crowdinvesting, seem to be the most attractive. They can be considered as an alternative to fan bonds and going public, obtaining similar benefits at lower costs of capital, ease and convenience of funding procedures, and deeper informational feedback on the project (Agrawal et al., 2013). In practice, the popularity of these two forms of crowdfunding among football clubs differ across countries. For instance, in Germany, crowdlending is much more popular than crowdinvesting; in Poland, the situation is the opposite (Weimar & Fox, 2021; Kościółek, in press). In this study, conducted in Poland, we thus focus on testing the heterogeneity of investment motivations in equity crowdfunding.

Investment motivations in crowdfunding and within the football industry

The theoretical framework for studies on the identification of motivations among crowdfunding participants is the self-determination theory (SDT). According to SDT, which was developed by Deci and Ryan (2000, 2008), actors engage in specific activities because they are motivated to do so intrinsically, when feeling internal desire for a certain action, or externally, when the reason for the action are rewards, punishments, or other instrumental forms of return. Moreover, such actions meet at least one of the following needs: autonomy, relatedness, and competence. One activity may be accompanied by many specific motivations, but it is important that each of them fit into this framework. This also applies to the crowdfunding participants.

As previously mentioned, there is no consensus among scholars as to which of the class of motivations, intrinsic or extrinsic, is more relevant in the context of crowdfunding participants. In donation-based crowdfunding, donors are motivated both intrinsically and extrinsically (Bagheri, Chitsazan, & Ebrahimi, 2019), mainly by ease of use, perceived self-efficacy, and social connection (Chen et al., 2021). In incentive-based crowdfunding (covering reward-based, lending-based, and equity crowdfunding together), there is an agreement among scholars on the significant role of rewards and financial returns as a motivation for participation in campaigns (Bretschneider &

Leimeister, 2017; Cholakova & Clarysse, 2015; Estrin et al., 2018; Gerber & Hui, 2013; Ryu & Kim, 2016), even if such rewards and returns are, as considered by Lukkarinen et al. (2018) the least important motivating factor. Inconsistency in results occurs when examining intrinsic motivations. Cholakova and Clarysse (2015) stated that non-financial motivations have no impact on crowdinvestors, while Gerber and Hui (2013), Bretschneider and Leimeister (2017), and Estrin et al. (2018) found self-image, gaining recognition, and lobbying for certain products, to be equally important to extrinsic motivations.

Faced with these discrepancies, research interest has begun to investigate investment motivations in projects related to specific sectors (Bürger & Kleinert, 2020), including sports (Kościółek, in press). In the case of football clubs, crowdinvestors are fans of the team that creates the campaign (feeling the personal obligation to invest in the club with which they identify), and their motivations are as follows: supporting the cause of a campaign, the status of being a football club owner, rewards, and, to some extent, return on investment.

Crowdinvesting motivations of fans are consistent with what motivates them in related areas such as reward-based crowdfunding and other forms of fan investments. In reward-based crowdfunding, they are fans or family and friends who back the sports club campaigns, for whom both the effects of the support and previous experiences with a club are the most relevant (Huth, 2018a, 2018b; Kościółek, 2021). Taking into account the investigations of the shareholding market, Demir and Rigoni (2017) claimed that football investors are emotionally driven fans who support 'their' clubs, while Huth (2020) and Weimar and Fox (2021) proved that traditional investment motivations (including financial returns) for the willingness to invest in sports clubs' instruments are mainly determined by attitudes and behaviors of club attachment, such as supporting or sympathizing with a club.

As Cocieru, Delia, and Katz (2019) explained, investing in a club is often an expression of fan activism. In a crisis situation, fans feel the need to get involved financially because they feel responsible for the club, as explained by the psychological ownership theory. On the other hand, football club shares do not attract financial-maximizing professional investors as, because of overvaluation, lack of liquidity, and high price volatility (Benkraiem, Le Roy, & Louhichi, 2011; Prigge & Tegtmeier, 2019), these shares do not offer promising returns for them.

Nevertheless, the above-mentioned findings do present aggregated data at the level of the entire population. It still cannot be ruled out that there are crowdinvestors who participate in football clubs' equity crowdfunding

campaigns and who are motivated mostly extrinsically in looking for rewards and return on investment. Therefore, the research question (RQ) is as follows.

RQ) Is motivation among football clubs crowdinvestors homogeneous in terms of priorities that they give to them?

Market segmentation

The instrumental solution to test investors' homogeneity is market segmentation, which is the process of dividing the heterogeneous mass market into a homogeneous group of customers (Shank & Lyberger, 2015). Marketing managers put effort into market segmentation to provide the *right* values to the *right* target groups by creating the *right* perception of the product by customers.

The idea of targeting marketing efforts to selected actors in the market was proposed by Frederick (1934) in the 1930s, but Smith (1956) conceptualized market segmentation in the present form we know today. Since then, multiple approaches and segmentation techniques have been proposed. The most relevant distinction is *a priori* segmentation (called *common sense*) and *post-hoc* (called *a posteriori*) (Dolnicar, 2003, 2008). In *a priori* segmentation, observations are grouped into *ex ante* given segments based on theory-driven criteria. In *post-hoc* segmentation, the segments and classification are estimated using a *data-driven* approach. Moreover, in *post-hoc* segmentation, there are two options: one- or two-step procedures; however, it is recommended to use the latter (Tkaczynski, Rundle-Thiele, & Beaumont, 2010). As part of the first step, the segments are estimated with the given sort of variables, and the obtained clusters are profiled with different variables in the second step. The second step has two roles: it deepens knowledge about the segments and validates the segmenting procedure (the segments should differ not only in terms of variables used for clustering).

Taken together, the two-step *a priori* motivation-based segmentation that is applied in this study is considered to be the most impactful approach, as it leads to finding out *who* invests in football clubs and *why* through equity crowdfunding, as well as to provide profiles of given market segments (Dolnicar, 2003; Tkaczynski et al., 2010). In the context of this study, the key point is that this approach leads to the assessment of motivation heterogeneity among crowdinvestors. As a result, it enables the assessment of motivational priorities across market segments and answers the posed research question.

METHODOLOGY

Measurement

Survey research was the method and motivation scale for crowdinvesting in European football clubs (Kościółek, in press) was the instrument used in this study. The scale is based on 17 items belonging to five motivation factors: status of football club ownership (STA: 4 items), fan identification (IDE, 4 items), return on investment (ROI, 4 items), rewards (REW, 3 items), and supporting a cause (SUP, 2 items). The task of the respondents was to assess how much they agreed with the items that were preceded by the sentence "I crowdinvest in [the Club] because…" The level of agreement was measured on a 7-point Likert scale (1 = *totally disagree*, 7 = *totally agree*). A list of the items is presented in Table 2.

In addition, the questionnaire included questions to help profile the segments: five measures of consumption behaviors (CON) and five sociodemographic characteristics, such as age, gender, income, place of residence, and marital status. Consumption behaviors were measured on single items, as it is easily interpretable by sports fans (Yoshida, Gordon, Nakazawa, & Biscaia, 2014). Again, they were asked to assess on a 7-point Likert scale how much they agree with performing the following activities 'very often': following the news about [the Club] in the media (CON-1), discussing [the Club] with family and friends (CON-2), purchasing [the Club's] merchandise (CON-3), attending [the Club's] matches (CON-4) and engaging in [the Club's] social media (CON-5). Thus, CON-2 measured generating word-of-mouth marketing. All consumption variables have already been used in the literature on sports management (Gray & Wert-Gray, 2012; Kościółek & Nessel, 2019).

Data collection and analysis

The questionnaires were distributed electronically among Wisla Krakow S.A. crowdinvestors, with the assistance of the club's marketing managers. Wisla Krakow is a Polish football club that remained bankrupt at the beginning of 2019. The club then created an equity crowdfunding campaign and, in a period of less than two hours, it fundraised one million euros (the highest legally allowed amount to be collected through equity crowdfunding in the EU at that time – Sadzius & Sadzius, 2017) from more than 9,000 investors. In March 2020, Wisla increased its capital through crowdfunding. They collected 700,000 EUR from 8,888 investors. Both times, the goal of the campaign was to recapitalize a club in a difficult financial situation and to enable its continued existence in the current legal form (Wisla Krakow, 2019, 2020). In June 2021,

each person who invested in Wisla (regardless of which campaign) received an email from the club's address with a request for participation in the research.

In total, 793 questionnaires were completed (Table 1). The sample was dominated by men (91.9%), people in a marital relationship (74.6%); it composed participants between 30 and 39 years of age (42.9%), and slightly younger (18-29 years: 17.9%) or slightly older (40-49 years: 23.3%). Not much more than half of them (56.0%) have middle-lower incomes as per the Polish standard (under 5,000 PLN ~ 1,250 EUR). More than 70.0% of the crowdinvestors live in Malopolska, the region where the club operates. This means that they have regional connections to the club, assuming that they are Wisla fans.

Table 1. Sample characteristics

Characteristics	n	%	Characteristics	n	%
Gender			**Age**		
Female	64	8.07	18-29	142	17.91
Male	729	91.93	30-39	340	42.88
Marital status			40-49	185	23.33
Single	201	25.35	50 and more	126	15.89
In relation	592	74.65	**Income**[a]		
Place of residence			2500 and less	70	9.10
Region of the club's residence	557	70.24	2501 - 5 000	361	46.94
Outside the region of the club's residence	236	29.76	5000 and more	338	43.95

Note: [a] The number of observations does not sum to the total sample as the answer to this question was not mandatory.

The data analysis comprised three stages, following the most common procedures and techniques for segmenting the market in a two-step approach (Dolnicar, 2003, 2008; Dolnicar et al., 2014; Tkaczynski et al., 2010). First, a confirmatory factor analysis (CFA) was applied to validate the motivation scale. The fitting of empirical data to the factorial structure was verified by the normalized chi-square, comparative fit index (CFI), goodness-of-fit index (GFI), root mean square error of approximation (RMSEA), and normed fit index (NFI). To verify the convergent validity of the scale, the reliability of the factors was assessed using composite reliability (CR) and average extracted variance to verify the convergent validity of the scale (AVE). The acceptable values of all model fit indices were sourced from Hair et al. (2010) and Kline (2005).

Second, cluster analysis was applied to classify crowdinvestors into segments. Despite the common practice of using one-item representatives

for a given factor, we followed the approach of Dolnicar et al. (2014) and applied all items to segment the market to avoid losing meaningful variation. The hierarchical Ward method with the Euclidean distance was used to assess the optimal number of segments and, subsequently, the non-parametric k-means method was applied to classify the observations into clusters. Non-parametric Kruskal-Wallis tests and Dunn's *post hoc* tests were performed to verify which of the variables (and to what extent) was responsible for the clustering solution and find which segments in pairs differed.

Finally, cluster profiling was performed. Quantitative variables, that is, consumption-related variables, were tested using both Kruskal-Wallis and Dunn's tests. Qualitative variables, that is, sociodemographic characteristics, were analyzed with chi-squared tests and, if segments differ significantly, Cramér's V tests show how much their variation is.

RESULTS

Factor analysis

The CFA showed that all constructs, that is, the status of football club ownership (STA), fan identification (IDE), the return on investment (ROI), the rewards (REW), and the support of a cause (SUP) were reliable and valid (Table 2). Factor loadings for all items exceeded the required 0.6 threshold (Hair et al., 2010). The critical ratios for each parameter were statistically significant. The composite reliability was highest for the fan identification (CR_{IDE} = 0.922), slightly lower for the status of football club ownership (CR_{STA} = 0.861), return on investment (CR_{ROI} = 0.849), and rewards (CR_{REW} = 0.846), and the lowest for supporting a cause (CR_{SUP} = 0.662). This means that all of them exceed the required cut-off value of 0.6, which ensures the reliability of these factors (Fornell & Larcker, 1981). The average variance extracted (AVE) also showed acceptable results (> 0.5). One of the factors – supporting a cause (AVE_{SUP} = 0.495) – is on the threshold, but since the CR is appropriate, this result can also be accepted, and the entire factorial structure is convergent valid.

The extant model fit was significant (χ^2 [df] = 462.596 [109], χ^2/df = 4.244, p<0.001), and the model fit indices were RMSEA = 0.064, CFI = 0.952, NFI = 0.939, and GFI = 0.933. The undesirable statistical significance of the model is due to the large sample size for structural modeling, which can be accepted under such conditions. Importantly, all the other indices meet the required criteria: RMSEA < 0.08, CFI > 0.95, NFI > 0.9, and GFI >0.9 (Hair et al., 2010; Kline, 2005).

Table 2. Results of the confirmatory factor analysis

	CR	AVE	Factor loading	S.E.	C.R.	M	SD
Status of a football club owner (STA)	**0.861**	**0.610**					
STA-1: Owning a part of a football clubs is a lot of fun.			0.880	-	-	4.45	2.17
STA-2: Owning a part of a football club means that my dreams have come true.			0.841	0.035	27.929***	4.39	2.20
STA-3: It feels nice to be a co-owner of the club.			0.724	0.029	22.967***	5.49	1.77
STA-4: I was aiming to obtain the status of the football club owner.			0.659	0.037	20.21***	4.29	2.17
Fan identification (IDE)	**0.922**	**0.748**					
IDE-1: I supported the club that is close to my heart.			0.923	-	-	6.68	1.00
IDE-2: It is just because I am a fan of this club.			0.864	0.029	36.364***	6.57	1.11
IDE-3: I identify myself with the club.			0.891	0.030	38.910***	6.46	1.19
IDE-4: I care about what will happen with the club.			0.774	0.018	28.954***	6.79	0.62
Return on investment (ROI)	**0.849**	**0.585**					
ROI-1: I can resell these shares for a higher price in the future.			0.747	-	-	2.14	1.53
ROI-2: My aim is to get a return on my investment.			0.794	0.043	21.044***	1.85	1.30
ROI-3: I think I can earn on these shares someday.			0.791	0.056	20.981***	2.71	1.70
ROI-4: This investment has the potential for a profitable return.			0.726	0.055	19.330***	2.64	1.67
Rewards (REW)	**0.846**	**0.648**					
REW-1: There was a chance to get a unique and attractive reward.			0.890	-	-	2.72	1.79
REW-2: There was a reward to get in return.			0.729	0.040	22.208***	3.00	1.94
REW-3: I wanted to receive tangible benefits in return for my support.			0.787	0.035	24.215***	2.42	1.73
Supporting a cause (SUP)	**0.662**	**0.495**					
SUP-1: I like the effect that is expected as a result of the campaign.			0.694	-	-	6.61	0.81
SUP-2: I like the aim of the campaign.			0.713	0.122	9.835***	6.54	0.95

Note: CR – Composite Reliability, AVE – Average Variance Extracted, S.E. – Standard Error, C.R. – Critical Ratio, M – Mean, SD – Standard Deviation, *p<0.05; **p<0.01; ***p<0.001.

Based on the mean values, fan identification (M > 6.4) and supporting a cause (M > 6.5) are definitely the predominant motivators for crowdinvestors. The status of football club ownership gives moderate values (M < 4.2), while both rewards, and return on investment are the lowest (≤ 3). All of these were used in the clustering procedure.

Cluster analysis

The resulting taxonomy based on Euclidean distance and Ward's method showed that the first major increment in the cluster dendrogram was above the standardized value of 220. At a distance level of 300, a clear increment was already visible, and hence, the cut-off line was drawn at this point (Figure 1). Three clusters occur at this stage, and this is the number of segments adopted in the subsequent analysis.

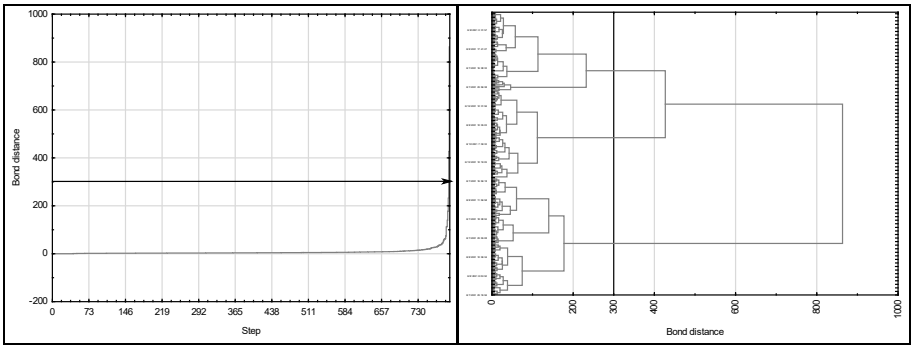

Figure 1. Results of the exploratory hierarchical cluster analysis

Therefore, the classification of observations (investors) using the k-means method was carried out for three clusters (segments). The segments shown were not quantitatively balanced (Table 3); Cluster 3 constituted the largest group (50.7% of the market; n = 402), followed by Cluster 1 (45.3%; n = 359), and a small segment of Cluster 2 (4.0%; n = 32).

The two dominant segments in terms of numbers (96% of the market) are concentrated among supporters of the club initiating the campaign (means above 6.50 for each IDE item tested). These two segments are similar in this respect: none of the items describing the fan identification differentiates them (Table 3). In contrast, Cluster 2 differed significantly from them (H_{IDE-1} = 231.515, H_{IDE-2} = 184.209, H_{IDE-3} = 153.004, H_{PER-4} = 178.435 [p<0.001 for each H]), with lower mean values for all items ($\bar{x}_{IDE-1}$ = 2.81, $\bar{x}_{IDE-2}$ = 2.50, $\bar{x}_{IDE-3}$ = 2.25, $\bar{x}_{IDE-4}$ = 4.88).

Table 3. Results of the k-means cluster analysis

	Cluster 1: *Club-oriented* (45.3%)	**Cluster 2: *Goal-oriented* (4.0%)**	**Cluster 3: *Benefit-oriented* (50.7%)**	**H**
Status of a football club owner (STA)				
STA-1	3.00[a]	3.00[a]	5.86	336.393***
STA-2	2.97[a]	2.94[a]	5.77	312.976***
STA-3	4.56[a]	4.16[a]	6.43	230.579***
STA-4	2.85[a]	3.31[a]	5.65	317.404***
Fan identification (IDE)				
IDE-1	6.84[a]	2.81	6.85[a]	231.515***
IDE-2	6.70[a]	2.50	6.78[a]	184.209***
IDE-3	6.57[a]	2.25	6.70[a]	153.004***
IDE-4	6.83[a]	4.88	6.91[a]	178.435***
Return on investment (ROI)				
ROI-1	1.53	3.50[a]	2.57[a]	104.462***
ROI-2	1.23	3.13[a]	2.31[a]	164.295***
ROI-3	1.85	3.28[a]	3.44[a]	181.103***
ROI-4	1.75	3.28[a]	3.39[a]	199.757***
Supporting a cause (SUP)				
SUP-1	6.62[a]	5.53	6.69[a]	26.465***
SUP-2	6.61[a]	5.31	6.57[a]	34.375***
Rewards (REW)				
REW-1	1.65[a]	2.31[a]	3.70	258.463***
REW-2	1.93[a]	2.50[a]	4.00	229.408***
REW-3	1.49[a]	2.03[a]	3.28	213.800***

Note: For each variable (row), the means for different customer segments with the superscript a are not significantly different ($p < 0.05$) based on Dunn's multiple comparison tests, *p<0.05; **p<0.01; ***p<0.001.

In addition to the fan identification, Clusters 1 and 3 shared similar levels of motivation to achieve the campaign goal. Equally important to them (> 6.0) is the effect this can have on the club and the purpose for which the money raised will be used. Compared to these two clusters, investors grouped in Cluster 2 are also significantly less motivated in this regard (H_{SUP-1} = 26.465, H_{SUP-2} = 34.375 [p<0.001 for both H]). However, simultaneously, compared to the other dimensions of motivation within this segment, achieving goals is the most important determinant of their campaign participation ($\bar{x}_{SUP-1}$ = 5.53; $\bar{x}_{SUP-2}$ = 5.31). Cluster 2 can be called a segment of "goal-oriented" crowdinvestors.

Despite some similarities between Clusters 1 and 3 (in terms of their relationship with the campaign initiator and importance of achieving the campaign goal), there are areas where the two segments differ significantly. This relates to the attitude toward their own profits that their participation

in the campaign can bring. These benefits can be seen in three areas: the status of the co-owner of the club (H_{STA-1} = 336.393, H_{STA-2} = 312.976, H_{STA-3} = 230.579, H_{STA-4} = 317.404 [p<0.001 for each H]), the return on investment (H_{ROI-1} = 104.462, H_{ROI-2} = 164.295, H_{ROI-3} = 181.103, H_{ROI-4} = 199.757 [p<0.001 for each H]), and the rewards received for the support provided (H_{REW-1} = 258.463, H_{REW-2} = 229.408, H_{REW-3} = 213.800 [p<0.001 for each H]).

For Cluster 1, the importance of the status of the co-owner was rather low ($\bar{x}_{STA-1}$ = 3.00, $\bar{x}_{STA-2}$ = 2.97, $\bar{x}_{STA-3}$ = 4.56, $\bar{x}_{STA-4}$ = 2.85). This strongly likens this segment to Cluster 2 of goal-oriented investors, with whom it shares a common approach for all items within this dimension. Thus, the role assigned to the status of the club co-owner is a characteristic of Cluster 3. Furthermore, the rewards that could be received for investments motivate them more than investors from the two other clusters ($\bar{x}_{REW-1}$ = 3.70, $\bar{x}_{REW-2}$ = 4.00, $\bar{x}_{REW-3}$ = 3.28). Again, Clusters 2 and 3 do not have statistically significant differences, giving potential personal benefits (here in the prospect of receiving rewards) negligible importance (across all three items for both groups $\bar{x} \leq 2.50$). It is not the reward; however, the shares issued are a typical form of return for equity crowdfunding. Unexpectedly, this motivation was found to have the weakest intensity in all three identified segments ($\bar{x} \leq 3.50$). These are crowdinvestors from Cluster 2 and Cluster 3, who present similar intensities of motivation expressing attitude to return on investment, while Cluster 1 has the lowest priority regarding ROI ($\bar{x} < 2.00$).

Overall, for most variables (items that form dimensions), one segment differed from the other two, interchangeably representing pairs with consistent motivations. It was also noted that there are two segments with high levels of fan identification, but differing in the importance attributed to the benefits an individual may derive from participating in equity crowdfunding. In contrast to Cluster 1 that group (only) "club-oriented" crowdinvestors, those of Cluster 3 are "benefit-oriented" as they are motivated by returns in the form of club co-ownership status, rewards, and – to a limited extent – by return on investment opportunities. The third segment, Cluster 2, consists of goal-oriented investors and represents a market niche. It is made up of people who have no emotional ties to the campaign's initiator (fan identification), and their support was motivated primarily by a desire to help the club achieve the campaign's goal.

Clusters profiling and validation

The results of the discriminant analysis (Table 4) confirmed the consistency of the classification achieved by observations into segments (Rohm, Milne, & McDonald, 2006). The high eigenvalues of the two estimated functions (2.26

and 2.00, respectively) and Wilks' lambda value confirm the significance of the clustering performed. The classification matrix indicated that 95.80% of all cases could be correctly classified, with the most accurate classification being in the benefit-oriented segment (97.5%). Furthermore, the high (>0.80) canonical correlation values indicate high correlations between discriminant values and segment allocations, ultimately confirming the good fit of the adopted taxonomy with empirical data.

Table 4. Results of the discriminant analysis

	Eigenvalue	% of variance	Canonical correlation	Wilks' lambda	chi-square	df	p
Function 1	2.26	53	0.83	0.10	1783.61	34	<0.001
Function 2	2.00	47	0.82	0.33	860.22	16	<0.001

Note: 1-1: 94.4%, 2-2: 90.6%, 3-3: 97.5%, and overall: 95.8% of original cases correctly classified.

Table 5. Consumption-related variability between clusters

	Total	Cluster 1: *Club-oriented* (45.3%)	Cluster 2: *Goal-oriented* (4.0%)	Cluster 3: *Benefit-oriented* (50.7%)	H
CON-1	6.54	6.65[a]	2.87	6.73[a]	136.420***
	(1.13)	(0.83)	(2.01)	(0.70)	
CON-2	5.75	5.71	1.90	6.09	90.789***
	(1.70)	(1.64)	(1.49)	(1.37)	
CON-3	4.34	4.13	1.61	4.74	76.822***
	(1.87)	(1.89)	(1.17)	(1.68)	
CON-4	5.05	4.97[a]	1.71	5.39[a]	69.095***
	(2.07)	(2.10)	(1.32)	(1.84)	
CON-5	3.94	3.65	1.45	4.39	67.470***
	(2.16)	(2.21)	(1.09)	(2.00)	

Note: *p<0.05; **p<0.01; ***p<0.001.

All the variables related to the level of consumption of sports club products that initiated the equity crowdfunding campaign significantly differentiated the identified market segments (Table 5). This was mainly the case for seeking media information on club-related topics (H_{CON-1} = 136.420; $p < 0.001$), generating word-of-mouth marketing about the club (H_{CON-2} = 90.789; $p < 0.001$), and the frequency of buying official merchandise (H_{CON-3} = 76.882; $p < 0.001$). The separated groups of investors also had different levels of frequency of attending their matches (H_{CON-4} = 69.095; $p < 0.001$) and social media engagement with the campaign initiator (H_{CON-5} = 67.470; $p < 0.001$).

Unlike purchase motivation, there is no single consumption variable, the intensity of which is the same for any pair of segments. Benefit-oriented investors exhibited the highest levels of consumption intensity in all areas studied. In general, it should be assumed that they show very high levels of interest in the club in the media ($\bar{x}$ > 6.5), generated word-of-mouth marketing ($\bar{x}$ > 6.0), have a high frequency of attendance at matches ($\bar{x}$ > 5.00), and a moderate interest in club merchandise and involvement in social media ($\bar{x}$ > 4.00). The counterbalance for the described segment is that of goal-oriented investors, who can be considered uninterested in the campaign creator's products. Excluding interest in the club in the media ($\bar{x}_{CON\text{-}1}$ = 2.87), the averages for all variables describing the consumer behavior of this group were extremely low ($\bar{x}$ < 2.00).

Unlike gender (χ^2 = 1.37; ns.), age (χ^2 = 12.21; p < 0.1), marital status (χ^2 = 5.34; p < 0.1), monthly income (χ^2 = 12.82; p < 0.1), and place of residence (χ^2 = 32.60; p < 0.001) were sociodemographic variables that significantly differentiated the identified market segments (Table 6). The magnitude of segment variation within these statistically significant sociodemographic variables was rather low (V < 0.10), with a moderate role for place of residence (V = 0.20).

We can observe the underrepresentation of the youngest crowdinvestors in the "club-oriented" segment (13% vs. 22% in the other two segments) and the overrepresentation of above-average earners in the "goal-oriented" segment (68% vs. 39% and 47% in the other two segments). Additionally, goal-oriented investors are distinguished by their lack of location ties to the club's headquarters (69% live outside the region). The presence of these differences creates the profiles of the segments and confirms the correctness of the analysis.

Table 6. Socio-demographic variability between clusters

	Cluster 1: *Club-oriented* (45.3%)	**Cluster 2: *Goal-oriented* (4.0%)**	**Cluster 3: *Benefit-oriented* (50.7%)**	**Chi-square (Cramer's V)**
Age				12.21*
18-29	13%	22%	22%	(0.09)
30-39	43%	34%	43%	
40-49	25%	31%	21%	
50 and more	18%	13%	14%	
Gender				1.37
Female	9%	3%	7%	

	Cluster 1: *Club-oriented* (45.3%)	Cluster 2: *Goal-oriented* (4.0%)	Cluster 3: *Benefit-oriented* (50.7%)	Chi-square (Cramer's V)
Age				12.21*
Male	91%	97%	93%	
Maritial status[a]				5.34*
Single	21%	26%	29%	(0.08)
In relation	79%	74%	71%	
Income				12.82*
2500 and less	8%	10%	10%	(0.09)
2501 - 5 000	45%	23%	51%	
5000 and more	47%	68%	39%	
Place of residence				32.60***
Region of the club's residence	72%	25%	72%	(0.20)
Outside the region of the club's residence	28%	75%	28%	

Note: [a] Cluster 2 was not included in chi-square tests due to the low number of observations, *p<0.05; **p<0.01; ***p<0.001.

DISCUSSION AND CONCLUSIONS

This study aims to segment the football club crowdinvestors using investment motivations. In the results of the cluster analysis, we obtained three market segments of crowdinvestors who can be described as follows: (*i*) benefit-oriented investors with a high level of fan identification that comes from emotional identification with the club, who care about the goal of the campaign, but are also motivated by external benefits in the form of rewards, and the status of being a co-owner of the club; (*ii*) club-oriented investors for whom the fan identification is predominant and the desire to achieve the goal, while other motivations are secondary; and (*iii*) goal-oriented – not expecting external benefits, with little emotional connection to the club, but hoping to achieve the goal for which the campaign is being run.

The segmentation criterion was a unique set of motivations related to sports crowdfunding (Kościółek, in press); therefore, it was not possible to compare the results with studies that used the same list of variables. However, in segmentation studies in sports, it is common to adopt the psychological

continuum model (PCM) for this purpose (see, e.g., Doyle, Kunkel, & Funk, 2013; Giulianotti, 2002; Park, Kim, & Chiu, 2021; Pu & James, 2017). According to the PCM (Funk & James, 2001), sports club activities go through four successive phases of involvement in its relationship with the fans of the club: awareness, attraction, attachment, and loyalty. In the case of equity crowdfunding campaigns, we found two large market segments (more than 95% of the entire market) with high levels of fan involvement. Therefore, it can be assumed that those involved in equity crowdfunding campaigns are fans at the highest levels of the continuum, that is, attachment and loyalty.

Unlike many segmentation studies on sports fans, analogous research on crowdfunding is scarce. In the Web of Science and Scopus databases, we found only two papers on this topic. First, it relates to the segmentation of crowdinvestors based on decision-making criteria (Feola et al., 2019) and the motivation-based segmentation of backers in reward-based crowdfunding (Ryu & Kim, 2016). From these two perspectives, it is difficult to relate the clustering of crowdfunding equity investors based on the decision criteria to the behavior of crowdinvestors of football clubs, as they are a group of incidental investors (creating a community focused around the fundraising initiator and not around the crowdfunding platform) (Kościółek, in press). This means that they do not make a choice that answers the question "which campaigns to support," but rather "whether to support the club's campaign."

Therefore, in line with analogies to the already known market segments of crowdfunding campaign participants, Ryu and Kim (2016) relate the rewards-based model as a point of reference. Among the four segments distinguished, there were: (*i*) *angelic backers* focused on altruistic help, not expecting personal benefits from the support provided; (*ii*) *reward hunters* looking for attractive rewards, which on the basis of equity crowdfunding should also be equated with those looking for investment opportunities; (*iii*) *avid fans* specific initiators, but also focused on gaining rewards and gaining a position in the community; and (*iv*) *tasteful hermits* strongly associated with the initiator (similar to die-hard fans), but they do not give high importance to other potential benefits of participation in the campaign (low level of extrinsic motivation). Based on the characteristics presented, there are great similarities between the pairs of *goal-oriented* and *angelic backers*, *benefit-oriented* and *avid fans*, and *club-oriented* and *tasteful hermits*. However, there is no counterpart to the *reward hunters* segment among crowdinvestors of football clubs. This shows that, contrary to previous research, the most extrinsically oriented segment was not found among them.

Theoretical contribution

The findings suggest a dominant role for intrinsic motivations among football club crowdinvestors: fan identification, supporting a campaign's cause, and the status of a football club owner. This supports evidence from previous work in the field of sports crowdfunding (Huth, 2018a, 2018b; Kościółek, 2021, in press) and football fans' investments (Huth, 2020; Prigge & Tegtmeier, 2020; Weimar & Fox, 2021). According to SDT (Deci & Ryan, 2008), humans are intrinsically driven to satisfy three basic needs: autonomy (i.e., having control), relatedness (refers to having a sense of belonging), and competence (refers to self-efficacy in one's achievement). In our case, each of the intrinsic motivations relates to different needs: fan identification to the need for relatedness, support of a campaign cause to the need for autonomy, and the status of football clubs to the need for competence. The result of segmentation showed that the need for autonomy is satisfied within all segments, the need for relatedness occurs in the vast majority of crowdinvestors, and the need for competence occurs only for some of them.

Overall, these results shed new light on what we know about crowdinvestor motivations by showing that their mix is quite heterogeneous, even if the scope of the analysis is limited to a homogeneous group of football clubs as campaign creators. However, regarding the categories of motivation, it has been confirmed that within such a narrowly defined group, there is a domination of one of them, in this case, intrinsic motivations.

Practical implications

The adopted two-step motivation-based segmentation makes it possible to provide recommendations to sports managers as to what the appropriate value proposition is for each market segment of football club crowdinvestors.

In respect of the particular segments, the marketing communication of the football club equity crowdfunding campaigns should include the following elements: (*i*) *Club-oriented crowdinvestors* – formulating a value proposition based on the collective action of the community for the club, with a clearly stated and universally accepted campaign goal by the community around the club, as well as providing information on moving higher in the internal hierarchy of the club after obtaining the symbolic status of its co-owner; (*ii*) *Benefit-oriented crowdinvestors* – the same value propositions as in the case of club-oriented crowdinvestors, as well as: providing attractive rewards with the club's logo, making a commitment that promotion to the level of club co-owners is associated with receiving confirmation of this fact in the form of a share certificate, declaration of the organization of general meetings, where

investors will have the opportunity to make decisions on topics related to the club; (*iii*) *Goal-oriented crowdinvestors* – value propositions referring to the importance of the goal being pursued, not only for the club itself, but also for its immediate environment (e.g., the "raison d'état" of given competitions, of which the club is an important part for historical reasons), as the addressee of the proposition in this segment is largely people who are not part of the club's fan community. This group should also be provided with information on the relationship between the provided support and the possibility of being a co-owner of the club and (optionally) an indication of the opportunity to sell the shares for a profit in the future (if applicable).

The value proposition presented to potential crowdinvestors within each segment is a form of commitment that the club initiating the fundraiser must fulfil. The target effect is customer satisfaction, which builds long-term relationships with customers. While the equity crowdfunding campaign itself can be classified as a one-time purchase product, it is aimed at the existing group of customers of the basic product (club fans), and obtaining and maintaining consumer loyalty to this group is a highly desirable situation.

Limitations and recommendations

As in the case of cultural projects and the reward-based model (Bürger & Kleinert, 2020; Huth, Ryu, & Kim, 2016), equity crowdfunding investors in sports are a heterogeneous group. Therefore, future research should include other sectors to test the robustness of the findings. Moreover, to complete the picture of sports crowdfunding, similar research on motivations and segmentations other than equity crowdfunding models is still necessary.

However, it is worth undertaking these studies in different national and situational contexts, to compare the results of the study coming from a singular Polish club. Despite the fact that both the Polish crowdfunding regulations (Sadzius & Sadzius, 2017) and the financial structures of football clubs (Sports Business Group, 2019) are in line with the main trends in the European market, limiting research to only one football club and the specific cause of campaigns, such as avoidance of the club's bankruptcy, are the greatest limitations of this study. In future research, it is highly recommended to investigate how the heterogeneity of motivations would differ, when the creator of the campaign has a good financial situation, and the campaign goal is not oriented toward the survival of the club, but its intensive development.

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Abstrakt

CEL: *Ponieważ kwestia motywacji inwestorów społecznościowych jest nadal przedmiotem intensywnej debaty, w badaniach empirycznych tej kwestii zaczęto skupiać się na określonych branżach oraz heterogeniczności motywacji w ramach określonych modeli finansowania społecznościowego. W niniejszym opracowaniu te dwie perspektywy zostały połączone. W związku z tym rozważane jest pytanie badawcze o niejednorodność motywacji inwestorów społecznościowych klubów piłkarskich. Celem badania jest segmentacja tych inwestorów przy użyciu ich motywacji inwestycyjnych.* ***METODYKA:*** *W badaniu zastosowano metodę sondażu na grupie inwestorów społecznościowych klubu piłkarskiego Wisła Kraków (n = 793) oraz podejście dwustopniowej segmentacji post hoc opartej na motywacjach. Jako że to przedstawiciele klubu prowadzili w lipcu 2021 roku elektroniczną dystrybucję ankiet wśród*

wszystkich jego inwestorów społecznościowy, wykorzystany dobór próby był doborem wygodnym. Do segmentacji rynku zastosowano analizę skupień, w tym metodę Warda z odległością euklidesową oraz nieparametryczną metodę k-średnich. Różnice między segmentami określano testami chi-kwadrat dla zmiennych jakościowych oraz testami H Kruskala-Wallisa wraz z testami post hoc Dunna dla zmiennych ilościowych. Analiza dyskryminacyjna skutecznie zweryfikowała procedurę segmentacji. ***WYNIKI:*** *Inwestorzy społecznościowi klubów piłkarskich dzielą się na trzy segmenty rynku: zorientowanych na korzyści (50,7%), zorientowanych na klub (45,3%) i zorientowanych na cel (4,0%). Na takie grupowanie miały wpływ wszystkie wcześniej zidentyfikowane motywacje: identyfikacja fanów, wspieranie celu kampanii, status właściciela klubu piłkarskiego, nagrody i zwrot z inwestycji. Segmenty były również zróżnicowane pod względem zachowań konsumpcyjnych (konsumpcja mediów, marketing szeptany, zakupy produktów klubowych, frekwencja na meczach i zaangażowanie w mediach społecznościowych) oraz profili społeczno-demograficznych (wiek, stan cywilny, dochód i miejsce zamieszkania). Z wyjątkiem niszy zorientowanej na cele, inwestorzy społecznościowi klubów piłkarskich to wysoce zidentyfikowani kibice, którzy są skoncentrowani na wspieraniu celu kampanii. Niektórzy z nich („zorientowani na korzyści") są przy tym bardziej wrażliwi na status właścicielski klubu, zwrot z inwestycji i nagrody niż pozostali („zorientowanie na klub"). Inwestorzy skupieni na korzyściach w największym stopniu konsumują produkty klubu, podczas gdy zorientowani na cele wręcz przeciwnie.* ***IMPLIKACJE:*** *Opierając się na teorii autodeterminacji, nie znaleziono zgrupowania z przewagą motywacji zewnętrznych. Wyniki te są sprzeczne z większością badań dotyczących finansowania społecznościowego, ale są zgodne z literaturą dotyczącą zarządzania w sporcie. Co ważne, dostarczono dowody na to, że jednorodna grupa pod względem aktywności w zakresie inwestowania społecznościowego może nadal być niejednorodna pod względem motywacji. Wynikającą z tego kontrybucją teoretyczną tego jest spostrzeżenie, że rozumienie motywacji do inwestowania społecznościowego powinno być rozpatrywane w sposób bardziej szczegółowy niż dotychczas. Potwierdziły się również założenia o zaspokajaniu wielu potrzeb jednocześnie w ramach zjawiska inwestowania społecznościowego w kluby piłkarskie. Menedżerom sportowym wyniki te dostarczają informacji na temat segmentów rynku inwestorów społecznościowych, co umożliwia skuteczniejszą komunikację kampanii crowdfundingowych.* ***ORYGINALNOŚĆ I WARTOŚĆ:*** *Niniejsze badanie jest pierwszym, w którym testowano badawczo heterogeniczność motywacji inwestycyjnych wśród inwestorów skupionych wokół klubów piłkarskich. W efekcie wykazano niestabilność wyników badań skoncentrowanych na całych modelach finansowania społecznościowego, które pomijały specyfikę branżową i wewnętrzną różnorodność inwestorów społecznościowych. Ponadto rozszerzono obszar badań nad kibicami inwestorami w branży piłkarskiej, gdyż do tej pory skupiano się na motywacjach inwestorów bez uwzględniania ich wewnętrznej heterogeniczności.*

Słowa kluczowe: *crowdfunding udziałowy, fani inwestorzy, identyfikacja z drużyną, kluby sportowe, segmentacja rynku, teoria autodeterminacji*

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Conflicts of interest

The author declares no conflict of interest.

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How funding matters: Reinitiating of New Product Development and the moderating effect of extramural R&D

Safi Ullah Khan[1]

Abstract

PURPOSE*: We examine whether financial obstacles affect the probability of a firm undertaking previously suspended (or abandoned) innovation projects for new product development (NPD), and whether extramural R&D, as well as the breadth of the types of R&D collaboration (i.e., knowledge sources), moderate the relationship between financing constraints and the probability of restarting previously suspended NPD from selected South Asian economies.* ***METHODOLOGY****: This study controls for potential endogeneity in innovation propensity and finance access by employing a recursive bivariate probit model. We also adopt an instrumental variable approach by employing a probit model with continuous endogenous regressor to account for the potential endogeneity between the breadth of collaboration partners and innovation propensity.* ***FINDINGS****: Financial obstacles significantly impact previously suspended NPD. Furthermore, extramural R&D positively affects the probability of a firm undertaking NPD projects and attenuates the relationship between financing constraints and the likelihood of restarting abandoned/suspended NPD projects, suggesting that extramural R&D alleviates financing constraints, which increases the likelihood of NPD restarts. However, the breadth of collaborating partners is not positively associated with the probability of a firm restarting NPD. This is consistent with the view that extramural R&D with diverse sets of partners is exposed to the risks of the "two worlds paradox" arising from a firm's collaboration with universities, research institutions, and consulting firms.* ***IMPLICATIONS****: The findings corroborate the view that firms must maintain a balance between their internal knowledge base and extramural R&D to optimize innovation outcomes. Nevertheless, extramural R&D reduces the reliance of financially constrained firms on resource requirements, improves access to financing, and enhances R&D productivity in NPD.* ***ORIGINALITY AND VALUE****: We provide the first firm-level and multi-country evidence of the importance of financial obstacles in the probability of reinitiating previously*

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suspended NPD at the execution phase. Second, to the best of our knowledge, this is the first study to examine the relationship between inter-organizational R&D collaboration diversity and the probability of a firm reinitiating previously abandoned (or suspended) NPD.

Keywords: *New Product Development, financial constraints, extramural R&D, inter-organizational R&D collaborations, external knowledge acquisition*

INTRODUCTION

Technological innovation is vital to a firm's innovation performance and success (Rauter, Globocnik, Perl-Vorbach, & Baumgartner, 2019). However, many innovation projects fail (or are abandoned) before their successful conclusion because several contingencies affect innovation performance, such as temporal coordination constraints, failure of innovation systems (Greco et al., 2020), and whether their suspension is an outcome of a lack of financial resources or intangible organizational competencies, knowledge, and capabilities (Hewitt-Dundas, 2006). These resources may be found beyond a firm's boundaries by leveraging its in-house R&D through extramural (i.e., collaborative) R&D, which can help the focal firm exploit externally acquired knowledge, sustain innovation (Santamaría, Nieto, & Rodríguez, 2021), and improve the likelihood of reinitiation of previously abandoned (or suspended) projects for new product development (NPD). This study examines whether extramural R&D affects the likelihood of a firm restarting innovation activities for NPDs that have been suspended or abandoned before completion.

The extant literature has acknowledged the relevance of financial obstacles to technological innovation (Canepa & Stoneman, 2008; Howell, 2016; Peng, Tan, & Zhang, 2020). Financial constraints prevent many firms from completing innovation activities, and may negatively affect the likelihood of restarting abandoned innovation projects for NPD. Mohnen et al. (2008) and Garcia-Vega and Lopez (2010) found that financial obstacles significantly affect the probability of premature stopping, abandoning, or not starting NPD innovation projects. Furthermore, because market friction is more severe in developing markets, financial constraints are likely to affect R&D investments and their eventual success or failure (Sasidharan, Lukose, & Komera, 2015). Our second main research objective is to examine whether extramural R&D and breadth in the types of R&D collaboration (i.e., open innovation sources) moderate the relationship between financing constraints and the probability of reinitiating previously abandoned (or suspended) NPDs.

This study contributes to the literature on corporate innovation in three ways. First, previous studies examined how R&D collaborations overcome the contextual causes of innovation failures, suspensions, and abandonment

(Antonioli, Marzucchi, & Savona, 2017; Radas & Bozic, 2012). Greco et al. (2020) show that firms collaborating with an extensive network of partners are less likely to abandon innovation activities. Recently, González-Moreno et al. (2019) showed that "coordination difficulties and bounded rationality" explain the inverted U-shaped relationship between breadth of knowledge sourcing and innovation propensity. Loss of control over critical internal know-how, increased managerial and/or organizational complexity, and the consequent increased costs (Gkypali, Filiou, & Tsekouras, 2017) associated with accessing a diverse set of knowledge from different collaborating partners may outweigh the positive effects on a firm's internal innovation outcomes. To the best of our knowledge, ours is the first study to examine the relationship between diversity in R&D collaboration and the probability of a firm reinitiating a previously abandoned (or suspended) NPD. We found that firms collaborating with a broader network of partners, such as domestic and foreign firms, academic institutes, and research organizations, are less likely to restart or attempt to start previously abandoned NPD projects. This result corroborates the "*two-worlds paradox*" (Hewitt-Dundas et al., 2019) arising from R&D collaborations between firms and academic research institutes. Our results imply that the innovation propensity concerning the reinitiation of previously suspended NPD benefits from a firm's extramural R&D, consistent with the idea that firms gain substantially from extramural innovation investments (Wadhwa, Bodas Freitas, & Sarkar, 2017). However, collaborating with a diverse set of partners also increases certain costs (e.g., transaction costs, managerial attention constraints, and coordination costs), which may hamper firms' propensity to restart previously suspended NPDs.

Second, we provide the first multicountry evidence from three South Asian countries on the importance of financial obstacles in the probability of initiating or attempting to develop an innovative product and service at the execution phase. For the empirical analysis, we used a unique enterprise innovation survey conducted as a follow-up to the baseline *enterprise surveys* by the World Bank Group in South Asian countries in 2013 (India, Pakistan, and Bangladesh) which collected detailed firm-level information on various types of innovation and innovation-related activities. Pakistan, India, and Bangladesh are major representatives of South Asia and relatively understudied in the literature on the interaction between financial obstacles to innovation and extramural R&D. Although they are neighboring countries with close geographical proximity and many similarities in terms of culture, religion, and shared history, they also differ in their level of economic development, financial market development, access to external financing, and corporate innovation. India's economic growth over the last few decades has mainly been attributed to advances in manufacturing-led development

and corporate innovation. Asian economies, particularly India, have invested massively in transforming into a knowledge economy and private firms have shown increased innovation performance (Zhang, Zhao, Voss, & Zhu, 2016). Empirical evidence on innovation propensity for NPD in the South Asian context is also much needed because corporate expenditure on R&D in developing countries such as India has increased exponentially over the last decade (Ivus, Jose, & Sharma, 2021), some of which is attributed to increased product-market competition following the abolition of License Raj (Bas & Paunov, 2018) and the strengthening of the intellectual property rights regime (Dhanora, Sharma, & Khachoo, 2018). By contrast, South Asian countries appear to be laggard in improving the corporate R&D environment because R&D expenditures (as a percentage of GDP) for India (0.50% in 2018) and Pakistan (0.24% in 2017) are much lower than the world's average expenditure of 2.2% in 2018 (World Bank, 2021). However, with the opening up of the Indian economy to international trade and investment in the 1990s, after decades of excessive banking regulations and illiquidity of capital markets and the gradual shift towards R&D and industrialization policy goals and innovation, Indian enterprises have progressed in technological innovation (Altenburg, Schmitz, & Stamm, 2008). India has one of the more developed capital markets and modern financial systems among developing countries (Allen, Chakrabarti, Qian, & Qian, 2012), but also has weak legal institutional settings and investor protections, which makes it an interesting case to examine the finance-innovation nexus in the context of developing markets. Furthermore, the absence of empirical studies on the role of extramural R&D in attenuating firm-level financing constraints on innovation propensity in South Asian economies, such as India, Pakistan, and Bangladesh, was one of the main motivating factors for the current study.

Controlling for potential endogeneity between financing constraints and innovation propensity, we show that credit constraints negatively influence the likelihood of restarting previously suspended NPDs. This result is consistent with the view that well-functioning capital markets promote technological innovation and reconcile the seemingly skeptical view of banks' role in facilitating innovation (e.g., Amore, Schneider, & Žaldokas, 2013; Khan, Shah, & Rizwan, 2021). We also observe a preference for internal funds to finance R&D investments in South Asian countries, consistent with *pecking order theory* in firms' preferences for financing innovation (Alam, Uddin, & Yazdifar, 2019). Consequently, when adequate internal funds are available, firms may undertake innovation activities such as those previously suspended or abandoned. This resumption of NPDs may be hampered if the firm is required to access external capital, which may be costly or unavailable for funding innovation.

Third, we contribute to the open innovation literature by examining whether extramural R&D moderates the relationship between financial obstacles and innovation propensity. We demonstrated that firms with extramural R&D are more likely to restart previously abandoned NPDs. Furthermore, we find that credit constraints are less binding for firms with extramural R&D, consistent with the view that R&D collaborations can produce "cost and risk-sharing" opportunities that lead to a reduction in the cost of external finance. Finally, previous studies on innovation failures and financial constraints have primarily employed self-perceived and self-reported measures of financial obstacles (e.g., Antonioli et al., 2017; García-Quevedo, Segarra-Blasco, & Teruel, 2018). We complement these studies using a direct measure of credit constraints faced by firms by utilizing loan application data from enterprise surveys. This study is similar to Czarnitzki and Hottenrott (2017), who examine whether R&D collaborations attenuates the firm's financial constraints to innovation using the OECD R&D Survey data. They employed the sensitivity of R&D expenditures to the availability of internal funds for working capital financing as an indirect proxy for financial constraints. In contrast, we employ a direct proxy for financial obstacles using the firm's actual experience of accessing credit markets.

The rest of the paper is organized as follows. The next section discusses theoretical background and hypotheses development. Then detailed methodology and data description are presented, followed by econometric analysis in the Empirical Results section, while the last section concludes the paper.

THEORY AND HYPOTHESES

Financing constraints and extramural R&D

Given the increasing technological complexity and multidisciplinarity of R&D activities in recent years, rapidly expanding knowledge bases have necessitated a move towards open innovation and technology partnerships (Kafouros, Love, Ganotakis, & Konara, 2020). While the relevance of R&D collaborations in exploiting externally acquired knowledge for innovation performance has been well documented (e.g., Beneito, 2006; Medda, 2018), collaborative R&D as an attenuation strategy to alleviate financial constraints has not received much attention in the literature. Antonioli et al. (2017) find that perceived financial barriers to innovation are associated with the adoption of collaborative strategies: firms resort to cooperation driven by risk and cost-sharing incentives. Similarly, Czarnitzki and Hottenrott (2017)

show that financial constraints are stronger for non-collaborating firms than for other firms. Lerner, Shane, and Tsai (2003) find that when public market financing opportunities are limited, small U.S. biotechnology firms finance their R&D activities through alliances with larger corporations. Similarly, Park, Chen, and Gallagher (2002) showed that resource-poor firms are more likely to form alliances to access external resources. Alam et al. (2019) show that firms with extramural R&D utilize both internal and external financing to fund innovation, whereas firms with in-house R&D lack access to external financing for R&D investments. Piga and Atzeni (2007) documented similar findings that firms with extramural R&D are more likely to have loan applications approved by their banks. We expect firms with R&D collaborations to be less likely to depend on internal funds to undertake previous NPD projects. Hence, we propose the following hypothesis.

H1: Extramural R&D alleviates the negative effects of credit constraints on the likelihood of restarting previously suspended (or abandoned) NPD projects.

Inter-organizational R&D collaboration breadth and innovation

The literature on innovation management suggests that a complex, uncertain, and troubled path towards successful innovation can lead to numerous obstacles to innovation. Exogenous obstacles may be related to the failure of R&D cooperation with important external partners (Greco et al., 2020). Endogenous causes of innovation failure are related to a firm's internal deficiencies (e.g., the focal firm's lack of attention, required expertise and knowledge, or process inadequacies). Prior studies have documented the benefits of R&D collaboration to the focal firm stemming from the exploitation of complementary assets and capabilities and additional opportunities for mutual learning, leading to higher innovation and commercialization capabilities for collaborating firms (Koch & Windsperger, 2017). Although the benefits of extramural R&D to the focal firm have been extensively examined, no previous study has examined the breadth of collaboration and a firm's propensity to restart innovation projects for previously suspended (or abandoned) NPDs. Firms can overcome endogenous and contextual causes of innovation abandonment by collaborating with a wide range of partners (Lasagni, 2012). Owing to their exposure to diverse sources of knowledge, firms gain new perspectives that can help them avoid cognitive myopia (Prahalad & Bettis, 1986), act as stimuli to engage in creative thinking, and identify new problem-solving approaches that may foster their propensity

to evaluate and restart abandoned (or suspended) NPD projects. Thus, we propose the following hypothesis.

H2a: The higher the breadth of R&D collaborations, the higher the probability that a firm restarts previously suspended (or abandoned) NPD projects.

Previous studies have provided evidence of excessive costs associated with extramural R&D. Leiponen and Helfat (2010, p. 226) argues that firms "… may encounter higher marginal costs due to the increased complexity of managing both the variety of knowledge and the relationships needed to maintain access to these sources." Gkypali et al. (2017) argue that such costs exist because there are highly interactive and complex processes between the point when external knowledge sources are accessed and the point at which knowledge is internalized and converted into tangible innovation outcomes by embedding it into organizational culture, processes, and routines. Laursen and Salter (2006) conceptualize three inter-related risks of "over-search" namely "the absorptive capacity problem, the attention allocation problem, and the *not-invented-here syndrome*," which potentially can outweigh the benefits emanating from breadth in the external knowledge search. Managing multiple external knowledge sources is challenging, and many firms may not have developed the requisite managerial capabilities and organizational processes to benefit from external knowledge. Hence, innovation processes and costs associated with the breadth of knowledge sources may coexist and jointly affect NPD projects. We propose the following hypothesis:

H2b: The higher the breadth in types of inter-organizational R&D collaborations, the lower is the probability that a firm restarts previously suspended NPDs.

METHODOLOGY

Financial obstacles and innovation propensity may be endogenously determined. This endogeneity may arise because, firstly, innovation requires additional funding from external financiers, which may increase the likelihood of a firm experiencing financial constraints. Second, the firm's decision to restart previously abandoned NPDs and how these innovation investments are financed may be simultaneously determined. We control for potential endogeneity between innovation propensity and the probability that a firm will face financial obstacles in funding innovation as simultaneous questions

in the bivariate probit model. A bivariate model is applicable "where there are good *a priori* reasons to consider a dependent binary variable as simultaneously determined with a dichotomous regressor" (Monfardini & Radice, 2008, p. 271) As in García-Quevedo et al. (2018), we use recursive bivariate probit model given as follows.

$$Y_{1i}^{*} = \beta_i X_{i1} + \gamma_2 Y_{2i}^{*} + \vartheta_i + \varepsilon_1 \quad (1)$$

$$Y_{2i}^{*} = \beta_i X_{i1} + \gamma_1 Y_{1i}^{*} + \omega_2 Z_i^{*} + \vartheta_i + \varepsilon_1 \quad (2)$$

with Y_{mi} is determined according to the rule:

$$\begin{cases} Y_{mi} = 1 \; if \; Y_{mi}^{*} > 0 \\ Y_{mi} = 0 \; if \; Y_{mi}^{*} < 0, \;\; m = 1, 2; \end{cases}$$

where Y_{1i}^{*} and Y_{2i}^{*} are latent variables, Y_{1i} and Y_{2i} are indicator variables: (a) firm restarts previously abandoned (or suspended) NPDs (innovation), and (b) a firm is credit-constrained (financing constraints) as defined in the Variable measurements section. ε_1 and ε_1 are iid errors with bivariate normal distribution having variance equal to 1 and $\rho = corr(\in_1, \varepsilon_2)$. If $\rho = 0$, $\in_1, \varepsilon_2$ are assumed to be uncorrelated, confirming the exogeneity assumption for the two equations, which can then be computed as independent univariate probit models. By contrast, $\rho \neq 0$ indicates the presenece of endogenity and requires the estimation of the two equations simultaneously to obtain consistent estimates of the two models. Following Savignoc (2008), we set $\gamma_1 = 0$ to allow the model to be consistent in empirical estimations.

Furthermore, X_{i1} in equations (1) and (2) is a set of controls as determinants of innovation, *FC* is a measure of credit constraints, ϑ_i are country and industry fixed effects, and Z_i is a vector of four variables as exclusion restriction to serve as instrumental variables in equation (2). Two dummy variables for whether (a) a firm's financial statements are audited by an external auditor, and (b) a firm has pre-existing loans and/or a credit line facility from a bank. These variables account for information asymmetry and credit worthiness and are likely to reduce a firm's credit constraints. Third, geographical location, whether the firm is located in a main business city or capital of a country, affects access to external financing. Arena and Dewally (2012) find that rural and small-city firms face higher debt costs, consistent with the proximity hypothesis, as firms located in small and less-developed

areas face informational disadvantages relative to firms located in major cities and financial hubs. Fourth, *LFA* is a binary variable equal to 1 if a firm has leased fixed assets. These four dummy variables are expected to affect credit constraints but are not not directly related to the firm's innovation propsensity for NPDs. Moreover, in equation (2) X_{i1} is the same set of controls as described in equation (1).

Data description

We use survey data from the World Bank Group's firm-level *enterprise surveys* (*ES*). The *ES* is a rich, multi-topic enterprise-level survey that collects data on firm characteristics, financial information, the firm's experiences in interacting with the business, legal, economic and regulatory environments. *ES* employs a uniform methodology across all countries, using a common questionnaire. Stratification of sample firms based on size, industries, and within-country regions make it a nationally representative sample of the country's private sector businesses, whereas the use of standardized global methodology and master questionnaire allows comparisons of the collected data and indicators consistent across countries. The *ES* surveys are completed across countries through intensive face-to-face interviews with business owners and managers. In 2013, the World Bank Group implemented a separate *innovation follow-up survey* (*IFS*) in nine developing countries (four South Asian and five East African economies). The *IFS* revisited the same sample of firms interviewed during the standard *ES* surveys in these nine countries in 2013, to collect firm-level data on various types of innovation and innovation-related activities and determinants of innovation. The *IFS* survey is cross-sectional covering a nationally representative sample of firms from manufacturing and services sectors. The *IFS* survey collected firm-level data on radical and incremental technological innovations (product or service innovation and process innovation) and non-technological innovations, such as managerial-organizational and marketing innovations, and how these innovations were funded from internal and external sources of finance. The *IFS* also collected firm-level information on innovation-related activities such as in-house R&D and their funding sources, R&D collaborations with universities, research institutions, domestic and foreign companies, and private individuals and consultants, and the use of Information and Communications Technology (ICT). Data from the World Bank Group's Enternprise Analysis Unit shows that some firms from the baseline *ES* surveys missed the completion of the innovation follow-up surveys. We merge this dataset with the baseline *ES* dataset using a unique firm identification code "*idstd*" for the three South Asian countries, namely Pakistan, India, and Bangladesh, comprising 5178

common firms from manufacturing industries and business services in the two survey data sets for the three countries, namely 990 firms from Bangladesh, 3492 from India and 696 from Pakistan.

Variable measurements

The dependent variable, *PABN*, captures whether a firm has attempted to restart its previously suspended or abandoned NPD innovation projects. We construct *PABN* from the following *IFS* question: "In the last three years, did this establishment attempt to develop an innovative product or service that was abandoned or suspended before completion? Yes/No". *PABN* takes a value of 1 if the firm responded affirmatively and 0 otherwise.

We employ a set of explanatory variables extracted from the innovation literature. Their explanations are as follows: Knott and Vieregger (2020) find robust evidence that R&D spending and innovation increase with firm size. Large firms may overcome obstacles to innovation abandonment owing to better access to external knowledge sources (Veugelers & Cassiman, 1999). However, organizational inertia associated mainly with large firms may hamper their innovation proprensity (Coad, Segarra, & Teruel, 2016; Shah, Shah, & Khan, 2017). Group-affiliated firms benefit from within-group R&D spillovers and shared resources to sustain their innovation activities (Abdullah, Shah, & Khan, 2012). We capture a firm's group affiliation using the dummy variable *GPD*.

R&D intensity (the ratio of R&D expenditure to sales) accounts for innovation effort and absorptive capacity to restart innovation projects (González-Moreno et al., 2019). This study also controls for potential complementarities between different innovation outcomes by including a dummy variable, *MOI*, indicating whether a firm has introduced organizational and/or marketing innovations. Skilled and qualified human capital is critical for successful innovation (Wang, Yeung, & Zhang, 2011). We construct a dummy variable, *TRGI*, indicating whether a firm has formal innovation-related employee training programs.

Previous research (e.g., Mateut, 2018) shows a positive link between public subsidies and increased firm-level innovation. We include a dummy variable, *GNFIN*, for whether a firm has received non-financial assistance from government support programs (e.g., training in the use of R&D-related equipment, NPDs, and their marketing). We also control for a firm's ability to employ various formal mechanisms for appropriating returns to innovation. Formal intellectual property (IP) protection mechanisms – a proxy for innovation capital – foster innovation outcomes and productivity (Cohen, Nelson, & Walsh, 2002). Hall and Sena (2017), using data from three waves

of the UK Community Innovation Surveys (CIS 3-5), the document that firms with more formal mechanisms of IP protection are more innovative than firms that prefer informal mechanisms of IP protection. As in Griffith, Huergo, Mairesse, and Peters (2006), we define a dummy variable, *APPLY_PATENT*, equal to one if a firm used at least one of the following formal mechanisms of IP protections namely "patent(s), utility model, industrial design, trademark, or copyright" to protect inventions; otherwise it takes the value 0. We constructed a binary variable, *COOP*, which takes the value of one if a firm has engaged in collaborative R&D for NPD with at least one of the following partners: domestic and/or foreign firms, academic or research institutes, private consulting firm, individuals, or a government agency; *COOP* otherwise equals 0.

As in Khan, Khan, and Ullah (2021), we construct a direct indicator of credit constraints using information from the *ES* survey. The firms were asked to report information on their bank loan applications, if any, submitted during the past year. The responses of *loan-applicant* firms were: (i) *approved in full*, (ii) *accepted partially*, (iii) *rejected*, and (iiv) *still in process*. The *non-applicant* firms were further required to identify the main reason why they did not apply for a loan from the following list: "(a) *having sufficient funds, (b) high interest rate, (c) complex application procedure, (d) high collateral requirements, (e) mismatch of loan size and maturity, and (f) a firm's perception that it will not get the loan*". We use these responses to construct a measure of credit constraints denoted by *FC*. As in Berkowitz and White (2004), Khan (2022), *FC* is an indicator variable that equals 1 if a firm's loan application was rejected or accepted partially; *FC* also equals 1 if a *non-applicant* firm's response was either b, c, d, e, or f. FC is equal to 0 if the firm's *loan applicantion was accepted in full* or the *non-applicant* firm's response was "(a): *have sufficient funds*". Hence, *FC* is coded 1 for credit–constrained firms and 0 for other firms.

Descriptive statistics

Table 1 presents summary statistics of the share of credit-constrained firms, NPD restarting firms, and innovative firms (i.e., applied for patents in the last three years covered by the survey) across sectors, firm size, and countries. There is a substantial variation in the share of NPD-restarting firms across industries. Unsurprisingly, high-technology sectors, such as information technology and related services (27.9%), electronics and communication equipment (18.3%), and fabricated metal products (21.7%) had the highest share of NPD-restart firms, whereas low-tech sectors, such as furniture (3.6%), transport and storage (2.7%), and garments (9%) had lower proportions of NPD-restart firms. We observe a similar distribution of the

proportion of innovative firms (i.e., those that applied for patents) across sectors, where high-tech sectors have the highest proportion of innovative firms, whereas the least innovative firms are in the low-tech sector. By contrast, we observe a fairly even distribution of credit-constrained firms across sectors, although, as expected, high-tech sectors have a slightly higher share of credit-constrained firms (i.e., 52.10%) relative to the average share of credit-constrained firms (47.4%) across the sample.

Table 1. Descriptive statistics

	Restarts NPD		Credit-constrained firms		Applied for a patent	
	N	**Mean**	**N**	**Mean**	**N**	**Mean**
Basic Metals & Metal Products	227	18.5%	213	51.6%	229	47.2%
Chemicals & Chemical Products	388	10.6%	345	42.9%	388	42.8%
Construction	111	18.0%	106	51.9%	111	40.5%
Electronics & Communications Equip.	241	18.3%	207	52.2%	243	49.4%
Fabricated Metal Products	226	21.7%	214	54.7%	225	44.9%
Food	461	11.7%	427	42.2%	456	28.5%
Furniture	55	3.6%	53	49.1%	55	20.0%
Garments	155	9.0%	140	26.4%	155	23.9%
Hotels & Restaurants	147	15.6%	132	41.7%	148	28.4%
Information Technology (IT) & IT Services	86	27.9%	85	58.8%	90	45.6%
Leather Products	98	9.2%	89	39.3%	98	16.3%
Machinery & Equipment	282	17.4%	263	44.9%	281	38.8%
Motor Vehicles	253	12.65%	229	51.5%	217	43.9%
Non-Metallic Mineral Products	249	12.9%	223	62.8%	248	35.9%
Other Manufacturing	909	14.1%	849	46.6%	914	29.1%
Other Services	140	5.7%	115	31.3%	139	4.3%
Rubber & Plastics Products	276	14.5%	254	58.7%	275	45.5%
Services of Motor Vehicles	104	17.3%	88	58.0%	102	37.3%
Textiles	276	14.1%	239	43.1%	281	33.1%
Transport, Storage, & Communications	114	2.6%	103	44.7%	115	18.3%
Wholesale & Retail	322	13.4%	296	45.9%	296	19.9%
High-Tech sectors	2,228	15.84%	2,033	52.10%	2,234	43.47%
Total (whole sample)	5120	13.9%	4670	47.4%	5132	33.8%
Panel B: Stratification by firm size						
Small firms (< 19 employees)	1473	12.9%	1379	49.4%	1472	23.8%
Medium-sized firms (20 – 99 employees)	2214	15.0%	2011	50.2%	2217	36.6%

	Restarts NPD		Credit-constrained firms		Applied for a patent	
	N	**Mean**	**N**	**Mean**	**N**	**Mean**
Large firms (100+ employees)	1433	13.5%	1280	41.0%	1443	39.8%
Panel C: Country-wise stratification						
India	3446	17.5%	3195	51.9%	3457	39.9%
Pakistan	685	5.0%	542	34.7%	686	14.9%
Bangladesh	989	7.7%	933	39.7%	989	25.5%
Panel D: NPD project reinitiation and credit constrained firms						
	N	Credit-constrained firms				
NPD restart firms	714 (14%)	301 (42%)				
NPD non restart firms	4,406 (86%)	53%				
	Share of firms restarted NPDs					
Credit-unconstrained firms	13.7%*					
Credit-constrained firms	15.2%					

Note: This table presents the descriptive statistics for the proportion of credit-constrained firms, NPD restart firms and innovative firms across sectors, firm sizes, and countries. High-Tech sectors refer to technology-intensive industries namely 'chemicals, electronics & communications, engineering, rubber & plastics, Information Technology and related services."

Interestingly, the distribution of NPD-restart firms is fairly even across firm sizes (Panel B, Table 1), whereas smaller and medium-sized enterprises are more credit-constrained than larger firms, and larger firms have the highest share of innovative firms (applied for patents). As expected, the country-wise distribution of the sample shows that India has a significantly higher proportion of NPD-restart (17.5%). This is also supported by the accompanying statistics for innovating firms as India has the highest share of innovative firms (39.9%) than Pakistan and Bangladesh do. However, India has the highest proportion of credit-constrained firms relative to the other two countries. Finally, Panel D reports descriptive statistics according to whether firms decide to restart previously abandoned NPD projects and whether they are credit-constrained. Approximately 138% (i.e., 714 firms) are NPD-restart firms, of which approximately 42% (301 out of 714) are credit constrained firms, whereas 53% of NPD non-restarts are credit constrained, suggesting that a higher share of NPD restarts is financially unconstrained. This preliminary descriptive statistic suggests a negative correlation between credit constraints and the probability of restarting NPD innovation projects.

Finally, Panel D of Table 1 presents the t-statistics for the mean difference between firms, whether to restart previously abandoned or suspended NPDs when the sample is split between credit constrained and other firms. On average, 15.2% of credit-unconstrained firms are likely to restart NPDs, whereas this ratio is 13.7% for credit-constrained firms. The mean difference between the two groups of firms was also statistically significant using the t-test of mean differences. In other words, credit-unconstrained firms are approximately 10.95% more likely to restart previously abandoned or suspended NPDs than are credit-constrained firms. These preliminary univariate tests warrant detailed econometric investigations to establish causal relationships between credit constraints and firms' innovation propensity for NPD restarts. This result is also in line with that of Sasidharan et al. (2015), who found a limited role for debt financing in R&D investments for Indian manufacturing firms.

EMPIRICAL RESULTS

Financing constraints and innovation propensity for previously abandoned NPD

Table 2 presents the estimated coefficients and marginal probabilities of the estimations for bivariate probit models. Firm vectors, industry dummies, and country fixed effects are included in all regressions. As presented in Table 2, the correlation coefficient between the error terms of the two models, *rho*, is statistically significant for all models, indicating the appropriateness of the bivariate probit models for our empirical estimations.

Table 2. Credit constraints and restarting previously suspended NPD

VARIABLES	(1) Credit constraint	(2) Marginal effects	(3) High-Tech sector dummy	(4) Interaction terms	(5) Interaction terms
FC	-1.549***	-0.235***	-1.435***	-1.346***	-1.148***
	(0.0612)	(0.0045)	(0.271)	(0.184)	(0.112)
SMALL_FIRM	0.0755*	0.025	0.060	0.0550	0.056***
	(0.0444)	(0.0197)	(0.0524)	(0.0460)	(0.0123)
MEDIUM_FIRM	0.155**	0.043**	0.140*	0.139**	0.144***
	(0.0606)	(0.0186)	(0.0747)	(0.0708)	(0.0361)
HIGH_TECH			0.0632*	0.140**	
			(0.0341)	(0.0548)	
				-0.188*	

VARIABLES	(1) Credit constraint	(2) Marginal effects	(3) High-Tech sector dummy	(4) Interaction terms	(5) Interaction terms
				(0.103)	
					-0.328***
					(0.121)
Group affiliation	-0.147***	-0.0141*	-0.188**	-0.187***	-0.159***
	(0.0446)	(0.0079)	(0.0786)	(0.0701)	(0.0303)
MOI	-0.014**	-0.0148**	-0.102*	-0.106**	-0.106***
	(0.0429)	(0.00318)	(0.0585)	(0.0536)	(0.0338)
AGE	-0.0718**	-0.019**	-0.0605	-0.0620	-0.0635**
	(0.0346)	(0.0070)	(0.0422)	(0.0392)	(0.0264)
EXPORTER	-0.102**	-0.015**	-0.0875***	-0.0854***	-0.117
	(0.0507)	(0.0068)	(0.0269)	(0.0297)	(0.0790)
TRGI	-0.194***	-0.029**	-0.202***	-0.201***	-0.203***
	(0.0513)	(0.0090)	(0.0566)	(0.0519)	(0.0442)
GNFIN	0.134***	0.020***	0.138**	0.138**	0.151***
	(0.0413)	(0.0073)	(0.0603)	(0.0551)	(0.0197)
APPLY_PATENT	0.169***	0.025***	0.189***	0.193***	0.180***
	(0.0228)	(0.0022)	(0.00769)	(0.0141)	(0.0420)
COUNTRY dummy (BANGLADESH)	-0.536***	-0.118***	-0.543***	-0.534***	-0.147**
	(0.0538)	(0.0131)	(0.0446)	(0.0439)	(0.0626)
COUNTRY dummy (PAKISTAN)	-0.760***	-0.151***	-0.729***	-0.721***	
	(0.0481)	(0.0068)	(0.07296)	(0.0679)	
COUNTRY_INDIA					0.817***
					(0.146)
Constant	-0.789***		0.173	0.146	-0.970***
	(0.171)		(0.278)	(0.227)	(0.120)
Rho	1.464***		1.216*	1.231**	1.197***
Wald test of rho=0	16.58***		3.239*	4.381**	110.31***
Observations	3,560	3,552	3,560	3,560	3,560
Country & industry Dummies	YES	YES	YES	YES	YES

Note: Second stage regression results of the bivariate probit model (standard error in parenthesis, clustered at the country-level). Key explanatory varaible for each model is mentioned at the top of each column. The dependent variable for all regressions is *PABAN*, a dummy variable for whether a firm initiates previously abandoned innovation project for NPD, 0 otherwise. *FC* is a measure of credit constraint as defined in the Variable measurements section.

This specification served as the base model. The regression specification in Column 1 tests the impact of credit constraints (*FC*) on the likelihood of restarting previously suspended innovation projects for NPD after controlling for firm and innovation vectors and industry and country fixed effects. The results for the firm vectors show that the coefficient estimates for firm size and age suggest that smaller and younger firms are more likely to restart previously abandoned NPDs, consistent with the idea that young firms are more agile by engaging in riskier innovations to catch up with larger and established firms. However, the small magnitude and statistical significance of the marginal probabilities (column 2) suggest that size and age are less significant for firms' innovation propensity to restart abandoned/suspended NPDs. Multi-establishment and export-oriented firms are less likely to restart their NPDs. Again, the magnitude of the marginal probabilities (Column 2) for the two variables suggests that export and multi-establishment status may have less of an impact on a firm's innovation propensity for an NPD restart. This result casts doubt on the general findings of previous studies on the existence of *internal capital markets* and the positive spillover effects of R&D and resource sharing within business groups. For instance, recent studies suggest that group affiliation and the associated *internal capital markets* may not guarantee insurance against a firm's financial constraints or access to external financing (e.g., Bhaumik, Das, & Kumbhakar, 2012). George, Kabir, and Qian (2011) report similar results for capital investments in group-affiliated firms in India. Our result is also in line with that of Sasidharan et al. (2015), who found marginal differences between cash flow sensitivity and R&D investments between group-affiliated and stand-alone Indian firms.

However, innovative firms (i.e., those that apply for patents) and firms that receive government support for innovation are more likely to restart previously abandoned or suspended NPDs. Innovation propensity and government subsidies are positively and statistically significantly related to the probability of a firm restarting previously suspended or abandoned NPDs. The impact of these two variables is much greater than that of the other firm and innovation vectors, as shown by the comparatively higher magnitude and statistical significance of their coefficient estimates at the 99% confidence level.

The probability of NPD restarts is significantly affected by cross-country differences. Using India as the reference category, the coefficients for the country dummies for Pakistan and Bangladesh are negative and highly statistically significant (at the 99% level), indicating a higher likelihood of firms restarting NPDs in India than in Pakistan or Bangladesh. In other words, firms in India are more likely to restart NPDs than firms in Pakistan and Bangladesh. The largest difference in innovation propensity for NPD restarts is for firms

located in Pakistan and India, which represents the mean difference between Indian and Pakistani firms. This finding is supported by the higher magnitude of the marginal effect of the coefficient (Column 2), which indicates that Indian firms are approximately 15% more likely to restart previously abandoned NPDs than firms in Pakistan, *ceteris paribus*. The coefficients for country dummies suggest that country differences is an important factor in explaining differences in innovation propensity in NPD restarts. This result is not surprising given that Indian firms have increasingly focused on global competitiveness through increased R&D spendings and innovation (Sasidharan et al., 2015) compared to other South Asian economies.

FC is a measure of credit constraints and is the key explanatory variable. Column 1 of Table 2 shows that the coefficient estimate for *FC* is negative and statistically significant at the 99% confidence level, suggesting that credit constraints negatively affect the probability of a firm restarting previously suspended (or abandoned) NPDs. Furthermore, the marginal probability for credit-constrained firms evaluated at the sample mean, as reported in Column 2, indicates that the probability of restarting NPDs increases significantly and statistically by 23.5% in the absence of credit constraints, which is a substantial increase in the incidence of NPD restarts. Recent empirical studies suggest that binding financing constraints increase the likelihood of innovation project failure (García-Quevedo et al., 2018). Consequently, some innovation projects have not been restarted or delayed, because of a lack of adequate financial resources. This result is also in line with Mohnen et al. (2008), who found a positive relationship between binding financing constraints and the probability of NPDs not starting an innovation project for Netherland firms using the *CIS 3.5* innovation survey. Similarly, Canepa and Stoneman (2003), show that financial obstacles are more important than other endogenous and exogenous obstacles in their impact on the probability of "not starting, delaying, or postponing" innovation projects in European countries. In short, our empirical results are consistent with studies from developed countries and literature on financial obstacles to innovation (Khan & Rizwan, 2020; Mancusi & Vezzulli, 2014; Savignac, 2008). Empirical literature shows that obstacles to innovation may be related to a lack of finance and cost factors (D'Este, Iammarino, Savona, & Von Tunzelmann, 2012). Although technically and economically viable, they may be suspended (or put on hold) because other rewarding projects that require the same resources are available. A suspended (or abandoned) NPD project can be restarted when a firm's resource constraints are resolved.

In Column 3 of Table 2, industry dummies are replaced with an indicator variable, *HIGH-TECH*, that equals one for firms in the high-technology innovation intensive sectors, namely chemicals, electronics and

communications, engineering, rubber and plastics, information technology and related services. This variable was included in the regression to explore innovation propensity across high-tech and low-tech sectors. The coefficient estimate of the variable is positively and statistically significantly related to the firm's innovation propesnity for NPD restarts. As expected, firms in innovation-intensive industries are more likely than low-tech sectors to restart NPDs. An interaction term between a measure of credit constraint and the indicator variable for high-tech sectors, denoted by, was included in regression, as reported in Column 4 of Table 2, to explore the differential impact of credit constraints on the likelihood of restarting NPDs accross high-technology and low-technology sectors. The negative coefficient of the credit constraint dummy variable indicates that constrained firms in low-tech sectors are less likely than unconstrained firms to restart previously suspended NPD. In other words, unconstrained firms in low-tech sectors are more likely to restart NPD and constrained low-tech firms are less likely to restart NPD. Furthermore, the positive coefficient for indicates that credit-unconstrained firms are more likely to restart previously abandoned (or suspended) NPD than credit-constrained firms in high-tech sectors are. In summary, the negative and positive coefficients of *FC* and *HIGH-TECH* suggest that credit-constrained firms, whether in the high-tech or low-tech sectors, are less likely to restart abandoned/suspended NPDs. This was confirmed by the negative coefficient of the interaction term between *FC* and *HIGH-TECH*.

In column 5, Table 2, we introduce the interaction term of the variable *FC* with the variable *COUNTRY_INDIA*. We include this interaction term to test whether the effect of credit constraints on the firm's propensity to restart NPDs depends on the country-level fixed effects (the country dummy captures the country differences in the level of development of institutions, regulatory environment and financial and economic development). The positive and statistically significant coefficient for *COUNTRY_INDIA* suggests that credit-unconstrained Indian firms are more likely to restart NPDs than credit-unconstrained firms in Pakistan and Bangladesh, indicating a higher innovation propensity for firms in India. This finding supports the earlier results in Table 2 that Indian firms are more likely to restart NPDs than firms in the other two countries in our sample. However, the coefficient of the interaction term is negative and statistically different from zero at the 95% confidence level, suggesting that credit-constrained firms in India are less likely to restart NPDs than are similar firms in Pakistan and Bangladesh. This finding suggests that the effect of credit constraints is more severe in Indian firms than in Pakistani or Bangladeshi firms. This result is unsurprising given that Indian firms have better access to external finance, where financial markets in India are more efficient and developed than those in Pakistan and

Bangladesh. Better developed capital markets in India are more efficient at allocating financial resources to more productive investments.

Next, we consider the type of finance used to fund innovation in order to explore whether it affects a firm's propensity to restart NPDs. Various forms of financing exhibit varying degrees of characteristics in terms of maturity, formality, and risk (Girma & Vencappa, 2015; Rizwan & Khan, 2007; Khan & Hijazi, 2009), indicating that various sources of finance may have differential inmpact on the firm's propensity to restart NPDs. We compare innovations funded by banks to those funded by internal funds to examine whether different sources of financing have a heterogenous impact on a firm's decision to undertake previously abandoned (or suspended) NPDs. We have data from the *IFS surveys* on how technological innovation (i.e., product and service innovations). The main funding sources were internal funds, bank loans, government agencies and departments, Non-Governmental Organizations, and international organizations. Many firms used multiple sources of financing to fund their NPDs. The funding sources were measured using binary variables. We constructed three dummy variables for whether a firm uses only bank finance (denoted by *ONLY_BANK*), internal funds (denoted by *ONLY_OWN*), or whether a firm used both sources of finance (denoted by *OWN_BANK*) to fund innovation investments.

Since the bank's acceptance of the firm's loan requests is not a randomized event, we control for sample selection bias in a two-step bivariate probit model. The dependent variable is also binary (restarting of NPD). In this situation, seemingly unrelated (SUR) binary probit regression is appropriate for our econometric specification. The same variables that we employed as instruments for credit constraint indicators were used as instruments for the probability that a firm funds innovation activities through bank loans. Columns (3) to (5) of Table 3 report the results of the second-stage bivariate probit model. Our main variables of concern are the measures of bank financing, internal funds, and a combination of both internal funds and bank finance.

Table 3. Extramural R&D, Credit constraints, and NPD

	(1) Extramural R&D	(2) Interaction of FC & Extramural R&D	(3) Internal Funding of innovation	(4) Bank Funding of innovation	(5) Internal & Bank funding of innovation
FC	-1.545***	-1.538***			
	(0.0395)	(0.0808)			
EXTRAM_RND	0.194***				

	(1) Extramural R&D	(2) Interaction of FC & Extramural R&D	(3) Internal Funding of innovation	(4) Bank Funding of innovation	(5) Internal & Bank funding of innovation
	(0.0465)				
ONLY_OWN			0.505***		
			(0.161)		
ONLY_BANK				-1.430***	
				(0.2610)	
OWN_BANK					-0.632**
					(0.284)
EXTERAM_RND*FC		0.117**			
		(0.0530)			
SIZE	-0.0297***	-0.0244***	0.182***	0.039**	0.107***
	(0.00476)	(0.00762)	(0.0278)	(0.0149)	(0.0128)
Group Affiliation	-0.143***	-0.156***	-0.199***	-0.227***	-0.234***
	(0.0323)	(0.0449)	(0.0692)	(0.0453)	(0.0715)
MOI	-0.0920**	-0.0990**	-0.250***	-0.090	-0.178***
	(0.0405)	(0.0468)	(0.0468)	(0.0645)	(0.00927)
AGE	-0.0691**	-0.0697*	0.0290	0.033	0.0135
	(0.0349)	(0.0361)	(0.0268)	(0.0437)	(0.0175)
TRGI	-0.208***	-0.201***	-0.416***	-0.253***	-0.282***
	(0.0482)	(0.0535)	(0.0183)	(0.0458)	(0.0262)
GNFN	0.133***	0.136***	-0.00541	0.1777***	-0.0538***
	(0.0452)	(0.0482)	(0.00352)	(0.0241)	(0.00641)
APPLY_PATENT	0.159***	0.172***	0.176***	0.221***	0.00519
	(0.0312)	(0.0234)	(0.0177)	(0.0447)	(0.0502)
COOP	-0.156**	-0.143**	-0.350***	-0.125*	-0.295***
	(0.0616)	(0.0611)	(0.0106)	(0.0674)	(0.0525)
Constant	-0.650***	-0.674***	-1.417***	-1.337***	-1.021***
	(0.203)	(0.257)	(0.289)	(0.153)	(0.0503)
Marginal Effects (FC, ONLY_ OWN, ONLY_BANK)		-0.153**	0.036**	-0.016**	
Marginal Effects (EXTRAM_ RND*FC)		0.0117*			
Rho	1.508***	1.443***	-0.390***	0.713**	0.525**
Wald test of rho=0	31.09***	14.79***	36.77***	15.52***	5.93**
Observations	3,533	3,533	981	3,604	2,075

	(1) Extramural R&D	(2) Interaction of FC & Extramural R&D	(3) Internal Funding of innovation	(4) Bank Funding of innovation	(5) Internal & Bank funding of innovation
Country & Industry dummies	YES	YES	YES	YES	YES

Note: Second stage regression results of the bivariate probit model (standard error in parenthesis). Key explanatory varaible for each model is mentioned at the top of each column. The dependent variable for all regressions is *PABAN*, a dummy variable for whether a firm initiates previously abandoned innovation project for NPD, 0 otherwise. FC is a measure of credit constraint as defined in theVariable measurements section. In Column 2, *EXTRAM_RND* is a dummy variable for whether a firm has collaborative R&D arrangements with external partners. Column 3 consists of an interaction term between *EXTRAM_RND* and *FC*. *ONLY_OWN*, *ONLY_BANK*, and *OWN_BANK* are dummy variables for whether a firm funds innovation with only internal sources, bank finance, or both bank funding and internally generated funds, respectively. The significance levels for each coefficient are represented by asterisks: *** = 1%; ** = 5%.

The positive and statistically significant coefficient of internal funds (*ONLY_OWN*) in Column 3 indicates that firms with sufficient internal funds are more likely to initiate previously abandoned innovation activities for NPD. By contrast, firms that employ only bank credit to fund innovation investments are less likely to undertake previously abandoned R&D projects as the coefficient of *ONLY_BANK* is negatively statistically significantly related to the likelihood of restarting previuosly abandoned or suspended NPDs. This result is consistent with the view that internal funds are more important for innovation activities than costly external finance is, particularly debt financing in developing countries (Brown, Martinsson & Petersen, 2012). This result is also consistent with our expectation that firms in South Asia rely more on internal financing to fund innovation, whereas traditional financing sources, such as banks and financial institutions, play a limited role despite significant developments in the financial sector of countries like India. The same factor is captured in the variable that considers both internal and bank financing for funding NPD innovation projects, as indicated by the negative coefficient of *OWN_BANK*. Our results are consistent with those of Sasidharan et al. (2015) for Indian firms, who found that internally generated funds are the preferred source of R&D financing, whereas external financing, both equity and debt, are not significantly related to R&D investments. They also attribute their findings to the excessively low ratio of new stock issuance to total assets by Indian firms, which was 0.018, which is very low compared to that of U.S. firms (0.204), as reported by Brown, Fazzari and Petersen (2009), and European firms (0.108), as reported by Brown et al. (2012).

Extramural R&D and innovation project initiation

We also explore whether extramural R&D attenuates the relationship between financial obstacles and the likelihood of restarting previously abandoned (or suspended) NPD projects. Several firms in our dataset have adopted both internal and extramural R&D for innovative product development. The *IFS* survey defines extramural R&D as "*creative work, undertaken by other enterprises, public or private research organizations, which was paid for by this establishment*." Therefore, if a firm had undertook external R&D, we define a dummy variable, *EXTRAM_RND.* Column 1 of Table 3 presents the results of the bivariate probit model where *EXTRAM_RND* was included in the regression from Column 1. Extramural R&D positively and statistically significantly increases the probability of a firm undertaking previously abandoned (or suspended) NPD. This result is consistent with our theoretical prediction that firms with extramural R&D have an increased likelihood of reinitiating previously abandoned/suspended NPD innovation projects. Firms with collaborative R&D strategies exploit complementary expertise and resources and build their capacity to enhance innovation efficiency and productivity (Mowery, Oxley, & Silverman, 1998).

To capture the effect of credit constraints in the presence of extramural R&D, we include the interaction of *FC* with the measure for extramural R&D (*EXTRAM_RND × FC*). This interaction term was included in a separate model. The positive and statistically different from zero coefficient of the interaction term (Column 2 of Table 3) suggests that credit constraints are less binding for firms with collaborative R&D investments. Extramural R&D may reduce the reliance of financially constrained firms on their own resource requirements, thereby enhancing innovation efficiency and productivity (Mowery et al., 1998). Furthermore, an extramural R&D attenuates a firm's financing constraints and increases its access to external financing.

Collaboration breadth and NPD restarts

The independent variable chosen to test Hypotheses 2a and 2b is measured using the channels through which a firm formally collaborated to develop innovative products and services. Following Laursen and Salter (2006), we construct R&D collaboration breadth, denoted by *COLB_BRDTH*, as the sum of the number of cooperating partners for NPD, where each source is assigned a value of one if a firm has collaborated with the specific channel in question. These collaborating partners, as reported by the *IFS* survey, include "domestic firms, foreign firms (or foreign-owned parent firms), domestic or foreign academic institutes, research organizations, private consulting companies or individuals, and government agencies." Simply put, for each

firm, the index takes a value between zero (non-collaborating firms) and six. Therefore, the breadth of a firm's collaboration increases its index value.

We use an instrumental variable approach because several factors affect both the probability of a firm collaborating with one or more partners based on their needs and capabilities and the probability that a firm decides to commit resources to restart previously abandoned innovation projects for NPD (Medda, 2018). For instance, larger firms are more likely to have several inter-organizational collaborations and are likely to have few R&D project abandonments because they may be simultaneously involved in several innovation projects and activities. As our dependent variable, *PABAN*, is an indicator variable, we employed a *probit model with a continuous endogenous regressor* (Stata command: *ivprobit*) to account for the potential endogeneity between the breadth of collaboration types and *PABAN*. Following Czarnitzki and Hottenrott (2017), the instruments employed for collaboration breadth are (a) the share of R&D performers in a firm's industry (2-digit ISIC Code 3.1) and (b) the share of firms with extramural R&D in the firm's industry. The appropriateness of the exclusion restriction was tested using auxiliary regression in which the dependent variable was *PABAN*. The coefficient estimates for both variables were statistically insignificant.

Column 1 (first-stage regression) and Column 2 (second-stage regression) of Table 4 reports the results of the *probit model with endogenous regressors* (Stata command: *ivprobit*).

Table 4. Collaboration breadth and Innovation

	(1) Collaboration Breadth		**(3)**	**(4)**	**(5)**
	(1)	**(2)**	**Industry-related Collaboration Breadth**	**Academia-related Collaboration Breadth**	**Financial constraint**
	Stage 1	Stage 2			
FIN_MAJOR					-1.639***
					(0.1052)
COLB_INDUSTRY			-2.366***	-0.294	
			(0.512)	(0.242)	
COLB_ACADMIC				-2.464***	
				(0.1795)	
COLB_BRDTH		-1.606***			
		(0.3534)			
SIZE	-0.0354***	-0.0152	0.068	-0.0835	-0.028***
	(0.00499)	(0.0373)	(0.0996)	(0.0839)	(0.00693)

	(1) Collaboration Breadth		(3) Industry-related Collaboration Breadth	(4) Academia-related Collaboration Breadth	(5) Financial constraint
	(1)	(2)			
R&D INTENSITY	-3.4e-08***	-3.70e-07*	-4.44e-07	-7.19e-08	-0.0019
	(5.91e-11)	(2.07e-07)	(8.08e-07)	(1.28e-07)	(0.00130)
Group Affiliation	0.146***	0.189	0.156	0.139	-0.067**
	(0.00224)	(0.141)	(0.334)	(0.263)	(0.0307)
MOI	0.0262***	-0.125*	0.184	-0.173	-0.173***
	(0.00807)	(0.0730)	(0.455)	(0.238)	(0.0138)
AGE	0.108*	0.0814	-0.00814	0.143	-0.028
	(0.0637)	(0.207)	(0.202)	(0.139)	(0.0241)
EXPORTER	0.156***	0.366***	-0.122	0.449*	-0.0129
	(0.00660)	(0.00272)	(0.297)	(0.254)	(0.0197)
TRGI	0.262***	0.565***	0.708***	0.246	-0.185***
	(0.0537)	(0.0922)	(0.249)	(0.213)	(0.0198)
APPROPRIABILITY	0.141***	0.176	0.0764	0.251***	1.304***
	(0.0458)	(0.216)	(0.151)	(0.0863)	(0.1540)
APPLY_PATENT	0.1998323	0.1718908	0.095	0.282	-0.0284
	(0.2955)	(0.1573)	(0.4223)	(0.34710	(0.0368)
Exclusion Restriction 1: Share of R&D performers (industry)	0.491				
	(0.322)				
Exclusion Restriction 2: Share of R&D collaborators (industry)	-0.408***				
	(0.118)				
GNFIN					-0.0187
					(0.0187)
GOVT_SUPORT		0.548***			-0.187***
		(0.0263)			(0.00778)
Constant	0.303***	122	0.549	0.349	-0.198***
	(0.0434)	(0.109)	(0.619)	(0.513)	(0.0525)
Wald chi2(3)		179484.22***	78.29**	240.92***	
Log Likelihood		-135.328	-79.19	-115.11	-1556.20
Rho		2.202***	1.89**		1.90**
Wald test of exogeneity: chi2(1)		9.82***	6.28**	2.86**	

	(1) Collaboration Breadth		(3) Industry-related Collaboration Breadth	(4) Academia-related Collaboration Breadth	(5) Financial constraint
	(1)	(2)			
Wald test of rho=0					6.65***
Observations	122	122	116	121	2,005
Country Dummies	YES	YES	YES	YES	YES

Note: Instrumental variable probit model coefficients (standard error in parenthesis, clustered at the country level) for columns 1 – 4. Stage-1 and stage-2 regression estimations in Columns 1 – 2 contain a constant, country, and industry fixed effects. The dependent variable for all models, *PABAN*, is a dummy for whether a firm restarts the prior innovation projects for NPD that were suspended/abandoned before completion. The key independent variable is mentioned at the top of each column. *COLB_BRDTH* is a sum of dummy variables for whether a firm has collaborated with the particular type of collaborating partner for NPD. *COLB_BRDTH* thus can assume a value between 0 (no collaboration) to a maximum of 6 (a firm collaborated with all partners as reported in the IFS survey). Column 5 presents second-stage results of the Seemingly Unrelated bivariate Probit model. *FIN_MAJOR* is a self-reported, perceived measure of financial constraints. *COLB_INDUSTRY* and *COLB_ACADMIC* are dummy variables for whether a firm has R&D collaboration with industry (foreign or domestic firm or a government agency) or academia (foreign or domestic research institute, a consultancy firm or an individual), respectively. The operational definitions of other variables are as reported in the Methodology section. The significance levels for each coefficient are represented by asterisks: *** = 1%; ** = 5%.

The Wald test of the exogeneity, reported in Column 1, rejects the null hypothesis of no endogeneity and confirms the appropriateness of the specification for modeling the relationship between innovation propensity and extramural R&D breadth. The coefficient estimate of our main variable of concern, *COLB_BRDTH,* is negative and statistically significant at the 1% level of significance. This negative coefficient, consistent with *Hypothesis 2b*, suggests that a higher breadth of inter-organizational collaborations decreases the probability that a firm restarts previously suspended (or abandoned) NPDs. Although R&D alliances enhance innovation efficiency and productivity for the focal firm (e.g., Hu, McNamara & Piaskowska, 2016; Medda, 2018), several studies show that these alliances are fraught with problems and increased costs because of the managerial and technical complexities arising from collaborating with various R&D collaborating partners. In other words, a wide-ranging external knowledge search involves high marginal costs owing to the greater complexity of knowledge management and the relationships necessary to maintain access to these resources (Leiponen & Helfat, 2010).

Robustness checks

First, we consider an alternative financing constraint indicator. We consider a firm's limited access to credit as a measure of financial obstacles, conveniently overlooking the fact that financing constraints also encompass difficulties

in accessing all sources of financing (Brown et al., 2012). As in Khan, Shah and Rizwan (2021), we construct a measure of financial obstacles generated from the response item "k30" of enterprise surveys that asks managers how they perceive access to finance as an obstacle on a 5-point Likert scale. The variable *FIN_MAJOR* takes the value of 1 if a manager perceives finance access as either "a major or very severe obstacle; otherwise, it equals zero for response items "no obstacle, minor obstacle, or moderate obstacle". This self-report measure captures the degree of perceived difficulty in accessing external finance, and has been shown to be informative in identifying firms constrained in their access to finance (e.g., Caggese & Cuñat, 2008). The econometric procedure and instrumental variables used to model *FC* were also employed in the regression specification for this measure of financing constraints. Table 4 (Column 5) presents the results of the bivariate probit model. The negative and statistically significant coefficient estimates for *FIN_MAJOR* indicate that the empirical results are consistent with those shown in Table 2. Financial constraints are likely to reduce the probability that a firm will restart or attempt to start innovation projects for suspended (or abandoned) NPDs.

Prior research employed search breadth by including all sources of external knowledge in a single measurement of collaboration breadth. Different sources of knowledge require varying processes, institutional norms, cultures, and contracts (Antolin-Lopez, Martinez-del-Rio & Cespedes-Lorente, 2015). Consequently, we distinguish between a firm's collaboration with industry from the firm's collaborations with academia. As in Wu (2014), we decomposed the overall search breadth into (a) industry-related search breadth and (b) academia-related search breadth. The former was computed with a dummy variable using the firm's R&D collaborations with "domestic firms, foreign firms or a foreign-owned parent firm" while the later was computed as a dummy variable using the firm's collaborations with "domestic and (or) foreign academic or research institutions, private consultants, or individuals." Columns 3 – 4 of Table 4 report the empirical results of the instrumental variable probit model. The negative and statistically significant coefficient estimates for both measures of breadth in knowledge sourcing confirm the earlier results of the negative impact on the probability of restarting previously suspended/abandoned NPD innovation projects.

CONCLUSION

This study examines the effect of financial constraints on a firm's decision to restart (or attempt to restart) the previously abandoned or suspended

innovation projects for NPD. In recent years, a growing stream of studies on financial obstacles to innovation tends to support the evidence of an increase in the risk of innovation project failures, delays, or abandonment for firms facing binding financing constraints. We contribute to the literature by examining the importance of financial obstacles in the probability that a firm decides to undertake innovation projects for NPDs that were previously suspended (or abandoned). Controlling for the endogeneity between innovation propensity and financial constraints, we show that credit constraints significantly reduce the probability that a firm undertakes previously abandoned/suspended NPDs. These results support the general view that financial obstacles to innovation negatively affect the innovation propensity. We further show that an extramural R&D attenuates the relationship between credit constraints and the firm's propensity to start previously abandoned NPDs, which is consistent with our theoretical prediction that an extramural R&D attenuates a firm's credit constraints and enhances innovation propensity.

While our findings support the notion that extramural R&D attenuates credit constraints, which in turn increases the likelihood of restarting previously abandoned or suspended NPDs, we did not find that R&D collaboration breadth (i.e., the number of various types of collaborating partners) positively influences the probability of a firm undertaking prior innovation projects for NPD. These results support the notion that the probability of a firm undertaking NPD innovation projects is lower for those collaborating with a wide range of partners. This result generally supports the *Optimal Combination of R&D Hypothesis*, which states that a firm must maintain a balance between internal R&D and extramural R&D to optimize innovation performance. While the cost factors and "managerial attention constraints" could be potential explanations, further research is needed to identify specific reasons.

Furthermore, significant cross-country differences in firm-level innovation propensity were found among firms. Specifically, firms in India are more likely to restart NPDs than firms in Pakistan and Bangladesh, which is consistent with recent literature suggesting India's significant progress in R&D spending and technological progress compared to its neighboring countries in South Asia. India has invested massively in transforming itself into a knowledge economy and private firms have shown increased innovation performance (Zhang et al., 2016). However, credit-constrained firms in India are less likely to restart NPDs than firms in Pakistan and Bangladesh. This finding suggests that the effect of credit constraints is more severe for Indian firms than it is for firms in other South Asian countries. This result is unsurprising given that financial markets in India are more developed and efficient at allocating financial resources to more productive investments compared to other

developing countries. Industry-level empirical analysis shows that credit-constrained firms, whether in high- or low-tech sectors, are less likely to restart abandoned (or suspended) NPDs. Furthermore, we observe a strong preference for internal funds for NPD financing in South Asian countries, whereas external financing, particularly bank credit, plays a limited role in NPD financing, consistent with recent studies of developing markets.

Finally, this study had a few limitations that future research may consider. First, our analysis of the firm's decision to start previously abandoned innovation activities for NPD was constrained by the fact that the IFS innovation data did not distinguish between product and process innovation or the reinitiation of innovation activities either at the conception or the execution phases of the NPD. Therefore, this study encourages researchers to explore the nature of reinitiated innovation activities, their various phases of development, and the types of innovation activities reinitiated for NPD. The second limitation of this study stems from data limitations. While the data reported the type of collaborating partner involved in NPD, they did not provide detailed information about the specifics of R&D collaborations and the nature of partnerships, thus limiting our analysis because of the lack of data on the specific mechanisms involved in collaborations with different collaborating partners.

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Abstrakt

CEL: *Badamy, czy ograniczenia finansowe wpływają na prawdopodobieństwo podjęcia przez firmę wcześniej zawieszonych (lub porzuconych) projektów innowacyjnych w zakresie rozwoju nowych produktów (NPD) oraz czy niestacjonarne B+R, a także zakres rodzajów współpracy B+R (tj. źródła wiedzy), moderują związek między ograniczeniami finansowania a prawdopodobieństwem ponownego uruchomienia zawieszonych wcześniej NPD z wybranych gospodarek Azji Południowej.* ***METODYKA:*** *Badanie to kontroluje potencjalną endogeniczność skłonności do innowacji i dostępu do finansów poprzez zastosowanie rekurencyjnego dwuwymiarowego modelu probitowego. Przyjmujemy również podejście oparte na zmiennych instrumentalnych, stosując model probitowy z ciągłym endogenicznym regresorem, aby uwzględnić potencjalną endogeniczność między szerokością współpracujących partnerów a skłonnością do innowacji.* ***WYNIKI:*** *Ograniczenia finansowe znacząco wpływają na zawieszone wcześniej NPD. Ponadto niestacjonarne B+R pozytywnie wpływają na prawdopodobieństwo podjęcia przez firmę projektów NPD i łagodzą związek między ograniczeniami finansowymi a prawdopodobieństwem wznowienia porzuconych/zawieszonych projektów NPD, co sugeruje, że niestacjonarne B+R łagodzą ograniczenia finansowe, co zwiększa prawdopodobieństwo wznowienia NPD. Jednak liczba współpracujących partnerów nie jest pozytywnie związana z prawdopodobieństwem wznowienia NPD przez firmę. Jest to zgodne z poglądem, że niestacjonarne B+R z różnymi grupami partnerów są narażone na ryzyko „paradoksu dwóch światów" wynikającego ze współpracy firmy z uniwersytetami, instytucjami badawczymi i firmami konsultingowymi.* ***IMPLIKACJE:*** *Odkrycia potwierdzają pogląd, że firmy muszą zachować równowagę między wewnętrzną bazą wiedzy a zewnętrznymi badaniami i rozwojem, aby zoptymalizować wyniki innowacji. Niemniej jednak zaoczne badania i rozwój zmniejszają zależność firm o ograniczonych finansach od zapotrzebowania na zasoby, poprawiają dostęp do finansowania i zwiększają produktywność badań i rozwoju w NPD.* ***ORYGINALNOŚĆ I WARTOŚĆ:*** *Dostarczamy pierwszy na poziomie firmy i wielu krajów dowód na znaczenie przeszkód finansowych w prawdopodobieństwie ponownego zainicjowania zawieszonych wcześniej NPD na etapie realizacji. Po drugie, zgodnie z naszą najlepszą wiedzą, jest to pierwsze badanie, w którym zbadano związek między różnorodnością współpracy między organizacjami w zakresie B+R a prawdopodobieństwem ponownego zainicjowania przez firmę porzuconych (lub zawieszonych) NPD.*

Słowa kluczowe: *rozwój nowych produktów, ograniczenia finansowe, niestacjonarne B+R, międzyorganizacyjna współpraca B+R, zewnętrzne pozyskiwanie wiedzy*

Biographical note

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Conflicts of interest

The author declares no conflict of interest.

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