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Abstract

The increasing pervasiveness of technology-driven firms that offer banking services has led to a growing pressure on traditional banks to modernize their core business activities. Banks attempt to confront the challenges of digitalization by cooperating with financial technology firms (fintechs) in various forms. In this paper, we investigate the factors that drive banks to form alliances with fintechs. Furthermore, we analyze whether such bank-fintech alliances affect the market valuation of banks. We provide descriptive evidence on the different forms of alliances occurring in practice. Using hand-collected data covering the largest banks from Canada, France, Germany, and the United Kingdom, we show that banks are significantly more likely to form alliances with fintechs when they pursue a well-defined digital strategy and/or employ a Chief Digital Officer. We evidence that markets react more strongly if digital banks rather than traditional banks announce a bank-fintech alliance. Finally, we find that alliances are most often characterized by a product-related collaboration between the bank and the fintech and that banks most often cooperate with fintechs providing payment services.

JEL-Codes: G210, G230, G340, M130.

Keywords: fintech, strategic alliance, entrepreneurial finance, financial institutions, banks.

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1. Introduction

Digitalization has already influenced many industries. Most recently, the banking industry – one of the most traditional and conservative sectors in the economy – has been confronted with potentially disruptive technology-driven innovations and Internet-based solutions. New ways to use technology in the financial industry aim at creating more customer-oriented and user-friendly digital applications. Many of these new banking solutions have been developed by startup companies typically referred to as *fintechs*, a portmanteau word combining "financial" and "technology". Current developments have the potential to reshape or even crowd out some of the business models of more traditional banks. To confront this threat, many traditional banks have engaged in strategic alliances with some of the newcomers. In this paper, we investigate what drives banks to engage in strategic alliances (including acquisitions)[1] with fintechs and the impact they have on banks.

The Financial Stability Board of the Bank for International Settlements defines fintech as "technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services" (European Banking Authority, 2017, p. 4). A lack of legacy infrastructure and comparatively low level of organizational complexity allows fintech firms to be more agile, innovate faster, and be more radical in their approach to innovate. In contrast, it appears to be more difficult for traditional banks to adapt to some of the new technological developments because they need to comply with more extensive regulatory

[1] Throughout this study, we use the term "alliance" to refer to any type of interaction between fintechs and banks. As will become clear below, alliances comprise full and partial acquisitions, product-related collaboration, and some other forms. Thus, alliances cover a broad spectrum of possible interactions with varying degrees of innovation. While some of the terms used here differ somewhat from Hagedoorn and Duysters (2002), overall, we take a similar approach in the context of externally sourcing innovative capacities.

requirements. Moreover, often a larger number of stakeholders needs to be convinced when adopting far-reaching organizational changes in a traditional bank. The sluggishness of traditional banks to adapt to digital challenges not only has implications at the individual bank level but can also affect the stability of the financial system.

Financial innovation, as measured by the filing of financial patents, has been increasing since the late 1970s (Lerner, 2002; Miller, 1986). Moreover, the financial industry had historically spent a large share of their expenses on information technology (IT), which reached over one third of all expenses in 1992 (Scott *et al*., 2017). One reason for the high share of IT expenses was that the financial industry employed computers early on as part of their business model. Historically, innovations like the ATM have led to changes in financial organizations (Merton, 1995). The quality of financial patents and financial innovations was, nevertheless, often considered low (Lerner *et al*., 2015). Hence, the financial industry was perceived as one of the least innovative. This has changed with the emergence of fintechs, which have pressured traditional banks to reinvent themselves and/or to engage in strategic alliances with the new competitors.

The academic literature on the bank-fintech alliances is still scarce. Until recently, scholars have mostly focused on certain developments in specific fintech sectors. For instance, D'Acunto, Prabhala, and Rossi (2018) investigated the performance of a robo-advice tool. Yermack (2017) was one of the first to analyze governance issues related to the blockchain. Only recently have scholars started to investigate the fintech market in its entirety. Haddad and Hornuf (2018) analyzed fintechs in 55 countries and provided evidence that markets witness more fintech formations when the economy is well-developed and venture capital is easily accessible. Other relevant factors for the formation of fintechs are access to loans, secure Internet servers, mobile telephone subscriptions, and the available labor force. Cumming and Schwienbacher (2016) found that

differences in the enforcement of financial regulation among startups and banks after the financial crisis contribute to venture capital investments in fintechs.

Puschmann (2017) provided a model to categorize the industry. Also, Navaretti *et al*. (2017) conducted a conceptual analysis on the relationship between fintechs and banks and found both that the "game is still open" and "a lot of work lies ahead" for the industry. A recent paper by Brandl and Hornuf (2017) ran a bank-fintech network analysis for Germany and found that most relationships turn out to be product-related collaborations. They argued that this is because most fintechs develop an algorithm or software solution, the value of which will only be determined over time when the software has been more thoroughly adapted to customer needs.

In this paper, we explore how banks cope with the digitalization of consumer services by technology-driven firms by establishing strategic alliances with them. We examine the drivers and extent to which banks interact with fintech firms. More precisely, we investigate the factors that have led banks to opt for different forms of alliances such as product-related collaborations and financial engagements. The latter may come in the form of a majority or minority equity stake in a fintech. We base our theoretical analysis on transaction cost theory (Coase, 1937; Williamson, 1981) and organizational theory, within the special context of technology developments (Teece, 1998; 1986). Our conjecture is that banks that have declared a digital strategy and employed a Chief Digital Officer (CDO) are more likely to initiate subsequently alliances with fintechs. Additional hypotheses on the relative preference of product-related collaborations over financial investments are also developed.

To test our hypotheses, we hand-collected detailed information on strategic alliances made over the period from 2007 to 2017 by the hundred largest banks in each of the following countries:

Canada, France, Germany, and the United Kingdom . We found 500 alliances during that period. Of these 500 alliances, the form of interaction could be unambiguously identified in 469 cases. Among these 469 alliances, 43% are financial engagements (with 39% minority interest investments and 4% full acquisitions); the rest are product-related collaborations (54%) and other forms of interaction (3%). During the sample period, 21% of the banks had a digital strategy, and 3% employed a CDO. Consistent with our hypotheses, banks that had a clearly defined digitalization strategy or employed a CDO initiated an alliance with a fintech 6–10% more often than those without. In absolute terms, this represents 0.6–1.4 more alliances per year. Regarding the type of alliance, financial engagements are more likely than product-related collaborations in the case of large banks and small fintechs. This finding is consistent with our hypothesis that larger banks have deeper pockets to buy fintech firms. Finally, digital banks experience a 3% cumulative abnormal return on average when engaging in a strategic alliance. Other types of banks benefit less from cooperating with fintechs, suggesting that they may not be able to integrate the fintech innovations in a similar way.

Our study contributes to the startup and banking literature in at least two ways. First, this is the first paper to analyze the extent and type of strategic alliances between banks and fintechs. We thereby analyze and explain the driving factors for the occurrence of alliances between banks and fintechs. Other studies have examined the fintech market more broadly (Haddad and Hornuf, 2018) without exploring whether and when fintechs interact with traditional financial institutions. Second, we conduct an event study to investigate the effect of bank-fintech alliances on the market valuation of banks. To the best of our knowledge, no empirical evidence exists so far about the benefits of bank-fintech alliances for banks.

The remainder of this paper is structured as follows. In the next section, we outline our theory and hypotheses. In Section 3, we describe our data and the methods we apply. The results are presented in Section 4. Section 5 provides a discussion, presents policy implications, and lists conclusions.

2. Literature review and hypotheses

Empirical evidence suggests that banks have been keen to enhance their profitability through financial innovation (Scott *et al*., 2017). Beck *et al*. (2016) showed that financial innovation is positively associated with bank growth. In line with these findings, we derive testable hypotheses about what drives bank-fintech interactions under the premise that alliances are the result of mutually beneficial transactions between banks and fintechs (Coase, 1960; Scott *et al*., 2017). These transactions are meant to improve the prospects of the bank and to enhance its value through the implementation of financial innovations. Put differently, bank-fintech alliances aim at improving the prospects and the market value of both fintechs and banks.

Fintechs might collaborate with banks for several reasons. Through an alliance with an established player from the financial industry, fintechs can obtain access to a broader customer base, gain access to superior knowledge in how to deal with financial regulation, and enhance their own brand awareness. Some fintechs engage in an alliance with a bank to obtain access to a banking license, which in many cases would be too cumbersome and too expensive for a fintech startup to obtain alone. On the other hand, banks might want to secure a competitive advantage by collaborating with fintechs that are developing or have already developed a better way to provide financial services. In some cases, completely acquiring a fintech firm may ensure a bank that it obtains an exclusive right to use a specific application or license and enables it to exclude competitors at its

discretion. Similar to industrial firms, banks can thereby protect their core businesses, (Hagedoorn and Duysters, 2002).

Many banks have adopted a digitalization strategy that outlines how digital transformation should occur. One way to execute this transformation is to assign responsibility for this process to a designated manager, and some banks have hence created the position of a CDO. While research has been conducted, for example, on the role of the Chief Executive Officer (CEO) and Chief Financial Officer (CFO) in earnings management (Jiang *et al*., 2010) or whether hiring a CFO changes fraudulent financial reporting (Geiger and North, 2006), little is known about the impact of hiring a CDO. This lack of research is most likely because the new board position was only recently established. Given the specific tasks assigned to the CDO and the context in which this position has been created, one might expect the CDO to predominantly develop in-house digitalization competencies and collaborate with fintechs only if it is the most cost-efficient solution. However, *ceteris paribus*, we expect banks with a CDO to also interact more frequently with fintechs than banks not having such a position. Similarly, we conjecture that banks with a clear digitalization strategy are more likely to initiate alliances with fintechs than banks without such a strategy. We summarize these predictions in our first hypothesis:

Hypothesis 1 (CDO and digitalization strategy): The employment of a CDO and the implementation of a digitalization strategy increases a bank's propensity to engage in an alliance with a fintech.

Since banks naturally pursue different strategic development plans, they might have different motives to engage in an alliance with a fintech. Given that it is too costly for many fintechs to obtain a banking license, they have decided to partner with banks that are sometimes startup firms

themselves. An example is the Berlin-based solarisBank, which was officially launched in 2016 after receiving a banking license. Some of these banks have specialized in the provision of IT services to corporate clients and extend their banking license to them. For example, fintechs offering crowdlending services often do not have a banking license to extend commercial loans (e.g., the German online platform Auxmoney). Once a loan is fully funded on a crowdlending website, the loan request is transferred to a partner bank (e.g., SWK Bank) that extends the loan to a borrower and then sells it to the lender (i.e., the crowd). This process works through application programming interfaces (APIs) and allows for a seamless customer experience. This type of banking is therefore often referred to as API-banking. Not surprisingly, API-banks are often more interested in a product-related collaboration with fintechs than a financial engagement.

Traditional banks have different motives when they engage in an alliance with fintechs. On the one hand, product-related collaborations enable banks to broaden their portfolio. Offering fintech services or applications on their websites potentially helps them to maintain their customer base without having to invent new specific services or applications themselves. Often, developing these services or applications alone would be a cumbersome task because many banks operate software systems that are barely compatible with modern end-user applications (Brandl and Hornuf, 2017). Moreover, since many fintechs offer software solutions, which must be customized to end-user needs and updated at regular intervals, acquiring a fintech is risky. Whether a fintech can achieve this task satisfactorily is uncertain and having the option to choose the software of another provider can be valuable. Waiting until the software solution has been customized and is running in the mass market might be a better strategy. By acquiring a fintech early on in the development or even commercialization phase, banks might thus easily bet on the wrong horse.

On the other hand, if banks wait too long, they might lose a valuable innovation to a competitor. Large banks have often deeper pockets than small banks and can also take the risk of acquiring fintechs at an early stage. A financial engagement (i.e., either partial or full acquisition) in a fintech allows banks to internalize the knowledge of the fintech and obtain sole possession of its knowledge (Teece, 1986). We therefore expect bank size to affect the form of alliances chosen and conjecture the following:

Hypothesis 2A (type of alliance): Large banks are more likely to acquire (partially or fully) fintech startups, while small banks engage in product-related collaborations.

The attractiveness of a financial engagement is likely to decline as a fintech grows. Indeed, larger fintechs typically have reached a certain maturity level that is beyond the sole development of a new product or service. At times, fintechs have even developed their own distribution channel as well as end-user base. This reduces the value of an acquisition since synergies with incumbent banks are reduced. Furthermore, technology-driven firms such as the Alibaba Group have set up their own fintech spin-offs like the third-party mobile and online payment platform Alipay, which have grown so big that a full acquisition by a bank is sometimes neither feasible nor even desired by the fintech.

Hypothesis 2B (type of alliance): Banks are more likely to invest in small rather than in large fintechs.

An important question is whether alliances between banks and fintechs ultimately create economic value. Because many banks have only recently engaged in alliances with fintechs, it is still too early to investigate the effect bank-fintech alliances have on long-term performance measures of banks or even their corporate structure. Nevertheless, event studies are an established method to

evaluate the market expectations about future cash flows that might result from organizational changes such as mergers, joint ventures, or strategic alliances (Amici *et al*., 2013; Gleason *et al*., 2003; Marciukaityte *et al*., 2009). Given the increasing importance of digitalization for the financial industry and its impact on the survival of incumbent banks, we expect markets to react to announcements of bank-fintech alliances. If stock prices reflect future earnings of banks and if strategic alliances with fintechs are value enhancing, this should be reflected in the market valuation of the involved bank.

Different types of banks are likely to benefit differently from an alliance with a fintech. The extent to which a bank can generate value from a strategic alliance with a fintech depends on its capacity to create synergies between the two corporate entities. Strategic alliances with fintechs act as knowledge exchange for banks. To benefit from knowledge-intense alliances, banks need to engage in organizational learning (see Dodgson, 1993; Inkpen, 2000; Inkpen & Crossan, 1995; and Lane & Lubatkin, 1998, for studies on the importance of learning in inter-firm alliances), which is arguably more difficult for larger and more traditional banks. Digital banks that operate their business solely online will have a mindset closer to fintech startups than traditional banks and, as a result, have a greater absorptive capacity to assimilate and take advantage of new information than other more traditional banks due to their corporate structure and digital affinity. A greater absorptive capacity facilitates synergies and especially stability of the alliance (Fang and Zou, 2010). Moreover, banks that have developed a digitalization strategy and/or hired a CDO are more likely to have a greater absorptive capacity and to benefit from a strategic alliance. We summarize these arguments in Hypotheses 3A and 3B:

Hypothesis 3A (CDO / digital strategy): Public announcements of a new alliance that are made by banks with a CDO or a digital strategy have a stronger positive effect on the market value of the bank.

Hypothesis 3B (digital banks): Public announcements of a new alliance have a larger impact on the market value of digital banks.

3. Data and methods

In this section we present our data, describe the methods used, and outline our empirical models. To test our hypotheses, we apply cross-sectional, panel data, and event study methods.

3.1 Data

Our initial sample consists of the hundred largest legally independent banks, as measured by their total assets, in each of the following four countries: Canada, France, Germany, and the United Kingdom. The list of banks was retrieved from the respective national supervisory authorities and comprises all active banks as of spring 2017. We choose these four countries because they have the highest GDPs in the Comprehensive Economic and Trade Agreement (CETA) area and represent different financial systems: While Canada and the UK are traditionally considered market-based financial systems, France and Germany are considered bank-based financial systems (Demirguc-Kunt and Levine, 1999).

To assemble a comprehensive overview of existing bank-fintech alliances, we used a broad Internet search encompassing three steps. First, we searched all bank websites to find official press releases concerning alliances with fintechs. Second, we investigated the firm side and searched the

Crunchbase database for alliances with banks. Third, we ran a comprehensive search for news articles about bank-fintech alliances on Factiva, which was also conducted to obtain more information on the respective forms of alliances. Alliances are coded as follows: (1) an alliance counts as *acquisition* if the bank has acquired at least 50% of the fintech; (2) a *product-related collaboration* is defined as a contract-based partnership. To be included in our sample, three additional requirements had to be fulfilled: (1) the alliance must have been announced between 1 January 2007, and 1 January 2018; (2) at least one bank is involved in the alliance together with at least one fintech; and (3) the bank's headquarters are located in one of the four countries that are part of our study. However, fintech startups could be located anywhere in the world. Our sample consists of 400 banks that have formed 500 bank-fintech alliances. During an average year, every tenth bank has engaged in an alliance with a fintech. However, there is strong variation among banks since some initiated up to 51 alliances during the sample period, while others initiated none.

To investigate whether and why banks engage in alliances with fintechs, we have constructed two dependent variables: first, a binary (dummy) variable *Alliance* equal to 1 if bank i has made at least one alliance with a fintech in year t, and 0 otherwise; and second, the number of new alliances *Nbr. New Alliances* that bank i began in year t.

To test Hypothesis 1, our two main explanatory variables are the dummy variables *Chief Digital Officer* equal to 1 if bank i employs a CDO in year t and 0 otherwise, and *Digital Strategy,* equal to 1 if bank i has a digital strategy in year t and 0 otherwise. Both variables were hand-collected through a systematic analysis of the annual reports published by the respective banks in our sample. The point at which a CDO joined the board was easily observable from the annual report and often published in the year the respective person was hired. Since the core task of a CDO is the design and support of technology-driven process changes, the time-varying, dummy variable *Chief Digital*

Officer provides an indicator for the digital orientation of a bank. We consider the bank to have adopted a digitalization strategy if it has officially declared a strategy to foster digitalization. More specifically, the time-varying, dummy variable *Digital Strategy* indicates whether or not a bank has a digital strategy and whose value was established through a thorough analysis of all annual reports during our sample period. The existence of a digital strategy is only confirmed if an explicit digitalization-related implementation plan has been announced. General statements on the importance of digitalization were not enough.

We consider a variety of control variables that have been recently used in the banking literature (Peng *et al*., 2017). These include firm characteristics such as whether the bank is publicly listed (*Bank is Listed*) and whether it is a universal bank (*Universal Bank*) as well as financial indicators such as the natural logarithm of total assets (*ln(Bank Total Assets)*) and return on average assets (*Bank ROAA*). General information about the banks, such as balance sheet data, is retrieved from the bank's annual reports and the Fitch Connect database. However, some information, such as financial data of privately-owned banks, could only be collected if banks were subject to some forms of disclosure requirement. Finally, we collapsed the data into a panel dataset for the period from 2007 to 2017 so that we obtain bank-year observations.

To test Hypotheses 2A and 2B, we focus on our sample of 500 bank-fintech alliances and create the variable *Financial Investment,* which constitutes a dummy variable equal to 1 if a bank has either partially or fully acquired at least one fintech and 0 if the alliance is characterized by a product-related collaboration. Because some banks neither have a financial engagement in a fintech nor engage in a product-related collaboration but in another form of partnership, the number of observations is somewhat lower than the overall number of alliances in our sample. We then use ln*(Bank Total Assets)* and the variable *Fintech Employees*, indicating the fintech's number of

employees, as respective measures of bank and fintech size and which thus function as our main explanatory variables here. In addition to the control variables from Hypothesis 1, we include additional variables to control for fintech characteristics, namely: *Fintech Front End Solution,* a dummy variable equal to 1 if a fintech offers front end solutions and 0 if it offers back end solutions; *Fintech HQ Country of Interest,* a dummy variable equal to 1 if the fintech operates in the same country as the partnering bank; *Fintech Nbr. Patents* a variable counting the number of patents the fintech had previously regiestered; *Fintech Age* accounting for the fintech's founding. Definitions of all variables and their sources are provided in Table 1.

- Table 1 about here -

3.2 Methodology

3.2.1 Estimating the Number and Type of Alliances

To test Hypothesis 1 (*Alliance*), we estimate panel probit regressions. We follow Peng *et al*. (2017) and additionally include bank, country, and year fixed effects to minimize the potential bias stemming from differences in, for example, national regulation or technological trends that occur over time. To account for the fact that fintechs like Alipay or PayPal are established firms and thus might act differently, we run a subsample analysis that excludes fintechs with more than 1000 employees or that were established at least 10 years before the bank-fintech alliance started. Furthermore, we do not include our two main explanatory variables *Digital Strategy* and *Chief Digital Officer* in the same regressions since they are correlated ($\rho = 0.29$) and potentially suffer from multicollinearity. Moreover, they constitute two alternative proxies for the same factor, namely a bank's strategic orientation in terms of digitalization. In our baseline specification, we

estimate the following panel probit model, whereby *Pr(Alliance$_{it}$* = 1*)* is the the probability that a bank *i* forms at least one alliance with a fintech in year *t*:

$$Pr(Alliance_{it} = 1) = F(Digital\ Strategy_{it}\ /\ Chief\ Digital\ Officer_{it} + Bank\ is\ listed_i + Digital\ Bank_i + Universal\ Bank_i + Bank\ HQ\ Country\ of\ Interest_i + \ln(Bank\ Age_{it}) + Year_t + Country_i).$$

To test whether the bank´s strategic orientation or a CDO impacts the *number* of bank-fintech alliances, we estimate a count data model using the *Number of New Alliances* as the dependent variable. Because the dependent variable is a count variable and its unconditional variance suffers from overdispersion, we estimate a negative binomial regression model using our panel dataset. The baseline equations are:

$$Pr(y_{i1}, y_{i2}, \dots, y_{iT}) = F(Digital\ Strategy_{it}\ /\ Chief\ Digital\ Officer_{it} + Bank\ is\ listed_i + Digital\ Bank_i + Universal\ Bank_i + Bank\ HQ\ Country\ of\ Interest_i + \ln\ (Bank\ Age_{it}) + Year_t + Country_i),$$

where y_{it} refers to the dependent variable *Number of New Alliances*. If a Hausman test indicates that a model with random effects is an inconsistent estimator, we adopt the fixed effects model. Otherwise, we rely on random effects in the respective regressions.

To test Hypotheses 2A and 2B, we estimate standard probit regressions. The baseline equations are:

$$Pr(Financial\ Investment_i = 1) = F(\ln\ (Bank\ Total\ Assets_i) + Fintech\ Employees_i + Digital\ Strategy_i\ /\ Chief\ Digital\ Officer_i + Bank\ is\ listed_i + Digital\ Bank_i + Universal\ Bank_i + Bank\ HQ\ Country\ of\ Interest_i + \ln\ (Bank\ Age_i) + Country_i).$$

3.2.2 Estimating the Effect of Alliances on Bank Value

In line with earlier studies that have investigated how strategic alliances and joint venture-announcements affect stock prices (Amici *et al*., 2013; Chiou and White, 2005), we rely on the cumulative abnormal returns (CAR) methodology to assess changes in the market valuation of banks after the announcement to establish an alliance with a fintech. We use the market model for calculating abnormal returns (following Brown and Warner, 1980, 1985), which is widely used in event studies.

To be included in the sample we required that: (i) the date of the first public announcement about the bank-fintech alliance can be uniquely identified and (ii) stock price data are available to calculate the returns for a minimum of 46 days prior to the first press announcement. We manually searched for the International Securities Identification Number (ISIN Code) of the banks in our sample on the websites of various retail brokers and financial data providers like www.onvista.de or www.finanztreff.de. With each ISIN Code, we then extracted stock prices from Thomson Reuters Datastream. Ultimately, we could identify 140 alliance announcements by 30 different banks, with 40 announcements from Germany (5 banks), 49 from UK (11 banks), 28 from Canada (8 banks), and 23 from France (6 banks).

As a benchmark stock portfolio for the country where the respective bank had its headquarters, we used the MSCI index, which measures the performance of the large and mid-cap segments of each market (MSCI, 2018). The parameters of the market model are estimated over a 200-trading day window, ending 20 days before the event day to avoid bias in the parameter estimations due to incidents surrounding the event date (Brown and Warner, 1985).

We follow previous event studies dealing with the announcement of strategic alliances and joint ventures in banks (Amici *et al*., 2013; Chiou and White, 2005) and focus on the following event windows (-1;0), (0;+1) and (-1;+1). Since information sometimes leaks to the market early or momentum effects are triggered that last for several days or weeks, we also perform robustness checks with alternative event windows. Therefore, CAARs are also estimated over the following event windows: (-15;+15), (-10;+10), (-5;+5) and (-3;+3); these do not yield significant results though. Finally, we estimate an ordinary least squares regression to study what drives the CARs for the three short event windows of (-1;0), (0;+1) and (-1;+1).

To test our Hypotheses 3A and 3B, we use the same explanatory variables as in the baseline equations above and, in addition, include interaction terms with the dummy variables *Chief Digital Officer* and *Acquisition.*

4. Empirical results

4.1 Descriptive statistics

Table 2.1 provides summary statistics for our panel dataset. During the sample period, every tenth bank in our dataset engaged in some form of alliance. The share of banks following a digital strategy is 21%, while merely 3% of the banks employ a CDO. Overall, 15% of the banks in our sample are publicly listed, 7% are digital banks, and 40% are universal banks.

- Table 2.1 about here -

Table 2.2 provides summary statistics for the alliance-level data. We find that 44% of the banks acquired at least a minority stake in a fintech. Considering only the banks cooperating with fintechs,

we find 86% follow a digital strategy, and 23% employ a CDO. In this sample, 56% of the banks are publicly listed, 11% are digital banks, and 67% are universal banks.

- Table 2.2 about here -

For the fintechs that have engaged in a bank-fintech alliance, Figure 1 provides an overview of the segments in which they operate and shows that many fintechs operate in the payment services sector. While fintechs generally most often engage in financing activities (Haddad and Hornuf, 2018), this is not part of their core business in our sample, which includes only fintechs that engaged in an alliance with banks. In comparison to Germany, Canada, and France, a relatively large number of fintechs in the UK provide bank-level software such as digital tools for customer relationship management. Furthermore, many fintechs in the UK cannot be assigned to one of the predefined segments, indicating that they either offer more diversified services or operate in niche segments.[2]

Figure 2 shows the most common types of bank-fintech alliances. We have classified them into four categories: acquisition, minority interest, product-related collaboration, and other forms of interaction. We find that minority interests and product-related collaboration are the two most common forms of interaction between banks and fintechs in all four countries, which suggests that comparatively loose form of alliances are preferred. We find a relatively high number of acquisitions in France, even though they are still small compared to alliances in the form of minority interests and product-related collaborations.

- Figures 1 and 2 about here -

[2] Although cyber security is a topic of increasing relevance in the financial services sector, we do not find many bank-fintech alliances in this area.

4.2 Regression results

4.2.1 Establishing Alliances

In Table 3, we examine whether the implementation of a *Digital Strategy* or the employment of a *Chief Digital Officer* has an effect on the emergence of a bank-fintech alliance. The coefficients of *Digital Strategy* for regressions (1) and (3) are found to be consistently positive and significant, suggesting that having a strategic focus on digitalization increases the probability of forming an alliance with a fintech by 6% to 8%. Employing a *Chief Digital Officer* increases the probability of a bank-fintech alliance by 10%. Thus, there is considerable evidence in line with Hypothesis 1. Moreover, we find *Bank is Listed* in most regressions and *Universal Bank* in all regressions are significantly positively related to bank-fintech alliances, indicating that the sheer size of a bank fosters interaction. In line with that finding, the coefficients of ln*(Bank Total Assets)* are all found to be significantly positive in all regressions. As a robustness check and as a way to exclude large, established fintechs, we performed the same analysis for the subsample of fintechs with fewer than 1000 employees or which were less than 10 years old at the time of forming the alliance. It turns out that no bank in our sample began an alliance with a large fintech without starting at least another one with a smaller fintech in the same year. Thus, in the panel data structure, we obtain exactly the same dataset both with and without the large, established fintechs (this will be different though with the next dependent variable that accounts for the number of alliances as well as in the cross-sectional analysis below).

- Table 3 about here -

We now investigate whether *Digital Strategy* and *Chief Digital Officer* influence the number of alliances a bank establishes with fintechs. The results of negative binominal regressions are

presented in Table 4. We report incident rate ratios, which can be interpreted as multiplicative effects or semi-elasticities. The results are largely consistent with the results of the probit regressions in Table 3. The coefficients of *Digital Strategy* in regressions (1) and (3) are positive and statistically significant at the 0.1% level. In economic terms, a digital strategy increases the number of bank-fintech interactions three to four times. The coefficients of *Chief Digital Officer* are again positive and statistically significant. Employing a CDO increases the number of bank-fintech interactions by two to three times. These findings are robust to the exclusion of the large fintechs in the sample (regressions (5) through (8)). Overall, our findings robustly indicate that a bank's strategic orientation is a relevant predictor for the number of bank-fintech alliances. The coefficients of *Bank is Listed* and ln*(Bank Total Assets)* are again statistically significant and have a positive effect in all the regressions. Large and listed banks interact with more fintechs than small and private banks.

- Table 4 about here -

4.2.2 Types of Alliances

To test Hypotheses 2A and 2B, we construct a dummy variable that classifies the two broad types of alliance, which we denote *Financial Investment*. This allows us to further investigate what motivates alliances while integrating additional explanatory variables measuring various fintech characteristics. The results presented in Table 5 show a significant negative coefficient of *Fintech Employees* at the 0.1%-level in the full sample in regressions (1) and (2), which indicate that a one unit change in the employee category decreases the probability of financial investments by approximately 10% and thus in line with Hypothesis 2B. However, the coefficients become insignificant when excluding large fintechs (regressions (3) and (4)), suggesting that the effect diminishes when only considering fintechs startups with fewer than 1000 employees. The

coefficients of ln*(Bank Total Assets*) are found to be positive and statistically significant at the 1%-level in regressions (1) and (2), indicating that – considering both small and large fintechs – large banks are more likely to invest in fintechs, which is in line with Hypothesis 2A. Again, the effect diminishes when excluding large fintechs, suggesting that the bank's size only plays a role for the decision to invest in larger fintech startups. Furthermore, the coefficients of *Universal Bank* are found to be negative and statistically significant at the 5%-level in all regressions. This suggests that specialized banks that focus on particular industries or business segments are more likely to invest in fintechs. The reason behind this might be that fintechs serve niches that are of interest to more specialized banks.

- Table 5 about here -

4.2.3 Effect of Alliances on Bank Value

To examine whether stock price reactions occur after an alliance was publicly announced, we calculate CAARs for different event windows. We find all short-term windows have a negative impact and that the event windows with (-1;0) and (-1;+1) are statistically significant at the 5%-level. Put differently, at least in the short run, alliances with fintechs are perceived to have, *on average*, a negative effect on firm value. However, Table 6 also reveals that the CAARs are not negative for all banks and in some cases, capital market investors value the public announcement of an alliance. We also run ordinary least squares (OLS) regressions not only on our financial performance measure, the cumulative abnormal returns (CAR), for the short event windows (-1;0), (0;+1), and (-1;+1) as suggested by Amici *et al*. (2013) and Chiou & White (2005), but also for the longer event window (0;+100) to account for potential momentum effects.

- Table 6 about here -

We report the results on Hypothesis 3A and 3B in Table 7. Since the variables *Digital Strategy* and *Chief Digital Officer* were both important predictors for the intensity of bank-fintech alliances, we first analyze them and find that neither one has an impact on bank value for the short-term event windows. However, *Digital Strategy* is statistically significant for the (0;+100) event windows, which is weak evidence in line with Hypothesis 3A. Second, we focus on the estimates regarding the variable *Digital Bank*, which we hypothesized to benefit the most from a strategic alliance. This variable is positive and statistically significant for most short-term event windows, which we consider strong evidence for Hypothesis 3B. Depending on the specification considered, the bank value increases by 2.5% to 3.2% after the digital bank announces a new alliance with a fintech. None of the other types of banks or fintechs affects bank value when it comes to a fintech alliance.

- Table 7 about here –

5. Summary and conclusions

In this paper, we have studied the impact of the digitalization in the banking industry by analyzing the factors that play a role for the emergence of alliances between banks and fintechs. Moreover, we investigated the factors that are relevant for a bank to become financially engaged in a fintech (partial or full acquisition) as compared to entering into a product-related collaboration. Finally, we tested whether announcing a newly started alliance affects the bank's market value.

Using a hand-collected dataset covering the 100 largest banks in each of the following countries: Canada, France, Germany, and the United Kingdom, we found that the type of bank-fintech alliances are rather similar in all four. Thus, there is no apparent difference in the way banks interact with fintechs in market-based (Canada and the UK) and bank-based (France and Germany)

financial systems. Alliances across the four countries examined are most often characterized by a product-related collaboration, which is a comparatively less institutionalized form of alliance that offers little or no control in the product development process of a fintech. This raises the question as to whether banks use this form of alliance to outsource their innovation activities and thereby become increasingly dependent on fintechs and other partners for ensuring digital transformation. Another result of our study is that fintechs engaging in alliances operate in various segments across the four countries we have investigated, with payment services being the most prevalent segment. Given that overall most fintechs operate in the financing segment (Haddad and Hornuf, 2018), banks seem to benefit from external technology in the realm of payment services.

Our findings confirm that the implementation of a digitalization strategy by banks has a positive effect on the emergence of alliances with fintechs. We further find that large, listed, and universal banks are more likely to establish alliances with at least one fintech, as compared to smaller, unlisted, and specialized banks. The bank's financial situation as measured by the return on average assets is a relevant predictor for explaining the number of alliances a bank becomes involved in.

Our results further suggest that neither a bank's implementation of a digitalization strategy nor the employment of a CDO significantly increases the likelihood of financial engagements. Even though this finding contradicts our hypothesis and previous literature about board positions (Geiger and North, 2006; Jiang and Li, 2009), it can be assumed that CDOs do not simply focus on acquring fintechs but are also interested in generating digitalization expertise in-house. Furthermore, we find that large banks are more often willing to become financially engaged in fintech firms. Through the full acquisition or purchasing a minority stake in a fintech, banks can often obtain representation on the fintech's board of directors and thereby achieve complete or partial control over it. While

larger banks also set up incubators and accelerators and thus obtain financial stakes in fintech firms early on, we find that banks are more often financially engaged in larger fintechs.

Regarding the market effect of publicly-announced alliances, we find announcements of such alliances have a negative effect on the bank's value for short-term windows. Apparently, alliances with fintechs are not perceived as a worthwile effort to gain a competitive advantage with regard to digitalization. Rather, there is some uncertainty about the alliance's impact. It is only in the long term does it seem that investors reward bank-fintech alliances, especially if banks follow a digitalization strategy. Our results suggest that stocks of digital banks benefit from alliances, which might result from being better able to internalize the fintech's expertise.

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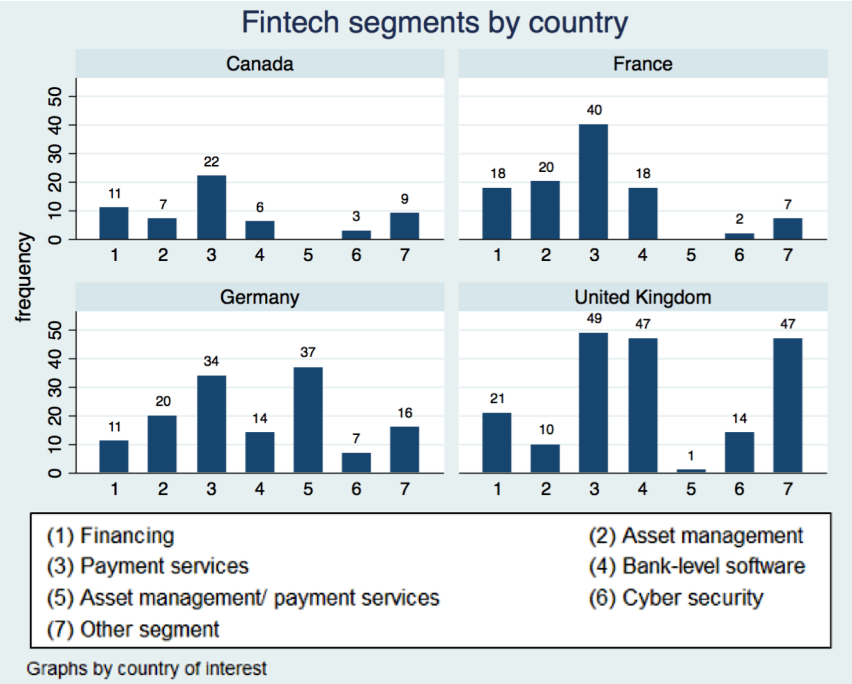

Fig. 1. Fintech segments by bank country. This figure presents the frequency of occurrence of bank alliances with fintechs by segment and country. The sample includes 492 fintechs from 27 countries collected from 2007 to 2017. The bars represent the number of fintechs in each segment and grouped by the bank's home country.

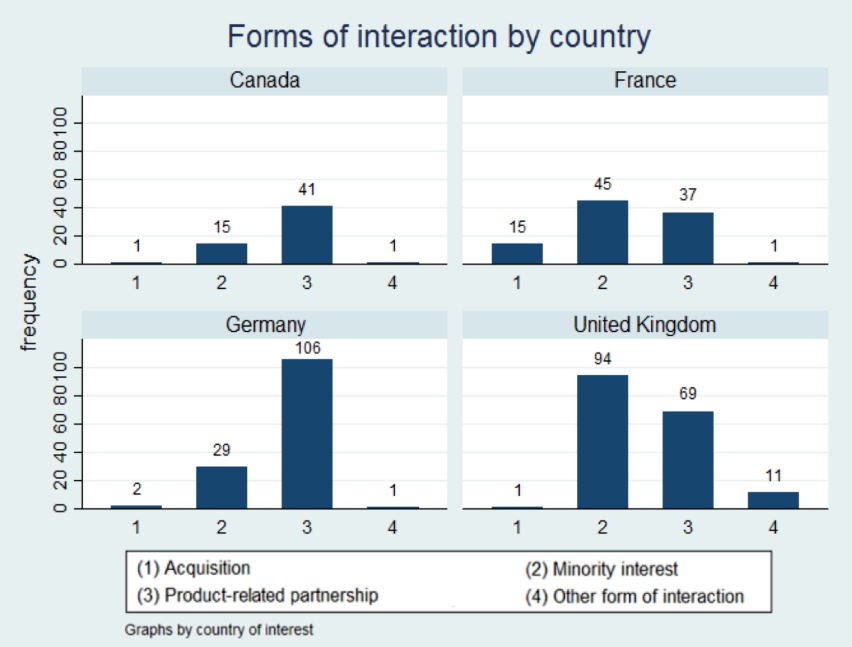

Fig. 2. Forms of interaction by country. This figure presents the frequency of occurrence of interacting fintechs by form and country. The sample includes 469 interacting fintechs from 28 countries collected from 2007 to 2017. The bars represent the frequency of the different arrangements of interaction with banks in Canada, France, Germany, and UK.

Table 1
This table provides the definition of variables included in the regression models. Here, (d*)* indicates a dummy variable.

Variable Name	Definition
Dependent variables	
Alliance (d)	Binary variable equal to 1 if the bank cultivates at least one alliance with a FinTech. Source: Factiva, Company websites.
Nbr. New Alliances	Number of new alliances in the year of interest. Source: Factiva, Company websites.
Financial Investment (d)	Binary variable equal to 1 if a bank acquires at least a minority stake of a fintech and equal to 0 if the alliance is characterized by a product-related collaboration. Other forms of alliances are excluded for the coding of this variable. Source: Factiva, Company websites, Crunchbase, Thomson Reuters M&A Database.
CAR(-X;+Y)	The cumulative abnormal return for the event window (-X;+Y). Event date 0 constitutes the date of the first public announcement of the alliance. In the analysis, we specify different window ranges. Source: Datastream.
Bank characteristics	
Bank is Listed (d)	Binary variable equal to 1 if the bank is publicly listed. Source: Onvista.
Bank HQ Country of Interest (d)	Binary variable equal to 1 if the bank's headquarter is located in the same country as the fintech that participates in the alliance. Source: Fitch connect.
Bank Loan-To-Assets Ratio	Ratio of a bank's loans over its assets as a measure of asset structure. It measures the total loans outstanding as a percentage of total assets and can be used for assessing a bank's liquidity. A higher ratio indicates a bank has a lower liquidity, which brings a higher risk in terms of defaults. Source: Fitch connect.
Bank ROAA	Ratio of a bank's return over its average assets as a measure of profitability. Source: Fitch connect.
Chief Digital Officer (d)	Binary variable equal to 1 if the bank employs a Chief Digital Officer. Source: Annual reports, LinkedIn, Company website.
Digital Bank (d)	Binary variable equal to 1 if the bank is a direct bank without any branch network, offering only remote services via online- and telephone banking. Source: Company websites.
Digital Strategy (d)	Binary variable equal to 1 if the bank has announced a credible digitalization strategy. Source: Annual reports.
ln(Bank Age)	Natural logarithm of the bank's age in years. Source: Fitch connect.
ln(Bank Total Assets)	Natural logarithm of the bank's total assets in euros. Source: Fitch connect.
Universal Bank (d)	Binary variable equal to 1 if the bank participates in many kinds of banking activities; e.g., if the bank is both a commercial bank and an investment bank, or provides other financial services as well. Source: Company websites.
Fintech characteristics	
Fintech Employees (rank)	Rank of the fintech's employees as a measure of size. Categories: 1-10, 11-50, 51-100, 101-1000, >1000. Source: Crunchbase company website, LinkedIn.
Fintech Age	Age of the fintech in years. Source: Crunchbase company website, LinkedIn.

Fintech Front End Solution (d)	Binary variable equal to 1 if the fintech offers front-end solutions. Source: Crunchbase company website, LinkedIn.
Fintech HQ Country of Interest (d)	Binary variable equal to 1 if the fintech is located in the same country as the headquarter of the bank. Source: Crunchbase company website, LinkedIn.
Fintech Nbr. Patents	Number of patents owned by the fintech until December 2017; Source: PATSTAT.
Fintech Segment	Categorical variable equal to 1 if the fintech provides financing services, 2 if asset management, 3 if payment services, 4 if bank-level software, 5 if asset management and payment services, 6 if cyber security services, and 7 if the fintech operates in another segment. Source: Company websites, Crunchbase, LinkedIn.

Table 2.1.
Summary statistics of panel data for the full sample of 4400 bank-year observations by the 100 largest banks each in Canada, France, Germany, and UK from 2007 to 2017 included in our sample. The table provides the mean, different standard deviations, and the number of banks and observations of the panel. Here, (d*)* indicates a dummy variable.

Variable	Mean	SD (Overall)	SD (Between)	SD (Within)	Number of Banks	Number of Observations
Dependent variables						
Alliances (d)	0.12	0.32	0.20	0.25	400	4400
Nbr. New Alliances	0.11	0.72	0.35	0.63	400	4400
Explanatory variables						
Digital Strategy (d)	0.21	0.41	0.25	0.34	327	3394
Chief Digital Officer (d)	0.03	0.16	0.10	0.13	353	3871
Bank is Listed (d)	0.15	0.35	0.35	0.00	400	4400
Digital Bank (d)	0.07	0.26	0.26	0.00	400	4400
Universal Bank (d)	0.40	0.49	0.49	0.00	400	4400
Bank HQ Country of Interest	0.82	0.38	0.38	0.00	398	4378
Ln(Bank Age)	3.83	0.96	0.96	0.00	371	4081
Ln(Bank Total Assets)	16.65	2.41	2.26	1.06	375	3345
Bank Loan-to-Assets Ratio	0.57	0.26	0.26	0.08	366	3211
Bank ROAA	0.01	0.04	0.04	0.03	374	3191

Table 2.2.
Summary statistics of deal-level data for the full sample of 500 alliances identified between banks and fintechs in Canada, France, Germany and UK from 2007 to 2017. The table provides the number of observations, mean, median, standard deviation, minimum and maximum of the deal-level data. Here, (d*)* indicates a dummy variable.

Variable	Nbr. Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
Dependent variables						
Financial Investment (d)	455	0.44	0	0.50	0	1
Explanatory variables						
Digital Strategy (d)	470	0.86	1	0.35	0	1
Chief Digital Officer (d)	489	0.23	0	0.42	0	1
Fintech Employees (rank)	462	2.40	2	1.19	1	5
Ln(Bank Total Assets)	362	18.99	19.79	2.26	12.53	22.73
Bank is Listed (d)	500	0.56	1	0.50	0	1
Digital Bank (d)	500	0.11	0	0.31	0	1
Universal Bank (d)	500	0.67	1	0.47	0	1
Bank HQ Country of Interest	500	0.87	1	0.34	0	1
Ln(Bank Age)	498	4.08	4.14	0.93	1.10	5.86
Bank ROAA	460	0.00	0	0.01	-0.07	0.04
Fintech Front End Solution	463	0.71	1	0.46	0	1
Fintech HQ Country of Interest (d)	493	0.65	1	0.48	0	1
Fintech Nbr. Patents	500	1.67	0	8.49	0	158
Fintech Age	456	5.67	4	6.41	0	45

Table 3
Panel data analysis for the dummy variables *Digital Strategy, Chief Digital Officer*, and *Alliance*. This table presents the results of random-effects probit regressions modeling the probability that at least one interaction between bank i and a fintech occurs in year t (dependent variable = 1) or not (dependent variable = 0), based on the full sample. The coefficients show the average marginal effects with standard errors in parentheses. All the variables are defined in Table 1. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1 % level. Here, (d*)* indicates a dummy variable.

	(1)	(2)	(3)	(4)
	full sample			
	Dep. Var. = Alliance (dummy)			
Explanatory variables				
Digital Strategy (d)	0.060***		0.077***	
	(0.009)		(0.016)	
Chief Digital Officer (d)		0.095***		0.072
		(0.022)		(0.039)
Bank is Listed (d)	0.062***	0.099***	0.054*	0.090***
	(0.016)	(0.018)	(0.021)	(0.018)
Digital Bank (d)	0.003	0.044*	0.078**	0.077**
	(0.021)	(0.018)	(0.027)	(0.026)
Universal Bank (d)	0.028**	0.036***	0.040*	0.035*
	(0.010)	(0.010)	(0.018)	(0.015)
Bank HQ Country of Interest (d)	0.001	0.011	0.006	0.025
	(0.015)	(0.014)	(0.030)	(0.025)
ln(Bank Age)	0.011*	0.013*	0.018*	0.027**
	(0.005)	(0.005)	(0.009)	(0.009)
ln(Bank Total Assets)			0.013***	0.009***
			(0.004)	(0.003)
Bank Loan-to-Assets Ratio			-0.033	0.003
			(0.044)	(0.031)
Bank ROAA			-0.145	-0.318
			(0.135)	(0.409)
Year Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
n (Obs.)	3344	3816	2421	2743
N (Banks)	322	348	297	318
Wald chi2	432.40	323.41	313.86	326.96
Prob > chi2	0.000	0.000	0.000	0.000

Table 4

Panel data analysis for the variables *Digital Strategy, Chief Digital Officer*, and *Number of Partnerships*. This table presents the results of random-effects negative binominal regressions. The dependent variable represents the number of new alliances of bank i in year t. We report incident-rate ratios with standard errors in parentheses. Models 1–4 use the full sample; Models 5–8 exclude fintechs with more than 1000 employees or fintechs which were more than 10 years old at the time of the alliance. All the variables are defined in Table 1. A Hausman test is used to identify whether fixed effects or random effects should be applied to each respective model. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1% level. Here, (d*)* indicates a dummy variable.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	full sample				*excluding large fintechs*			
	Dep. Var. = Number of Alliances							
Explanatory variables								
Digital Strategy (d)	4.097***		3.133***		4.791***		3.555***	
	(0.880)		(0.669)		(1.238)		(0.915)	
Chief Digital Officer (d)		2.721***		1.945**		2.815***		1.810*
		(0.614)		(0.440)		(0.736)		(0.466)
Bank is Listed (d)	2.679***	4.061***	1.913**	2.703***	3.529***	5.160***	1.953**	2.715***
	(0.615)	(0.927)	(0.397)	(0.579)	(0.927)	(1.377)	(0.468)	(0.666)
Digital Bank (d)	1.418	1.946*	2.174**	2.225**	1.597	2.477**	2.019*	2.295**
	(0.443)	(0.597)	(0.585)	(0.621)	(0.558)	(0.850)	(0.634)	(0.727)
Universal Bank (d)	1.715**	1.719**	1.534*	1.506*	1.663*	1.682*	1.445	1.397
	(0.341)	(0.338)	(0.283)	(0.290)	(0.383)	(0.382)	(0.313)	(0.313)
Bank HQ Country of Interest (d)	0.876	1.003	0.814	0.944	0.739	0.967	0.761	0.996
	(0.242)	(0.273)	(0.207)	(0.253)	(0.237)	(0.308)	(0.224)	(0.311)
ln(Bank Age)	1.112	1.171	1.144	1.213*	1.183	1.253*	1.121	1.213
	(0.106)	(0.108)	(0.100)	(0.108)	(0.130)	(0.133)	(0.113)	(0.121)
ln(Bank Total Assets)			1.283***	1.248***			1.357***	1.338***
			(0.060)	(0.057)			(0.074)	(0.070)
Bank Loan-to-Assets Ratio			0.706	0.961			0.871	1.105
			(0.258)	(0.352)			(0.386)	(0.483)
Bank ROAA			0.000**	0.000*			0.000*	0.000
			(0.000)	(0.000)			(0.000)	(0.000)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n (Obs.)	3344	3816	2421	2743	3344	3816	2421	2743
N (Banks)	322	348	297	318	322	348	297	318
Wald chi2	369.45	400.14	401.58	415.12	282.23	319.36	313.91	327.84
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5
Cross-sectional regression results for *Financial Investment* versus *Product-related Collaboration*. This table presents the results of a Probit regression. The coefficients show the average marginal effects, and standard errors are clustered by banks (in parentheses). The dependent variable *Financial Investment* is equal to 1 if the bank invests in a fintech and to 0 if the alliance is characterized by a product-related collaboration. Models 1 and 2 use the full sample; Models 3 and 4 fintechs with more than 1000 employees or fintechs which were more than 10 years old at the time of the alliance. All the variables are defined in Table 1. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1% level. Here, (d*)* indicates a dummy variable.

	(1)	(2)	(3)	(4)
	full sample		*excluding large fintechs*	
	Dep. Var.: Financial Investment (d)			
Explanatory variables				
Digital Strategy (d)	-0.069		-0.078	
	(0.083)		(0.104)	
Chief Digital Officer (d)		-0.082		-0.113
		(0.118)		(0.122)
Fintech Employees (rank)	-0.098***	-0.095***	-0.037	-0.034
	(0.026)	(0.026)	(0.035)	(0.036)
ln(Bank Total Assets)	0.057**	0.050**	0.048*	0.041
	(0.019)	(0.018)	(0.022)	(0.021)
Bank is Listed (d)	0.107	0.132	0.16	0.186
	(0.114)	(0.126)	(0.123)	(0.134)
Digital Bank (d)	0.181	0.185	0.205	0.204
	(0.121)	(0.119)	(0.121)	(0.119)
Universal Bank (d)	-0.157*	-0.137*	-0.204*	-0.176*
	(0.070)	(0.067)	(0.080)	(0.080)
Bank HQ Country of Interest (d)	-0.051	-0.080	-0.003	-0.055
	(0.076)	(0.104)	(0.073)	(0.105)
ln(Bank Age)	0.010	0.004	0.022	0.014
	(0.044)	(0.041)	(0.046)	(0.043)
Bank ROAA	4.501	2.589	2.515	0.654
	(7.238)	(7.091)	(6.930)	(7.344)
Fintech Front End Solution (d)	-0.032	-0.039	-0.034	-0.043
	(0.054)	(0.055)	(0.060)	(0.061)
Fintech HQ Country of Interest (d)	-0.143**	-0.138**	-0.094	-0.084
	(0.055)	(0.053)	(0.060)	(0.059)
Fintech Nbr. Patents	0.001	-0.000	0.000	-0.001
	(0.005)	(0.005)	(0.006)	(0.005)
Fintech Age	-0.005	-0.006	-0.021*	-0.022*
	(0.004)	(0.005)	(0.010)	(0.011)
Country Dummies	Yes	Yes	Yes	Yes
N (Banks)	331	346	282	295
Pseudo ar2	0.273	0.285	0.268	0.285
Wald chi2	51362	58935	57.687	58.797
Prob > chi2	0.000	0.000	0.000	0.000

Table 6

Cumulative Average Abnormal Returns (CAAR) for bank-fintech alliances. This table reports descriptive statistics of CARs for various event windows, based on 140 alliances done by all the 21 publicly listed banks in our sample for the period from 2007 to 2017. Daily Abnormal Returns are obtained using the market model with a 200-trading day window, ending 20 days before the event day to avoid bias in the parameters estimations due to changes in firm characteristics around the event date. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1 % level.

				t-test	Wilcoxon sign-rank			
Event window			CAAR (%)	t-statistic	z-statistic	Minimum (%)	Maximum (%)	Percentage of positive CAR (%)
-1	to	+1	-0.52	-2.050*	-1.82	-7.25	6.10	43.69
-1	to	0	-0.53	-2.475*	-2.538*	-5.43	4.59	38.95
0	to	+1	-0.18	-0.823	-0.928	-5.81	6.03	44.25
-3	to	+3	-0.72	-1.893	-1.564	-12.06	8.25	42.70
-5	to	+5	-0.25	-0.353	-0.021	-9.50	7.64	52.74
-10	to	+10	-0.70	-1.117	1.591	-15.24	17.55	46.95
0	to	100	2.89	1.506	-1.082	-40.94	38.78	58.16
N			140					

Table 7

Determinants of shareholder value creation from bank-fintech alliances. This table provides results of ordinary least squares (OLS) regression, where the dependent variables are the standardized CARs for the selected event windows (-1;0), (0;+1), (-1;+1), and (0;+100). Standard errors shown in parentheses are clustered by banks. All variables are defined in Table 1. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1 % level. Here, (d*)* indicates a dummy variable.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	bank-variables				bank- and acquisition- variables				bank- and fintech- variables			
	Dep. Var. = CAR											
Event Windows	-1 to +1	-1 to 0	0 to +1	0 to +100	-1 to +1	-1 to 0	0 to +1	0 to +100	-1 to +1	-1 to 0	0 to +1	0 to +100
Digital Strategy (d)	-0.018	-0.014	-0.007	0.187*	-0.019	-0.015	-0.007	0.193*	-0.012	-0.01	-0.002	0.199*
	(0.011)	(0.009)	(0.009)	(0.079)	(0.011)	(0.009)	(0.009)	(0.077)	(0.011)	(0.010)	(0.009)	(0.081)
Chief Digital Officer (d)	0.005	0.002	-0.001	-0.055	0.007	0.001	0.001	-0.058	0.007	0.003	-0.002	-0.059
	(0.006)	(0.005)	(0.005)	(0.043)	(0.006)	(0.005)	(0.005)	(0.045)	(0.007)	(0.006)	(0.005)	(0.049)
Acquisition (d)					0.03	0.005	0.031*	-0.004	-0.015	0.008	-0.011	-0.052
					(0.017)	(0.015)	(0.014)	(0.126)	(0.013)	(0.011)	(0.010)	(0.092)
Chief Digital Officer x Acquisition					-0.040*	0.005	-0.037*	-0.04				
					(0.020)	(0.017)	(0.016)	(0.142)				
Universalbank (d)	0.003	-0.001	0.001	-0.100	0.007	0.002	0.005	-0.106	0.000	0.003	-0.003	-0.166
	(0.009)	(0.008)	(0.008)	(0.070)	(0.010)	(0.009)	(0.008)	(0.073)	(0.012)	(0.010)	(0.009)	(0.084)
Digital Bank (d)	0.032**	0.029**	0.025*	0.008	0.026*	0.026*	0.019	0.017	0.030*	0.024	0.029*	0.029
	(0.012)	(0.010)	(0.010)	(0.089)	(0.012)	(0.011)	(0.010)	(0.090)	(0.015)	(0.013)	(0.012)	(0.106)
ln(Bank Age)	-0.002	-0.001	-0.003	-0.005	-0.002	-0.002	-0.004*	-0.009	-0.002	-0.001	-0.003	-0.007
	(0.002)	(0.002)	(0.002)	(0.019)	(0.003)	(0.002)	(0.002)	(0.019)	(0.003)	(0.003)	(0.002)	(0.021)
ln(Bank Total Assets)	0.002	0.004	0.003	0.013	0.002	0.004	0.003	0.016	0.002	0.003	0.004	0.020
	(0.002)	(0.002)	(0.002)	(0.018)	(0.003)	(0.002)	(0.002)	(0.018)	(0.003)	(0.002)	(0.002)	(0.020)
ROAA	-0.358	0.013	-0.407	7.366	-0.252	0.126	-0.209	6.353	-0.060	0.403	-0.283	6.558
	(0.550)	(0.469)	(0.451)	(4.123)	(0.567)	(0.499)	(0.457)	(4.117)	(0.666)	(0.597)	(0.529)	(4.822)
Fintech Front End Solution (d)									-0.004	-0.002	-0.004	-0.043
									(0.004)	(0.004)	(0.004)	(0.032)
Fintech Employees (rank)									0.001	0.000	0.001	-0.008
									(0.002)	(0.002)	(0.002)	(0.016)
Fintech HQ Country of Interest (d)									-0.002	-0.006	0.003	0.040
									(0.005)	(0.004)	(0.004)	(0.035)
Fintech Nbr. Patents									0.000	0.000	0.000	-0.002
									(0.000)	(0.000)	(0.000)	(0.003)
Fintech Age									0.003	0.001	0.003	0.002
									(0.004)	(0.003)	(0.003)	(0.025)
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	139	139	139	139	128	128	128	128	116	116	116	116
R2	0.105	0.094	0.152	0.126	0.135	0.105	0.207	0.131	0.14	0.135	0.17	0.188
P	0.143	0.225	0.016	0.06	0.134	0.347	0.006	0.157	0.453	0.502	0.231	0.141