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**Bank-FinTech relationship: Open
Banking, performance and sustainability
profiles for SMEs and individuals**

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Contents

Abstract (English version)	4
Abstract (Italian version)	5
 Introduction	6
1. Background.....	6
2. Literature gaps and contribution to academic literature	8
3. Purposes of the thesis, main results and practical implications	9
3.1 First contribution	9
3.2 Second contribution.....	10
3.3 Third contribution.....	12
References	14
 Banks' attitude to partnership as an antecedent of Open Banking platforms: structural determinants and effects on performance in the Italian context	17
Abstract	17
1. Introduction	17
2. Literature review	20
3. Data and methods	24
3.1 Sample and measures of banks' partnership propensity.....	24
3.2 First empirical model: determinants of banks' attitude to partnership	25
3.3 Second empirical model: the effect of attitude to partnership on banks' performance	28
4. Empirical results and discussion.....	31
4.1 Descriptive analysis of banks' attitude to partnership	31
4.2 Results and discussion of the first empirical model	34
4.3 Results and discussion of the second empirical model.....	36
5. Conclusions, implications and further research.....	39
References	42
 Getting some fuel from incumbents: bank-FinTech relationships and their effects on performance, growth and visibility of newcomers. Evidence from Italy	47
Abstract	47
1. Introduction	47
2. Literature review	49
3. Data and methods	52

3.1 Sample and data.....	52
3.2 Methods.....	57
4. Empirical results.....	57
4.1 Descriptive statistics.....	57
4.2 Regression results.....	60
5. Discussion.....	67
6. Conclusions, implications and further research.....	69
References	72
Appendix	76

FinTech and sustainability: does FinTech firms' SDG-orientation play a role in bank-FinTech relationship?	81
Abstract	81
1. Introduction	81
2. Literature review	84
2.1 Sustainability, financial and social inclusion and financial institutions	85
2.2 Payment services	87
2.3 Financing services	87
2.4 Investment services	88
2.5 Insurance services.....	89
3. Data and methods	91
3.1 Sample and data.....	91
3.2 Methods.....	97
4. Results and discussion.....	99
5. Conclusions, implications and further research.....	106
References	109
Acknowledgements	114
Ringraziamenti	115

“We went from being the Flintstones to the Jetson in 9 months.”

- Dan Schulman, PayPal-

Abstract (English version)

The following thesis originates from the increasing competition and dynamism of the financial services industry and that traditional credit intermediaries are experimenting following the entry of new players within the financial industry, i.e. FinTech firms, and which call for revisions to traditional banking. Now, innovation and development strategies practicable by banks also contemplate the possibility to participate to Open Banking ecosystems and to cooperate with FinTech firms. Both themes are little explored in the extant literature, especially from an empirical point of view, and are the focus of this dissertation.

PSD2 created the possibility, under certain conditions, to obtain/give access to customers' account data for authorized Third Party Providers (TPPs), fostering Open Banking, a potentially collaborative model in which data, services and applications are shared through APIs with TPPs, including FinTechs, with the aim to develop customer-oriented financial products and services. An active approach to PSD2 may allow to go beyond minimum regulatory requirements and support the development of Open Banking ecosystems and platforms. Based on this, the thesis examines the current attitude to partnership as an antecedent of Open Banking, exploring its structural and economic determinants and its effects on banks' performance in the Italian context. Results reveal a current low attitude to partnership of banks, which may hinder the development of Open Banking. The attitude to partnership tends to be higher for small and less capitalized banks, which may be interested in participating to Open Banking platforms in order to overcome size and resources constraints. Overall, we observe a positive effect of attitude to partnership on banks' performance, which may justify the participation to Open Banking platforms.

The second part of the thesis explores bank-FinTech relationship, which, in general, allows incumbents to quickly access to advanced technologies useful to improve their digital services and allows FinTechs to ensure a faster and less risky development path, by accessing to new financial resources and to banks' wider customer base and distribution channels. The purpose is to explore if the theorized benefits of bank-FinTech relationships actually exist and, by assuming FinTech firms' perspective, we investigate if the presence and diffusion of strategic alliances with banks affect the performance, growth and visibility of FinTech firms. Our results show that bank-FinTech relationships do not generate any positive performance; on the contrary, there is a positive effect on revenue growth and visibility of FinTech firms, potentially allowing them to quickly reach the economic break-even.

Finally, the thesis examines the potential contribution of FinTech firms in the pursuit of the goals embodied in the UN Agenda 2030 (SDGs), studying if it affects the likelihood of having one or more relationships with banks and whether this effect differs across various types of agreement. The contribution of FinTech firms in reaching the SDGs is recognized by many authors in the literature. However, FinTech firms' potential contribution to sustainability is hampered by the economic and financial weakness of FinTech firms, that mainly are in their start-up phase in which premature failures often occur. Cooperation with banks can facilitate their growth path, supporting their potential contribution to the 2030 Agenda. Results show a positive relationship between FinTech sustainability orientation and the presence of at least one relationship with a bank, which is more likely to take the form of equity agreement. This reveals that SDG-orientation may be strategic for FinTech firms and that bank-FinTech relationship should be considered by policymakers in the formulation of guidelines and requirements.

Abstract (Italian version)

La tesi prende avvio dalla crescente concorrenza e dinamicità del settore dei servizi finanziari che gli intermediari creditizi tradizionali stanno sperimentando a seguito dell'ingresso delle imprese FinTech nel settore finanziario, che hanno messo in discussione il tradizionale modo di fare banca. Le strategie di innovazione e di sviluppo percorribili dalle banche vedono ora la possibilità di partecipare a ecosistemi di Open Banking e di cooperare con le imprese FinTech. Entrambe le vie sono poco esplorate in letteratura, soprattutto da un punto di vista empirico.

La PSD2 ha generato la possibilità, sotto alcune condizioni, di avere/dare accesso ai dati di pagamento della clientela per terze parti autorizzate (TPP), favorendo lo sviluppo dell'Open Banking, un modello potenzialmente collaborativo in cui dati, servizi e applicazioni sono condivisi attraverso API con i TPP, tra cui le FinTech, con l'obiettivo di sviluppare prodotti e servizi finanziari orientati al cliente. Un approccio attivo alla PSD2 potrebbe permettere di andare oltre i requisiti minimi e favorire la nascita di ecosistemi e piattaforme di Open Banking. Partendo da ciò, la tesi esamina, nel contesto italiano, l'attuale propensione alla partnership delle banche, esplorandone le determinanti strutturali ed economiche e gli effetti sulla performance. I risultati rivelano una attuale scarsa propensione alla partnership da parte degli intermediari tradizionali, che può ostacolare lo sviluppo dell'Open Banking. La propensione alla partnership tende ad essere più elevata per banche piccole e meno capitalizzate, che potrebbero essere interessate a partecipare alle piattaforme di Open Banking al fine di superare vincoli dimensionali e di risorse. Nel complesso, si rileva un effetto positivo di tale propensione sulla performance delle banche, che potrebbe, quindi, giustificare la partecipazione a piattaforme di Open Banking.

La seconda parte della tesi indaga il rapporto banca-FinTech, che, in generale, permette alle banche di avere accesso immediatamente a tecnologie avanzate utili a migliorare i propri servizi digitali e alle FinTech di assicurarsi un percorso di sviluppo più rapido e meno rischioso, attraverso l'accesso a nuove risorse finanziarie e ad una più ampia base di clientela e rete distributiva. L'obiettivo è quello di esplorare se i benefici teorizzati del rapporto banca-FinTech esistano realmente e, assumendo la prospettiva delle FinTech, si indaga se le alleanze strategiche con le banche influenzino la loro performance, crescita e visibilità. I risultati mostrano che il rapporto banca-FinTech non genera effetti positivi sulla redditività delle FinTech; si dimostra, invece, un effetto positivo sul tasso di crescita dei ricavi e sulla visibilità delle FinTech, elementi questi che potenzialmente possono consentire un più rapido raggiungimento del break-even economico.

Infine, la tesi esplora il potenziale contributo delle FinTech al perseguimento degli obiettivi dell'Agenda ONU 2030 (SDGs), studiando se questo influisce sulla probabilità di avere uno o più rapporti con le banche e se tale effetto differisce tra diversi tipi di accordi. Il contributo delle FinTech al perseguimento degli SDGs è riconosciuto da molti autori in letteratura; tuttavia, tale contributo può essere ostacolato dalla fase di start-up in cui tipicamente si trovano e in cui il rischio di fallimento è elevato. La cooperazione con le banche può agevolare il loro percorso di crescita, sostenendone il potenziale contributo all'Agenda 2030. I risultati mostrano una relazione positiva tra orientamento alla sostenibilità della FinTech e la presenza di almeno un rapporto con una banca, il quale ha una maggiore probabilità di assumere la forma di accordo di partecipazione. Ciò rivela che l'orientamento alla sostenibilità può essere strategico per le FinTech e che il rapporto banca-FinTech dovrebbe essere considerato dai regolatori nella formulazione di linee guida e normative.

Introduction

1. Background

Over the last decade, the financial services industry is undergoing a process of dramatic transformation, attributable to deep economic, technological, regulatory and market changes, which call for revisions to traditional banking management. A large contribution to these changes is given by FinTech firms, which are fostering innovation and digital transformation in the financial market. Thanks to their ability in exploiting new ICT technologies for dealing with new purchase and consumption habits of customers, whose main drivers of choice are personalization, convenience, accessibility and ease of use (Ernst & Young, 2019), and favourable regulations, in particular the Payment Service Directive 2 (PSD2), many FinTech firms are entering in specific segments of the multi-product financial industry, contributing to the so called “unbundling” of financial services (Basole and Patel, 2018), a phenomenon that is changing the way in which customers have access to financial services and that is slowly nibbling banks’ profitability margins (Navaretti et al. 2017; Euro Banking Association, 2017). Faced with these profound changes in competitive scenario, banks are trying to not be disintermediated and stay relevant to the customers through new innovation and growth strategies, which in most cases contemplate a cooperative attitude towards newcomers, i.e. FinTech firms. Indeed, there is broader awareness that both parties can be mutually supportive, and not just competitors in the same market (Gomber et al. 2018) and researchers have theorized numerous avenues through which bank-FinTech relationships can be beneficial for both incumbents and newcomers.

On one side, banks have the possibility to speed up their digital innovation process, that would otherwise consume much time and financial and managerial resources because of their large dimension and traditional, sometime old and static, internal processes (Hornuf et al., 2020). Digital innovation can help banks in achieving greater efficiency, by reducing their traditional brick-and-mortar infrastructure and workforce (Holmes and King, 2019), and effectiveness, by offering to customers something new that better meets their needs in terms of cost, quick, ease of use and quality expectations (Zalan and Toufaily, 2017; Coetzee, 2019). Also, banks are motivated to join forces with FinTech firms to enter in new market segments, access to new revenue streams and to learn from FinTech firms’ new way of thinking and their different approach in providing financial services (KPMG, 2017; EBA, 2018; Drasch et al. 2018; Enriques and Ringe, 2020). On the other side, FinTech firms are mainly interested in ensuring a faster and less risky development path, through the opportunity to access to larger financial resources, which is fundamental for sustaining their growth. Also, cooperation allows FinTech firms to better develop their products, exploiting

banks' know-how, informative assets and any complementary products/services that can make their offering more attractive for customers. In this sense, also the access to banks' specific licenses can be important for FinTech firms to enter the market, since in many cases it would be too difficult and expensive for them to obtain them on their own (Klus et al., 2019; Hornuf et al., 2020). Other benefits are the possibility to leverage the regulatory and risk management experience of incumbents (Gimpel et al. 2018), to acquire knowledge about the market and the industry and to access to banks' relational network and reputational heritage, that allow FinTech firms to gain visibility and trust in potential investors and customers (Hornuf et al., 2020; Enriques and Ringe, 2020). Finally, FinTech firms could aim at accessing to bank's customer base and distribution channels, so that they can rapidly reach the break-even point and pursue a fast growth (EBA, 2018; Vives, 2019; Hornuf et al. 2020).

In practical terms and following the entry into force of PSD2, bank-FinTech relationships can take place in a more or less structured context depending on the approach with which banks decide to interpret and adapt to new regulations (Fratini Passi, 2018), which empower account holders with the authority to share data, removing the financial institution's role as gatekeeper (Brodsky and Oakes, 2017), thus allowing Third Party Providers, including FinTech firms, to access, collect and process such data for the purpose of developing and offering their own payment services (Brodsky and Oakes, 2017; Romanova et al., 2018). Through an active approach in aligning to PSD2, the obligation for banks to open their information assets to authorized third parties may result in the development of Open Banking ecosystems and platforms, in which banking data, services and applications are shared through collaborative Application Programming Interfaces (APIs) with partners, internal and external developers and customers in a secure and controlled way (Evans and Basole, 2016; Broadsky and Oakes, 2017; Premchand and Choudhry, 2018), enabling banks and TPPs to develop new financial products and services that better meet customer needs.

From a social perspective, bank-FinTech relationships can help newcomers in their development and growth path (Hornuf et al, 2020), thus allowing them to rapidly deliver cheaper and innovative financial products to the market, reaching market segments with the greatest need for intervention. Indeed, by leveraging on the advantages allowed by the implementation of new technologies, (UN Task Force on Digital Financing of the SDGs, 2020), FinTech firms bring to the market affordable, of greater quality and personalized financial services able to satisfy unmet needs of the market, in particular those of underserved, excluded and unsatisfied customer segments, such as vulnerable households, micro and small-medium enterprises (MSMEs) and digital natives (Salampasis and Mention, 2018). FinTech firms are recognised to have an important

role in democratising a wide range of financial services (payments, savings, financing and insurance), especially among MSMEs and low-income households, and in creating greater social value than conventional banking (Milne and Parboteeah, 2016; Hua and Huang, 2020). Overall, there is a strong consensus that FinTech firms, together with traditional financial institutions, can directly or indirectly support the transition to a sustainable economic model (Linciano et al., 2021), thus contributing to the underpinning of the Agenda 2030 and the embodied 17 Sustainable Development Goals (SDGs) to be achieved in the economic, social, and environmental dimensions by 2030 (UN, 2015). For this reason, often regulators promote initiatives aimed at fostering FinTech firms' activity and digital innovation in the financial sector.

2. Literature gaps and contribution to academic literature

In the extant literature, studies exploring bank-FinTech relationships, also in Open Banking contexts, are scarce, especially from an empirical point of view. In this field, empirical research may be very challenging due to the limited amount of financial and non-financial data provided by FinTech firms. In particular, three main gaps are identified.

First, as concerns Open Banking, academics mainly spent their efforts in defining it, studying its enabling technologies and its impact on the banking intermediation model. However, the literature lacks contributions considering that Open Banking ecosystems and platforms mainly emerge because of a positive attitude of banks to partner with external parties: if banks are characterized by a low attitude to partnership (or adopt a passive approach to PSD2), then hardly go beyond minimum compliance requirements, thus inhibiting the formation of Open Banking ecosystems and platforms.

Secondly, researchers have theorized numerous avenues through which bank-FinTech relationships can improve the offering of products or services, processes and business models of both parties, but little is known about the actual benefits of bank-FinTech relationships, especially from FinTech firms' perspective. In particular, there are not any studies that empirically explore if relationships with banks affect the performance, growth and visibility of FinTech firms.

Finally, an increasing number of articles focus on how FinTech firms operating in payment, savings, financing and insurance fields may contribute to sustainable development and to the Agenda 2030, especially through financial inclusion. However, authors usually do not consider that new financial players are mainly in their start-up phase, when premature failures often occur, and that cooperation with traditional financial institutions, in particular with banks, can help newcomers in their development and growth path, thus strengthening their potential contribution to sustainable development. More specifically, the connection between FinTech firms'

contribution to sustainability and bank-FinTech relationship, and in particular how the former influences the latter, are still underexplored, although important to investigate for managerial and regulatory purposes.

This dissertation aims at filling part of the aforementioned gaps, which are addressed separately in the next three chapters, featuring with a scientific article structure. For the readers' better understanding, the research questions of the three articles and their main results and implications are described in the next section of this chapter.

3. Purposes of the thesis, main results and practical implications

3.1 First contribution

The first contribution “Banks’ attitude to partnership as an antecedent of Open Banking platforms: structural determinants and effects on performance in the Italian context” focuses on the current attitude of banks to collaborate with other financial intermediaries, internal or external to banking groups, by shedding light on its structural determinants and its effect on banks’ performance through a sample of 45 Italian banks representing the 73% of the domestic banking system in terms of total assets. More specifically, research questions are the following:

RQ1. Have banks a positive attitude to partnership with external parties, thus creating fertile ground for Open Banking ecosystems?

RQ2. What are the structural determinants of banks’ attitude to partnership with external parties?

RQ3. Does banks’ attitude to partner with external parties affect their performance?

Results show that Italian banks do not currently have a positive attitude to infra- or extra-group collaboration and that, often, a self-referential approach to customer satisfaction prevails. Also, the scarcity of partnerships in the development phase of financial products and services is the proof of the limited openness of banks to external ideas, which could inhibit innovation and the formation of Open Banking ecosystems. In general, even from a cultural point of view, banks do not seem to be keen on partnering with other intermediaries and FinTech firms; indeed, our analysis reveals that collaborations mainly involve stand-alone products. This is more frequent in larger and more capitalized banks while it fades in small and medium-sized banks, accustomed to optimizing synergies and collaborations with external partners to compensate for possible constraints in size, resources and human capital.

Therefore, the participation to Open Banking platforms can be of strategic importance, in particular for small-medium size banks, in order to continue to compete in a market whose

complexity is progressively intensifying, to reduce operational, technological and innovation gaps and, not least, to reduce the risks of takeover by larger banks. This can improve their innovation capacity, production and distribution processes and, consequently, their ability to better meet customers' needs and to create value for their stakeholders and shareholders. The participation of banks to Open Banking ecosystems could be justified by the positive effect of their attitude to partnership on performance. In general (and regardless to dimension), banks' managers should consider that participation to Open Banking platforms can speed up the acquisition of new customers and reduce market fragmentation by becoming a one-stop shop (Mensah and Muroura, 2017). On the other side, banks should face critical issues, such as the risk of partial disintermediation, mainly due to the difficulty of maintaining a direct relationship with customers, if they prefer to purchase financial products from other TPPs and intermediaries participating in the Open Banking platform, and cybersecurity risks related to API adoption which involve, for example, fraudulent TPPs activity, digital intrusion, identity theft, data misuse and privacy issues (Mensah and Muroura, 2017).

3.2 Second contribution

The main purpose of the second contribution, titled "Getting some fuel from incumbents: bank-FinTech relationships and their effects on performance, growth and visibility of newcomers. Evidence from Italy", is to investigate if the presence and diffusion of strategic alliances between banks and FinTech's affect the performance, growth and visibility of the latter (i.e. "newcomers"). In particular, using a panel of 124 FinTech firms operating in Italy over the period 2007-2019, with a total of 582 FinTech-year observations, we address to the following research questions:

RQ1. Do bank-FinTech relationships affect the performance, growth and visibility of newcomers?

RQ2. Does the presence of relationships with several banks affect the performance, growth and visibility of newcomers?

In answering our research questions, we separately study the different types of bank-FinTech relationships. In particular, we distinguish equity investments, further classified in banks' (1) majority and (2) minority stakes in FinTech firms' equity, from (3) partnership agreements.

Results reveal that banks' majority equity investments, which require FinTech firms to be subject to the management, coordination and control of the parent bank, have a negative impact on performance due to the higher costs of aligning operations and processes to banking groups' objectives and regulatory requirements. We can observe similar effects for banks' minority equity investments, although less persistent and of lower intensity. Less important for FinTech firms'

performance is the establishment of partnership agreements. It is feasible that banks become shareholders of FinTech firms with a long-term perspective, tolerating negative performance in the short term with the idea that through their financial and managerial support FinTech firms' activity can grow rapidly. Furthermore, the focus of equity agreements between banks and FinTech firms are synergies that can arise through the integration of tangible and intangible assets, so that the related value may be transferred to shareholders in the medium term through other types of returns, such as value of information assets, value of the community or value of cross-selling to customers. If we move from traditional performance indicators and focus on revenue growth and visibility, we can observe that these are positively affected by all types of bank-FinTech relationships. We also find that FinTech firms with a long presence on the market appear to be more profitable than recently established ones, and that age, size and the efficiency of processes contribute to improve revenue growth.

On one side, these results show that engaging in all type of relationships with banks sustains the growth of FinTech's and allows them to gain visibility; but when deciding to cooperate with banks, FinTechs' managers should consider that equity agreements are also associated to weaker performance, as usually occur when new financial resources are employed for growth purposes, especially for banks' majority equity investments, which show more persistently and stronger negative effects. On the other side, banks' managers should consider that equity investments have a negative effect the performance of FinTech's. For this reason, banks should assess the economic viability of connecting to FinTech's with a long-term orientation, also considering that value increase does not always take the form of positive financial performance, but can be represented by other types of returns, such as value of information assets, of the community or of cross-selling to customers. It is also important to create an environment able to foster the activity of the acquired FinTech firm, avoiding that the high compliance and coordination costs, typical of banking groups, as well as banks' poorly streamlined decision-making and operational processes, hinder the value-enhancing potential of the FinTech company.

Finally, regulators should support the development of ecosystems where traditional and new financial intermediaries share ideas, information, technologies, product/services and customers, thus fostering the establishment and growth of FinTech firms and facilitate global financial competitiveness (Lee and Shin, 2018). To this purpose, policymakers should understand the opportunities, risks and development stage of financial innovation and, consequently, develop multiple regulatory methods that ensure flexibility for FinTech firms, so that more formal methods are implemented in regulating mature technologies whose benefits and risks are clear (Brummer and Yadav, 2019). Also, regulators should encourage the positive value associated to bank-

FinTech relationships by ensuring that agility, flexibility, efficiency and innovativeness characterizing FinTech firms' business model are preserved even if they are integrated in banking groups.

3.3 Third contribution

The last contribution “FinTech and sustainability: does FinTech firms' SDG-orientation play a role in bank-FinTech relationship?” studies if SDG-orientation of FinTech firms affects the likelihood of establishing one or more bank-FinTech relationships and if this effect differs between various types of agreements. Through a sample of 124 Italian FinTech firms, we address the following research questions:

RQ1. Does SDG-orientation of FinTech firms determine the presence of one or more relationships with banks?

RQ2. Does the role of SDG-orientation of FinTech differs between various types of bank-FinTech relationships?

We build SDG-orientation variables through a qualitative approach. We retrieved SDG-relevant information from FinTech's website and passed them to a panel of four independent experts who were asked to make independent assessments of SDG-orientation on that basis.

Our results show that FinTech's SDG-orientation positively affects the probability to observe at least one relationship with a bank, concluding that such relationships may be considered as an additional avenue in the pursuit of Agenda 2030. This holds for economic, social and environmental dimensions introduced by the Agenda 2030. This conclusion is strengthened by the evidence that FinTech's that contribute the most to sustainability, and in particular to the economic pillar, are more likely to cooperate with banks through equity agreements (the highest degree of integration) which usually imply a strong commitment of banks in sustaining FinTechs' activity. The presence and diffusion of bank-FinTech relationships is also influenced by the diversification strategy of FinTech firms in terms of customers, products and distribution channels and by the adopted intermediation model. Also other features, such as size, age, innovativeness and visibility play a role, showing that FinTech firms that already own stronger growth capacity have less need to receive support from incumbents, which, on the other side, seem to be more interested in cooperating with more structured and experienced FinTech firms.

FinTech firms' managers could derive several benefits from being oriented to sustainability; indeed, this should be considered as a strategic choice, since it is positively

associated to the probability of establishing relationships with banks, which can support their development and growth path, as also outlined in the second contribution of this dissertation.

From a social perspective, bank-FinTech relationships may contribute to the efficiency and completeness of the financial market by delivering cheaper, innovative, of greater quality and personalized financial products to customers, thus tapping underserved, excluded and unsatisfied market segments. Furthermore, SDG-orientation of FinTech firms, on one side, and its inclusion in banks' decision making concerning strategic alliances, on the other, could be useful for both in improving reputation, as well as acquisition and retention of customers, who are increasingly careful about sustainability and interested in financial products embodying economic, social and environmental issues.

Important implications also emerge for policymakers. First, they should promote the spread of digital financial services because these are commonly recognized to offer strong support to the transition toward an inclusive financial system (Arner et al., 2020), and foster the development of ecosystems where FinTechs can be fostered through interactions with traditional financial institutions. More specifically, bank-FinTech relationships, when involving sustainability-oriented initiatives, may be an additional tool in the pursuit of the 17 SDGs and, as such, should be considered by policymakers in setting guidelines and regulations, and should be included in the assessment of financial institutions' commitment to sustainability.

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Banks' attitude to partnership as an antecedent of Open Banking platforms: structural determinants and effects on performance in the Italian context

Abstract

The recent developments in regulation, in particular PSD2, and ICT technologies are fostering the Open Banking phenomenon, a model of forced or voluntary collaboration based on the sharing of data and applications between subjects not necessarily affiliated, in order to develop, produce and distribute innovative and value-added financial products and services for the customer. Open Banking is still at its embryonic phase and the approach with which banks decide to interpret and adapt to the new PSD2 regulations is crucial to grasp the evolution of the structure and operativity of the financial system in the coming years and the role that banks will have within it. Certainly, a positive banks' attitude to partnership is a crucial factor for the development of Open Banking ecosystems and platforms and deserve attention of researchers.

In this paper we investigate the attitude to partnership of a sample of 45 Italian banks, that allows us to better understand if there are the conditions for the creation of Open Banking ecosystems. Furthermore, we explore the economic determinants of banks' attitude to partnership and its effect on performance.

Results reveal a low current attitude to partnership of Italian banks, a factor that may hinder the formation of Open Banking ecosystems and platforms. The attitude to partnership tends to be low for larger and more capitalized banks, while the opposite occurs for smaller and less capitalized banks, which can be more inclined to participate to Open Banking platforms in order to compensate for possible constraints in size, resources and human capital. Overall, the participation to Open Banking platforms can be justified by the positive effect of attitude to partnership on banks' performance, as shown by our analysis.

1. Introduction

In the current context of digital economy, the financial services market is constantly evolving. The profound changes occurring in the purchase and consumption habits of customers, whose main drivers of choice are personalization, convenience, accessibility and ease of use (Ernst & Young, 2019), have accelerated, compared to the past, the spread of technological product and process innovations within the financial market (Arner et al., 2016), contributing to the birth of

new and increasingly articulated forms of intermediation (Cosma et al., 2020) and the rethinking of the business models of traditional financial intermediaries. Certainly, an important contribution is given by FinTech firms, which are fostering innovation and digital transformation in the financial market, a role that has been consolidated with the entry into force of the Payment Services Directive 2 (PSD2). Many FinTech firms are entering in specific segments of the multi-product financial industry, contributing to the so called “unbundling” of financial services (Basole and Patel, 2018), a phenomenon that is changing the way in which customers have access to financial services and that is slowly nibbling banks’ profitability margins (Navaretti et al. 2017; Euro Banking Association, 2017).

The approach with which banks decide to interpret and adapt to the new PSD2 regulations is crucial to understand the evolution of the structure and operativity of the financial system in the coming years and the role that banks will have within it (Fratini Passi, 2018). The obligation to share information on payment transactions of customers, under certain conditions, with other market participants may upset one of the fundamentals of the existence of banks: confidential information assets and the ability to overcome the problems and risks arising from the existence of information asymmetries in financial exchanges. This asset of banks has been progressively affected by the emergence of new types of information (Big Data) available through innovative channels and able to grasp, in other ways, the elements of riskiness and opportunism that characterize individual customers (Wei et al. 2016, Addo et al. 2018, Onay and Öztürk, 2018; Berg et al., 2020).

The new legislation contributes to increasing competition within the financial services market by obliging banks to share customers’ payment data with authorized Third-Party Providers (TPPs), which in turn can develop their own financial services. At the same time (and paradoxically), it offers the conditions for the formation of collaborations by means of digital platforms, also called Open Banking platforms, in which banks, FinTechs and other financial institutions can participate, obtaining numerous potential benefits. What discriminates against the two possible scenarios is the approach with which financial intermediaries, and in particular banks, comply with the new directive.

The regulatory obligation to share some information relating to its customers through APIs can be interpreted in a minimal sense (mandatory) through the literal adaptation to the dictates of the regulation, or it can become the incipit of a different way of competing in the financial system. The ability to ensure the interaction of information systems and the exchange of information, in a more cooperative approach (voluntary), can contribute to the birth of new credit and financial

ecosystems and Open Banking platforms in which, according to different rules, traditional financial intermediaries, banks and FinTechs cooperate.

Therefore, PSD2 gives regulatory concreteness to a phenomenon already underway in the banking system that sees some actors, banks and FinTechs, share information and technologies to better serve their customers and, at most, share their customers to offer more innovative services.

In literature there are very few contributions that deal with Open Banking, clearly because it is a new and still evolving phenomenon. Researchers' efforts are mainly spent in defining Open Banking and the enabling technologies (APIs) (Brodsky and Oakes, 2017; Zachariadis and Ozcan, 2017), in understanding its impact on banks' intermediation model (Gomber et al., 2018; Colombari and Tedeschi, 2019) and in identifying the roles that banks can assume in Open Banking ecosystems (Euro Banking Association, 2016; Gozman et al., 2018). To the best of our knowledge, there is not any contribution that approach these issues from an empirical point of view.

In our paper, we study an important antecedent of Open Banking: banks' attitude to partnership. The greater the willingness to partner and to open up to external parties, the greater the probability that Open Banking platforms will be configured. This article studies the current propensity of banks to collaborate with other financial intermediaries, internal or external to banking groups, by shedding light on its structural determinants and its effect on banks' performance through a sample of 45 Italian banks representing 73% of the domestic banking system in terms of total assets.

Our results show that Open Banking ecosystems are still under-developed and that, currently, Italian banks are characterized by a low attitude to partnership, mainly oriented to distribution agreements. This is more frequent in larger and more capitalized banks while it fades in small and medium-sized banks, accustomed to optimize synergies and collaborations with external partners to compensate for possible constraints in size, resources and human capital. This is also the consequence of the spread of business models less linked to traditional credit intermediation typical of deposit banks and the progressive fading of territorial barriers that has made customers more contestable and willing to purchase digital financial services. Furthermore, results show that banks' attitude to partnership has a positive effect on performance, thus justifying their participation to Open Banking ecosystems.

The article is structured as follows: in section 2 we present a literature review of Open Banking related studies. In section 3 we present our data and methodology, with a detailed description of the variables in our dataset. In section 4 we present and discuss results and section 5 concludes.

2. Literature review

PSD2, although limited to the payment services segment, beyond protecting consumers through an improvement in the security and transparency of services, is promoting a greater level of competition and efficiency within the market, reducing barriers to entry for new payment service providers (called TPPs) in order to increase quality and convenience for the final consumer (Zachariadis and Ozcan, 2017; Romanova et al., 2018). Indeed, there is evidence that PSD2 has positively influenced the establishment of new TPPs in the early years of its introduction (Polasik et al., 2020). Entered into force on the 13th of January 2018 and went into full effect on the 14th September 2019, PSD2 identifies three types of TPPs: i) Payment Initiation Service Provider (PISP), which lies between the customer and the institution with which he holds his payment account, also called Account Servicing Payment Service Providers (ASPSP), and which initializes payment transactions (art. 4, paragraph 15), ii) Account Information Service Provider (AISP), that offers an information aggregation service to customers who hold payment accounts with different ASPSPs (art.4, paragraph 15), and iii) Card Issuer Service Provider (CISP) which offers a fund checking service, i.e. it checks the availability of a certain amount of money on payment account before the customer pays by card (art. 65).

In order to promote the activity of TPPs, including numerous FinTech firms, PSD2 explicitly empowers account holders with the authority to share data, removing the financial institution's role as gatekeeper (Brodsky and Oakes, 2017), i.e. the intellectual property of payment data is shifted from the bank to customers (Omarini, 2018), which have the power to authorize TPPs to access, collect and process such data for the purpose of developing and offering its own payment service (Brodsky and Oakes, 2017 Romanova et al., 2018). Banks cannot deny the access to such information, unless there are justified and substantiated reasons relating to fraudulent or unauthorised access to the payment account by such TPPs (art. 6-bis) or if the customer withdraw the consent to the provision of TPPs' services.

What is clear from the text of PSD2 is that banks are obliged to open their information assets to authorized third parties, a phenomenon known in the literature as "Open Banking". Academics mainly spent their efforts on the definition of Open Banking, its enabling technologies (Brodsky and Oakes, 2017; Zachariadis and Ozcan, 2017; Premchand and Choudhry, 2018) and its impact on the banking intermediation model (Gomber et al., 2018; Colombari and Tedeschi, 2019).

At a technical level, Open Banking can be defined as a customer-oriented model in which banking data, services and applications are shared through Application Programming Interfaces (APIs) with partners, internal and external developers and customers in a secure and controlled

way (Evans and Basole, 2016; Broadsky and Oakes, 2017; Premchand and Choudhry, 2018), enabling banks and TPPs to develop new financial products and services that better meet customer needs. The APIs, therefore, represent a point of contact between the three subjects that participate in the Open Banking ecosystems: i) banks, that hold customer payment data, which are provided to authorized TPPs, ii) TPPs, including FinTech and TechFin firms, which ask for permission to access, receive and process customer payment data held at banks, and iii) customers, who hold their payment information at banks and who, at their own discretion, may make it available to TPPs, which can offer them value-added products and services (Open Data Institute, 2016).

On a practical level, on the other hand, the concept of Open Banking can take a more or less broad meaning based on the active or passive approach that banks adopt in aligning with the legislation (Fratini Passi, 2018). These approaches differ in how data is exchanged, the type of data exchanged and the purposes for which they are exchanged. According to the passive approach, banks comply with the minimum requirements request by regulation, allowing authorized TPPs to access customer data through a forced collaboration model in which the exchange of data is unidirectional (from bank to TPPs using standard/competitive APIs), limited to the type and quantity of data for which authorization is given by the customer and aimed exclusively at providing the latter with the service offered by the TPPs, which can eventually exploit the information within the limits imposed by PSD2 and the GDPR to improve its offer of financial products and services. On the contrary, through an active approach, a model of voluntary collaboration is established, according to which the exchange of data is bidirectional (from bank to TPPs and vice versa using collaborative APIs), it may concern a wider set of information for which authorization is given by the customer and which is finalized, through collaborations in the different stages of development, production and distribution of financial services, to improve the processes and the overall offering of financial products and services of both the banks and the TPPs.

Only through a different interpretation of the concept of competition it is possible to develop and adopt complex and integrated API systems that allow the practical realization of Open Banking concept through Open Banking platforms, in which participants interface and from which they can derive important benefits. The participation to Open Banking ecosystems is profoundly changing the intermediation model of banks', shifting from a universal model to a modular model, mainly due to the unbundling of financial services after the entrance of FinTech firms in financial industry, that expose banks to a high risk of disintermediation (Rabitti and Sciarrone Alibrandi, 2019). In fact, FinTech firms carry out numerous activities that range from payments services to financing, investments and insurance services, but usually they follow a specialization rather than

a diversification strategy, thus their offering has limited scope and their business model is the opposite of universal banking (Navaretti et al. 2017). This means that new entrants create niche products that target very specific groups of customers based on their characteristics, thus competing with incumbents for few products they have on offer and contributing to the unbundling of financial services (Gomber et al., 2018; Basole and Patel, 2018). Depending on the legal framework of the country in which FinTech firms operate, the disaggregation of incumbents' value chain allows FinTech firms to position themselves in operational segments which escape regulatory and supervision requirements, thus reducing compliance costs (e.g. licenses and capital and liquidity requirements), as well as in market segments where traditional financial institutions cannot effectively meet customers' needs (Tanda and Schena, 2019). The unbundling of banking activities is deeply changing the way in which customers access and use financial services, thanks to a re-bundling process: unbundled services offered by several financial firms are selected and combined according to customers' needs and offered as "new" financial products. This leads to shift from a traditional universal banking model to a modular banking model with a strong customer-centric orientation and customer control (Euro Banking Association, 2017).

Practically, this means that instead of choosing a single bank for the totality of financial services basing on an average benefit/cost analysis, customers can access to single preferred financial services offered by different financial firms (banks, FinTech firms and TechFin firms), usually through an aggregation and comparison platform (Colombari and Tedeschi, 2019; Borgogno and Colangelo, 2020). The process of platformization of financial services lays the foundation for the creation of Open Banking ecosystems in which producers, distributors and users interact and collaborate with each other.

The presence of FinTech firms in Open Banking ecosystems and their contribution to the disaggregation of the value chain and to the disintermediation of financial services have some important implication for the delivery of financial services to final consumers. Traditionally, banks have not only provided their customers with products, but have also been responsible for their distribution, thus characterizing themselves by a low openness degree (Euro Banking Association, 2016). According to these three dimensions (production, distribution and openness), Open Banking ecosystems may feature different roles of banks in the financial value chain, thanks to the implementation of APIs. More specifically incumbents' activity can evolve in four scenarios: i) Bank-as-a-Integrator, ii) Bank-as-a-Producer, iii) Bank-as-a-Distributor, and iv) Bank-as-a-Platform (Euro Banking Association, 2016; Gozman et al., 2018).

Adopting the role of Bank-as-a-Integrator, banks create and distribute the offering under one brand, so that they fully control the whole value chain and the customer experience. This

model is characterized by a low openness degree, as banks do not open their boundaries to external parties for partnerships beyond compliance issues. In the Bank-as-a-Producer role, the offering to the customer is created by the bank and distributed by external parties. This means that banks decide to set up distribution partnerships with FinTech firms or other financial institutions. On the opposite side, we have banks that adopt the Bank-as-a-Distributor role, which usually leverage on their physical and digital distribution channels, thus distributing financial products that are developed by FinTech firms or other financial institutions extending their market presence. Both roles have a medium openness degree, because even if banks open up their boundaries, usually external parties are carefully selected, resulting in a limited number. Finally, banks adopting Bank-as-a-Platform role facilitate the business of others by acting as an intermediary, also referred as B2B model. Banks neither produce nor distribute financial products, but offer different capabilities to TPPs, such as the matching of parties, security, Know Your Customer (KYC), Anti Money Laundering (AML) and APIs technologies, allowing others to set up partnerships. This role has the highest openness degree, because banks do not communicate with a limited number of TPPs, but they may potentially interact with the totality of financial institutions.

These four roles can be adopted simultaneously (Gozman et al., 2018). In fact, banks may assume different roles in different lines of business/product; it is common that, for example, banks can at the same time produce and distribute their own financial services, allow TPPs to distribute them or distribute TPPs' financial services. Certainly, banks tend to adopt more or less each specific role.

As outlined above, in literature there are very few contributions that deal with Open Banking, clearly because it is a new and still evolving phenomenon and, to the best of our knowledge, there is not any contribution that approach these issues from an empirical point of view. We want to fill part of this gap by studying an important antecedent of Open Banking, i.e. banks' attitude to partnership, which is fundamental for the opening to external parties and for the formation of Open Banking ecosystems. If banks are characterized by a low attitude to partnership, then hardly go beyond compliance requirements, thus inhibiting the formation of ecosystems and Open Banking in general. In particular, through a sample of 45 Italian banks representing 73% of the domestic banking system in 2019 in terms of total assets, we answer to the following research questions:

RQ1. Have banks a positive attitude to partnership with external parties, thus creating fertile ground for Open Banking ecosystems?

RQ2. What are the structural determinants of banks' attitude to partnership with external parties?

RQ3. Does their attitude to partnership with external parties affect their performance?

3. Data and methods

3.1 Sample and measures of banks' partnership propensity

The present study uses a cross-sectional dataset of 45 Italian banks, 35 of which belong to some banking group and representing 73% of the domestic banking system in terms of total assets. In order to measure banks' attitude to partnership, we collected information from the transparency section in their websites, screening and recording a total of 5.262 product and services and depicting banks' offering at December 2019. The structure of this kind of information is highly comparable among banks, as usually they follow common and strict requirements in drafting products' information sheets. This allowed us to identify the number of products and services offered to customers through a collaboration with partners, which can be internal or external the banking group. Subsequently, we computed two measures of attitude to partnership for each bank in the sample: i) share of products with partnership (Q_i) and ii) Shannon-Wiener diversity index (H'_{SW}). The share of products with partnership is computed as follows:

$$Q_i = \frac{PP_i}{TP_i}$$

where PP_i is the number of products that are created and/or distributed in partnership by the bank i and TP_i is the total number of products that bank i holds in its offering. This ratio can assume the following values:

- $Q_i = 0$, if there are no partnerships;
- $0 < Q_i < 1$, if $PP_i < TP_i$;
- $Q_i = 1$, if $PP_i = TP_i$.

The Shannon-Wiener diversity index is computed as follows:

$$H'_{SW,i} = - \sum_{s=1}^S \frac{PP_{is}}{TP_i} \ln \frac{PP_{is}}{TP_i}$$

where $s = 1, \dots, S$ is the partner s with which the bank i collaborates. TP_i is the total number of products that bank i holds in its offering and PP_{is} is the number of products that the bank i co-creates and/or co-distributes with its partner s . Diversity measures, such as the Shannon-Wiener index, are usually implemented in the analysis of ecosystems' species heterogeneity, and allow to consider both the richness of species and the number of individuals appearing in each of them. If we consider banks as ecosystems and their partners as species, it is possible to study how

heterogeneous the offer of a bank is: the higher the heterogeneity (or diversity) and the higher the willingness to collaborate and the degree of openness to external subjects. The Shannon-Wiener Diversity Index can only take positive values and is applicable to representative samples of an unknown population in its entirety. Because of the last feature, the Shannon-Wiener Diversity Index was preferred over other diversity measures (for more details on diversity measures see Frerebeau, 2019), since banks' collaborations do not always involve a financial product or service and we are aware that the sample used may not consider the entire population of partners and collaborations with external parties.

Both indices are computed on a two-level basis. The first-level consider inter-group collaborations as partnerships, while in second-level indices these are excluded. This differentiation allows us to discriminate partnerships that are a consequence of the organizational and strategic approach of the group and the business model chosen by the parent company from those that contribute to the actual opening of bank's boundaries to third parties. Therefore, we ended up with four different measure of banks' attitude to partnership: (1) Q_1 , which measures the share of products with partnership by also considering inter-group collaborations, (2) Q_2 , which measures the share of products with partnership by excluding inter-group collaborations (3) H'_{SW1} , i.e. the Shannon-Wiener diversity index comprehensive of inter-group collaborations, and (4) H'_{SW2} , i.e. the Shannon-Wiener diversity index computed excluding inter-group collaborations.

Differently from the first research question, investigated in "Results and discussion" section through descriptive statistics, in order to answer to the second and third research questions, we implement two different empirical model, whose equations and variables are explained below.

3.2 First empirical model: determinants of banks' attitude to partnership

In particular, to explore the determinants of banks' attitude to partnership (RQ2), we apply a linear regression model according to the following specification:

Model 1

$$Z_i = \alpha + \sum_{j=1}^J \beta_j X_{i,j} + \sum_{c=1}^C \beta_c X_{i,c} + \varepsilon_i$$

where Z_i is the index of attitude to partnership of bank i , with $i = 1, \dots, N$, which is alternatively represented by (1) Q_1 , (2) Q_2 , (3) H'_{SW1} and (4) H'_{SW2} . α is the constant term, X_i 's are explanatory

variables grouped into structural determinants features and control variables (j and c respectively) and ε_i is the error term.

Following the literature concerning organisational, economic and strategic motives of inter-firm strategic alliances formation, we consider four possible structural determinants of banks' attitude to partnership: (1) *Avg_Size_{5Y}*, measured as the logarithm of the average total assets of the last five years and used as a proxy of the ownership of complex structures and strategic resources necessary to internally develop financial products and services, that should be associated with a lower attitude to partnership (Grant and Baden-Fuller, 1995; Madhok and Tallman, 1998; Gulati, 1999; Dyer, & Singh, 2002). At the same time, the larger size could be associated with a well-developed commercial network, so that third parties may be inclined to partner with the analysed bank in order to reach a higher market share (Todeva and Knoke, 2005). We also use as explanatory variable (2) *Avg_Leverage_{5Y}*, calculated as the logarithm of the average leverage (debt on total assets) of the last five years, in order to control for bank's risk capacity, so that the higher its debt, the lower the amount of own funds available to support its business activity. The lack of funds could result in a lower ability to internally develop products, and consequently to a higher bank's attitude to partnership aimed at completing the offering. We considered also (3) *Avg_Branch_prod_{5Y}*, i.e. branch productivity, calculated as the logarithm of the average of the last five years ratio of the sum of direct and indirect funding from customers and net customers lending to the number of branches, since banks with a lower productivity could be more inclined to distribute third parties' products, in order to reach scope economies and to improve performance (Mariti and Smiley, 1983; Varadarajan and Cunningham, 1995). Finally, we considered (4) *Avg_Business_model_{5Y}*, measured by the logarithm of the average of the last five years ratio of non-interest income to total assets, which represents the extent of off-balance sheet activities and is considered as a proxy of the width of the range of financial products and services offered by banks, which can be positively associated to the necessity to partner with external parties in order to dispose of all the strategic resources and competences needed.

Since the documentation of products and services in transparency section of banks' websites do not allow us to exactly know when partnerships started, we decided to implement the last five years average (i.e. 2015-2019) of structural features of banks in order to better align them to the time in which partnerships were formed, thus partially overcoming reverse causality problems. This choice is also justified by the stability that structural features tend to have over the period 2015-2019. In fact, the percentage standard deviations computed individually for each bank and for each structural feature show a distribution with a mean that range between 3% and 18%

and a median between 1% and 14%, which are quite low if we consider the post-crisis economic growth period (Table 1).

Table 1. Descriptive statistics of the percentage standard deviations from the mean of structural features of banks in the sample over the period 2015-2019.

	Mean	Median	Standard Deviation	Minimum	Maximum
%SD_Size _{5Y}	9.96	7.79	8.09	1.58	49.72
%SD_Leverage _{5Y}	2.92	0.78	0.0593	0.15	51.99
%SD_Branch_prod _{5Y}	17.78	13.81	18.43	2.46	114.59
%SD_Business_model _{5Y}	14.49	6.69	28.37	2.07	186.6

During the screening of banks' offering, for each identified partnership, the following was verified:

1. *Type of product.* Each product or service offered through a collaboration was classified into 5 different types: i) payments, ii) financing, iii) investments, iv) collaterals and v) other products.

2. *Type of collaboration.* When a product is created and/or distributed in collaboration, such collaboration can assume 5 different forms: i) production-in, if the product is co-created and distributed only by the bank, ii) production-out, if the product is co-created and distributed only by the partner, iii) distribution-in, if the product is created by the partner and distributed only or also by the bank, iv) distribution-out, if the product is created by the bank and distributed only or also by the partner, and v) production-distribution, if the product is both co-created and co-distributed.

3. *Type of partner.* When a product is created and/or distributed in partnership, we classify the partner(s) in 5 possible classes: i) bank, ii) other financial institution, iii) FinTech firm, iv) online bank, v) other type of partner.

Information concerning collaborations at product-level was fundamental in building our control variables. In particular, we aggregated the information concerning the type of product, collaboration and partner, obtaining three qualitative variables at bank-level, which summarize the diversification of the banks' collaborations according to three perspectives: (1) *Partner_divers*, which measure partner diversification and takes a value between 0 and 5 based on the variety of partners with whom the bank collaborates (see *Type of partner* classification), (2) *Prod_divers*, which measures product diversification and takes a value between 0 and 5 based on how many types of products are developed or distributed in collaboration (see *Type of product* classification),

and (3) *Coll_divers*, which measure the diversification of collaborations and takes a value between 0 and 5 based on how many types of collaborations are formed (see *Type of partnership* classification). Similarly to the measures of attitude to partnership, variety measures are computed on a two-level basis, in order to be consistent with the dependent variables.

Finally, we control for group membership through the variable *Group*, a dummy variable that is equal to 1 when the bank belongs to a banking group and 0 otherwise. Table 2 provides descriptive statistics for the variables included in the first regression model.

Table 2. Descriptive statistics of variables employed in the first OLS regression model. All values refer to the original distribution of variables, before applying logarithmic transformation.

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Dependent variables					
Q ₁	0.2653	0.2727	0.1278	0	0.487
Q ₂	0.2311	0.2469	0.1427	0	0.487
H' _{SW1}	0.9338	1.0009	0.419	0	1.7533
H' _{SW2}	0.8058	0.8053	0.419	0	1.678
Independent variables					
Avg_Size _{5Y} (mln €)	55,980.6	4,157.9	167,861.2	407.2	848,915
Avg_Leverage _{5Y}	0.9088	0.93	0.0593	0.6013	0.9116
Avg_Branch_prod _{5Y} (mln €)	143.79	295.49	424.287	59.34	2,511.52
Avg_Business_model _{5Y}	0.0151	0.1124	0.0174	0.0011	0.1065
Control variables					
Partner_divers ₁	2.311	2	0.925	0	5
Partner_divers ₂	2.067	2	0.8893	0	4
Prod_divers ₁	3.044	3	1.1862	0	5
Prod_divers ₂	2.778	3	1.2227	0	5
Coll_divers ₁	1.311	1	0.6682	0	4
Coll_divers ₂	1.2	1	0.5477	0	3
Group	0.7778	1	0.4204	0	1

3.3 Second empirical model: the effect of attitude to partnership on banks' performance

To explore the effect of attitude to partnership on banks' performance, we apply another OLS regression model according to the following specification:

Model 2

$$P_i = \alpha + \beta_z Z_i + \sum_{j=1}^J \beta_j X_{i,j} + \varepsilon_i$$

Where P_i is the performance measure of bank i , with $i = 1, \dots, N$, alternatively represented by (1) *ROA*, i.e. the operating performance of banks calculated as the ratio of the difference of operating income and operating expenses to total assets, and (2) *ROE*, i.e. the overall performance calculated as net income to equity (Bourke, 1989; Athanasoglou et al., 2008). Both are employed in logarithmic form and refer to fiscal year 2019. α is the constant term, Z_i is the index of banks' attitude to partnership of bank i , alternatively represented by (1) Q_1 , (2) Q_2 , (3) H'_{sw1} and (4) H'_{sw2} and X_i 's are bank-specific control variables and ε_i is the error term.

The bank-specific explanatory variables that we selected are: (1) *Size*, measured by the logarithm of total assets and whose effect on performance is still ambiguous in the literature (Antoun et al., 2018); it is supposed to capture the effects of economies of scales through increased operational efficiency, with a consequent positive effect on performance, but it is also suggested that this relationship is non-linear (Bourke, 1989; Athanasoglou et al., 2008; Lee & Kim, 2013). Other studies also found a negative relationship between bank size and performance, suggesting that only smaller banks benefit from economies of scale (Pasiouras & Kosmidou, 2007; Sufian & Chong, 2008). In our specific case, decreasing economies of scale are already considered implementing the logarithmic form of total assets. We also implemented (2) *Leverage*, calculated as the logarithm of debt on total assets, in order to control for the bank's risk profile, as well as for the availability of funds to support the bank's business and to operate as a buffer in case of adverse situation. In particular, the higher the debt, the higher the risk of financial distress for the bank, especially if debt is mainly composed by deposits, which constitute a fragile funding source, inclined to bank runs (Athanasoglou et al., 2008; Diamond and Dybvig, 2000). Other explanatory variables are: (3) *Branch_prod*, i.e. branch productivity, calculated as the logarithm of the ratio of the sum of direct and indirect funding from customers and net customers lending to the number of branches, and used as a proxy for bank's scope economies, so that a higher productivity should impact positively on bank performance, and vice versa. (4) *Efficiency*, measured by the logarithm of the ratio of operating expenses to operating income and considered as an outcome of bank management, since a better allocation and outflows of resources should lead to higher revenues at equal cost, with a positive impact on performance. (5) *Liquidity_risk*, measured by the logarithm of the ratio of net customer lending to direct customer deposits and used to control for the bank's ability to cover loan losses and withdrawals by its customers and the ability of banks to finance its

lending operation through deposits, instead of using debt or equity, thus avoiding higher funding costs. (6) *Credit_risk*, calculated as the ratio of loan loss provisions to net customer lending and considered as the economic outcome of banks' credit risk management activity: the higher the exposure to credit risk and the ineffectiveness in its screening and monitoring activity, the higher the amount of loan loss provisions and the lower the performance. Finally, (7) *Business_model*, calculated as the logarithm of the ratio of non-interest income to total assets, in order to capture the effects of off-balance sheet activity on bank performance (Goddard et al., 2004; Petria et al., 2015; Antoun et al., 2018), usually associated with new revenue streams and more stable results.

In this model bank-specific explanatory variables refer to fiscal year 2019, the same year for which we computed performance measures used as dependent variables. Table 3 provides descriptive statistics for the variables included in the first regression model.

Table 3. Descriptive statistics of variables employed in the second OLS regression models. All values refer to the original distribution of variables, before applying logarithmic transformation.

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Dependent variables					
ROA	0.0087	0.0078	0.007	-0.0181	0.0327
ROE	0.0303	0.0439	0.1466	-0.5481	0.2966
Independent variables					
Q ₁	0.2653	0.2727	0.1278	0	0.487
Q ₂	0.2311	0.2469	0.1427	0	0.487
H' _{SW1}	0.9338	1.0009	0.419	0	1.7533
H' _{SW2}	0.8058	0.8053	0.419	0	1.678
Control variables					
Size (mln €)	58,269.9	4,261.5	174,003.4	433.6	85,5647
Leverage	0.9209	0.9296	0.0299	0.7853	0.9525
Branch_prod (mln €)	365.42	172.02	0.5113	67.97	3,071.51
Efficiency	0.7267	0.6894	0.2609	0.4376	2.2213
Liquidity_risk	1.0313	0.991	0.2799	0.6711	2.136
Credit_risk	0.0063	0.0059	0.0059	-0.0012	0.033
Business_model	0.014	0.011	0.0134	0.0014	0.0677

4. Empirical results and discussion

4.1 Descriptive analysis of banks' attitude to partnership

Firstly, we want to investigate if banks have a positive attitude to partnership with external parties, thus creating fertile ground for Open Banking ecosystems (RQ1). Figure 1 shows the distribution of the measures of banks' attitude to partner with external parties (box A refers to Q_1 and Q_2 , while box B concerns H'_{SW1} and H'_{SW2}). As you can see from Q_1 distribution, 76% of the banks in the sample show a share of products created and/or distributed in collaboration between 20 and 50% of the total products in their offering, which is a fairly high value. The percentage is reduced if infra-group collaborations are excluded (Q_2 distribution), although still high and equal to 60% of the banks in the sample. However, drawing conclusion from this data could be misleading, because Q_1 and Q_2 do not consider the number of partners and the related products.

In fact, if we look at the distribution of Shannon-Wiener diversity index, which considers both the richness of partnership and the diversification of partners, 77% of the sample shows a H'_{SW1} index below 1.2 and the percentage increase at 80% for H'_{SW2} . Furthermore, for the sample on average H'_{SW1} and H'_{SW2} do not exceed the unit (see Table 2), thus indicating a low attitude to partnership. In fact, if we analyse Shannon-Wiener diversity with reference to the typical range between 0 to 5 and, a value less than 1 reveal that Italian banks, currently, are characterized by a limited willingness to collaborate with third parties, a factor that could slow down or even hinder the birth and widespread development of Open Banking ecosystems and platforms in the Italian financial system.

This conclusion can be further strengthened by also analysing the type of collaborations and partners of banks in the sample. As you can see from Figure 2, FinTech firms, that should represent the most important contributors of Open Banking ecosystems in terms of innovation, are an under-represented type of partner in the sample. Only 9% of banks in the sample collaborate with at least a FinTech firm (Box A), 7% if we exclude collaborations with FinTech firms which belongs to the banking group (Box B).

Furthermore, in most cases banks do not collaborate in the production phase of products and services (Boxes C and D), in which usually resources, knowledge and skills in R&D are shared, which can be an obstacle for the access to new competences and ideas. This may firstly inhibit innovation and, subsequently, the creation of Open Banking ecosystems in which banks and third parties develop innovative financial products and services that better meet customers' needs. If, on the one hand, legislation and technology have provided market players with the

conditions to communicate and collaborate profitably, on the other we should consider that currently, and in particular in the Italian context, banks do not have an organisational culture geared to exchanging ideas and know-how.

Figure 1. Distribution of banks' attitude to partner with external parties for the sample. Our elaboration.

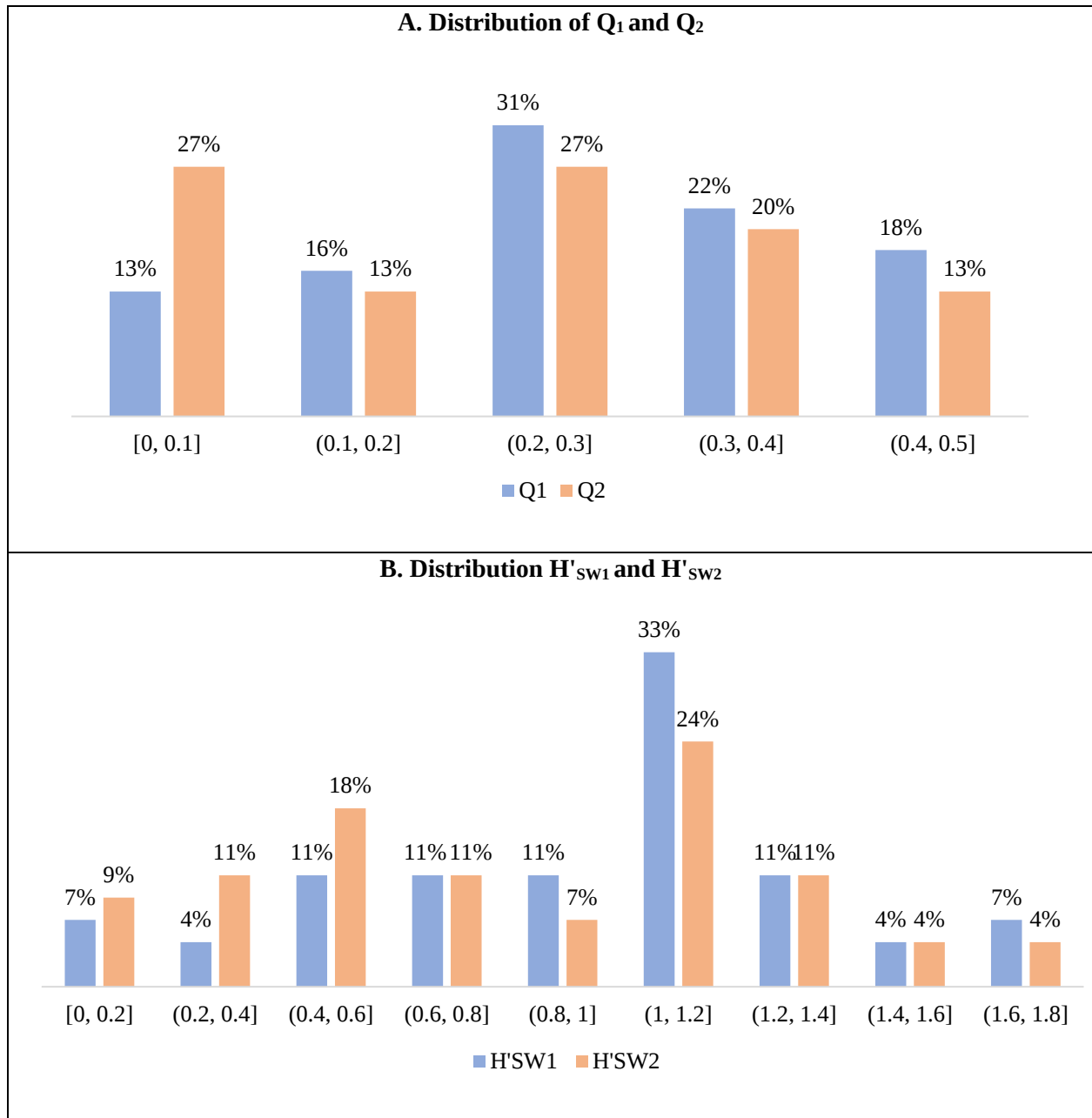
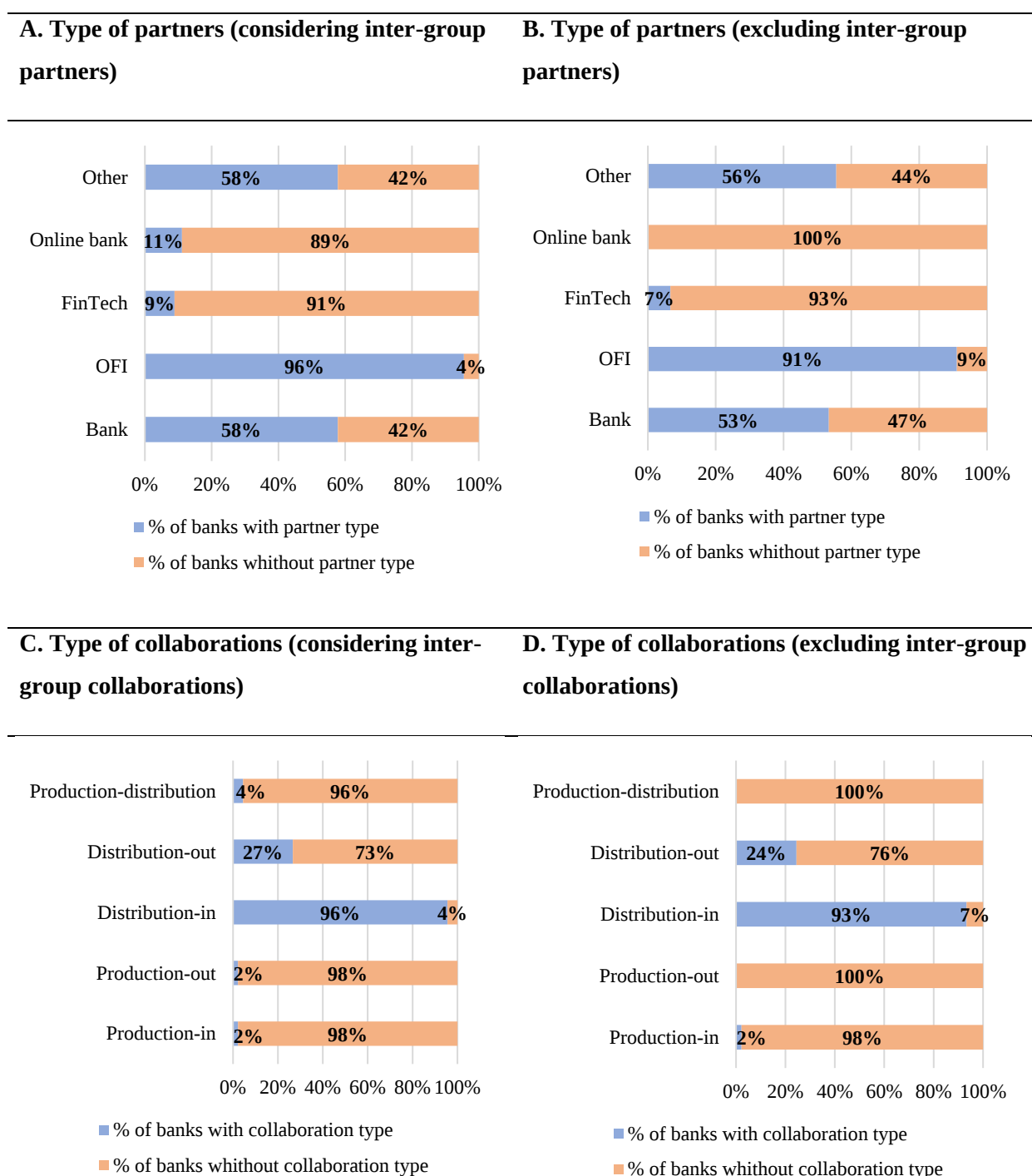


Figure 2. Type of partner and collaborations identified in the offering of banks in the sample. Our elaboration.



4.2 Results and discussion of the first empirical model

The following step is to investigate if banks' structural features influence their attitude to partnership (RQ2). To this purpose, Table 4 shows the results of the first empirical model. Overall, the adjusted R^2 is fairly high in all models. We also tested the presence of heteroskedasticity, through a Breusch-Pagan test, and collinearity, through Variance Inflation Factors test (VIF), concluding that they are not an issue for our analysis. Furthermore, errors seem to follow a normal distribution (we run Shapiro-Wilk test).

The coefficient of *Avg_Size_{5Y}* is negative and highly significant, regardless to the type and level of attitude to partnership measure used as dependent variable; that is, as the size increases, the propensity to collaborate with third-party intermediaries is reduced. Larger banks are more likely to use their facilities, resources and expertise in the development of financial products and services and this approach is confirmed both towards infra-group and external collaborations. On the contrary, as the size decreases, banks are more likely to form partnerships both inside and outside their group, thanks to which it is possible to pursue objectives of expansion and completion of its product lines. This may also mean that smaller banks could be more inclined to participate to Open Banking ecosystems in order to increase their ability to satisfy customers' needs.

Although less robust from a statistical point of view, there is also evidence that *Avg_Leverage_{5Y}* has a positive and statistically significant coefficient in Models 1 and 3, showing that as the level of capitalization decreases (or the incidence of debt capital increases), there is a greater degree of openness to third parties and a greater willingness to form collaborations. Also, a lower availability of own funds (or additional funding/borrowing capacity) can result in a lower ability to independently develop, produce and distribute new products and this determines a greater propensity to seek for collaborations to complete the offering. It cannot be excluded that capital constraints may prevent the possibility of taking additional risks and making further investments for which it is necessary to lighten the balance sheet by replacing revenues from traditional lending activity with revenues from intermediated services and ensuring, at the same time, quality and innovative services to customers.

An explanatory contribution also comes from the business model variable *Avg_Business_Model_{5Y}*, as you can see in Models 1 and 3: the choice of banks to diversify activities towards financial and non-traditional credit services determines a higher willingness to collaborate with external parties. Offering a wider range of financial products and services, together with the willingness to offer high quality services, may require outsourcing decisions for certain production and/or distribution activities.

Table 4. Results of the first OLS regression model for studying the structural determinants of banks' attitude to partnership.

	Q₁	Q₂	H'_{SW1}	H'_{SW2}
	(1)	(2)	(3)	(4)
Intercept	0.4064 ** (0.1923)	0.3805 * (0.2108)	0.7502 * (0.4233)	0.6491 (0.4439)
Avg_Size_{5Y}	-0.035 *** (0.0082)	-0.0392 *** (0.0089)	-0.0523 *** (0.0181)	-0.6653 *** (0.0187)
Avg_Leverage_{5Y}	0.5133 ** (0.2382)	0.3336 (0.2485)	0.894 * (0.5245)	0.6449 (0.5233)
Avg_Branch_prod_{5Y}	0.0095 (0.0906)	0.0131 (0.0197)	0.0039 (0.0422)	0.0204 (0.0416)
Avg_Business_model_{5Y}	0.0424 ** (0.0195)	0.0323 (0.0207)	0.078 * (0.0429)	0.0465 (0.0436)
Partner_divers₁	-0.0301 *** (0.0108)	-	-0.0559 ** (0.0238)	-
Partner_divers₂	-	-0.0237 ** (0.0111)	-	-0.0462 * (0.0233)
Prod_divers₁	0.0333 *** (0.0228)	-	0.0825 *** (0.0208)	-
Prod_divers₂	-	0.0343 *** (0.0089)	-	0.0847 *** (0.0187)
Coll_divers₁	0.0062 (0.0097)	-	0.0271 (0.0214)	-
Coll_divers₂	-	-0.0044 (0.0119)	-	0.0171 (0.025)
Group	0.0309 * (0.0164)	0.0276 (0.0179)	0.0528 (0.0361)	0.049 (0.0377)
R²	0.4824	0.5343	0.5209	0.5834
Adj. R²	0.3674	0.4308	0.4145	0.4908
N° observations	45	45	45	45
F-stat	4.195 ***	5.163 ***	4.893 ***	6.302 ***

Note: OLS regressions for four different dependent variables, i.e. Q_1 , which measures the share of products with partnership by also considering inter-group collaborations (Model 1), Q_2 , which measures the share of products with partnership by excluding inter-group collaborations (Model 2), H'_{SW1} , i.e. the Shannon-Wiener diversity index comprehensive of inter-group collaborations (Model 3), and H'_{SW2} , i.e. the Shannon-Wiener diversity index calculated excluding inter-group collaborations (Model 4). Control variables concerning diversification of collaboration are implemented according to the inclusion/exclusion of inter-group collaborations in the dependent variables. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

Avg_Branch_prod_{5Y} is never significant in explaining the propensity to collaborate with financial intermediaries inside and outside the banking group. This is an unexpected and, in some ways, surprising result, since one could expect a negative relationship showing that banks with lower productivity are more inclined to collaborate with external parties with the aim of saturating and exploiting production capacity, thus generating scope economies. Probably this result reflects both the extreme variety existing in the credit system and the changed commercial value of the branch networks, given the changes occurred in customers' purchasing and utilization habits.

As for control variables, results show that banks who form collaborations in several product or services categories (*Prod_divers₁* and *Prod_divers₂*) are characterized by higher attitude to partnership. This result reflects the choice of banks in the sample to collaborate with specialized partners, with which they form partnership agreements for several products in the same field and in which the partner presents profiles of excellence. Frequent collaborations make partners to work more cooperatively and less opportunistically than parties that do not expect to have future dealings with each other (Williamson, 1991). For this reason, if banks have a greater diversification of products with collaboration, co-created and/or co-distributed products increase even if the number of partners is not high, with a positive effect on the degree of openness of banks. The opposite occurs if banks partner with several type of third parties, as shown by the negative and statistically significant coefficient of *Partner_divers₁* and *Partner_divers₂*. This result is unexpected, but may be due to the greater difficulty to interface with players who offer a narrow range of products, reducing the possibility to form multiple production or distribution agreements. This, for example, may be the case of FinTech firms, which often have a very narrow product offering, especially if they are recently established. *Coll_divers₁* and *Coll_divers₂*, instead, are never statistically significant in our models.

The coefficient of belonging to a banking group is positive and significant only when Q_1 as dependent variable (Model 1). This result reflects the typical strategic orientation of banks to reach scope economies through inter-group collaborations.

4.3 Results and discussion of the second empirical model

Finally, we want to investigate if banks' attitude to partnership affects their performance (RQ3). Table 5 shows the results of second model specifications. We run all robustness checks as for the previous model and found not any evidence of heteroscedasticity or non-normality of errors. In all models, R^2 is high, showing a satisfying goodness of fit.

With the exception of Model 4, banks' attitude to partnership is positively and significantly associated to performance, measured by ROA and ROE. This may be due to several reasons. First, partnerships could be a mean to externalize activities that otherwise would be expensive if carried out internally (Williamson, 1975,1985,1991,1993), as well as helping in circumventing many of the administrative costs of hierarchical forms, while maintaining market efficiencies that come from scale and scope economies and operational flexibility (Jarillo, 1988; Child et al. 2019). Also, according to the resource-based view of the firm, cooperation can facilitate learning both in terms of knowledge sharing and transfer of existing knowledge, as well as the creation of new knowledge that neither of the partners previously possessed (Grant and Baden-Fuller, 1995; Gulati, 1999;

Dyer, & Singh, 2002; Child et al. 2019) and that firms could not own and/or create independently because of high costs or long development-time. Therefore, partnerships enable firms to access to knowledge and skills, which may be important for the development of new products and processes crucial to innovate and survive in their changing competitive environment (Lei et al. 1997; Grant, 2016; Rothaermel, 2016).

With respect to control variables (bank-specific features), in all models the coefficient of *Efficiency* is negative and strongly significant, showing that less efficient banks register lower revenues at equal cost, which in turn lead to worst performance. We found also a negative effect of *Leverage* on ROA, but not on ROE, showing that less capitalized banks are characterized by a weaker availability of funds to support the banks' operations, with a negative effect on the operating performance. Similarly to other studies, *Credit_risk* has the highest negative and statistically significant coefficient, showing that overall performance (ROE) is strongly and negatively affected by the amount of loan loss provision per euro of outstanding loans to customers (in all models, the effect of 1% increase of *Credit_risk* on ROE is approximately -13%), thus showing that the ineffectiveness of credit risk management activities can strongly negatively impact performance. Another important result concerns the *Business_model* variable, that has a positive and statistically significant effect on both performance measures, confirming that the strategic choice to offer services that go beyond traditional credit intermediation services can improve performance thanks to the access to new revenue streams, contributing to stabilize results.

Differently from other studies in literature, *Size*, *Branch_prod* and *Liquidity* are never statistically significant in our models.

Table 5. Results of the first OLS regression model for studying the effect of banks' attitude to partnership on their performance.

	ROA				ROE			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.0039 (0.004)	0.0042 (0.0043)	0.0039 (0.0043)	0.005 (0.0044)	0.0233 (0.0934)	0.0456 (0.1029)	0.0131 (0.1003)	0.0469 (0.1039)
Q₁	0.0094 ** (0.0037)	-	-	-	0.2739 *** (0.0864)	-	-	-
Q₂	-	0.0069 * (0.0036)	-	-	-	0.1735 * (0.0867)	-	-
H'_{sw1}	-	-	0.0033 * (0.0017)	-	-	-	0.105 ** (0.0394)	-
H'_{sw2}	-	-	-	0.0021 (0.0016)	-	-	-	0.0715 * (0.0374)
Size	0.0000 (0.0002)	0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	0.0039 (0.0044)	0.0037 (0.0052)	0.0003 (0.0042)	0.0018 (0.0048)
Leverage	-0.0599 *** (0.0115)	-0.0554 *** 0.0116	-0.0612 *** (0.0126)	-0.0545 *** (0.0119)	-0.0121 (0.2664)	0.1373 (0.2775)	-0.0814 (0.2907)	0.1279 (0.2806)
Branch_prod	-0.0001 (0.0004)	-0.0001 (0.0004)	0.0000 (0.0004)	0.0000 (0.0004)	-0.0046 (0.0086)	-0.0045 (0.0093)	-0.0004 (0.0092)	-0.0025 (0.0095)
Efficiency	-0.023 *** (0.0015)	-0.0228 *** (0.0015)	-0.0229 *** (0.0015)	-0.0229 *** (0.0016)	-0.3444 *** (0.034)	-0.3402 *** (0.0367)	-0.341 *** (0.0352)	-0.3418 *** (0.0368)
Liquidity_risk	-0.0012 (0.0019)	-0.0015 (0.0019)	-0.0019 (0.0019)	-0.0019 (0.002)	-0.0045 (0.0434)	-0.018 (0.0464)	-0.0242 (0.0437)	-0.0218 (0.0462)
Credit_risk	0.0079 (0.0651)	0.0013 (0.0683)	-0.0061 (0.0677)	0.0092 (0.0699)	-12.8936 *** (1.5053)	-12.979 *** (1.6401)	-13.0171 *** (1.5676)	-12.9428 *** (1.6467)
Business_model	0.0033 *** (0.0006)	0.0033 *** (0.0006)	0.0032 *** (0.0006)	0.0033 *** (0.0006)	0.0304 ** (0.014)	0.0318 ** (0.015)	0.0265 * (0.0145)	0.0328 ** (0.0152)
R²	0.928	0.923	0.9232	0.9193	0.9026	0.8879	0.896	0.8869
Adj. R²	0.912	0.9059	0.9061	0.9014	0.881	0.8629	0.8729	0.8617
N° observations	45	45	45	45	45	45	45	45
F-stat	57.99 ***	53.92 ***	54.08 ***	51.29 ***	41.7 ***	35.63 ***	38.76 ***	35.27 ***

Note: OLS regressions for two different dependent variables, i.e. ROA (Models 1-4) and ROE (Models 5-8). The four explanatory variables concerning banks' attitude to partnership are considered separately in order to avoid multicollinearity problems. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

5. Conclusions, implications and further research

Recent technological and regulatory developments and, in particular, the entry into force of PSD2 have given rise to the Open Banking phenomenon, a model of forced or voluntary collaboration based on the sharing of data and applications between subjects not necessarily affiliated, in order to develop, produce and distribute innovative and value-added financial products and services for the customer.

The regulatory thrust coming from PSD2 makes the phenomenon and "voluntary" sharing of data, information, services and technological and financial innovation more concrete, contributing to the creation of ecosystems and relational networks, also in the form of Open Banking platforms. This paper shed light on one fundamental factor for the development of Open Banking platforms, namely the banks' attitude to collaborate and open up to external parties through partnership agreements, by also providing empirical evidence on its structural determinants and its effect on performance.

The possibility of seizing opportunities from sharing information, customers and innovation and, therefore, of opening up to collaboration with other financial intermediaries - traditional but also of the new generation such as FinTechs and TechFins - depends on the ability to overcome traditional competitive models. The analysis carried out shows that Italian banks do not currently have a positive attitude to infra- or extra-group collaboration and that, often, a self-referential approach to customer satisfaction prevails. Also, the scarcity of partnerships in the development phase of financial products and services is the proof of the limited openness of banks' boundaries to external ideas, that could inhibit innovation and formation of Open Banking ecosystems. In general, even from a cultural point of view, banks do not seem to be keen on partnering with other intermediaries and FinTech firms; indeed, our analysis reveals that collaborations mainly involve individual products.

This is more frequent in larger and more capitalized banks while it fades in small and medium-sized banks, accustomed to optimizing synergies and collaborations with external partners to compensate for possible constraints in size, resources and human capital. This is also the consequence of the spread of business models less linked to traditional credit intermediation typical of deposit banks and the progressive fading of territorial barriers that has made customers more contestable and willing to purchase digital financial services.

Our study has some managerial implications for banks. At present, small and medium-sized banks have greater expertise in collaborating with external financial partners. For them, participation in Open Banking platforms can be of strategic prospective importance in order to

continue to compete in a market whose complexity is progressively intensifying, to reduce operational, technological and innovation gaps and, not least, to reduce the risks of takeover by larger banks. This can improve their innovation capacity, production and distribution phases and, consequently, their ability to better meet customers' need and to create value for their stakeholders and shareholders, by also renewing and strengthening its role for its customers and for the reference territories. Their participation to Open Banking ecosystems could be justified by the positive effect of banks' attitude to partnership on their performance, as shown by our analysis. In general (and regardless banks' dimension), banks' managers should consider that participation to Open Banking platforms can speed up the acquisition of new customers and reduce market fragmentation by becoming a one-stop shop (Mensah and Muroura, 2017), in which the customer has the opportunity to choose the individual financial services he needs from a plurality of subjects thanks to the aggregation and comparison of the solutions offered by banks and TPPs participating in the platform (Euro Banking Association, 2016). The participation of traditional financial intermediaries, banks, FinTech, TechFin and other providers of innovative services allows not only to develop and expand the offer of services, but also to make greater financial innovation available to the end customer (Coetzee, 2019). If the set of financial services offered by banks and TPPs is perceived as valuable by customers, then Open Banking platforms can also improve customer retention (Zachariadis and Ozcan, 2017).

On the other side, a critical issue for banks is the risk of partial disintermediation, mainly due to the difficulty of maintaining a direct relationship with customers if they prefer to purchase financial products of other TPPs and intermediaries participating in the Open Banking platform. Certainly, banks should maximize the quality of their offering, in order to reduce such risk, which, however, could be partly mitigated by the existence of infra-platform agreements and bilateral agreements between partners, which regulate the bidirectional exchange of data and define the roles, conditions and limits for the parties in the production and distribution phases of the financial product.

Finally, banks' managers should consider security challenges arising from participation to Open Banking platforms, which are primarily related to API adoption and involve, for example, fraudulent TPPs activity, digital intrusion, identity theft, data misuse and privacy issues, since customer data is aggregated into API infrastructures posing significant cybersecurity risks (Mensah and Muroura, 2017). These risks can have negative impacts on the reputation of the platform participants and on the credibility of the services they offer (Romanova et al., 2018); this makes necessary an adequately standardized approach in terms of security, in order to protect the image and brands of banks, but also of other participants of the Open Banking platform (Euro

Banking Association, 2016; Open Data Institute, 2016; Gozman et al., 2018). However, trust in banks' role as custodians of customers' data is sometime insufficient (van Zeeland and Pierson, 2021). For banks, it is important to strongly comply to privacy and data protection regulations (GDPR in the European Union context), while regulators should develop effective oversight and enforcement methods, so that people feel safe in a fast-moving financial market.

Our study has two main limitations, which provide new research avenues. First, the difficulty of finding complete information on all banks' collaborations lead us to analyse their attitude to partnership by only considering products and services offered to customers. This problem is partially overcome through the implementation of Shannon-Wiener diversity index, which is applicable to representative samples of an unknown population in its entirety. However, it is important to further verify our results by including all types and forms of partnerships. Second, the unavailability of information concerning the year in which banks formed collaborations with external parties can introduce some reverse causality problems when studying the determinants of banks' attitude to partnership. We tried to circumvent this problem by considering the average structural features of banks in the sample in the last five years, but future research may better align dependent and explanatory variables by also including the punctual year of partnership formation.

Furthermore, it would be interesting to compare the Italian context to other countries' one, in order to understand if the limited openness of bank's boundaries, and our results in general, can be generalized on an international level. Finally, future research may also limit the analysis on financial institutions that participate to the same Open Banking platform, in order to better understand why they decided to join the ecosystem, which are the advantages and disadvantages of such strategic choice and how relationships between them works.

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Getting some fuel from incumbents: bank-FinTech relationships and their effects on performance, growth and visibility of newcomers. Evidence from Italy

Abstract

The focus of our article is the relationship between banks and FinTech firms. Newcoming FinTechs, through a customer-centric and technology-based business model, are contributing to the digitalization, innovation, efficiency and competitiveness in the market of financial products and services. Incumbent traditional banks have acknowledged that digital transformation is crucial to enhance their ability to meet customers' needs and performance. In the extant literature, many authors investigate possible complementarities between the activities of FinTech firms and banks, discussing how they interact and what are the related advantages; less common are systematic empirical contributions exploring the effects that such relations entail in terms of performance, especially from the perspective of FinTech firms.

This paper aims to fill part of this gap by studying the effects of the bank-FinTech relationships on performance, growth and visibility of newcomers. To this purpose, we built a panel of 124 FinTech firms operating in Italy over the period 2007-2019 and analysed it by random-effects regressions. Our results show that bank-FinTech relationships do not generate any positive performance in terms of ROA and ROE; on the contrary, there is a positive effect on revenue growth and visibility. This is important for FinTech firms, because allows them to quickly reach a break-even point after the first phase of their life cycle.

Therefore, relationships between banks and FinTechs foster the growth of the latter and are strategic investments for the former, provided that FinTechs' innovation potential is warranted. This is not only to the benefit of the financial industry, but also to its clients; this aspect deserves the attention of regulators.

1. Introduction

In the actual context of digital economy, the financial services market is constantly evolving. The profound changes in the purchasing and consumption habits of customers, whose main drivers of choice are personalisation, convenience, accessibility and ease of use (FSB, 2019), have accelerated the diffusion of technological innovations in products and processes within the financial market (Arner et al., 2016), contributing to the emergence of new and increasingly articulated forms of intermediation and to the rethinking of the business models of traditional

financial institutions. Certainly, an important contribution is given by FinTech firms, whose heterogeneous activities foster innovation and digital transformation in the financial market. In particular, through the implementation of new technologies, such as Cloud Computing, IoT and Artificial Intelligence, and the pursuing of specialization strategies, FinTech firms are developing new financial product and services and distribution channels aimed at maximizing customers' experience and satisfaction.

FinTech is often perceived as something disrupting and many authors use the term “revolution” to describe it (see for example Mackenzie, 2015; Gabor and Brooks, 2017; Gomber et al. 2018); but recently it was realised that interactions between incumbents and newcomers may be beneficial for both parties, promising avenues for their further development (Saksonova and Kuzmina-Merlino, 2017). For this reason, attention to the gradual appearance of relationships between FinTech firms and banks has grown in recent years as a result of a broader awareness that both parties are not just competitors in the same market (Gomber et al. 2018). On one hand, incumbents' driving force for establishing strategic alliance is the access to advanced technologies useful to improve their digital services, while on the other FinTech firms are mainly interested in ensuring a faster and less risky development path, through the access to new financial resources and to banks' wider customer base and distribution channels (Hornuf et al. 2020).

The literature concerning bank-FinTech relationships is scarce, and even scarcer are contributions aimed at studying if the theorized benefits of bank-FinTech relationships allow to achieve higher performance. To the best of our knowledge, none of them assumes the perspective of FinTech firms. Our study aims at filling part of this gap. We investigate if the presence and diffusion of strategic alliances between incumbents and newcomers affect the performance, growth and visibility of the latter – i.e. FinTech's. In order to do so, we built a panel of 124 FinTech firms operating in Italy over the period 2007-2019, with a total of 582 FinTech-year observations. We focus on the Italian context, as we are interested in how bank-FinTech relationships can enhance performance, growth and visibility of newcomers in second mover financial systems (Caratelli et al., 2016), where digitalization of financial services started late and where FinTech phenomenon is at the forefront of its development. We argue that Italy represents an interesting context to consider because it is characterized by a bank-based financial system, where households and firms satisfy their financial needs with traditional intermediaries on the basis of a long-standing, often captive, relationship (Bank of Italy, 2020). This feature, together with a low general level of financial literacy (OECD, 2020) and the presence of a high share of elderly population (Eurostat, 2020), may reduce the size of the market to which FinTech firms can target, thus making relationships with banks crucial in maximizing customer acquisition and in increasing customers'

willingness to buy FinTech firms' financial products and services, consequently fostering newcomers' visibility, growth and performance.

Our results reveal that banks' majority equity investments have a negative impact on performance (ROA) due to the higher costs of aligning operations and processes to the group's objectives and regulatory requirements. We can observe similar effects for banks' minority equity investments, although less persistent and of lower intensity. Less important for FinTech's performance is the establishment of partnership agreements.

Traditional performance measures based on profit and loss margins could be misleading when applied to FinTech firms, which are mainly start-ups and innovative SMEs with prospective long-growth paths and late break-even point achievement. If we move away from traditional performance indicators and focus on their revenue growth and visibility, we can observe that these are positively affected by all types of bank-FinTech relationships, which help newcomers to quickly reach a break-even point and to become profitable in a shorter period of time.

The contribution of our study is twofold. First, ours is the first study that provides empirical evidence on bank-FinTech relationships assuming FinTech firms' perspective, studying if the theorized benefits of bank-FinTech relationships in terms of performance, growth and visibility actually occur. More broadly, we contribute to the make-buy-ally literature in the context of asymmetric strategic alliances, where larger firms interact with start-ups through different avenues, namely partnerships and minority or majority equity stakes, also known as hybrid structures (Williamson, 1975).

The structure of the article is the following: in section 2, we outline the state of art of bank-FinTech relationships literature and present our research questions, in section 3, we describe data collection, variables and the methods applied. In section 4, we present our findings, to which we provide theoretical explanations in section 5. Section 6 concludes with practical implications for banks, FinTech firms and regulators and introduces possible research topics for the future.

2. Literature review

The growth of FinTech poses numerous challenges for traditional financial institutions, in particular for banks. Even if there is not a unique definition for the term "FinTech" (Schueffel, 2016; Zavolkina et al., 2016; Iman, 2020), in the literature there is a broad consensus that FinTech firms, i.e. new established businesses that apply sophisticated technologies in providing new and improved financial services to the market, are reshaping the financial industry, by reducing costs and increasing quality, rapidity, flexibility and innovativeness in the development and delivery of financial products and services (Dapp, 2014; Gomber et al., 2017; Thakor, 2020; Wang et al.,

2020). Thanks to the heterogeneity of their activities and their customer-centric business model, they foster innovation and digital transformation in the financial industry. Many FinTech firms enter in specific segments of the multi-product financial industry, contributing to the so called “unbundling” of financial services, a phenomenon that is changing the way in which customers have access to financial services and that is slowly nibbling banks’ profitability margins (Gomber et al., 2018; Omarini, 2018; Tanda and Schena, 2019). Faced with these profound changes in competitive scenario, banks are trying to not be disintermediated and stay relevant to the customers. Beyond maintaining their status quo, other strategic responses that the banking sector is adopting can be resumed in the well-known make-buy-ally decision, i.e. adopt a competitive strategy by investing in in-house development of new products, services and processes, or adopt a cooperative strategy through strategic alliances, i.e. becoming FinTech firms’ majority or minority shareholders or establishing partnership with them (Zalan and Toufaily, 2017; Holmes and King, 2019; Hornuf et al. 2020). The choice mainly depends on the replicability and perceived threat of FinTech firms’ innovation, as well as on its possible substitution or complimentary effect (Anand and Mantrala, 2019; Vives, 2019), and, of course, the possibility for banks to enhance their innovation capabilities and product offerings (Holmes and King, 2019).

Attention to relationships between FinTech firms and banks has grown in recent years as a result of a broader awareness that both parties can be mutually supportive, and not just competitors in the same market (Gomber et al. 2018). There are several reasons why banks and FinTech firms decide to enter into strategic alliances. Through interviews carried out in the German market, Bömer and Maxin (2018) found that cooperating with banks gives FinTech firms the opportunity to access to larger financial resources, which is fundamental for sustaining their growth, since they usually are in the start-up phase in which premature failures often occur. Another important reason is the possibility for FinTech firms to better develop their products, exploiting banks’ know-how, informative assets and any complementary products/services that can make their offering more attractive for customers. In this sense, Klus et al. (2019) and Hornuf et al. (2020) state that also the access to banks’ specific licenses can be important for FinTech firms to enter the market, since in many cases it would be too difficult and expensive for them to obtain them on their own. Furthermore, authors in literature suggest that collaborating with banks allows FinTech firms to leverage the regulatory and risk management experience of incumbents (Gimpel et al. 2018), to acquire knowledge about the market and the industry and to access to banks’ relational network and reputational heritage, that allow FinTech firms to gain visibility and trust in potential investors and customers (Hornuf et al., 2020; Enriques and Ringe, 2020). Finally, FinTech firms may aim

at accessing to bank's customer base and distribution channels, so that they can rapidly reach the break-even point and pursue an exponential growth (EBA, 2018; Vives, 2019; Hornuf et al. 2020).

On the other side, the main reason for banks to interact with FinTech firms is the possibility to speed up their digital innovation process, that would otherwise consume much time and financial and managerial resources because of their large dimension and traditional, old and static internal processes (Hornuf et al., 2020). Digital innovation can be the means through which a bank can improve its competitive advantage: it allows to achieve greater efficiency, by reducing the traditional brick-and-mortar infrastructure and the workforce (Holmes and King, 2019), and effectiveness, by offering to customers something new that better meets their needs in terms of cost, quick, ease of use and quality expectations (Zalan and Toufaily, 2017; Coetzee, 2019). Also, banks are motivated to join forces with FinTech firms to enter in new market segments, access to new revenue streams and to learn from FinTech firms' way of thinking and their different approach in providing financial services (KPMG, 2017; EBA, 2018; Drasch et al. 2018; Enriques and Ringe, 2020).

As outlined above, researchers have theorized numerous avenues through which bank-FinTech relationships can improve the offering of products or services, processes and business models of both parties. Despite the new challenges introduced by advanced technologies, such as trust, cybersecurity and privacy issues, one could conclude that accelerating the modernization of banking services through strategic alliances can be beneficial for the performance of incumbents and newcomers. In the literature there is little evidence on bank-FinTech relationships and their effect on performance. Furthermore, the few studies that explore this topic usually assume the banks' perspective and often show divergent results. Hornuf et al. (2020), for example, found that cooperation announcements have a negative effect on banks' stock returns for short-term windows in 4 different countries (Canada, France, Germany and United States), suggesting that markets believe that in-house development of digital financial products and services is more valuable than cooperating with FinTech firms. Similar results are also provided by Takeda et al. (2020) for the Japanese market. On the contrary, Li et al. (2017) observe that, in the American context, the funding of FinTech firms is more likely to have a positive effect on the incumbents' stock returns than a negative effect. Asmarani and Wijaya (2020), instead, conclude that FinTech funding in Indonesia has no effect on banks' stock returns. Finally, studies that use traditional performance measure, such as ROA and ROE, show discordant results too (see for example Putri et al. 2019 and Phan et al., 2020). Although FinTech firms are growing rapidly, the contradiction between studies in the literature may be a consequence of the small size of FinTech firms compared to incumbents. Also, results could be very heterogeneous depending on the geographical context, the

development phase of FinTech phenomenon and the type of banks considered, as also the above authors underline.

To date, in the extant literature there are few studies based on FinTech firms' perspective (Bömer and Maxin, 2018), especially as concern cooperation with banks and its impact on the performance, growth and visibility of newcomers (Drasch et al. 2018), probably because usually FinTech firms are unlisted start-ups and, as such, can often opt for simplified accounting and are not obliged to publicly disclose annual accounts. With our study we fill part of this gap, by addressing the following research question:

RQ1. Do bank-FinTech relationships affect the performance, growth and visibility of newcomers?

In answering our research question, we study separately the different types of bank-FinTech relationships. In particular, following Hornuf et al. (2020), we distinguish equity investments, further classified in banks' (1) majority and (2) minority stakes in FinTech firms' equity, from (3) partnership agreements. This choice is justified by the different degrees of interaction and integration between parties, as well as by the different associated costs and efforts and the different rational and need on which the possible bank-FinTech relationships are based (Williamson, 1991; Chaharbaghi et al., 2005). Since there could be cases in which several banks invest or partner with a FinTech firm, we complete our analysis studying whether the effort to engage in relationships with several banks has any effect on the performance, growth and visibility of FinTech firms. Therefore our second research question is the following:

RQ2. Does the presence of relationships with several banks affect the performance, growth and visibility of newcomers?

3. Data and methods

In this work, we are interested to analyse to what extent the presence and diffusion of bank-FinTech relationships affect the performance, growth and visibility of newcomers. In this section, we describe in detail our data-collection strategy, present our data, the methods used and our empirical models.

3.1 Sample and data

Our sample is the result of a complex procedure, also characterized by hand-collected information. In order to answer to our research questions, we built a panel of FinTech firms operating in Italy following a two-stage procedure. First, in order to identify the population of Italian FinTech firms, we rely on the Italian FinTech ecosystem report elaborated by Ernst &

Young (2020)¹. The report highlights that in 2019 there were 254 FinTech start-ups and 91 Tech firms; the latter offer new technological solutions servicing the financial industry. Only FinTech firms that provide innovative financial product and services to individuals and firms were selected, thus excluding the 91 Tech firms who offer technological solutions to incumbents, such as RegTech and Big Data Analytics (Románova and Kudinska, 2016; Tanda and Schena, 2019). This choice comes from the willingness to study bank-FinTech relationships in a potential dichotomous context, where cooperation may arise or competition may increase. This would be impossible considering also Tech firms, who by nature are inclined to have only a cooperative relationship with banks.

In a second stage, we selected only FinTech firms that are active online and matched the remaining firms with Aida database, which is the largest source of financial information for Italian firms. We ended up with an unbalanced panel data of 124 Italian FinTech firms, observed over the period 2007-2019, with a total of 582 records. At this stage, the number of FinTech firms has halved because many of them have their headquarters in other countries, thus their financial information was not available in Aida.

To study the performance, growth and visibility of FinTech firms we consider four different dependent variables: (1) *ROA*, calculated as the ratio of operating income to total assets multiplied by 100, (2) *ROE*, calculated as the ratio of net income to equity multiplied by 100, (3) *Rev_growth*, a revenue growth indicator that measures the increase or decrease in revenue compared to the year in which it reaches at least 10% of total assets (considered as base year); this index is expressed in logarithmic form, and (4): *Gtrend* (i.e. Google Trend), a proxy of the visibility of FinTech firms in the sample, which measures over time the search interest of Google users about a particular FinTech firm. In order to draw reliable data from Google Trend, we searched each name of FinTech firms in the sample by applying topic, time, and geographical filters, thus considering only information regarding searches in the “Finance” field, starting from the year in which FinTech firms were established and limited to the Italian context. Google Trends data range between 0 and 100, which respectively represent the lowest and the highest search volume of a specific term in a certain time frame, and are usually provided in weekly or monthly form. Therefore, for each firm we computed the yearly average of their Google Trend time series.

Because our sample is composed of several start-up firms, we also decide to consider revenue growth as a performance measure, as it is unaffected by the dynamics of prospective

¹ The report was published in partnership with the FinTech District, the biggest community of FinTech firms in Italy. Based in Milan, the community reached over 100 start-ups and has multiple collaborations with public institutions, investors, professionals, financial institutions, international innovation hubs, universities and corporations. For further details see <https://www.fintechdistrict.com/>.

economic equilibrium and typical delay of FinTech companies in reaching a break-even point. Also, other studies in the literature consider revenues and revenue growth as proxies of start-ups' performance (see for example Davila and Foster, 2005; Eesley and Roberts, 2012; Lange et al., 2020; Choi et al., 2021). Furthermore, growth allows to capture the speed with which firms reach their markets, even if we are aware that some of them could generate value that is not visible either in their profit and loss accounts or in revenues themselves (such as the value of information assets and the value of the community), but which may be transferred to shareholders in the medium term through other types of returns. In order to better explore if the theorized benefits for newcomers associated to bank-FinTech relationships, in particular in terms of reputational spillovers, cross-selling agreements and the access to a larger customer base and wider distribution channels, we complete our analysis by considering as a dependent variable, in addition to revenue growth, a proxy of FinTech firms' visibility, i.e. Google Trends data.

From the Aida database, we retrieved FinTech firms' shareholding structure, which is fundamental for the identification of minority and majority equity stake acquisitions. We separately considered investments made by banks, which are the focus of our research, and those made by other non-bank-affiliated financial institutions (e.g. PE/VC funds, incubators/accelerators and consulting companies), which are included in the analysis for control purposes. This choice comes from the evidence that the relationships with financial institutions other than banks can be beneficial for the development and growth of FinTech firms, sometimes acting as substitutes of them in the financing of FinTech entrepreneurship especially in countries with low credit availability, such as Italy (Kolokas et al. 2020; Herck Giaquinto and Bertoluzzi, 2020). In order to be included in our dataset, all kind of relationships must be established before 2019, the last year in which we have financial information. The variables concerning banks' investments in FinTech firms' equity are: (1) *MajorInv_Bank*, a dummy variable that takes the value of one when a bank acquires a FinTech firm or holds a majority stake in it and (2) *MinorInv_Bank*, a dummy variable that takes the value of one when at least a bank becomes minority shareholder of the FinTech firm. In both cases, we considered also indirect majority or minority equity investments carried out by means of bank-owned PE/VC funds and investments directly made in the context of an incubation or acceleration program sponsored by the bank. In order to consider the number of banks participating in FinTech firms' equity, we also created the variable (3) *N_MinorInv_Bank*, that is the number of minority-shareholding banks. The variables concerning equity investments made by Other Financial Institutions (OFIs) are very similar to those built for banks' investments, but, since they are included as controls and are not of our main interests, we do not consider major or minor investments separately: (1) *Inv_OFI*, a dummy variable that takes the value of one when at

least one OFI invests in the FinTech firm, and (2) *N_Inv_OFI*, a variable that represents the number of OFIs that are shareholders of the FinTech firm.

Information about partnerships of FinTech firms are identified through their websites, in particular looking at the press releases sections. Indeed, very often FinTech firms disclose their partnership agreements to the public with the aim to gain visibility; in order to ensure that all existing partnerships are included in our sample, we also checked news articles on Fintastico, an online portal where FinTech-related topics are discussed, and BeBeez, an online magazine which provides up-to-date information on equity or debt financing and partnership agreements of Italian companies. Finally, we carried out a Google search, including the name of all sampled FinTech firms followed by the term “partnership”, “partner”, “alliance” or “collaboration”. Following the same procedure for majority and minority investments, we include only partnerships established within 2019 and separately consider partnerships with banks and those established with OFIs. The variables concerning partnerships with banks are: (1) *Partner_Bank*, a dummy variable that takes the value of one when at least a bank becomes partner of the FinTech firm, and (2) *N_Partner_Bank*, a variable that measures the number of banks with which the FinTech firm forms partnerships. As regards partnerships with OFIs, the variables are similar to those concerning banks, thus the interpretation is the same: (1) *Partner_OFI*, a dummy variable that takes the value of one when at least an OFI becomes partner of the FinTech firm, and (2) *N_Partner_OFI*, the number of OFIs with which any FinTech firm forms partnerships. For all variables concerning partnerships with banks and OFIs we presume that, from the year in which the partnership is announced, the agreement continues in to the end of the period of analysis and coded them accordingly (Hornuf et al., 2020).

We also considered FinTech firms’ characteristics concerning financial, economic and structural information as control variables. In particular, we include: (1) *Leverage*, the ratio of debt to total assets, (2) *Operating Efficiency*, the ratio of EBIT to operating costs, (3) *Age*, years of business activity, (4) *Age*², the square of *Age* in order to check if there is a non-linear relationship between FinTech firms’ performance and age (Loderer and Waelchli, 2010), and (5) *Size*, measured as the logarithm of total assets. Table 1 provides definitions and sources of the variables in our dataset.

Table1. Definition and source of the variables included in the analysis.

Variable	Description
<i>Dependent variables</i>	
ROA	Operating performance of a given FinTech firm and year, calculated as the ratio of operating income (EBIT) to total assets multiplied by 100. Source: Aida.
ROE	Total performance of a given FinTech firm and year, calculated as the ratio of net income to equity multiplied by 100. Source: Aida.
Rev_Growth	Revenue growth indicator of a given FinTech firm and year. It assumes the value of 1 until revenues reach at least 10% of total assets (base year). In all subsequent years, it measures the increase or decrease in revenues compared to that base year. Source: Aida.
Gtrend	Yearly average of Google Trends data of a given FinTech firm and year, implemented as a proxy of the visibility of firms in the sample. Source: Google Trends.
<i>Independent variables (Bank-FinTech relationships)</i>	
MajorInv_Bank	Binary variable that takes the value of 1 if a bank becomes major shareholder of the FinTech firm and 0 otherwise. Source: Aida.
MinorInv_Bank	Binary variable that takes the value of 1 if at least a bank becomes minor shareholder of the FinTech firm and 0 otherwise. Source: Aida.
N_MinorInv_Bank	Number of banks that are simultaneously minor shareholders of a given FinTech firm and year. Source: Aida.
Partner_Bank	Binary variable equal to 1 if the FinTech firm engaged in at least one partnership with a bank and 0 otherwise. Source: FinTech firms' website, Fintastico, BeBeez, Google.
N_Partner_Bank	Number of banks that are simultaneously partners of a given FinTech firm and year. Source: FinTech firms' website, Fintastico, BeBeez, Google.
<i>Control variables (OFI-FinTech relationships)</i>	
Inv_OFI	Binary variable that takes the value of 1 if at least a non-banking financial institution becomes minor shareholder of the FinTech firm and 0 otherwise. Source: Aida.
N_Inv_OFI	Number of non-banking financial institutions that are simultaneously minor shareholders of a given FinTech firm and year. Source: Aida.
Partner_OFI	Binary variable equal to 1 if the FinTech firm engaged in at least one partnership with a non-banking financial institution and 0 otherwise. Source: FinTech firms' website, Fintastico, BeBeez, Google.
N_Partner_OFI	Number of non-banking financial institutions that are simultaneously partners of a given FinTech firm and year. Source: FinTech firms' website, Fintastico, BeBeez, Google.
<i>Control variables (FinTech firms' characteristics)</i>	
Leverage	The ratio of debt to total assets of a given FinTech firm and year. Source: Aida.
Operating Efficiency	The ratio of operating income (EBIT) to operating costs of a given FinTech firm and year. Source: Aida.
Age	Age of the FinTech firm in years in the respective year. Source: Aida.
Age^2	The square of the age of the FinTech firm in years in the respective year. Source: Aida.
Size	Logarithm of total assets of a given FinTech firm and year. Source: Aida.

3.2 Methods

For testing the effect of bank-FinTech relationships on the performance of newcomers, we implement three firm-specific random effects models:

Model 1

$$P_{i,t} = \sum_{j=1}^J \beta_j Z_{i,t} + \sum_{k=1}^K \beta_k X_{i,t} + \sum_{c=1}^C \beta_c FC_{i,t} + \varepsilon_{i,t} \quad \varepsilon_{i,t} = \mu_i + u_{i,t}$$

Model 2

$$P_{i,t} = \sum_{j=1}^J \beta_j Z_{i,t-1} + \sum_{k=1}^K \beta_k X_{i,t-1} + \sum_{c=1}^C \beta_c FC_{i,t} + \varepsilon_{i,t} \quad \varepsilon_{i,t} = \mu_i + u_{i,t}$$

Model 3

$$P_{i,t} = \sum_{j=1}^J \beta_j Z_{i,t-2} + \sum_{k=1}^K \beta_k X_{i,t-2} + \sum_{c=1}^C \beta_c FC_{i,t} + \varepsilon_{i,t} \quad \varepsilon_{i,t} = \mu_i + u_{i,t}$$

Here, $P_{i,t}$ is the performance of the i -th FinTech firm in t , alternatively represented by *ROA*, *ROE*, *Rev_Growth* and *Gtrend*. Z_i are the independent variables about the bank-FinTech relationships of the i -th FinTech firm, X_i are the control variables concerning the relationships with other financial institutions of the i -th FinTech firm and, finally, FC_i are the control variables concerning the characteristics of the i -th FinTech firm. Depending on the models, Z_i and X_i are included as contemporaneous or lagged by one or two periods (t , $t - 1$ and $t - 2$).

The error term $\varepsilon_{i,t}$ includes two components: μ_i , which is specific to each firm (individual effects) and $u_{i,t}$, which is idiosyncratic and, for now, it is assumed to be homoscedastic and not serially correlated.

In order to avoid multicollinearity problems, we run distinct models that alternatively include the variables concerning the existence of relationships with financial institutions and the variables measuring their extension; this is motivated by the magnitude of their correlation coefficients, which is above 0.6.

4. Empirical results

4.1 Descriptive statistics

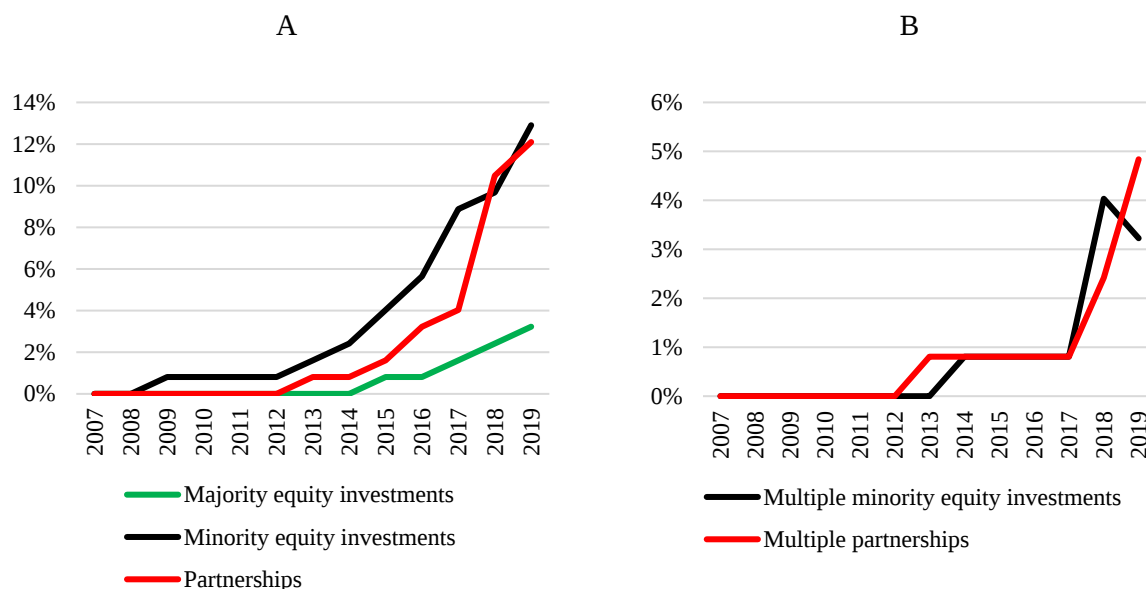
Descriptive statistics of the panel dataset are shown in Table 2. Bank-FinTech relationships mainly occur in minority investments or partnership agreement form, 10.3% and 7% of presence respectively; only 2% of the FinTech-year observations involve the acquisition of majority equity

stakes in FinTech's. This result is in line with previous evidence (for example Basole and Patel, 2018 and Hornuf et al. 2020). Furthermore, observations are characterized by up to eleven coexistent banks' minority investments and six simultaneous partnership with banks, even if on average *N_MinorInv_Bank* and *N_Partner_Bank* are very close to null. Overall, these numbers suggest that, in Italy, bank-FinTech relationships have been developed in very recent years and that few FinTech firms have multiple equity/partnership agreements with banks (Figure 1).

Table 2. Summary statistics of panel data for 582 FinTech-year observations from 2007 to 2019.

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
<i>Dependent variables</i>					
ROA (%)	-23.1	-10.1	57.4	-537.8	69.2
ROE (%)	-72.6	-15	244.6	-2,847	863.5
Rev_growth	11.606	1	56.772	0	841.521
Gtrend	9.443	3.199	14.223	0	72.827
<i>Independent variables (Bank-FinTech relationships)</i>					
MajorInv_Bank	0.019	0	0.136	0	1
MinorInv_Bank	0.103	0	0.304	0	1
N_MinorInv_Bank	0.168	0	0.753	0	11
Partner_Bank	0.071	0	0.256	0	1
N_Partner_Bank	0.124	0	0.558	0	6
<i>Control variables (OFI-FinTech relationships)</i>					
Inv_OFI	0.433	0	0.496	0	1
Partner_OFI	0.096	0	0.295	0	1
N_Inv_OFI	1.232	0	2.191	0	16
N_Partner_OFI	0.206	0	0.837	0	9
<i>Control variables (FinTech firms' characteristics)</i>					
Leverage	0.55	0.509	0.539	-0.286	5.783
Operating Efficiency	-2.97	-0.375	63.312	-1,526.16	64.476
Age	2.991	2	2.835	0	19
Size (€)	1,476,652	325,874	3,951,784	397	41,180,021

Figure 1. On the left (A) the yearly trend of the establishment of bank-FinTech relationships; on the right (B) the graph of the yearly trend of the presence of two or more bank-FinTech relationships. In both cases, the percentage of FinTech firms in the sample by type of relationship is plotted.

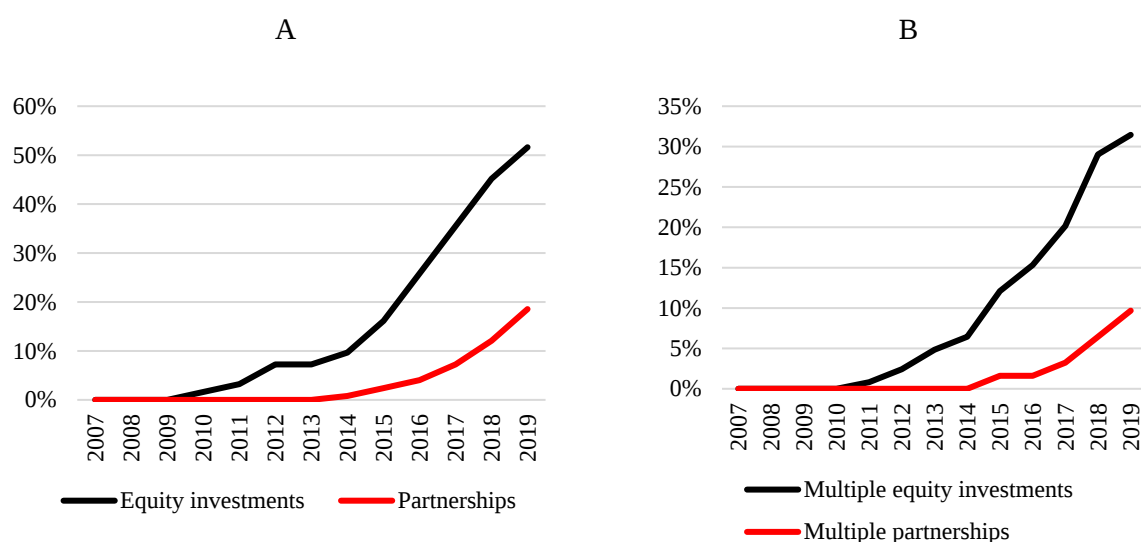


Regarding relationships of FinTech firms with OFIs, for the 43.3% of observations there is at least a majority or minority investment carried out by an OFI, while for partnership agreements the percentage is 9.6%. The maximum number of coexistent investments and partnerships are respectively sixteen and nine, with a mean of 1.2 and 0.2. As for the relationships with banks, investments and partnerships carried out with OFIs are recent, with the difference that FinTech firms in the sample are more frequently characterized by multiple and simultaneous relationships with OFIs, regardless to their legal form (Figure 2).

The evidence that FinTech firms in our sample tend to have more relationships with other financial institutions than with banks is not surprising, since we grouped together equity or partnership agreements formed with several types of other financial institutions (mainly PE/VC funds, incubators/accelerators and consulting companies). It is interesting that, differently from banks, where equity and partnership agreements seem to be equally likely, other financial institutions tend to interact with FinTech firms mainly thorough equity investments. This probably reflects the different objectives pursued by financial institutions: banks look at FinTech companies with strategic purposes, with a particular interest for example to their products, their technology or their community, while for other financial institutions, in particular PE/VCs funds or incubators/accelerators, the inclusion of FinTech firms in their portfolio through equity investments represents their core business. However, the frequent presence of OFI-FinTech relationships justifies posteriori their inclusion as control variables.

Turning to performance measures, on average FinTech firms show a large negative ROA and ROE. This is mainly due to the recent establishment of many FinTech firm in the sample (on average they have three years of business activity); thus, we are observing them in their first stage of business activity in which, usually, operating costs are greater than revenues. This is also confirmed by the average operating efficiency index, which is largely negative (-2.97). For the same reason, it is quite understandable that the visibility of FinTech firms (i.e. Google Trends) is still small on average (9.443). Despite this evidence, the revenue growth index of FinTech firms is rapid, showing a yearly average value of 11.6.

Figure 2. On the left (A) the yearly trend of the establishment of OFI-FinTech relationships, on the right (B) the graph of the yearly trend of the presence of two or more OFI-FinTech relationships. In both cases the percentage of FinTech firms in the sample by type of relationship is plotted.



4.2 Regression results

Because continuous variables have different scales, we standardized them before running our random effects models. Table 3 presents panel data regressions of the determinants of FinTech's performance and growth; the focus is on the presence of relationships with banks that may affect ROA, ROE, revenue growth and visibility. Therefore, our variables of interest are *MajorInv_Bank*, *MinorInv_Bank* and *Partner_Bank*. We find a negative and statistically significant effect of banks' equity investments on contemporaneous FinTech's operating performance (ROA), with a decrease of 0.61 and 0.32 standard deviation when at least a bank is a majority or minority shareholder, respectively (Model 1). In both cases the significance is at 5% level. The negative effect of banks' majority investments persists even in the second year after the agreement, with a decrease in ROA of 0.74 standard deviation at the 10% significance level (Model

3). There is not any evidence that other types of bank-FinTech relationships affect the ROA of newcomers in subsequent years; also, the presence of at least a partnership with banks is never significant (Models 1, 2 and 3). Accordingly, equity-based bank-FinTech relationships have a negative effect on ROA in the short-term, with the strongest effect registered for majority equity investments, the only type of agreement that seems to be relevant also after two years.

Results also show that, in general, bank-FinTech relationships do not affect the overall performance measured by ROE (Models 4, 5 and 6). Differently, we find that *MinorInv_Bank* and *Partner_Bank* have a positive and statistically significant effect (at 1% and 5% level respectively) on *log(Rev_Growth)* in the same and subsequent years (Models 7, 8 and 9). *MajorInv_Bank* seems to have a positive effect after two years, with a coefficient equal to 0.7, significant at the 10% level (Model 9). Overall, bank-FinTech relationships have a positive effect on revenue growth, which occur in the same and subsequent years.

Finally, bank-FinTech relationships positively influence the visibility of FinTech firms, with a stronger and more persistent effect for equity agreements. In particular, *MajorInv_Bank* shows a positive and statistically significant effect in all models in which we implemented *Gtrend* as dependent variable (Models 10, 11 and 12), with an increasing effect that range between 0.81 and 1.52 standard deviations. *MinorInv_Bank* seems to have a positive and significant effect at the 5% level in t and $t + 1$ (Models 10 and 11), while *Partner_Bank* positively influence visibility only in $t + 1$, with a coefficient of 0.31, significant at the 10% level (Model 11).

We also see significant and negative coefficients for *Inv_OFI* and *Partner_OFI* at the 1% level in Model 1, which indicates that the presence of equity or partnership agreements with other financial institutions decreases ROA in the same year by 0.23 and 0.22 standard deviations respectively. Compared with equity investments made by banks, equity agreements with OFIs show a weaker negative effect. As for banks, there is no evidence that OFI-FinTech relationships affect ROE of newcomers (Models 4, 5 and 6). Regarding revenue growth, only the presence of at least one partnership with OFIs seems to have a positive influence in t and $t + 1$ (Models 7 and 8). Both equity and partnership agreements have a positive and statistically significant effect (at 5% and 1% level respectively) on *Gtrend* only in the same year (Model 10).

The coefficients of *Leverage* are always negative and significant at the 1% level when ROA and ROE are the dependent variables, while there is no significance for revenue growth and visibility. *Operating Efficiency* has a positive and significant effect on ROA, ROE and revenue growth when relationships with other financial institutions are lagged by one or two periods. The effects of Age^2 are significant for revenue growth, showing an inversed U-shaped relationship: revenue growth is strong and positive in early years, then slows down. For *Size*, the

effect is always positive and significant at the 1% level for revenue growth, while for ROA and ROE the effect is positive and significant when studying the effect in t and $t + 1$ of relationships with financial institutions. *Age* has also a positive effect on *Gtrend*.

In Table 4, we show the effect of the extent of bank-FinTech relationships on performance, growth and visibility of newcomers; here, the variables of interest are *N_MinorInv_Bank* and *N_Partner_Bank*. In all the models, we control for the presence of banks' majority equity investments which exclude the entrance of other banks as majority shareholder. It is apparent that having relationships with several banks does not affect FinTech's performance when measured by ROA and ROE; the same holds for relationships with OFIs.

On the other hand, the number of banks who are simultaneously minority shareholder has a significant and positive effect on the revenue growth after two years (Model 21), with an increase of 0.39 standard deviations for a unit increase of *N_MinorInv_Bank*. On the contrary, *N_Partner_Bank* preserves its positive and significant effect on revenue growth in all considered periods, ranging from 0.2 to 0.39 standard deviations (Models 19, 20 and 21). *N_Inv_OFI* and *N_Partner_OFI* have both a positive and significant effect on revenue growth in Models 16 and 17 (at 1% and 5% significance level respectively).

As concern visibility, you can see that minority equity investments carried out by several banks have a positive effect on *Gtrend* in all considered periods, with an increase that range between 0.32 and 0.41 standard deviations for a unit increase of *N_MinorInv_Bank*. The number of banks with which FinTech firms establish partnership agreements do not affect their visibility, as also occur for *N_Inv_OFI* and *N_Partner_OFI*. As for the other control variables, results are very similar to Models 1 to 12.

The results shown in tables 3 and 4 could be in some way influenced by the extreme values registered in ROA and ROE, both on the left and right tail of the distributions, as also occurs for *Leverage* and *Operating Efficiency* (see the descriptive statistics reported in Table 2). As a robustness check, we apply a 90% winsorization on these variables to limit the potential distortive effect of such outliers. With this procedure, all data below the 5th percentile are set to the 5th percentile, and data above the 95th percentile are set to the 95th percentile; this effectively reduces the spread of variables and is supposed to lead to more robust results (Table A of the Appendix shows descriptive statistics after winsorization). We prefer pre-processing of variables to the exclusion of sample cases because in this way we can retain relevant information that would otherwise be lost (Nyitrai and Virág, 2019). After running random effects models with winsorized data, the main previous findings are confirmed with higher statistical significance (Table B and C in the Appendix).

Table 3. Panel data analysis for the variables of interest *MajorInv_Bank*, *MinorInv_Bank* and *Partner_Bank*, included as either contemporaneous or lagged by one or two periods (t, t-1 and t-2).

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.1232 (0.0815)	-1.1241 *** (0.1788)	-1.2481 *** (0.1922)	0.1958 ** (0.0883)	-0.5805 ** (0.2455)	-0.5584 * (0.2884)	-0.4049 *** (0.0816)	-1.1718 *** (0.162)	-1.3992 *** (0.2035)	-0.3861 *** (0.0829)	-0.4814 ** (0.1958)	-0.5561 **
MajorInv_Bank_t	-0.6105 ** (0.2914)	-	-	-0.4911 (0.3409)	-	-	-0.0772 (0.2543)	-	-	0.8927 *** (0.2803)	-	-
MajorInv_Bank_{t-1}	-	-0.414 (0.3366)	-	-	-0.156 (0.4489)	-	-	0.3699 (0.2911)	-	-	0.8092 ** (0.3674)	-
MajorInv_Bank_{t-2}	-	-	-0.7426 * (0.3945)	-	-	-0.2815 (0.5133)	-	-	0.7039 * (0.4246)	-	-	1.5150 *** (0.5356)
MinorInv_Bank_t	-0.3192 ** (0.1361)	-	-	-0.1933 (0.1657)	-	-	0.4175 *** (0.1151)	-	-	0.2602 ** (0.1286)	-	-
MinorInv_Bank_{t-1}	-	-0.2427 (0.1485)	-	-	-0.1566 (0.2059)	-	-	0.3819 *** (0.124)	-	-	0.3520 ** (0.1607)	-
MinorInv_Bank_{t-2}	-	-	-0.0043 (0.145)	-	-	0.0696 (0.2101)	-	-	0.3855 *** (0.1363)	-	-	0.2676 (0.1924)
Partner_Bank_t	-0.01 (0.1542)	-	-	-0.0811 (0.1878)	-	-	0.3025 ** (0.1311)	-	-	0.2265 (0.1411)	-	-
Partner_Bank_{t-1}	-	-0.0158 (0.1703)	-	-	-0.1914 (0.2411)	-	-	0.3402 ** (0.1426)	-	-	0.3144 * (0.1809)	-
Partner_Bank_{t-2}	-	-	0.0294 (0.2012)	-	-	0.0536 (0.293)	-	-	0.3949 ** (0.1917)	-	-	0.1264 (0.2572)
Inv_OFI_t	-0.2341 *** (0.0888)	-	-	-0.0898 (0.0999)	-	-	-0.0641 (0.0785)	-	-	0.1834 ** (0.0861)	-	-
Inv_OFI_{t-1}	-	-0.106 (0.0935)	-	-	-0.0254 (0.1223)	-	-	0.0911 (0.0827)	-	-	0.1472 (0.1026)	-
Inv_OFI_{t-2}	-	-	-0.0504 (0.0862)	-	-	-0.0142 (0.1217)	-	-	0.1387 (0.0869)	-	-	0.1892 (0.1157)
Partner_OFI_t	-0.2139 * (0.12)	-	-	0.0633 (0.1564)	-	-	0.3343 *** (0.1094)	-	-	0.4098 *** (0.1211)	-	-
Partner_OFI_{t-1}	-	0.1027 (0.1504)	-	-	0.0344 (0.2096)	-	-	0.3344 *** (0.1278)	-	-	0.2390 (0.1615)	-
Partner_OFI_{t-2}	-	-	0.0785 (0.1574)	-	-	0.1646 (0.2439)	-	-	0.1413 (0.1502)	-	-	-0.0301 (0.2052)

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Leverage	-0.4757 *** (0.0366)	-0.413 *** (0.0431)	-0.4276 *** (0.0407)	-0.1915 *** (0.044)	-0.1932 *** (0.0537)	-0.2164 *** (0.0564)	-0.018 (0.0317)	-0.0268 (0.0402)	-0.0386 (0.0438)	-0.0188 (0.0351)	-0.0244 (0.0478)	-0.0462 (0.0552)
Operating Efficiency	0.0133 (0.0296)	28.366 *** (3.8941)	30.4174*** (3.9012)	0.0061 (0.0402)	19.6486*** (5.3804)	19.5452*** (5.6005)	-0.008 (0.0242)	19.1823*** (3.3019)	27.0168*** (3.8182)	-0.0003 (0.0275)	4.5868 (4.2284)	3.6676 (5.2100)
Age	-0.0133 (0.0293)	-0.0084 (0.0357)	0.0082 (0.0399)	-0.061 (0.0366)	-0.0809 (0.0516)	-0.0921 (0.0636)	0.1572 *** (0.025)	0.1413 *** (0.0302)	0.1324 *** (0.0382)	0.0564 ** (0.0278)	0.0434 (0.0387)	0.0898 * (0.0528)
Age^2	0.0015 (0.0024)	0.0015 (0.0027)	0.0011 (0.0027)	0.0024 (0.0029)	0.0032 (0.0037)	0.0048 (0.004)	-0.0076 *** (0.0021)	-0.0071 *** (0.0023)	-0.0055 ** (0.0026)	0.0002 (0.0023)	0.0004 (0.0029)	-0.0026 (0.0036)
Size	0.2695 *** (0.0531)	0.2029 *** (0.0617)	0.0366 (0.0583)	0.2223 *** (0.0567)	0.2278 *** (0.0719)	0.0848 (0.0682)	0.4461 *** (0.0487)	0.5084 *** (0.0603)	0.4753 *** (0.0684)	0.2278 *** (0.0522)	0.2853 *** (0.0691)	0.3121 *** (0.0803)
R2	0.2781	0.301	0.3746	0.0656	0.0881	0.0903	0.4669	0.4988	0.4987	0.2715	0.2091	0.1974
Adj. R2	0.2655	0.2853	0.3558	0.0492	0.0676	0.063	0.4576	0.4875	0.4837	0.2587	0.1914	0.1732
N° observations	582	456	344	582	456	344	582	456	344	582	456	344
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Random effects panel regressions for four different dependent variables, i.e. *ROA*, *ROE*, *log(Rev_Growth)* and *Gtrend*. In models 1, 4, 7 and 10 relationships with banks and OFIs are considered as contemporaneous; in models 2, 5, 8 and 11 they are lagged one period; in models 3, 6, 9 and 12 they are lagged two periods. All variables concerning relationships with banks and OFIs are binary variables - see Table 1. All continuous variables are scaled; thus coefficients of these variables represent the impact on the dependent variable of one standard deviation's change. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

Table 4. Panel data analysis for the variables of interest *N_MinorInv_Bank* and *N_Partner_Bank*, included as either contemporaneous or lagged by one or two periods (t, t-1 and t-2).

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Intercept	0.067 (0.0797)	-1.1671 *** (0.1763)	-1.2522 *** (0.1923)	0.1841 ** (0.08384)	-0.5866 ** (0.2377)	-0.5584 * (0.2884)	-0.4577 *** (0.0786)	-1.1412 *** (0.1583)	-1.3992 *** (0.2035)	-0.3540 *** (0.0773)	-0.4216 ** (0.1871)	-0.5332 ** (0.2575)
MajorInv_Bank_t	-0.4646 (0.3077)	-	-	-0.4374 (0.3474)	-	-	-0.3661 (0.2647)	-	-	0.4106 (0.2888)		
MajorInv_Bank_{t-1}	-	-0.2479 (0.3577)	-	-	-0.0898 (0.4601)	-	-	0.0027 (0.3116)	-		0.1938 (0.3796)	
MajorInv_Bank_{t-2}	-	-	-0.7207 * (0.4202)	-	-	-0.2815 (0.5133)	-	-	0.7039 * (0.4246)			1.1285 ** (0.5703)
N_MinorInv_Bank_t	-0.0513 (0.0621)	-	-	0.0057 (0.0677)	-	-	0.0348 (0.056)	-	-	0.3212 *** (0.0584)		
N_MinorInv_Bank_{t-1}	-	-0.0573 (0.0675)	-	-	-0.044 (0.0885)	-	-	0.0383 (0.0631)	-		0.408 *** (0.0714)	
N_MinorInv_Bank_{t-2}	-	-	-0.0127 (0.1204)	-	-	0.0696 (0.2101)	-	-	0.3855 *** (0.1363)			0.3672 ** (0.1607)
N_Partner_Bank_t	0.0177 (0.0827)	-	-	-0.0024 (0.094)	-	-	0.2117 *** (0.0689)	-	-	0.0118 (0.0638)		
N_Partner_Bank_{t-1}	-	-0.0673 (0.1017)	-	-	-0.0354 (0.1295)	-	-	0.1966 ** (0.0866)	-		0.0427 (0.0821)	
N_Partner_Bank_{t-2}	-	-	-0.0401 (0.1009)	-	-	0.0536 (0.293)	-	-	0.3949 ** (0.1917)			-0.0635 (0.0986)
N_Inv_OFI_t	-0.0301 (0.0219)	-	-	-0.0267 (0.0252)	-	-	0.082 *** (0.0183)	-	-	0.0206 (0.0203)		
N_Inv_OFI_{t-1}	-	-0.014 (0.0224)	-	-	-0.01846 (0.0308)	-	-	0.0808 *** (0.0186)	-		0.0108 (0.0235)	
N_Inv_OFI_{t-2}	-	-	0.011 (0.0222)	-	-	-0.0142 (0.1217)	-	-	0.1387 (0.0869)			-0.014 (0.0296)
N_Partner_OFI_t	-0.0409 (0.0504)	-	-	-0.0574 (0.056)	-	-	0.1128 ** (0.0439)	-	-	0.0532 (0.0475)		
N_Partner_OFI_{t-1}	-	0.0599 (0.0721)	-	-	0.02273 (0.0722)	-	-	0.1514 ** (0.0679)	-		-0.0276 (0.0772)	
N_Partner_OFI_{t-2}	-	-	0.0408 (0.0807)	-	-	0.1646 (0.2439)	-	-	0.1413 (0.1502)			-0.0226 (0.1092)

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Leverage	-0.474 *** (0.0371)	-0.413 *** (0.0433)	-0.4205 *** (0.0408)	-0.1901 *** (0.0438)	-0.1944 *** (0.0532)	-0.2164 *** (0.0564)	-0.0056 (0.031)	-0.0025 (0.0399)	-0.0386 (0.0438)	-0.0114 (0.0344)	-0.0202 (0.0462)	-0.0443 (0.0551)
Operating Efficiency	0.0139 (0.0298)	29.142 *** (3.875)	30.633 *** (3.8869)	0.0059 (0.0402)	19.759 *** (5.2897)	19.545 *** (5.6005)	-0.0077 (0.0236)	18.665 *** (3.2198)	27.017 *** (3.8182)	-0.001 (0.0273)	3.1293 (4.0921)	2.8595 (5.1961)
Age	-0.0283 (0.0289)	-0.0205 (0.0348)	-0.0026 (0.0385)	-0.063 * (0.0362)	-0.0829 (0.0507)	-0.0921 (0.0636)	0.1355 *** (0.0237)	0.1289 *** (0.0284)	0.1324 *** (0.0382)	0.0782 *** (0.0268)	0.0677 * (0.0367)	0.125 ** (0.012)
Age^2	0.0031 (0.0024)	0.0023 (0.0026)	0.0016 (0.0026)	0.0027 (0.0029)	0.0034 (0.0037)	0.0048 (0.004)	-0.0059 *** (0.002)	-0.0065 *** (0.0021)	-0.0055 ** (0.0026)	-0.0006 (0.0022)	-0.0007 (0.0028)	-0.0047 (0.0035)
Size	0.2481 *** (0.0544)	0.2006 *** (0.0622)	0.0333 (0.0597)	0.2214 *** (0.0574)	0.2273 *** (0.0722)	0.0848 (0.0682)	0.3959 *** (0.0483)	0.4838 *** (0.06)	0.4753 *** (0.0684)	0.229 *** (0.0515)	0.2869 *** (0.0665)	0.3508 *** (0.0808)
R2	0.2599	0.2952	0.3694	0.0645	0.087	0.0903	0.4918	0.5194	0.4987	0.2921	0.2491	0.1966
Adj. R2	0.247	0.2793	0.3505	0.0482	0.0665	0.063	0.4829	0.5086	0.4837	0.2797	0.2322	0.1725
N° observations	582	456	344	582	456	344	582	456	344	582	456	344
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Random effects panel regressions for four different dependent variables, i.e. *ROA*, *ROE*, *log(Rev_Growth)* and *Gtrend*. In models 13, 16, 19 and 22 relationships with banks and OFIs are considered as contemporaneous; in models 14, 17, 20 and 23 they are lagged one period; finally, in models 15, 18, 21 and 24 they are lagged two periods. *MajorInv_Bank* is a binary variable, while all the other variables are count variables – see Table 1. All continuous variables are scaled; thus, coefficients of these variables represent the impact on the dependent variable of one standard deviation's change. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

5. Discussion

In this article we study if the presence of bank-FinTech relationships, categorized as majority or minority equity investments or partnership agreements, affect the performance, growth and visibility of FinTech firms, while also controlling for the possible effect of interactions with other financial institutions (OFIs) and other FinTech firms' characteristics. We also examine if the decision to interact with several banks can also play a role. Using a sample of 124 Italian FinTech firms observed over the period 2007-2019, we found that equity agreements negatively influence ROA in all periods, even if entering in relationships with several banks does not affect FinTech firms' performance. Less important is the presence of partnership agreements, which do not determine FinTech firms' performance. We found similar effects also for OFI-FinTech relationships.

A possible explanation for the short-term evidence we provide is that when FinTech firms access financial resources through big players like banks, they have the possibility to improve and expand their business activity by pursuing new projects and development plans (a similar result within the financial industry is obtained by Campa and Hernando (2006)). In a first phase, this growth strategy leads to weaker performance if the firm is not mature enough to cover incremental costs with consistent revenues; this especially occurs among start-up firms.

The fact that banks' majority investments have a stronger negative effect on operating performance than minority investment is not surprising: the higher is the equity share owned by the bank, the stronger is the necessity to align FinTech firms' processes and operations to bank's strategic objectives and regulatory requirements. In extreme cases, this could also mean rethinking the entire business model.

This finding suggests that there seem not any of economic advantage for banks and FinTech firms to interact through equity investments. If we consider the increase of equity investments in FinTech firms carried out by banks in recent years (KPMG (2018,2020) states that global investments in FinTech firms increased from 18.9 billion dollars in 2013 to 168 billion dollars in 2019), these results are important to investigate. Banks become shareholders of FinTech firms with a long-term perspective, tolerating negative performance in the short term with the idea that through their financial and managerial support FinTech firms' activity can grow rapidly. It is also feasible that the focus of equity agreements between banks and FinTech firms are synergies that can arise through the integration of tangible and intangible assets (such as the value of information assets and the value of the community), so that the related value may be transferred to shareholders in the medium term through other types of returns.

What is interesting is that all kind of bank-FinTech relationships have a positive effect on revenue growth. This gives empirical support to what it was theorized by, among the others, Bömer and Maxin (2018), Vives (2019) and Hornuf et al. (2020). First, the existence of equity or partnership agreements with banking institutions may allow FinTech firms to benefit from reputational spillover, thus gaining trust and credibility, which are fundamental in customer acquisition. Secondly, if equity or partnership agreements so provide, FinTech firms can reach a larger customer base and benefit from banks' cross-selling activity. It is also feasible that FinTech firms can increase revenues through white-labelling agreements, either by expanding their offering by distributing bank's products under their own brand, or by licensing their financial products and services to the bank. Furthermore, the strategic choice to establish partnerships with several banks seems to be beneficial for revenue growth in all considered periods, showing that enlarging relational networks further strengthens reputation and customer acquisition. To this purpose, less important for FinTech firms are minority equity investments carried out by multiple banks, which however turn to be determinant after two years. As concern relationships with OFIs, the presence and diffusion of partnerships positively affect revenue growth, even if the effect is registered only within the first year of the agreement, while OFIs' equity investments are important for FinTech firms' growth only when carried out by several OFIs.

The benefits of bank-FinTech relationships in terms of reputational spillovers, cross-selling activity and access to a larger customer base and wider distribution channels are also confirmed by the positive effect that the presence of at least a relationship with a bank have on newcomers' visibility, that is Google Trends data. In particular, for FinTech firms, equity agreements seem to be more useful than partnership agreements in increasing the awareness and willingness of customers to know, evaluate and, eventually, buy FinTech products, probably because they consider the presence of a bank who has "skin in the game" as a quality signal. This could also explain why only minority equity investments carried out by multiple banks can strengthen the positive effect on FinTech firms' visibility. The presence of equity and partnerships agreements with OFIs positively influence visibility only within the first year of the agreement, even if there is no effect when carried out by several OFIs.

Overall, when comparing FinTech firms' interaction with banks with those established with OFIs, we can observe that usually the effects on performance, growth and visibility go in the same direction, but with different intensity for OFI-FinTech relationships.

To conclude, similarly to previous studies in literature that study firms' performance, we found that leverage, operating efficiency, size and age play a role in determining the performance, growth and visibility of FinTech firms. In particular, more efficient FinTech firms register a higher

performance and revenue growth, probably because by operating at lower costs they can, *ceteris paribus*, offer a cheaper financial product or service to the market, attracting new clients and supporting revenue growth and, consequently, improving operating and overall performance. We can also observe a positive relationship between size and all our dependent variables, showing that larger FinTech firms are better structured, have a greater visibility, and can reach a greater market share, with a positive effect on growth and performance. As was expected, the leverage level negatively influences performance measures when operational margins are, on average, negative. Finally, the age seems to have an inversed U-shape relationship with revenues growth, showing that revenues growth is strong and positive in the early years and then slows down. This result enhances the previous conclusions concerning bank-FinTech relationships: through the establishment of equity or partnership agreements with banks, FinTech firms can seize the opportunity to sustain growth when it appears to be slowing down. As was expected, the age has a positive relationship with the visibility on the FinTech firms, since the longer they operate, the better they are well-known on the market.

6. Conclusions, implications and further research

The aim of this article is to study whether and how establishing relationships with banks can be beneficial for FinTech firms' performance, growth and visibility. Results reveal that banks' majority equity investments, which require FinTech firms to be subject to the management, coordination and control of the parent bank, have a negative impact on performance due to the higher costs of aligning operations and processes to the group's objectives and regulatory requirements. We can observe similar effects for banks' minority equity investments, although less persistent and of lower intensity. Less important for FinTech firms' performance is the establishment of partnership agreements.

Traditional performance measures based on profit and loss margins could be misleading when applied to FinTech firms, which are mainly start-ups and innovative SMEs with long growth paths and late break- even point achievement. If we move from traditional performance indicators and focus on their revenue growth and visibility, we can observe that these are positively affected by all types of bank-FinTech relationships.

We also found that FinTech firms with a longer market existence appear to be more profitable and that age, size and the existence of efficient processes contribute to greater revenue growth.

It is necessary to underline that costs and revenues in FinTech firms are not always correlated, investments are not always scalable and that their value can be represented by the

development of a community, the access to new information or customer base and which, therefore, can manifest itself in the long run. This explains the growing interest of banks in establishing relationships with FinTech firms, despite disappointing and negative ROE and ROA.

Our study has managerial and policy implications.

For FinTech firms' managers, our results suggest that engaging in all type of relationships with banks sustains their growth and allows them to gain visibility, but when deciding how to arrange agreements, they should consider that: i) partnership agreements with one or more banks has always a positive effect on revenue growth, ii) banks' minority equity agreements have also a positive effect on revenue growth, but they are associated to weaker performance measure, as usually occur when new financial resources are employed for growth purposes, and iii) the same effects of the previous point are observed for banks' majority equity investments, but occur more persistently and with stronger intensity.

On the other side, when dealing with FinTech firms, banks' managers should consider that equity investments have a negative effect on FinTech firms' performance. For this reason, banks should assess the economic viability of bank-FinTech relationships with a long-term orientation, considering at the same time that value does not always take the form of positive financial performance, but can also be represented by other types of returns, such as value of information assets, value of the community or value of cross-selling to customers. It is not excluded that benefits and synergies arising from different types of bank-FinTech relationships could be directly observable in bank's income statement, when FinTech's technologies and expertise are adopted by the bank. Finally, when engaging through majority equity investments, it is necessary to create an environment able to foster the activity of the acquired FinTech firm, avoiding that the typical high compliance and coordination costs of banking groups, as well as their less streamlined decision-making and operational processes, may hinder the value-enhancing potential of the FinTech company.

From a social perspective, bank-FinTech relationships may allow newcomers to rapidly deliver cheaper and innovative financial products to the market, reaching market segments with the greatest need for intervention. This can improve the efficiency and completeness of the financial system, enhancing its ability to meet the needs of segments traditionally underserved by traditional financial institutions, with benefits in terms of financial inclusion (Arner et al., 2020). This reveals important implications for the regulators, which should support the development of ecosystems where traditional and new financial intermediaries share ideas, information, technologies, product/services and customers, thus fostering the establishment and growth of FinTech firms and facilitate global financial competitiveness (Lee and Shin, 2018), while still

preserving financial stability. To this purpose, policymakers should understand the opportunities, risks and development stage of financial innovation and, consequently, develop multiple regulatory methods that ensure flexibility for FinTech firms, so that more formal methods are implemented in regulating mature technologies whose benefits and risks are clearer (Brummer and Yadav, 2019). Also, regulators should encourage the positive value associated to bank-FinTech relationships by ensuring that agility, flexibility, efficiency and innovativeness characterizing FinTech firms' business model are preserved even if newcomers are integrated in banking groups.

We acknowledge that our analysis has a limitation, thus offering avenues for further research. We focused our work on the Italian context, as we are interested in how bank-FinTech relationships can enhance performance and growth of newcomers in second mover financial systems, where digitalization of financial services started late and where FinTech phenomenon is at the forefront of its development. In this sense, the Italian case is particularly interesting, because financial innovation and FinTech entrepreneurship can be further hampered by its bank-based financial system, the lower financial literacy of the population and the presence of a high share of elders, which make bank-FinTech relationships crucial in increasing customers' willingness to buy FinTech firms' financial product and services, even for those with the lowest inclination towards innovation. This also means that our findings are partially driven by the young age of FinTech firms in the sample and this does not allow us to study the effect of bank-FinTech relationships in the long run.

For the future, we will replicate our analysis considering a longer period of observation of Italian FinTech firms, in order to better capture the long-term effects of bank-FinTech relationships, in particular as concern equity agreements. In fact, there is evidence in the literature that, in the financial industry, equity investments improve target firms' performance two years after the deal (Campa and Hernando, 2006). Also, further research could investigate the effect of bank-FinTech relationships on growth and performance of newcomers with an international sample, highlighting whether there are differences between bank-oriented countries that are first or second movers in FinTech entrepreneurship.

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Appendix

Table A. Summary statistics of panel data for 582 FinTech-year observations from 2007 to 2019. We applied a 90% winsorization on *ROA*, *ROE*, *Leverage* and *Operating Efficiency*.

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
<i>Dependent variables</i>					
ROA (%)	-17.9	-10.13	29.5	-87.8	24.9
ROE (%)	-49.9	-15	97	-344.6	57.5
Rev_growth	11.606	1	56.772	0	841.521
Gtrend	9.443	3.199	14.223	0	72.827
<i>Relationships with banks</i>					
MajorInv_Bank	0.019	0	0.136	0	1
MinorInv_Bank	0.103	0	0.304	0	1
N_MinorInv_Bank	0.168	0	0.753	0	10
Partner_Bank	0.071	0	0.256	0	1
N_Partner_Bank	0.124	0	0.558	0	6
<i>Relationship with OFIs</i>					
Inv_OFI	0.433	0	0.496	0	1
Partner_OFI	0.096	0	0.295	0	1
N_Inv_OFI	1.232	0	2.191	0	16
N_Partner_OFI	0.206	0	0.837	0	9
<i>Control variables</i>					
Leverage	0.503	0.509	0.333	0.024	1.14
Operating Efficiency	-0.46	-0.375	0.569	-1.55	0.428
Age	2.991	2	2.835	0	19
Size (€)	1,476,652	325,874	3,951,784	397	41,180,021

Table B. Panel data analysis for the variables of interest *MajorInv_Bank*, *MinorInv_Bank* and *Partner_Bank*, included as either contemporaneous or lagged by one or two periods (t, t-1 and t-2). We applied a 90% winsorization on *ROA*, *ROE*, *Leverage* and *Operating Efficiency*.

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.2638 *** (0.0721)	0.0238 (0.0896)	-0.1414 (0.1246)	0.2587 *** (0.0741)	0.2187 ** (0.0977)	0.1484 (0.1468)	-0.4012 *** (0.078)	-0.411 *** (0.0977)	-0.3067 *** (0.1329)	-0.5442 *** (0.1819)	-0.4774 ** (0.2301)	-0.4545 (0.2878)
MajorInv_Bank_t	-0.6971 *** (0.2662)	-	-	-0.4642 (0.2852)	-	-	0.0111 (0.2501)	-	-	0.921 *** (0.2815)	-	-
MajorInv_Bank_{t-1}	-	-0.5695 * (0.3219)	-	-	0.0299 (0.3542)	-	-	0.3883 (0.2886)	-	-	0.8091 ** (0.3681)	-
MajorInv_Bank_{t-2}	-	-	-1.2639 ** (0.4215)	-	-	-0.5354 (0.4643)	-	-	0.7404 * (0.4200)	-	-	1.5067 *** (0.5365)
MinorInv_Bank_t	-0.4058 *** (0.1248)	-	-	-0.2924 ** (0.1359)	-	-	0.4369 *** (0.1134)	-	-	0.2691 ** (0.1287)	-	-
MinorInv_Bank_{t-1}	-	-0.3927 *** (0.1432)	-	-	-0.2715 * (0.1601)	-	-	0.3859 *** (0.1228)	-	-	0.3528 ** (0.1608)	-
MinorInv_Bank_{t-2}	-	-	-0.1818 (0.1608)	-	-	-0.0479 (0.1882)	-	-	0.3761 *** (0.1346)	-	-	0.262 (0.1926)
Partner_Bank_t	-0.0815 (0.1409)	-	-	0.045 (0.1532)	-	-	0.3009 ** (0.1288)	-	-	0.2178 (0.1409)	-	-
Partner_Bank_{t-1}	-	-0.0875 (0.1646)	-	-	-0.1305 (0.1848)	-	-	0.3425 ** (0.1413)	-	-	0.3141 * (0.1812)	-
Partner_Bank_{t-2}	-	-	-0.0713 (0.2223)	-	-	-0.0562 (0.2592)	-	-	0.3799 ** (0.1892)	-	-	0.1332 (0.2575)
Inv_OFI_t	-0.2526 *** (0.081)	-	-	-0.2478 *** (0.0856)	-	-	-0.0449 (0.0774)	-	-	0.1893 ** (0.0868)	-	-
Inv_OFI_{t-1}	-	-0.111 (0.0884)	-	-	-0.1014 (0.0965)	-	-	0.0799 (0.0817)	-	-	0.1385 (0.1022)	-
Inv_OFI_{t-2}	-	-	-0.0484 (0.0936)	-	-	-0.0972 (0.1068)	-	-	0.1205 (0.0858)	-	-	0.1835 (0.1156)
Partner_OFI_t	-0.0911 (0.1176)	-	-	0.0296 (0.1278)	-	-	0.3533 *** (0.1077)	-	-	0.41 *** (0.1212)	-	-
Partner_OFI_{t-1}	-	0.074 (0.1451)	-	-	0.0863 (0.162)	-	-	0.321 ** (0.1269)	-	-	0.2392 (0.1620)	-
Partner_OFI_{t-2}	-	-	0.0602 (0.1745)	-	-	0.0791 (0.2062)	-	-	0.1531 (0.1483)	-	-	-0.0197 (0.2055)

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Leverage	-0.2376 *** (0.0353)	-0.246 *** (0.0419)	-0.3158 *** (0.0475)	-0.5087 *** (0.0381)	-0.4900 *** (0.0458)	-0.5691 *** (0.0534)	-0.032 (0.0327)	-0.0218 (0.0385)	-0.05953 (0.0444)	-0.0021 (0.0599)	-0.0211 (0.0782)	-0.0867 (0.0959)
Operating Efficiency	0.5945 *** (0.0358)	0.6523 *** (0.0412)	0.6769 *** (0.0461)	0.4500 *** (0.0387)	0.4981 *** (0.0457)	0.5191 *** (0.0527)	0.1651 *** (0.0242)	0.2394 *** (0.0367)	0.3125 *** (0.0415)	4.1307 (4.165)	4.3866 (5.2243)	0.5576 (6.2975)
Age	-0.0594 ** (0.0273)	-0.0133 (0.0346)	0.0208 (0.0445)	-0.0677 ** (0.0299)	-0.0857 ** (0.039)	-0.0617 (0.053)	0.1474 *** (0.025)	0.1414 *** (0.0301)	0.1241 *** (0.0379)	0.0515 * (0.0284)	0.0457 (0.0389)	0.0962 * (0.0532)
Age^2	0.0048 ** (0.0022)	0.0021 (0.0026)	0.0007 (0.003)	0.0033 (0.0024)	0.0046 (0.0029)	0.0041 (0.0035)	-0.0069 *** (0.0021)	-0.0071 *** (0.0023)	-0.0051 ** (0.0026)	0.0004 (0.0023)	0.0002 (0.0029)	-0.0029 (0.0036)
Size	0.1951 *** (0.0478)	0.1488 *** (0.0575)	0.0315 (0.061)	0.1523 *** (0.0492)	0.1192 ** (0.0602)	0.0494 (0.0649)	0.3906 *** (0.0479)	0.5038 *** (0.0602)	0.4898 *** (0.0675)	0.2222 *** (0.0527)	0.2889 *** (0.0695)	0.3167 *** (0.0803)
R2	0.4083	0.4309	0.4702	0.3776	0.3724	0.4003	0.4832	0.5087	0.5107	0.2722	0.2079	0.1963
Adj. R2	0.3979	0.4181	0.4543	0.3667	0.3583	0.3823	0.4741	0.4976	0.4961	0.2595	0.1901	0.1722
N° observations	582	456	344	582	456	344	582	456	344	582	456	344
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Random effects panel regressions for three different dependent variables, , i.e. *ROA*, *ROE*, *log(Rev_Growth)* and *Gtrend*. In models 1, 4, 7 and 10 relationships with banks and OFIs are considered as contemporaneous; in models 2, 5, 8 and 11 they are lagged one period; in models 3, 6, 9 and 12 they are lagged two periods. All variables concerning relationships with banks and OFIs are binary variables - see Table 1. All continuous variables are scaled; thus, coefficients of these variables represent the impact on the dependent variable of one standard deviation's change. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

Table C. Panel data analysis for the variables of interest *N_MinorInv_Bank* and *N_Partner_Bank*, included as either contemporaneous or lagged by one or two periods (t, t-1 and t-2). We applied a 90% winsorization on *ROA*, *ROE*, *Leverage* and *Operating Efficiency*.

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Intercept	0.1965 *** (0.0697)	0.025 (0.0894)	-0.116 (0.1244)	0.2144 *** (0.0712)	0.2046 ** (0.097)	0.1407 (0.1475)	-0.4499*** (0.075)	-0.4035*** (0.0976)	-0.2871 ** (0.1309)	-0.4371 ** (0.1757)	-0.3976 * (0.2204)	-0.4357 (0.2884)
MajorInv_Bank _t	-0.4896 * (0.2788)	-	-	-0.2923 (0.2933)	-	-	-0.2614 (0.2599)	-	-	0.4259 (0.2899)	-	-
MajorInv_Bank _{t-1}	-	-0.3763 (0.3402)	-	-	0.204 (0.3695)	-	-	0.0314 (0.3101)	-	-	0.1905 (0.3804)	-
MajorInv_Bank _{t-2}	-	-	-1.1303 ** (0.4399)	-	-	-0.464 (0.481)	-	-	0.2235 (0.4529)	-	-	1.1205 * (0.5713)
N_MinorInv_Bank _t	-0.1145 ** (0.055)	-	-	-0.017 (0.057)	-	-	0.0211 (0.0543)	-	-	0.3202 *** (0.0583)	-	-
N_MinorInv_Bank _{t-1}	-	-0.1346 * (0.0637)	-	-	-0.0726 (0.0693)	-	-	0.0401 (0.0626)	-	-	0.4084 *** (0.0714)	-
N_MinorInv_Bank _{t-2}	-	-	-0.2122 (0.1315)	-	-	-0.0613 (0.1535)	-	-	0.2999 *** (0.1138)	-	-	0.3651 ** (0.1608)
N_Partner_Bank _t	-0.0407 (0.0752)	-	-	0.0477 (0.0795)	-	-	0.2091 *** (0.0678)	-	-	0.0102 (0.0637)	-	-
N_Partner_Bank _{t-1}	-	-0.1512 (0.0969)	-	-	-0.0528 (0.1055)	-	-	0.1939 ** (0.086)	-	-	0.0425 (0.0821)	-
N_Partner_Bank _{t-2}	-	-	-0.1018 (0.1089)	-	-	-0.0243 (0.1232)	-	-	0.3099 *** (0.0966)	-	-	-0.0638 (0.0987)
N_Inv_OFI _t	-0.006 (0.0199)	-	-	-0.0523 ** (0.0212)	-	-	0.0843 *** (0.018)	-	-	0.0216 (0.0203)	-	-
N_Inv_OFI _{t-1}	-	0.0156 (0.0215)	-	-	-0.027 (0.0239)	-	-	0.0767 *** (0.0183)	-	-	0.0107 (0.0235)	-
N_Inv_OFI _{t-2}	-	-	0.0502 ** (0.0246)	-	-	-0.0041 (0.0296)	-	-	0.0412 ** (0.02)	-	-	-0.0128 (0.0295)
N_Partner_OFI _t	-0.0065 (0.0452)	-	-	-0.0361 (0.0471)	-	-	0.1108 *** (0.0428)	-	-	0.0527 (0.0474)	-	-
N_Partner_OFI _{t-1}	-	0.0753 (0.0675)	-	-	0.0711 (0.0718)	-	-	0.1466 ** (0.0676)	-	-	-0.0267 (0.0773)	-
N_Partner_OFI _{t-2}	-	-	0.0449 (0.0851)	-	-	0.0791 (0.096)	-	-	0.2207 ** (0.0903)	-	-	-0.0194 (0.1093)

	ROA			ROE			log(Rev_Growth)			Gtrend		
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Leverage	-0.2196*** (0.0355)	-0.2395 *** (0.042)	-0.3156 *** (0.047)	-0.4956 *** (0.038)	-0.4909 *** (0.0457)	-0.573 *** (0.0534)	-0.0228 (0.0318)	-0.0131 (0.0379)	-0.0599 (0.0432)	0.0012 (0.0584)	-0.0235 (0.0758)	-0.0819 (0.0955)
Operating Efficiency	0.6135 *** (0.0362)	0.6691 *** (0.041)	0.6803 *** (0.0456)	0.4634 *** (0.0387)	0.5078 *** (0.0452)	0.5244 *** (0.0523)	0.1516 *** (0.0324)	0.2265 *** (0.0359)	0.2997 *** (0.0406)	2.2111 (4.0953)	2.3717 (5.0511)	-0.1093 (6.2862)
Age	-0.0955 *** (0.027)	-0.0436 (0.0348)	0.0075 (0.0431)	-0.081 *** (0.0295)	-0.0951 ** (0.0507)	-0.0721 (0.0523)	0.1305 *** (0.0236)	0.1303 *** (0.0284)	0.1203 *** (0.0353)	0.0755 *** (0.0271)	0.0693 * (0.0369)	0.13 ** (0.0516)
Age^2	0.0069 *** (0.0024)	0.0036 (0.0026)	0.0011 (0.0029)	0.0044 * (0.0024)	0.0052 * (0.0029)	0.0047 (0.0034)	-0.0056 *** (0.002)	-0.0065 *** (0.0021)	-0.0054 ** (0.0024)	-0.0005 (0.0022)	-0.0008 (0.0028)	-0.0049 (0.0035)
Size	0.1535 *** (0.0485)	0.1328 ** (0.0581)	0.0135 (0.0618)	0.1449 *** (0.0497)	0.1158 * (0.0607)	0.041 (0.0664)	0.3443 *** (0.0475)	0.4792 *** (0.06)	0.4543 *** (0.0676)	0.2265 *** (0.0519)	0.2889 *** (0.0669)	0.3535 *** (0.0808)
R2	0.3901	0.4274	0.4775	0.3699	0.3704	0.3996	0.5035	0.5262	0.533	0.2924	0.2483	0.196
Adj. R2	0.3794	0.4145	0.4618	0.3589	0.3562	0.3815	0.4948	0.5156	0.519	0.28	0.2314	0.1719
N° observations	582	456	344	582	456	344	582	456	344	582	456	344
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Random effects panel regressions for three different dependent variables, i.e. *ROA*, *ROE*, *log(Rev_Growth)* and *Gtrend*. In models 13, 16, 19 and 22 relationships with banks and OFIs are considered as contemporaneous; in models 14, 17, 20 and 23 they are lagged one period; finally, in models 15, 18, 21 and 24 they are lagged two periods. *MajorInv_Bank* is a binary variable, while all the other variables are count variables - see Table 1. All continuous variables are scaled; thus, coefficients of these variables represent the impact on the dependent variable of one standard deviation's change. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

FinTech and sustainability: does FinTech firms' SDG-orientation play a role in bank-FinTech relationship?

Abstract

Digital finance and FinTech play a role in the pursuit of the Agenda 2030, a plan of action for people, planet and prosperity that integrates economic, environmental and social issues introduced in 2015 by the United Nations (UN). Leveraging on new technologies, FinTech firms may contribute to UN's Sustainable Development Goals (SDGs) thanks to their ability to redirect financial resources towards more sustainable uses and to mitigate financial exclusion. However, this contribution may be hampered by their typical start-up phase, in which failures often occur. Cooperation with traditional financial institutions, in particular with banks, can support newcomers FinTechs in their development and growth path, thus strengthening their potential contribution to sustainable development.

The connection between FinTech firms' contribution to sustainability and bank-FinTech relationship is yet underexplored. This paper aims to fill some of this gap by studying if SDG-orientation of FinTech firms affects the likelihood of establishing one or more bank-FinTech relationships and if this effect differs between various types of agreements.

Using a sample of 124 Italian FinTech firms, we provide evidence that FinTech firms' SDG-orientation positively affects the probability to observe at least one relationship with a bank, which is more likely to occur in equity agreement form. Therefore, sustainability orientation could be considered as strategic for FinTech firms and bank-FinTech relationship may be considered as an additional avenue in the pursuit of Agenda 2030 and, as such, should be considered by policymakers when they design new guidelines and regulations.

1. Introduction

The increase of extreme environmental and climatic disasters, both in frequency and intensity, and of risky elements that, directly and indirectly, impact on the lives of people around the world as well as the recent COVID-19 pandemic, have increased the attention to the adverse side-effects of economic growth. Sustainable development is a particular form of economic growth suitable to meet the needs of societies in terms of well-being in the short, medium and long term. Through the Brundtland Report entitled "Our Common Future", published by the World Commission on Environment and Development in 1987, the UN defined sustainable development as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". The transition to a sustainable economic model has become

a more urgent and priority objective since the UN Summit held in New York in September 2015; there, the leaders of 193 countries signed the Agenda 2030, a plan of action for people, planet and prosperity, that integrates economic, environmental and social issues embodied in 17 SDGs, further articulated in 169 targets (UN, 2015a). It is expected that all countries and stakeholders will implement the plan, by acting in a collaborative partnership.

Even if the role of the financial system in achieving a sustainable development path is not mentioned explicitly, there is a strong consensus that it can directly or indirectly support the transition to a sustainable economic model (Linciano et al., 2021). Traditional financial institutions and new financial players (e.g. FinTech firms) can support Agenda 2030 and its SDGs thanks to their potential to redirect financial resources towards more sustainable uses and to mitigate financial exclusion through services, products, strategies and initiatives (Ferrata, 2019; Moufakkir and Mohammed, 2019; Demir et al., 2020; Arner et al., 2020). In particular, many authors acknowledge that FinTech firms, by leveraging on new technologies, “democratize” finance because they bring to the market affordable, better and personalized financial services able to satisfy unmet needs of customers, in particular those belonging to underserved, excluded and unsatisfied segments, such as vulnerable households, micro and small-medium enterprises (MSMEs) and digital natives (Salampasis and Mention, 2018).

In the extant literature there are contributions investigating how FinTech firms may democratize financial services in the payments, savings, financing and insurance fields and their contribution to SDGs. However, FinTech firms’ potential contribution to sustainability is hampered by the gap between FinTech development and the usage of digital financial services, as well as by the economic and financial weakness of FinTech firms, that mainly are in their start-up phase in which premature failures often occur. As also outlined in the second contribution of this dissertation, cooperation with traditional financial institutions, in particular with banks, can help newcomers FinTechs in their development and growth path (Hornuf et al, 2020).

Therefore, bank-FinTech relationship foster FinTech firms’ growth and, if it concerns sustainability-oriented FinTech initiatives, then it also strengthens the role of financial institutions in promoting sustainable development models (Ozili, 2018; Moufakkir and Mohammed, 2019). However, the connection between FinTech firms’ contribution to sustainability and bank-FinTech relationship is still underexplored, but extremely important to investigate, since relationships between incumbents and newcomers may strengthen the role of the overall financial system in the underpinning of the Agenda 2030.

This study aims at filling some of this gap by investigating if the sustainability orientation of FinTech firms facilitates bank-FinTech relationships and if the effect differs between various

types of agreement (in particular, either equity or partnership agreements). To do so, we built a sample of 124 Italian FinTech firms; we carefully analysed their contributions to SDGs, relationships with banks and business models.

Results show that FinTechs' SDG-orientation positively affects the probability to observe at least one relationship with a bank, concluding that bank-FinTech relationship may be considered as a significant avenue in the pursuit of Agenda 2030 and, as such, should be included by policymakers in their guidelines and regulations. This holds for economic, social and environmental dimensions introduced by the Agenda 2030. This conclusion is strengthened by the evidence that FinTech firms contributing the most to sustainability and, in particular, to the economic pillar, are more likely to cooperate with banks through the highest degree of integration between parties (i.e. equity agreements) which usually imply a strong commitment of banks in sustaining FinTech firms' activity.

The contribution of our study is twofold. First, we empirically explore FinTech features, their sustainability and strategic alliances with banks in a single framework. These elements are usually considered separately, and only from a theoretical point of view, by the extant literature; also, these topics are still underexplored (Arner et al., 2020).

From a social perspective, even if Italy is a well-developed country, its sustainability performance is not completely satisfying and none of the SDG goals has been reached yet (Sachs et al., 2021)². Furthermore, in Italy the diffusion of digital financial services may be hindered by its bank-based financial system (Bank of Italy, 2020), the general low level of digital competences (Istat, 2021) and financial literacy (OECD, 2020) and the high incidence of elderly population (Eurostat, 2020). In this context, bank-FinTech relationships may be fundamental in fostering FinTech initiatives and in spreading the use of digital financial products among individuals and micro and small-medium enterprises (MSMEs), with positive effects on sustainability performance.

The article is structured as follows: in section 2, we present a literature review of extant research on FinTech and its contribution to the 17 SDGs, together with our research questions, in section 3 we describe data collection, variables and methodology, in section 4 we present and discuss our results and section 5 concludes.

² In the Sustainable Development Report 2021, Italy shows 5 SDG goals for which challenges are still unsolved, 9 goals for which significant challenges are still unsolved and 3 goals for which major challenges still unsolved.

2. Literature review

Due to the increasing awareness of the unsustainability of the current development model and the need for a change of pace in the progress of society, on 27th September 2015 the governments of the 193 UN member countries introduced the Agenda 2030, a plan of action for people, planet and prosperity, that integrates economic, environmental and social issues (UN, 2015a). The Agenda 2030 embodies 17 Sustainable Development Goals embedded within a broader program of action consisting of 169 targets, measurable through over 200 indicators, to be achieved in the economic, environmental, and social dimensions by 2030 (Table 1).

Table 1. The 17 SDGs and their dimension.

N.	Goal	Main target	Dimension
1	No poverty	End poverty in all its forms everywhere	Social
2	Zero hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Economic/Social
3	Good health and well-being	Ensure healthy lives and promote well-being for all at all ages	Social
4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Social
5	Gender equality	Achieve gender equality and empower all women and girls	Social
6	Clear water and sanitation	Ensure availability and sustainable management and sanitation for all	Economic/ Environmental/Social
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all	Economic/Social
8	Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Economic
9	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Economic
10	Reduced inequalities	Reduce inequality within and among countries	Economic/Social
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable	Environmental/Social
12	Responsible consumption and production	Ensure sustainable consumption and production patterns	Economic
13	Climate action	Take urgent action to combat climate change and its impacts	Environmental
14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Environmental
15	Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Environmental
16	Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Social
17	Partnership for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Economic/ Environmental/Social

Source: UN (2015), Rockström and Sukhdev (2015), TF on Digital Financing of the SDGs (2020)

The 17 SDGs formally replaced the 8 Millennium Development Goals (UN, 2000), agreed at the UN Millennium Declaration in year 2000 and to be achieved by 2015, but with a narrower scope. Important results were achieved through the Millennium Goals between 2000 and 2015, especially toward the reduction of extreme poverty; however, it was soon acknowledged that the poorest and most vulnerable individuals were left behind (UN, 2015b). In order to complete what was started with the Millennium Goals, the Agenda 2030 aims to end poverty, fight inequality, address climate change, and build peaceful societies that respect human rights, by simultaneously ensuring that nobody is left behind. The goals set for sustainable development have global validity and, as also underlined by SDG 17, require a strong cooperation between countries, institutions, governments, private sector and citizens (Kara et al., 2021).

2.1 Sustainability, financial and social inclusion and financial institutions

Even if there is not any explicit mention about the role of the financial system in achieving a sustainable development path, there is strong consensus that it can directly or indirectly support the transition to a sustainable economic model (Linciano et al., 2021). In particular, traditional financial institutions and new financial players (e.g. FinTech firms) can support Agenda 2030 and its SDGs thanks to their potential to redirect financial resources towards more sustainable uses and to mitigate financial exclusion through services, products, strategies and initiatives (Ferrata, 2019; Moufakkir and Mohammed, 2019; Demir et al., 2020; Arner et al., 2020). The first channel consists in the integration of social and environmental considerations in financial institutions' culture, strategy and decision-making processes. More specifically, the Final Report of the HLEG on Sustainable Finance (2018) and subsequently the "Action Plan: Financing Sustainable Growth" released by the European Commission in 2018 highlight the importance of the commitment of financial institutions to redirect existing resources towards sustainable uses through their investment, lending and insurance activities, serving the Agenda 2030 over the medium to long term.

The role of the governance of financial institutions is crucial in aligning their activity to the Agenda 2030 by ensuring the inclusion of sustainability issues in the decision-making process, highlighting the interdependency between sustainable development, SDGs and ESG factors (*Environmental, Social, Governance*) (Sciarelli et al., 2021). These practices, largely encouraged by regulators, include long-term investment approaches, which aim to create value for the investors and for the entire society through selection and allocation strategies that integrate traditional financial analysis with ESG criteria (*Sustainable and Responsible Investments*) (European Commission, 2021), the incorporation of ESG factors in lending institutions' credit risk

appetite and risk management policies and procedures, thus expanding the traditional creditworthiness assessment of borrowers with their potential exposure to ESG-related risks and possible mitigation strategy, in particular physical and transition risks due to climate change (EBA, 2020), and the integration of ESG considerations and factors into insurers' activity, including investment advice, product oversight and governance, risk management and suitability assessment procedures (European Commission, 2021).

The second possible contribution of the financial system to the achievement of SDGs is by mitigating financial exclusion. The European Commission (2008) defined financial exclusion as *“a process whereby people encounter difficulties accessing and/or using financial services and products in the mainstream market that are appropriate to their needs and enable them to lead a normal social life in the society in which they belong”*. Therefore, there is a strong relationship between the difficulty to accessing financial services and being socially excluded (Carbo et al., 2007). Financial inclusion, and in particular fostering access to payments, credit, savings and insurance services, supports poverty reduction, enables people to reduce vulnerability through the stabilization of their cash-flows, to invest in education and health and to cope with unforeseen emergencies (Mehrotra, 2019); also, it improves the fulfilment of financial obligations and supports economic growth through the financing of entrepreneurship and SMEs (Ozili, 2018; Moufakkir and Mohammed, 2019; Arner et al. 2020). The important role of financial inclusion in reaching numerous SDGs is also underlined in the third Financial Inclusion Action Plans (FIAP), drafted by the Global Partnership for Financial Inclusion (GPFI) in 2017.

To such ends, FinTechs, as natural digital firms, leverage on the advantages allowed by the implementation of new technologies: (1) a better collection, management and analysis of data, (2) the reduction of intermediation costs and (3) the possibility to introduce new forms of intermediations and customer-centric business models (UN Task Force on Digital Financing of the SDGs, 2020). Overall, this brings to the market affordable, better and personalized financial services which can satisfy unmet needs of customers, in particular those of underserved, excluded and unsatisfied segments, such as vulnerable households, MSMEs and digital natives (Salampasis and Mention, 2018). FinTech firms are recognised to have an important role in democratising a wide range of financial services, as listed above, especially among MSMEs and low-income households, and in creating greater social value than conventional banking can (Milne and Parboteeah, 2016; Hua and Huang, 2020).

2.2 Payment services

Fuelled by the spread of internet and mobile devices even among the poorest (Ozili, 2018) and the increasing consumer comfort with online financial transactions and the general acceptance of new technologies (CGFS-FSB, 2017; FSB, 2019), FinTech firms are contributing to the expansion of mobile money, i.e. the use of mobile phones to deposit, transfer and withdraw money without having a bank account (Suri, 2017), thus offering affordable payment services due to lower regulatory and risk exposure costs. Within the payment segment, and especially in developing countries, FinTech firms promote the access to formal financial services (Ozili, 2018), in particular to payment accounts, which are the first step towards financial inclusion of individuals, households and MSMEs (Gautam, 2019). Having a payment account allows people to store, send and receive money, also in the form of remittances (Gomber et al. 2018; Gautam, 2019), by accumulating savings and producing the necessary information for their assessment and to access other financial services, such as loans and insurance, which are crucial in starting a business, invest or save for education, manage risk and cope with unexpected financial distress, with an overall improvement of financial resilience, quality of life and income equality (Ouma et al., 2017; Gosavi, 2018; Bongomin and Ntayi, 2019; Demir et al., 2020). Furthermore, payment services provided by FinTech firms help to reduce risks of loss, theft, corruption and other financial crimes due to cash-based transactions (Mhlanga, 2020).

2.3 Financing services

In the financing field, FinTech firms contribute to SDGs through financial inclusion in two ways. First, the implementation of sophisticated credit risk assessment algorithms that consider non-traditional, unstructured and accurate customer data (Berg et al., 2020), such as those retrieved from social media, user behaviour when using apps and websites, e-commerce platforms, geo-localization and telcos companies (also known as *digital footprints*), can lead to a better understanding of the financial position of each customer, potentially reducing information asymmetries and credit rationing or exclusion due to the application of traditional, standard and, sometimes inappropriate, risk assessment and management methods typical of banks (Donald, 2020; Mhlanga, 2020; Hua and Huang, 2020). Some authors argue that the ability to consider more information in creditworthiness assessment may also lead to lower interest rates for borrowers (Jagtiani and Lemieux, 2019). Second, FinTech firms offering crowdfunding platforms, in particular equity- and lending-based crowdfunding platforms, have introduced a new intermediation model aimed at facilitating a direct financial exchange between investors and individuals or firms seeking for funds, giving to the latter the opportunity to realize their projects

through a new financing channel able to serve untapped customer segments and to complete the market (Dai, 2020; Jagtiani and Lemieux, 2018; Gomber et al, 2018). Crowdfunding platforms mainly operate online, without the necessity to open branches and to hire employees, thus facing lower operating costs with respect to traditional bank (Lee and Shin, 2018), and they are not expected to hold huge capital reserves, since they usually do not undertake risks (Odinet, 2018), so that individuals and SMEs can access less expensive financing products. Overall, the contribution of FinTech firms to financial inclusion can, in turn, stimulate entrepreneurial activity, with a positive effect on job creation, innovation and economic growth (Kara et al, 2021). If fundraising is also intended to, for example, woman entrepreneurship (Saputra et al., 2019), business ideas in support of sustainable and circular production systems, renewable energies and medical research, the financing of education, medical or other unexpected expenses or the purchase of necessary goods or other personal or charitable initiatives in support of environmental and social causes, then FinTech firms also contribute to redirect financial resources towards more sustainable uses (Macchiavello and Siri, 2020).

2.4 Investment services

Turning to investment services, FinTech firms are contributing to sustainable development by offering innovative digital solutions focused on MSMEs' resource planning. These include business financial manager software and treasury management services, that, for example, allow MSMEs to create and archive invoices, receipts and other documents, track income and expenses, calculate and manage tax declarations and payroll and check comprehensive reports on business performance, in order to gain real time visibility of cash flows, to easily identify potential problems and quickly determine the appropriate action to take, reducing the risks to which they are exposed (Pooley, 2020). These services are usually offered on a pay-per-use basis, allowing MSMEs to affordably reach the optimization of cash flows, a greater ability to manage all aspects of their business and the achievement of longer-lasting financial relationships with customers (Pizzi et al. 2021). Also, these tools are important sources of reliable information to be used for loan application purposes, allowing MSMEs to be more likely to be eligible (Donald, 2020). Again, these digital financial products may improve the resilience of MSMEs, supporting innovation, job creation and economic growth. Still, in the investments field, FinTech firms contribute also to financial inclusion by enlarging the range of affordable saving options available to investors, allowing them to invest small amount of money for a short period of time (Chuen, 2018). In particular, robo-advisors can target underserved investors, providing web-based portfolio management services with almost zero human intervention and using algorithms powered by

artificial intelligence that reduce the cost for personalized advice, thus meeting the needs of investors with small assets available for investments, especially where cost-efficient investments products are not actively offered to retail segment by traditional financial institutions (Schwinn and Teo, 2018). On the whole, digitalization of investment services may strengthen capital markets through enhanced savings rates (Arner et al., 2020) and improve the asset allocation of retail investors, in particular for those with low financial literacy and with limited knowledge of investing, who are more likely to held unfruitful cash-holdings (Agarwal and Chua, 2020). The expansion of saving options may reduce poverty and inequalities by allowing people to invest and cope with unexpected financial shocks, and to shift excess wealth for retirement purposes, with an improvement in consumption smoothing (Schwinn and Teo, 2018). This also means that saving rates may increase, bringing new financial resources into the financial system which can in turn support innovation, MSMEs development, human capital and infrastructure; in fact, some FinTech firms offer to investors the possibility to allocate their resources in ESG-related investment products, thereby underpinning attainment of the UN SDGs (Arner et al., 2020).

2.5 Insurance services

Finally, FinTech firms operating in the insurance segment, also known as InsurTech firms, contribute to SDGs by introducing new and cost-effective insurance products targeting unserved markets. InsurTech products include microinsurance, i.e. low-priced tailored products to low-income people, and peer-to-peer insurance, which makes individuals pool together to share risks; if no claims occur during the coverage period, then members can get back a part of their premiums, making insurance more inclusive and affordable to high risk groups that are difficult to cover in traditional insurance (Abdikerimova and Feng, 2021). Also, specific products are addressed to customers that are not continuously exposed to risks, such as on-demand insurance and usage-based insurance, which fulfil the need of temporary and less expensive coverage (Nicoletti, 2021). Furthermore, InsurTech firms play an important role in widening the spectrum of insurable risks and customers thanks to their ability to incorporate new and innovative source of data in their actuarial assessments of customers. For example, through the inclusion of meteorological information, images, geospatial and other ESG-related risks information, they can offer coverage against weather events, allowing households, farmers, entrepreneurs and MSMEs operating in climate-sensitive sectors to manage climate risk and increase their resilience to negative economic shocks caused by climate change (Volz et al., 2020). Also, the possibility to exploit data retrieved from networked devices (i.e. Internet of Things technology), such as drive behaviour, sport and dietary habits, data breach and other risk expositions, reduces information asymmetries and allows

InsurTech firms to accurately assess every kind of customers, thus potentially including people and MSMEs without insurance history or which are traditionally associated to riskier groups through personalized and fairly priced life and non-life insurance products (McFall and Moor, 2018). Overall, InsurTech firms' activity is contributing to reduce the risks to which households and firms are exposed and, consequently, to build more resilient societies.

Because FinTech and InsurTech companies are mostly new players on the financial market and rely on digital technologies that are quite new, most of them are in a start-up phase. This phase of a company life cycle is characterized by substantial risks of failure. So, the contributions of such firms in reaching the UN SDGs may be hampered. Cooperation with traditional financial institutions, in particular with banks, can help newcomers in their development and growth path (Hornuf et al, 2020). Therefore, bank-FinTech relationship foster FinTech firms' growth and, if it concerns sustainability-oriented FinTech initiatives, then it also strengthens the role of financial institutions in promoting sustainable development models (Ozili, 2018; Moufakkir and Mohammed, 2019). However, the connection between FinTech firms' contribution to sustainability and bank-FinTech relationship, and in particular how the former influences the latter, are still underexplored. Given that bank-FinTech relationships may lead to benefits in terms of growth and visibility for newcomers (Bömer and Maxin, 2018; Klus et al., 2019; Hornuf et al., 2020), as also outlined in the second contribution of this dissertation, and given the consensus among academics on their contribution to SDGs, we argue that investigating this issue is important, since, if a positive relation emerges, bank-FinTech relationships may be considered as an additional tool in the pursuit of Agenda 2030, and, as such, should be considered by policymakers in their guidelines and regulations. Our purpose is to fill some of this gap by providing empirical evidence through the following research question:

RQ1. Does SDG-orientation of FinTech firms determine the presence of one or more relationships with banks?

Since bank-FinTech relationships can assume different degrees of interaction and integration between parties (Williamson, 1991), if interesting results emerge from the first research question, we are also interested in studying whether the role of SDG-orientation of FinTech firms in determining the presence of one or more relationships with banks can differ among partnership and equity agreements (Hornuf et al., 2020). So, we also address the following research question:

RQ2. Does the role of SDG-orientation of FinTech differs between various types of bank-FinTech relationship?

3. Data and methods

In this section, we describe our sample, data-collection strategy and variables, with particular attention to the measures of SDG-orientation of FinTech firms and to the methods used and our empirical models.

3.1 Sample and data

Our sample consists of 124 Italian FinTech firms selected through the Italian FinTech ecosystem report elaborated by Ernest and Young(2020). We limit our analysis to FinTech firms operating in payment, financing, investments and insurance segments, for which the extant literature contributed the most in terms of the understanding of their role in the pursuit of the Agenda 2030, thus excluding firms which are mainly technological providers of financial institutions (Tanda and Schena, 2019). All FinTech firms in the sample have an active website, which is fundamental in retrieving qualitative information, and are available in the Aida database, which is the largest source of financial information for Italian firms.

To study the role of SDG-orientation in determining the presence of one or more relationships with banks (RQ1) we built an unbalanced panel in which the 124 identified FinTech firms are observed over the period 2007-2019, with a total of 528 data-points. Similarly to Hornuf et al. (2020), we consider two possible dependent variables concerning the interaction between the two parties: (1) *Rel*, a binary indicator, equal to one when least a relationship with a bank is established for a specific FinTech and zero otherwise, and (2) *N_Rel*, a count variable which measure the number of banks with which a FinTech relates to; both variables are year-specific. Both variables are built regardless to the type of established relationships, considering equity and partnership agreements without distinction. The former are identified through FinTech firms' shareholding structure available in Aida, while the latter are identified through their websites, in particular looking at the press releases sections, and by checking news article on Fintastico and BeBeez, two online magazines that provide information on partnership agreements also for Italian firms, and by carrying out a Google search, including the name of all sampled FinTech firms followed by the term “partnership”, “partner”, “alliance” or “collaboration” .

We built SDG-orientation through a qualitative approach following a two-stage procedure. In the first stage, the contribution of each FinTech in the sample to SDGs was rated by relying on the information available on their website, by assigning a score from 0 to 3 for each pillar on which the Agenda 2030 is based (economic, social and environmental), where zero indicates the absence of a substantial contribution, while one, two and three points refer to, respectively, low, medium and high contribution. The choice to qualitatively assess SDG-orientation mainly comes from the

unavailability of non-financial declarations or social reports published by FinTech firms in the sample, probably because they usually are unlisted start-ups and, as such, are not obliged to draft and issue this kind of information. Being aware that this data-collection methodology may lead to bias due to subjectivity in the evaluation process, we tried to overcome this problem by engaging a panel of four independent experts who individually and independently assessed SDG-orientation of FinTech firm in the sample. Also, in order to obtain comparable evaluations, the experts were provided with the same supporting materials based on the extant literature, comprehensive of the list of SDGs, the related pillars, and the theorized avenues through which FinTech firms can pursue them in the payments, financing, investments and insurance fields. Once the evaluations were collected, in the second stage, we build our measures of SDG-orientation by also considering possible discrepancies in score assignment. In particular, for each FinTech firm in the sample we compute the following variables:

(1) *Economic_Score*, the mean of the scores given by the experts on the contribution to the economic pillar less half of its variance;

(2) *Social_Score*, the scores given by the experts on the contribution to the social pillar less half of its variance;

(3) *Environmental_Score*, the scores given by the experts on the contribution to the environmental pillar less half of its variance;

(4) *Sustainability_Score*, which resumes the overall contribution to SDGs and is computed as the mean of all the scores given by the experts less half of its variance; this way, the average scores assigned by the experts decrease as the discordance between them increases.

SDG-orientation measures are included in the analysis in different combinations in order to avoid multicollinearity problems.

We also consider some components of FinTech firms' business model for control purposes, since their *modus operandi* may be more or less in line with the cooperation deemed ideal by incumbents and, consequently, determines the likelihood of forming one or more bank-FinTech relationships (Schmidt et al, 2018). In particular, we built the variables:

(1) *Customers*, a categorical variable representing the type of customers to which financial products are offered; there are three possible level, i.e. "Business", if the FinTech only offers financial services to firms, "Consumer", if the FinTech only offers financial services to individuals, and "All", if customers are both firms and individuals and is considered as the base level (Laidroo et al., 2021);

(2) *Products*, a categorical variable representing the type of financial services offered, which has five possible levels: "Payments", "Financing", "Investments", "Insurance" and

“Diversified” (Tanda and Schena, 2019), where the last level refers to FinTech firms operating in more than one segment and “Payments” is considered as the base level;

(3) *Distribution*, a categorical variable based on distribution channel strategy that has two possible level: “Website Only”, if the FinTech firm distributes products and services only through their website, taken as base level, and “Multichannel” if the FinTech also exploits other distribution channels (such as mobile applications, APIs and devices) (Laidroo et al., 2021); diversification or specialization strategy in terms of customers, products and distribution channels, may determine different needs for skills, knowledge and resources from outside, as well as different degrees of scalability and attractiveness of the business, thus implying a higher or lower probability to establish one or more relationships with banks;

(4) *Intermediation_Model*, a categorical variable representing the intermediation model adopted by the FinTech firm composed of three possible levels: “Direct”, if the FinTech directly offers to customers its own financial products, “Platform”, if the FinTech offers an online marketplace where two opposite side of the market can meet, thus satisfying opposite needs, and “Broker”, if the FinTech distributes to customers financial services of other financial institutions, which is considered as the base level (Gimpel et al., 2018); the adopted intermediation model is associated with a major or minor operational necessity to establish one or more relationships with banks, representing, therefore, an important factor to be considered in our analysis.

Finally, we included some economic and structural features as control variables. More specifically, for a specific FinTech firm observed in a specific year we considered the logarithms of:

(1) *Avg_Rev_Growth_{3Y}*, a variable that measures the previous three years average revenue growth. In order to avoid extreme values in the distribution of the variable, we computed revenue growth as the increase or decrease in revenue compared to the year in which it reaches at least 10% of total assets (considered as base year); this computation method allows us to deal with the early years of FinTech firms, in which the product launch has not occurred yet or has recently taken place, both cases for which traditional measures of revenues growth could be unrepresentative;

(2) *Avg_Gtrend_{3Y}*, a variable that measures the previous three years average of the yearly Google Trend³ of FinTech firms in the previous three years, which is used as a proxy of their visibility;

³ In order to drawn reliable data from Google Trend, we searched each name of FinTech firms in the sample by applying topic, time, and geographical filters, thus considering only information regarding searches in the “Finance” field, starting from the year in which FinTech firms were established and limited to the Italian context.

(3) *Avg_Intangibles_{3Y}*, which measures the average incidence of intangibles on total assets of the previous three years and used as a proxy of technological innovation developed by FinTech firms;

(4) *Avg_Size_{3Y}*, the average total assets of the FinTech firm in the previous three years;

(5) *Age*, the years of business activity.

Depending on the FinTechs' or banks' perspectives, control variables concerning economic and structural features may play opposite roles in determining the presence of one or more relationships between them. High-growth, more visible, innovative, bigger and older FinTech firms may be characterized by a lower propensity to cooperate with banks, since they are better structured, have a stronger position and a longer experience in the market and need less support from outside for reaching a break-even point. On the other hand, the same characteristics can be of extreme interest to banks, who may be more inclined in establishing alliances with most promising, innovative and successful FinTech firms.

In order to explore if the SDG-orientation of FinTech firms affects the type of relationship established with banks (RQ2), we built a cross-sectional dataset starting from the panel dataset explained above. First, we built a sample of the identified bank-FinTech relationships, with a total of 72 records, 27 of which are partnership agreements and 45 are equity agreements. Here, the focus is on cooperation, thus a FinTech firm can be recorded two or more times if it established several partnership or equity agreements. This is our "treatment sample". Then, we built a "control sample" by excluding FinTech firms belonging to treated cases from the panel dataset. Finally, we applied the Propensity Score Matching (PSM) technique in order to match to each of the 72 bank-FinTech relationship 3 cases from the control sample through the Nearest Neighbour technique, which matches treated units to one or more control units that is/are closest in terms of distance measure computed with a logistic regression. More specifically, the matching is based on all control variables concerning business model and economic and structural features. The final cross-sectional dataset includes a total of 288 observations: 27 partnership agreements and their 81 matched control-cases, and 45 equity agreements and their 135 matched control-cases.

All variables from the panel dataset are kept in the cross-sectional dataset; we then add the variable *Type_Rel*, an ordinal categorical variable that takes the value of one when there are not bank-FinTech relationships (i.e. identifies control cases), two for partnership agreements and three for equity agreements. The order reflects the increasing degree of integration between parties that occurs when moving towards equity agreements. Table 2 provides definitions and sources of the variables in our datasets, while Table 3 and 4 provide, respectively, descriptive statistics of the variables in our panel and cross-sectional database.

Table2. Definition and source of the variables included in our datasets.

Variable	Description
<i>Dependent variables (bank-FinTech relationship)</i>	
Rel	Binary variable that takes the value of 1 if the FinTech firm cooperate with at least a bank in a certain year and 0 otherwise. Source: Aida, FinTech firms' website, Fintastico, BeBeez, Google.
N_Rel	Number of banks with which the FinTech firm cooperate in a certain year. Source: Source: Aida, FinTech firms' website, Fintastico, BeBeez, Google.
Type_Rel (*)	Ordinal categorical variable that takes the value of 1 if the FinTech firms is not engaged in relationships with banks, 2 if the FinTech firm becomes partner of a bank and 3 if a bank becomes major or minor shareholder of the FinTech firm. Source: Aida, FinTech firms' website, Fintastico, BeBeez, Google.
<i>Independent variables (SDG-orientation measures)</i>	
Economic_Score	Average contribution to economic SDGs based on the scores assigned by a panel of four experts, adjusted by subtracting half of their variance. Source: panel of experts.
Social_Score	Average contribution to social SDGs based on the scores assigned by a panel of four experts, adjusted by subtracting half of their variance. Source: panel of experts.
Environmental_Score	Average contribution to environmental SDGs based on the scores assigned by a panel of four experts, adjusted by subtracting half of their variance. Source: panel of experts.
Sustainability_Score	Average overall contribution to SDGs based on the scores assigned by a panel of four experts, adjusted by subtracting half of their variance. Source: panel of experts.
<i>Control variables (business model components)</i>	
Customers	Categorical variable with three possible levels based on the type of customers served: "Business", "Consumer" and "All". Base level: "All". Source: FinTech firms' website.
Products	Categorical variable with five possible levels based on the type of products offered: "Payments", "Financing", "Investments", "Insurance" and "Diversified". Base level: "Payments". Source: FinTech firms' website.
Distribution	Categorical variable with two possible levels based on the type of distribution channel exploited: "Website Only" and "Multichannel". Base level: "Website Only". Source: FinTech firms' website.
Intermediation_Model	Categorical variable with three possible levels based on the type of intermediation model adopted: "Direct", "Platform" and "Broker". Base level: "Broker". Source: FinTech firms' website.
<i>Control variables (FinTech firms' economic and structural features)</i>	
Avg_Rev_Growth _{3Y}	Logarithm of the previous three years revenue growth indicator for a certain FinTech firm and year. It assumes the value of 1 until revenues reach at least 10% of total assets (base year). In all subsequent years, it measures the increase or decrease in revenues compared to that base year. Source: Aida.
Avg_Gtrend _{3Y}	Logarithm of the previous three years average Google Trend for a certain FinTech firm and year. Source: Google.
Avg_Intangibles _{3Y}	Logarithm of the previous three years average incidence of intangibles on total assets for a certain FinTech firm and year. Source: Aida.
Avg_Size _{3Y}	Logarithm of the previous three years average total assets. Source: Aida.
Age	Age of the FinTech firm in years in the respective year. Source: Aida.

(*) Available only for cross-sectional database

Table 3. Summary statistics of our panel dataset with 582 FinTech-year observations from 2007 to 2019.

Continuous variables	Mean	Median	Standard Deviation	Minimum	Maximum
<i>Bank-FinTech relationship</i>					
Rel	0.165	0	0.371	0	1
N_Rel	0.354	0	1.212	0	11
<i>FinTech firms' SDG-orientation measures</i>					
Economic_Score	1.179	0.958	0.688	-0.375	3
Social_Score	0.582	0.625	0.544	-0.375	3
Environmental_Score	0.169	0	0.369	0	2.333
Sustainability_Score	0.494	0.364	0.402	-0.091	2.273
<i>FinTech firms' economic and structural features</i>					
Avg_Rev_Growth _{3Y}	0.383	0.301	0.381	0	2.513
Avg_Gtrend _{3Y}	0.444	0	0.556	0	1.794
Avg_Intangibles _{3Y}	0.078	0.057	0.081	0	0.301
Avg_Size _{3Y}	4.217	5.114	2.308	0	7.333
Age	2.991	2	2.835	0	19
Categorical variables (% of cases in the sample)					
<i>Business model components</i>					
<u>Customers:</u>	<u>Products:</u>	<u>Distribution:</u>	<u>Intermediation Model:</u>		
Business 31.45%	Payments 13.71%	Website Only 68.55%	Direct 46.77%		
Consumer 20.16%	Financing 49.19%	Multichannel 31.45%	Platform 45.97%		
All 48.39%	Investments 26.61%		Broker 7.26%		
	Insurance 6.45%				
	Diversified 4.03%				

Table 4. Summary statistics of our cross-sectional dataset with 288 observations: 27 partnership agreements, 45 equity agreements and a total of 144 control cases.

Continuous variables	Mean	Median	Standard Deviation	Minimum	Maximum
<i>FinTech firms' SDG-orientation measures</i>					
Economic_Score	1.110	0.792	0.645	0	3
Social_Score	0.579	0.333	0.516	-0.375	2.333
Environmental_Score	0.151	0	0.312	0	2.333
Sustainability_Score	0.471	0.364	0.359	0	2.273
<i>FinTech firms' economic and structural features</i>					
Avg_Rev_Growth _{3Y}	0.422	0.301	0.392	0	2.208
Avg_Gtrend _{3Y}	0.534	0.359	0.574	0	1.794
Avg_Intangibles _{3Y}	0.075	0.057	0.078	0	0.301
Avg_Size _{3Y}	4.208	5.056	2.363	0	7.106
Age	3.319	3	3.207	0	19
Categorical variables (% of cases in the sample)					
<i>Bank-FinTech relationship</i>	<i>Business model components</i>				
<u>Type Rel:</u>	<u>Customers:</u>	<u>Products:</u>	<u>Distribution:</u>	<u>Intermediation Model:</u>	
1 75%	Business 28.82%	Payments 27.08%	Website Only 61.11%	Direct 51.04%	
2 9.38%	Consumer 14.58%	Financing 43.75%	Multichannel 38.89%	Platform 45.14%	
3 15.62%	All 56.6%	Investments 20.48%		Broker 3.82%	
		Insurance 3.13%			
		Diversified 5.56%			

3.2 Methods

For testing if SDG-orientation of FinTech firms determines the presence of one or more relationships with banks, we use the panel dataset and implement two different random effect models, since our independent and control variables also include time-invariant information. The models differ in their dependent variable. In Model 1 the binary dependent variable *Rel*, is related to the probability of the *i*-th FinTech firm in year *t* to establish at least a relationship with banks through the logistic function:

$$\pi_{i,t} = \text{Prob}(y_{i,t} = 1 | \mathbf{x}) = \frac{1}{1 + \exp(\beta_0 + \sum_{j=1}^J \beta_j X_{i,t} + \sum_{k=1}^K \beta_k BM_{i,t} + \sum_{c=1}^C \beta_c FC_{i,t} + \varepsilon_{i,t})}$$

for $i = 1, 2, \dots, n$ and $t = 1, 2, \dots, T$ and where $\varepsilon_{i,t} = \mu_i + u_{i,t}$. Here $X_{i,t}$ are the time-invariant independent variables concerning the contribution of the i -th FinTech firm to SDGs, $BM_{i,t}$ are the time-invariant features of the i -th FinTech firm business model and $FC_{i,t}$ are the economic and structural features of the i -th FinTech firm in t . $\varepsilon_{i,t}$ is the error term composed by μ_i , which measures individual effects, and the idiosyncratic error $u_{i,t}$. The β parameters are estimated by numerically maximizing the log-likelihood function:

$$\mathcal{L}(\boldsymbol{\beta} | \mathbf{x}) = \sum_{i=1}^n \sum_{t=1}^T y_{i,t} \ln(\pi_{i,t}) + (1 - y_{i,t}) \ln(1 - \pi_{i,t})$$

with respect to $\boldsymbol{\beta} = [\beta_0, \beta_{j=1}, \dots, \beta_J, \beta_{k=1}, \dots, \beta_K, \beta_{c=1}, \dots, \beta_C]$.

In Model 2 the dependent variable is the count N_Rel ; therefore, we evaluate the probability of the i -th FinTech firm in t to establish a number of y relationship with banks through the Poisson function:

$$\pi_{i,t} = \text{Prob}(y_{i,t} = y | \mathbf{x}) = \frac{\exp(-\lambda_{i,t}) (\lambda_{i,t})^{y_{i,t}}}{y_{i,t}!}, \quad y_{i,t} = 0, 1, 2, \dots$$

for $i = 1, 2, \dots, n$ and $t = 1, 2, \dots, T$. We decided to implement a Poisson panel regression since unconditional variance of N_Rel is not over-dispersed.

Here $\lambda_{i,t} = \exp(\beta X_{i,t}) = \exp(\beta_0 + \sum_{j=1}^J \beta_j X_{i,t} + \sum_{k=1}^K \beta_k BM_{i,t} + \sum_{c=1}^C \beta_c FC_{i,t} + \varepsilon_{i,t})$, with $\varepsilon_{i,t} = \mu_i + u_{i,t}$ and where $X_{i,t}$, $BM_{i,t}$, $FC_{i,t}$ and $\varepsilon_{i,t}$ are the same variables explained for Model 1. In this case, the β parameters are estimated by numerically maximizing the log-likelihood function:

$$\mathcal{L}(\boldsymbol{\beta} | \mathbf{x}) = \sum_{i=1}^n \sum_{t=1}^T y_{i,t} \lambda_{i,t} - \exp \lambda_{i,t} - \ln(y_{i,t}!)$$

with respect to $\boldsymbol{\beta} = [\beta_0, \beta_{j=1}, \dots, \beta_J, \beta_{k=1}, \dots, \beta_K, \beta_{c=1}, \dots, \beta_C]$.

Both in Model 1 and in Model 2, the log-likelihood function is maximized by the Broyden, Fletcher, Goldfarb, and Shannon (or BFGS) second-order optimization. Beside parameters, we computed average partial effects (APE) for all independent and control variables, together with their robust standard errors and p -values, in order to evaluate the magnitude of the effect of SDG-

orientation, business model components and economic and structural features on the probability for FinTech firms to collaborate with one or more banks (Wooldridge, 2009). Also, for all models we computed some goodness of fit measures: McFadden's and Nagelkerke's pseudo-R², Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Furthermore, we computed the Wald test statistics against constant-only ("null") model, in order to test if all estimates are simultaneously statistically different from zero ("overall statistical significance").

In order to explore if SDG-orientation of FinTech firms affect the type of relationship established between banks and FinTech firms (RQ2), we used the cross-sectional database and introduce the third model. More specifically, in Model 3 we model the ordinal categorical variable *Type_Rel*, by representing the probability for the i -th FinTech firms to fall within the m ordered outcome through the ordinal logistic function:

$$\pi_{m,i} = \text{Prob}(y_{m,i} = m | \mathbf{x}) = \frac{1}{1 + \exp(-\kappa_m + \beta X_i)} - \frac{1}{1 + \exp(-\kappa_{m-1} + \beta X_i)}, m = (1, 2, 3)$$

for $i = 1, 2, \dots, n$ and where $\kappa_0 = -\infty$ and $\kappa_2 = +\infty$.

Here $\beta X_i = (\beta_0 + \sum_{j=1}^J \beta_j X_i + \sum_{k=1}^K \beta_k BM_i + \sum_{c=1}^C \beta_c FC_i + \varepsilon_i)$ where X_i , BM_i and FC_i are, respectively, SDG-orientation measures, business model components and economic and structural features, and where ε_i is the error term. The β parameters are estimated by numerically maximizing the log-likelihood function:

$$\mathcal{L}(\boldsymbol{\beta} | \mathbf{x}) = \sum_{i=1}^n \sum_{m=1}^3 I_m(y_i) \ln(\pi_{m,i}), \quad I_m(y_i) = \begin{cases} 1, & \text{if } y_i = m \\ 0, & \text{otherwise} \end{cases}$$

Also, in this case we computed APEs for each ordinal outcome, as well as all the appropriate goodness of fit, i.e. McFadden's and Nagelkerke's pseudo-R², Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), and Wald test.

4. Results and discussion

The results of Models 1 and 2 are shown in Table 5, while results of Model 3 are reported in Table 6. As you can see, we provide two version for each model, which consider separately the overall contribution of FinTech firms to SDGs and the single contribution to the economic, social and environmental pillar.

The first major result is that the overall contribution to SDGs has a positive influence on the probability to establish at least one relationship with a bank (Model 1a), significant at the 1% level; in particular for a one unit increase in *Sustainability_Score* the likelihood to observe a bank-FinTech relationship increases by 7.8% on average. If we consider separately the three

sustainability pillars introduced by the Agenda 2030 (economic, social and environmental), we can see that all of them positively influence the likelihood to observe a bank-FinTech relationship (Model 1b). In particular, the average effect of a one unit increase in *Economic_Score* is almost 2.7% and significant at the 5% level, while the effects of a one unit increase in *Social_Score* and *Environmental_Score*, are respectively 4.2% and 3.2% and significant at the 1% level. Furthermore, there is not any evidence that SDG-orientation affects the number of bank-FinTech relationships, since in Model 2a and 2b the coefficients of *Sustainability_Score*, *Economic_Score*, *Social_Score* and *Environmental_Score* are never statistically significant. Finally, as can be seen from Table 6, the overall contribution to sustainability has a positive effect on the establishment of both partnership and equity agreements (Model 3a); the effect is stronger for the latter, for which the coefficient is equal to 10.6% (outcome 3) and larger than the coefficient of 4.2% estimated for partnerships (outcome 2). However, when considering the contribution to the three pillars separately, we do not find significant differences between the two types of relationship, with the exception of *Economic_Score*, which shows a statistically significant effect at the 10% level only for equity agreements, with a coefficient of about 6.2% (Model 3b).

Overall, SDG-orientation of FinTech firms positively affects the probability of some relationships with banks, but not their diffusion. These results provide evidence that bank-FinTech relationships, which may be beneficial for the resilience of FinTech firms, represent an additional avenue through which both parties can make steadier and stronger the contribution of the financial system to sustainability. This holds for economic, social and environmental dimensions introduced by the Agenda 2030. This finding should also be considered in the light of evidence that FinTech firms which contribute the most to sustainability, and in particular to the economic pillar, are more likely to cooperate with banks through the highest degree of integration between parties, i.e. equity agreements; this usually implies a strong commitment of banks in providing new financial resources and enlarging the market share of the participated FinTech firm through reputational spillovers and the access to a wide customer base and distribution network, beyond the possibility to exploit synergies arising from the integration of tangible and intangible assets. This can further enhance the underpinning of the Agenda 2030 and its SDGs.

Other interesting results concern FinTech's business model components. In particular, firms that offer financial products to both businesses and individuals seem to have a higher probability (from 4.2% to 10.5%) to establish a strategic alliance with a bank compared to firms that choose to serve only one customer segment (Models 1a and 1b).

Table 5. Results of logistic panel regressions (*Rel*) and Poisson panel regression (*N_Rel*) - Models 1 and 2

Variable	Rel		N_Rel	
Model	(1a)	(1b)	(2a)	(2b)
Intercept	0.2128 *** (0.0056)	0.2019 *** (0.0036)	-1.6307 *** (0.2588)	-1.6298 *** (0.2518)
<u>SDG-orientation</u>				
Sustainability_Score	0.078 *** (0.0159)	-	0.3733 (0.5798)	-
Economic_Score	-	0.0271 ** (0.0109)	-	0.0472 (0.5477)
Social_Score	-	0.0423 *** (0.0107)	-	0.2803 (0.5627)
Environmental_Score	-	0.0324 ** (0.0141)	-	-0.3242 (0.6412)
<u>Customers</u>				
Business	-0.1053 *** (0.03)	-0.094 *** (0.0146)	-0.8416 (0.7381)	-0.9299 (0.7351)
Consumer	-0.023 (0.032)	-0.0439 *** (0.0119)	-1.4801 * (0.8348)	-1.7154 * (0.8829)
<u>Products</u>				
Diversified	0.1682 *** (0.0361)	0.2076 *** (0.0477)	-0.7429 (1.0769)	-0.749 (1.1664)
Financing	-0.2617 *** (0.03)	-0.2705 *** (0.0336)	-5.9932 * (3.6398)	-5.9286 * (3.5481)
Insurance	-0.253 *** (0.0698)	-0.2367 *** (0.0329)	-3.5314 ** (1.6169)	-3.644 ** (1.6459)
Investments	-0.1128 *** (0.036)	-0.1464 *** (0.0281)	-1.4701 (1.2557)	-1.3345 (1.1125)
<u>Distribution</u>				
Multichannel	-0.1072 *** (0.0249)	-0.0996 *** (0.0249)	-0.87 (0.8542)	-0.8127 (0.7867)
<u>Intermediation Model</u>				
Direct	-0.0205 (0.0343)	-0.0264 (0.0238)	-2.2137 * (1.1797)	-2.1939 * (1.1662)
Platform	0.031 (0.0729)	-0.0365 (0.027)	1.0024 (3.0695)	1.1094 (3.0238)
<u>Economic and structural features</u>				
Avg_Rev_Growth _{3Y}	-0.0065 (0.0074)	-0.0091 ** (0.0034)	0.0742 (0.1538)	0.076 (0.1563)
Avg_Gtrend _{3Y}	0.0193 (0.0174)	0.0376 *** (0.0071)	0.2416 (0.1906)	0.2329 (0.1891)
Avg_Intangibles _{3Y}	0.0029 (0.0067)	0.0142 *** (0.0054)	-0.0526 (0.1758)	-0.0498 (0.1757)
Avg_Size _{3Y}	0.0357 * (0.0198)	0.0254 *** (0.0087)	0.0049 (0.1775)	0.0065 (0.1764)
Age	0.0295 *** (0.0048)	0.0196 *** (0.0021)	0.2272 ** (0.1019)	0.2283 ** (0.1042)
N° observations	582	582	582	582
Wald χ^2	32.44 ***	76.04 ***	175.43 ***	201.79 ***
McFadden's R2	0.3322	0.357	0.1504	0.1504
Nagelkerke's R2	0.4034	0.4303	0.2232	0.2232
AIC	276.7014	271.6962	543.5135	547.4886
BIC	350.9314	354.6591	617.7435	630.4515
Firm effects	Yes	Yes	Yes	Yes

Note: Random effects regressions for two dependent variables, i.e. *Rel* and *N_Rel*. In Models 1a and 2a we implement the overall measure of SDG-orientation, while in Models 1b and 2b we separately consider the contribution to economic, social and environmental pillars. Average Partial Effects (APEs) are shown. Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

The choice to specialize in the consumer segment negatively affects the number of bank-FinTech relationships (Models 2a and 2b), with a coefficient ranging from -1.5 to -1.7% and significant at the 10% level. Specialization in the business segment is more negatively related to equity than partnership agreements (Models 3a and 3b), with statistically significant coefficients that range between -10.5% and -15.1% for the former and -4.4 to -6.3% for the latter. FinTech firms operating in the payment field (the base level of the variable *Products*) have a greater probability to cooperate with a bank with respect to those operating in financing, insurance or investments segments; the opposite occurs if the comparison is made with diversified FinTech firms, for which coefficients range between 16.8% and 20.8% in Models 1a and 1b, respectively, and are significant at the 1% level. Financing and insurance specializations are associated to a lower number of bank-FinTech relationships (Models 2a and 2b) and, together with investments segment, show a greater negative effect for equity than partnership agreements (Models 3a and 3b).

There is also evidence that FinTech firms that also exploit distribution channels other than their website have a 10 to 11% less probability to cooperate with at least a bank (Model 1a and 1b), even if there is not a significant effect on *N_Rel* and *Type_Rel*.

Finally, *Intermediation_Model* variable, which has “Broker” as base level, shows only that FinTech firms that do not have the characteristics to also offer the products of others, i.e. direct model, are less likely to develop relationships with multiple banks (Models 2a and 2b), especially in the form of equity agreements (Models 3a and 3b).

These results show that the diversification of customer segments and product range are factors that positively influence the establishment of bank-FinTech relationships, probably because they are associated to more areas of potential collaborations, thus increasing the attractiveness of FinTech firms for banks keen on strategic alliances. Also, the ability to serve different customers with heterogeneous needs may lead to benefits for both parties in terms of synergies and knowledge sharing. From the opposite perspective, this also justifies why cooperation with banks for specialized FinTech firms have a large and negative probability to occur in equity form. Among product specializations, the payment segment seems to be the most targeted by banks, probably because it represents the most mature field in which FinTech firms operate. Another meaningful result concerns the distribution strategy. In particular, FinTech firms that distribute their products via multiple channels are less likely to cooperate with banks, probably because they are already able to reach a large market share and do not need to expand it by partnering with banks. Finally, the distribution of products of other financial intermediaries is clearly associated to the need to complete the product range by establishing multiple bank-FinTech

relationships, even if this is true especially when comparing broker and direct intermediation models.

As concerns economic and structural features, it seems that the likelihood to establish at least one relationship with a bank is higher for FinTech firms that, in the previous three years, are characterized by larger dimension and market experience, as shown by the positive and statistically significant coefficients of *Avg_Size_{3Y}* and *Age* in Model 1a and 1b. Only in Model 1b we find a statistically significant effect of growth, visibility and innovativeness proxies characterizing FinTech firms in the previous three years.

Table 6. Results of ordered logit regressions (dependent variable *Type_Rel*) using the cross-sectional dataset - Model 3

Variable	Type_Rel		
	Outcome level	Model 3a	Model 3b
Intercept	No relationship	0.7552 *** (0.0221)	0.7546 *** (0.0219)
	Partnership agreement	0.0954 *** (0.0164)	0.0963 *** (0.0166)
	Equity agreement	0.1494 *** (0.0202)	0.1491 *** (0.0201)
<u>SDG-orientation</u>			
Sustainability_Score	No relationship	-0.148 ** (0.0676)	-
	Partnership agreement	0.0422 * (0.0219)	-
	Equity agreement	0.1058 ** (0.0476)	-
Economic_Score	No relationship	-	-0.0864 * (0.0482)
	Partnership agreement	-	0.0247 (0.0151)
	Equity agreement	-	0.0617 * (0.0341)
Social_Score	No relationship	-	0.1236 (0.0941)
	Partnership agreement	-	-0.0354 (0.026)
	Equity agreement	-	-0.0882 (0.0691)
Environmental_Score	No relationship	-	-0.0973 (0.0894)
	Partnership agreement	-	0.0279 (0.0254)
	Equity agreement	-	0.0695 (0.0647)

Variables	Type_Rel		
	Outcome level	Model 3a	Model 3b
<u>Customers</u>			
Business	No relationship	0.1484 ** (0.0612)	0.2147 *** (0.0566)
	Partnership agreement	-0.0439 ** (0.0195)	-0.0632 *** (0.0188)
	Equity agreement	-0.1045 ** (0.0445)	-0.1515 *** (0.044)
Consumer	No relationship	0.1053 (0.1087)	0.1133 (0.124)
	Partnership agreement	-0.0293 (0.032)	-0.0285 (0.0337)
	Equity agreement	-0.076 (0.0774)	-0.0848 (0.0911)
<u>Products</u>			
Diversified	No relationship	-0.0419 (0.1034)	-0.048 (0.1242)
	Partnership agreement	-0.0033 (0.0094)	-0.0034 (0.0099)
	Equity agreement	0.0452 (0.1126)	0.0514 (0.1334)
Financing	No relationship	0.5457 *** (0.0904)	0.5028 *** (0.1269)
	Partnership agreement	-0.0881 *** (0.0261)	-0.0935 *** (0.0218)
	Equity agreement	-0.4576 *** (0.1068)	-0.4093 *** (0.1352)
Insurance	No relationship	0.5993 *** (0.0901)	0.5943 *** (0.0881)
	Partnership agreement	-0.1117 ** (0.0563)	-0.1339 *** (0.0424)
	Equity agreement	-0.4876 *** (0.0933)	-0.4604 *** (0.1104)
Investments	No relationship	0.3199 *** (0.1179)	0.3824 *** (0.1044)
	Partnership agreement	-0.0206 (0.0416)	-0.0514 (0.0582)
	Equity agreement	-0.2993 *** (0.091)	-0.331 *** (0.0838)
<u>Distribution</u>			
Multichannel	No relationship	0.0272 (0.0954)	0.0432 (0.0946)
	Partnership agreement	-0.0076 (0.026)	-0.012 (0.0254)
	Equity agreement	-0.0196 (0.0694)	-0.0312 (0.0693)
<u>Intermediation Model</u>			
Direct	No relationship	0.4032 ** (0.1796)	0.541 *** (0.1786)
	Partnership agreement	-0.0595 *** (0.0168)	-0.0438 (0.0497)
	Equity agreement	-0.3437 ** (0.175)	-0.4972 ** (0.2242)

Variable	Type_Rel		
	Outcome level	Model 3a	Model 3b
Platform	No relationship	0.2589 (0.2693)	0.4577 * (0.2723)
	Partnership agreement	-0.0258 (0.0302)	-0.0219 (0.0396)
	Equity agreement	-0.2332 (0.2461)	-0.4359 (0.293)
<u>Economic and structural features</u>			
Avg_Rev_Growth _{3y}	No relationship	-0.0994 (0.0773)	-0.1129 (0.0767)
	Partnership agreement	0.0283 (0.0221)	0.0323 (0.0221)
	Equity agreement	0.0711 (0.0561)	0.0806 (0.0558)
Avg_Gtrend _{3y}	No relationship	-0.1082 * (0.0592)	-0.1117 * (0.0639)
	Partnership agreement	0.0308 * (0.0185)	0.032 (0.0199)
	Equity agreement	0.0773 * (0.042)	0.0797 * (0.0453)
Avg_Intangibles _{3y}	No relationship	0.2365 (0.5324)	0.2684 (0.5323)
	Partnership agreement	-0.0674 (0.1542)	-0.0769 (0.1553)
	Equity agreement	-0.1691 (0.3788)	-0.1916 (0.3779)
Avg_Size _{3y}	No relationship	-0.0045 (0.019)	-0.0045 (0.0179)
	Partnership agreement	0.0013 (0.0054)	0.0013 (0.0052)
	Equity agreement	0.0032 (0.0136)	0.0032 (0.0128)
Age	No relationship	0.0225 ** (0.0095)	0.0225 ** (0.0094)
	Partnership agreement	-0.0064 ** (0.0029)	-0.0064 ** (0.0029)
	Equity agreement	-0.0161 ** (0.007)	-0.0161 ** (0.0069)
N° observations		288	288
Wald χ^2		42.94 ***	42.52 ***
McFadden's R2		0.1348	0.1433
Nagelkerke's R2		0.1802	0.191
AIC		396.6678	397.0938
BIC		458.9381	466.6901

Note: Ordered logit regressions for the dependent variables *Type_Rel*. In Model 3a we implement the overall measure of SDG-orientation, while in Model 3b we separately consider the contribution to economic, social and environmental pillars. The Table shows the Average Partial Effects (APEs) of each independent variable on the three levels of *Type_Rel* (1 = No partnership; 2 = Partnership agreement; 3 = Equity agreement). Robust standard errors are in parenthesis. Significance levels: *, **, *** for 10%, 5% and 1% respectively.

In particular, for a 1% increase in *Avg_Revenue_Growth_{3Y}* the likelihood to establish a relationship with a bank decreases by almost 1%, significant at the 5% level. FinTech firms' visibility and innovativeness, approximated through the variables *Avgv_Gtrend_{3Y}* and *Avg_Intangibles_{3Y}*, show respectively a positive coefficient of 3.8% and 1.4% statistically significant at the 1% level. Economic and structural features do not affect the number of relationships with banks, with the exception of *Age* which preserves its positive and statistically significant effect of almost 23% also on *N_Rel*. As concern differences between equity and partnership agreements determinants, in Model 3a and 3b we can observe that older FinTech firms and those with greater visibility are more likely to receive investments from banks rather than establishing partnership agreements.

Overall, results show that FinTech firms that already own stronger growth capacity have less need to receive support from incumbent banks, which, on the other side, seem to be more interested in cooperating with more structured and experienced FinTech firms that had the opportunity to create, test and implement their technological innovations and have already gain visibility in the market, especially when opting for equity investments.

5. Conclusions, implications and further research

In September 2015 the governments of the 193 UN member countries introduced the Agenda 2030, a plan of action for people, planet and prosperity in order to deal with and overcome the unsustainability of the current development model. The Agenda embodies 17 Sustainable Development Goals (SDGs) to be achieved in the economic, environmental, and social dimensions by 2030. The goals have global validity and require a strong cooperation between countries, institutions, governments, private sector and citizens (Kara et al., 2021).

Old and new financial institutions can have an important role in supporting the transition to a sustainable economic model. By leveraging on new technologies, FinTech firms can contribute to the Agenda 2030 thanks to their ability to redirect financial resources towards more sustainable uses and to mitigate financial exclusion (Arner et al., 2020). However, this contribution may be hampered by their being in a start-up phase, when failures often occur. For this reason, cooperation with banks can help newcomers in their growth path, thus strengthening their potential contribution to the Agenda 2030. On the other hand, relationships with FinTech firms could accelerate and increase the sustainability of the financial activity carried out by traditional intermediaries.

In this paper we investigate if FinTech firms' SDG-orientation affect the presence of one or more relationship with banks and if such effect differs between various types of bank-FinTech

relationship, which we classify in equity and partnership agreements (Hornuf et al., 2020). Results show that FinTech firms' SDG-orientation positively affects the probability to observe at least one relationship with a bank, concluding that bank-FinTech relationship may be considered as an additional avenue in the pursuit of Agenda 2030.

This holds for economic, social and environmental dimensions introduced by the Agenda 2030. This conclusion is strengthened by the evidence that FinTech firms that contribute the most to sustainability, and in particular to the economic pillar, are more likely to strongly cooperate with banks through equity agreements, which usually imply a firm commitment of banks in sustaining FinTech firms' activity. The presence and diffusion of bank-FinTech relationships is also influenced by the diversification strategy of FinTech firms in terms of customers, products and distribution channels and by the adopted intermediation model.

Also other features, such as size, age, innovativeness and visibility play a role, showing that FinTech firms that already own stronger growth capacity have less need to receive support from incumbents, which, on the other side, seem to be more interested in cooperating with more structured and experienced FinTech firms.

Our findings have some implications FinTech firms' managers and policymakers.

FinTech firms' managers could derive several benefits from being oriented to sustainability; indeed, this should be considered as a strategic choice, since it is positively associated to the probability of establishing relationships with banks, which can support their development and growth path.

From a social perspective, bank-FinTech relationships may contribute to the efficiency and completeness of the financial market by delivering cheaper, innovative, of greater quality and personalized financial products to customers, thus tapping underserved, excluded and unsatisfied market segments.

Furthermore, SDG-orientation of FinTech firms, on one side, and its inclusion in banks' decision making concerning strategic alliances, on the other, could be useful for both in improving reputation, as well as acquisition and retention of customers, who are increasingly careful about sustainability and interested in financial products embodying economic, social and environmental issues.

Important implications also emerge for policymakers.

First, they should promote the spread of digital financial services because these are commonly recognized to offer strong support to the transition toward an inclusive financial system (Arner et al., 2020), and foster the development of ecosystems where FinTechs can be fostered through interactions with traditional financial institutions. More specifically, bank-FinTech

relationships, when involving sustainability-oriented initiatives, may be an additional tool in the pursuit of the 17 SDGs and, as such, should be considered by regulators in setting guidelines and regulations, and should be included in the assessment of financial institutions' commitment to sustainability.

Furthermore, bank-FinTech relationships boost innovation and sustainability within the financial industry, while still preserving confidence of customers, who can rely on the participation of trustworthy and experienced entities, i.e. banks.

We acknowledge that our study has some limitations, which offer possible future research avenues. First, we measured sustainability orientation of FinTech firms through a qualitative approach, by collecting opinions on their contribution to the economic, social and environmental SDGs from a panel of four independent experts. Even if this procedure reduces possible subjectivity bias, the processed information could still be incomplete, in particular as concerns the integration of sustainability issues in internal processes and policies. Future research can certainly benefit from the release of non-financial declarations or social reports by FinTech firms which, however, are not yet legally obliged to provide. Another possible limit of this study is its focus on the Italian market. On the one hand this is an interesting context to analyse, because FinTech initiatives may alleviate internal gaps and accelerate the path toward sustainability goals by 2030 but are still hampered by the typical bank-based financial system and the general low level of digital competences and financial literacy. On the other, Italian FinTech entrepreneurship is of recent development, thus resulting in a small sample of bank-FinTech relationships for answering our research questions. Also, it shall be stressed that our results are country specific and not easily generalized to countries with different financial market structures.

For the future, we will replicate our analysis to check if our findings and conclusions hold for a wider sample of bank-FinTech relationships. It would be also interesting to analyse determinants of bank-FinTech relationships through an international sample, in order to explore possible differences between advanced, developed and developing countries, in which digital finance and its contribution to financial inclusion and sustainability can be more or less pronounced.

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