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Lars Hornuf, Milan F. Klus, Todor S. Lohwasser, Armin Schwienbacher

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Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
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How Do Banks Interact with Fintech Startups?

Abstract

The increasing pervasiveness of technology-driven firms that offer financial services has led to growing pressure on traditional banks to modernize their core business activities. Many banks tackle the challenges of digitalization by cooperating with startup firms that offer technology-driven financial services (fintechs). In this paper, we examine which banks typically collaborate with fintechs, how intensely they do so, and which form of alliance they prefer. Using hand-collected data covering the largest banks from Canada, France, Germany, and the United Kingdom, we provide detailed evidence on the different forms of alliances occurring in practice. 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. Moreover, in line with incomplete contract theory, we find that banks more frequently invest in small fintechs but often build product-related collaborations with larger fintechs.

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

Keywords: fintech, strategic alliance, make, buy, or ally, entrepreneurial finance, banks.

Lars Hornuf
University of Bremen / Germany
hornuf@uni-bremen.de

Milan F. Klus
University of Münster / Germany
milan.klus@wiwi.uni-muenster.de

Todor S. Lohwasser
University of Münster / Germany
todor.lohwasser@uni-muenster.de

Armin Schwienbacher
SKEMA Business School
Lille / France
armin.schwienbacher@skema.edu

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1. Introduction

In this article, we analyze which characteristics of banks are associated with different forms of alliances with financial technology (fintech) companies. 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). We are particularly interested in the number of bank–fintech alliances that have been established in developed economies and the factors related to different forms of alliances such as investments or product-related collaborations. Finally, we investigate the impact of these alliances on banks' market value.[1]

In the past two decades, digitalization has influenced many industries, offering new entrepreneurial opportunities and creating new systems of innovation (Autio, Nambisan, Thomas, and Wright 2018). 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 (Navaretti, Calzolari, Mansilla-Fernandez, and Pozzolo 2017). Digital technology in the financial industry has in many cases created more customer-oriented and user-friendly digital applications, leading to increased digital servitization of financial products.[2] Many

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1 Throughout this study, we use the term "alliance" to refer to any type of interaction between fintech startups and banks. This term is widely used in the "make, buy, or ally" literature (Borah and Tellis 2014; Jacobides and Billinger 2006). As will become clear, alliances comprise minority and majority investments, product-related collaborations, and some other forms. Thus, alliances cover a broad spectrum of possible interactions with fintechs. While some of the terms used here differ somewhat from those in Hagedoorn and Duysters (2002), overall, we take a similar approach in the context of externally sourcing innovative capacities.

2 In a classic sense, digital servitization refers to "the provision of digital services embedded in a physical product" (Vendrell-Herrero, Bustinza, Parry, and Georgantzis 2017, p. 69), a definition that results from the fact that most research on the topic was conducted on the manufacturing industry. In the financial industry, the term "product" is viewed more broadly, as financial products do not physically exist. In the financial industry, servitization refers to the way financial products are now offered and brokered. New services became available for traditional financial

of these new banking solutions have been developed by fintechs. Some of the new digital innovations have the potential to reshape or even crowd out some of the business activities of more traditional banks. As a result, digitalization and platform-enabled fintechs have forced banks to reconsider their corporate boundaries and make them more permeable to market interactions (Kohtamäki, Parida, Oghazi, Gebauer, and Baines 2019). To confront the threat of technology-driven firms, many traditional banks have engaged in strategic alliances with some of the newcomers. Such permeable vertical organizational forms offer banks advantages to benefit from innovations developed by fintechs in ways different from the simple "make or buy" decision (Borah and Tellis 2014; Jacobides and Billinger 2006). For example, banks have established fintech incubators and accelerators to enable innovations while maintaining control through a minority share in the firms that are built or supervised.

A lack of legacy infrastructure and comparatively low level of organizational complexity often enable fintech firms to be more agile, innovate faster, and be more radical in their approach to innovation. By contrast, it is more difficult for traditional banks to adapt to some of the new technological developments because they need to comply with more extensive regulatory requirements. Often, a larger number of stakeholders need to be convinced when adopting far-reaching organizational changes in a traditional bank (Klus, Lohwasser, Holotiuk, and Moormann 2019). Moreover, digital services typically crowd out or cannibalize banks' existing distribution channels (Vendrell-Herrero et al. 2017), thereby reducing banks' incentives to introduce new distribution channels on their own. The sluggishness of traditional banks to adapt to digital

products that did not exist a decade ago and were enabled by digitalization. For example, application programming interfaces allow fintechs to screen the accounts of bank customers and to offer new services such as account switching or the automated switching or termination of an agreement based on the information from the account and the algorithms the fintech developed.

challenges not only has implications at the individual bank but also affects the entire financial ecosystem.

The literature on financial innovation in general and bank–fintech alliances in particular is scarce. First, our analysis contributes to the empirical literature on financial innovation. Lerner (2002) and Miller (1986) provide empirical evidence that financial innovation, as measured by the filing of financial patents, has been increasing since the late 1970s. Moreover, Scott, Van Reenen, and Zachariadis (2017) find that the financial industry had historically spent a large share of expenses on information technology (IT), which reached more than one-third of all expenses in 1992. 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 (e.g., the automated teller machine) have led to changes in financial organizations and services (Merton 1995). The quality of financial patents and financial innovations was, nevertheless, often low (Lerner, Speen, Baker, and Leamon 2015). Therefore, the financial industry was perceived as one of the least innovative. Still, scant empirical research has investigated whether fintech startups have pressured traditional banks to innovate or even forced banks to engage in strategic alliances with them. We fill this gap in the literature by analyzing bank characteristics that are associated with different forms of alliances with fintech companies.

Second, our analysis also contributes to the literature on different fintech business models, which has mostly focused on specific fintech sectors. For example, D'Acunto, Prabhala, and Rossi (2018) investigate 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 begun investigating the fintech market in its entirety. Haddad and Hornuf (2019) analyze fintechs in 55 countries and provide 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 a large labor force. Cumming and Schwienbacher (2018) find that differences in the enforcement of financial regulations of startups and banks after the financial crisis contributed to venture capital investments in fintech startups. Puschmann (2017) provide a model to categorize the industry. Navaretti et al. (2017, p. 17) conduct a conceptual analysis on the relationship between fintechs and banks and find that the "game is still open" and "a lot of work lies ahead" for the industry.

A related article to ours is that of Brandl and Hornuf (2020), who run a bank–fintech network analysis for Germany and find that most relationships turn out to be product-related collaborations. They argue that this is because most fintechs develop an algorithm or software solution, the value of which can only be determined over time when the software has been adapted more thoroughly to customer needs. We add to their findings by investigating the particular bank characteristics associated with a bank–fintech alliance. These alliances occur against the backdrop that the arrival of fintechs modifies the supply chain interdependency of banks and thus also establishes new ecosystems (Kohtamäki et al. 2019; Vendrell-Herrero et al. 2017). More precisely, we consider different forms of alliances, such as product-related cooperation and minority and majority equity stakes, which tend to be classified in the transaction cost literature as "hybrid structures" (Jacobides and Billinger 2006; Williamson 1991), and investigate bank characteristics (e.g., profitability) associated with these alliances.

We base our theoretical analysis on transaction cost theory (Coase 1937; Williamson 1981) and organizational theory (Jacobides and Billinger 2006) within the special context of technology developments (Teece, 1986; 1998). Our conjecture is that banks that have declared a digital strategy or employed a chief digital officer (CDO) are also more likely to initiate alliances with fintech

startups. Because innovation activities are typically difficult to contract (Aghion and Bolton 1992; Grossman and Hart 1986), we further hypothesize that investments, including partial acquisitions, are made more often in small firms, which allows banks to control the product development process of the firm. By contrast, product-related collaborations should occur more often with larger, established fintechs that offer a technically mature product portfolio and for which contractual arrangements are enforceable.

Finally, we also contribute to the "make, buy, or ally" literature (Borah and Tellis 2014; Jacobides and Billinger 2006), which evidences a broad range of interactions that firms can have with other firms in the market, particularly in the context of innovation management. Our results on why certain types of alliances occur (e.g., investments vs. product-related collaborations) are consistent with incomplete contract theory (Aghion and Bolton 1992; Grossman and Hart 1986). To the best of our knowledge, no empirical evidence exists about the benefits of bank–fintech alliances for banks. Furthermore, we contribute to the literature on digital servitization, which traditionally focuses on manufacturing industries. The financial industry is a relevant sector to examine in this context, given the evolving ecosystem that currently results from the digitalization of financial products and services alike. Manufacturing industries affected by digital servitization typically confront either upstream or downstream competition; the current changes in the financial industry affect both upstream (through new products offered) and downstream (through enhanced customer services and novel distribution channels) competition. In the former case, dis-intermediated finance solutions such as crowdfunding give retail investors access to new investment products. In the second case, the emergence of various platforms that allow customers to directly compare prices of different banks has modified how financial products are offered and distributed.

To test our hypotheses, we follow a quantitative approach. Although a qualitative approach would have been equally valid, we were interested in the *extent* of bank–fintech alliances and wanted to compare them across different countries and financial subsectors. We therefore hand-collected detailed information on alliances formed by the hundred largest banks in Canada, France, Germany, and the United Kingdom between 2007 and 2017. Among the identified alliances, 43% are investments (with 39% minority investments and 4% majority investments); the rest are product-related collaborations (54%) and other forms of alliances (3%). During the sample period, 57% of the banks initiated a digital strategy, and 10% employed a CDO. Consistent with our hypotheses, banks that had a well-defined digital strategy or employed a CDO initiated an alliance with a fintech 6–10% more often than those without. In absolute terms, this corresponds to 0.6–1.4 more alliances per year. Regarding the type of alliance, investments are more likely than product-related collaborations in the case of large banks and small fintechs. The first finding is consistent with the notion that larger banks have deeper pockets to buy fintechs. The second finding is in line with incomplete contracting theory, which predicts that contractual arrangements are more efficient when the fintech has tangible assets and already developed products or services. If the fintech is still small and works intensely on innovations, control is more effective through an investment.

The structure of this paper is as follows: In Section 2, we outline our theory and hypotheses, and in Section 3, we describe our data and the methods applied. In Section 4, we present the results. Section 5 summarizes our findings, presents practical implications, and concludes.

2. Literature review and hypotheses

To increase their profitability, banks develop financial innovations (Scott et al. 2017). Beck, Chen, Lin, and Song (2016) show that financial innovations are 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 enhance the bank's value through the implementation of financial innovations. In other words, bank–fintech alliances aim to improve the market value of both fintechs and banks.

While early research on the boundary of firms has primarily considered market transactions versus the acquisition of firms, and thus the internalization of externally developed products or services (starting with Coase 1937), recent research on organizations has evidenced various other forms of interactions that could lead to alliances for the joint development of products or services and the exploitation of innovation opportunities (Borah and Tellis 2014; Jacobides and Billinger 2006). Current innovations pose particular challenges to the optimal boundary of banks, for which market transactions could provide more flexible solutions to the increasing digitalization of organizations and the emergence of platform-based business models in the financial industry. If banks cannot develop new digital services themselves, to reap the benefit of digitalization they must adopt a more permeable structure that facilitates interactions with fintechs to better match capabilities with the particular needs of the market.

Fintechs might collaborate with banks for several reasons. Through an alliance with an established player in the financial industry, fintechs can obtain access to a broader customer base, gain access to superior knowledge in how to deal with financial regulations, and enhance their own brand

awareness and reputation. 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 (Klus et al. 2019). By contrast, banks can 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, investing in a fintech firm can give a bank the exclusive right to use a specific application or license, enabling it to exclude competitors at its discretion. Similar to industrial firms, banks can thus protect their core businesses (Hagedoorn and Duysters 2002). Moreover, such an investment allows the bank to exercise control and directly influence the product development process of the fintech.

Given the opportunities and challenges associated with the digital transformation of the financial industry, the majority of banks have by now adopted a digital 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 thus created the position of a CDO. While research has examined the role of the chief executive officer and chief financial officer in earnings management (Jiang, Petroni, and Wang 2010) and explored whether hiring a chief financial officer changes fraudulent financial reporting (Geiger and North 2006), little is known about the role of the CDO. This lack of research is likely due to the recent creation of this new board position. Given the specific tasks assigned to the CDO and the context in which this position has been created, the CDO may predominantly develop in-house digitalization competencies and collaborate with fintechs only if doing so is the most cost-efficient solution. However, ceteris paribus, a bank with a CDO may also interact more frequently with fintechs than banks without such a position because initiating alliances with fintechs could simply be part of the same corporate change strategy.

If CDOs implement strategies to develop new digital services within the bank, they might also be more likely to pursue organizational changes that make banks more permeable to the market to reap the full benefits of the new services, thus making interactions with fintechs more likely. These interactions may take the form of an investment or a product-related collaboration. Alliances enable banks to benefit from innovations without facing the burden of having to develop them in the presence of existing organizational structures and legacy IT systems. A clear mission of a CDO and the reduced burden to innovate in the absence of a legacy system thus lead banks with a CDO to launch more alliances. Similarly, some banks do not hire a CDO but nevertheless develop a clear digital strategy and delegate the development of this strategy to other managers of the bank. As this may lead to the same outcome, we conjecture that banks with a clear digital strategy are more likely to have alliances with fintechs than banks without such a strategy. We summarize these predictions as follows:

H1 (CDO and digital strategy): Alliances with fintechs are more common among banks with a CDO or that have defined digitalization as a goal in their corporate strategy.

Banks have different motives when they engage in an alliance with a fintech. The development of digital services affects how financial products look and how they are distributed to customers. If banks cannot develop new digital services themselves because of their IT legacy and organizational structure, product-related collaborations enable them to broaden their portfolio and use alternative distribution channels to reach new customers. Offering fintech services or applications on their websites helps banks maintain their customer base without having to develop new services or applications themselves. Often, developing these services or applications alone is a cumbersome task because many banks operate software systems that are barely compatible with modern end-user applications and suffer from organizational legacy (Brandl and Hornuf 2020). Moreover,

because many fintechs offer software solutions, which must be customized to end-user needs and updated at regular intervals, acquiring a fintech is risky for a bank. Whether a fintech can develop efficient digital services in a timely manner is uncertain, and having the option to choose the software of another provider can be a risk-minimizing strategy for a bank. Waiting until the digital service of a fintech has been customized and is running in the mass market might therefore be a better strategy. By acquiring a fintech early on in the development or even commercialization phase, banks can easily bet on the wrong horse. In such a situation, taking the route of setting up alliances may allow the bank to reduce technological and market risk. As the make, buy, or ally literature indicates (Borah and Tellis 2014; Jacobides and Billinger 2006), alliances can therefore represent a more flexible solution particularly suitable for innovations.

The relative benefits of setting up an alliance with an existing fintech startup rather than acquiring it are factor specific, as not all banks will benefit equally from forming an alliance. If banks wait too long, given the competitive environment in which they are evolving, they might lose a valuable innovation to a competitor, something banks may be able to shield themselves against by acquiring the startup early on. Large banks often have deeper pockets than small banks and can also bear the risk of acquiring the wrong fintech. An investment, through either a minority or majority acquisition, in a fintech allows banks to internalize the knowledge of the fintech better and obtain sole possession of its knowledge (Teece 1986). We, therefore, expect bank size to be associated with the form of alliances chosen and conjecture the following:

H2a (type of alliance): Large banks are more likely to invest in fintech firms, while small banks engage in product-related collaborations.

In the context of innovation, the theoretical literature on incomplete contracting has developed strong arguments on the choice between building corporate, collaborative relationships governed by contracts and acquiring the innovating firm (Grossman and Hart 1986). Innovation activities are typically difficult to contract because their ultimate outcome is hard to determine *ex ante* and thus is non-verifiable *ex post* (Aghion and Bolton 1992). This is especially true for early-stage firms, in which the ultimate outcome of an innovation is still largely unknown. In this case, contracting between the fintech and the bank is not an effective way of generating synergies because the fintech cannot be contractually constrained in creating synergies with the bank. When contract terms about future innovations cannot clearly be written down, *ex post* enforcement becomes impossible. Consequently, investing in the fintech is superior to a product-related cooperation because it allows the bank to control the decisions made inside the fintech firm more directly.

H2b (type of alliance): Banks are more likely to invest in small fintechs and engage in product-related collaborations with large fintechs.

After analyzing the characteristics of alliances, an important question is whether the 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 of these alliances on long-term performance measures of banks or even their corporate structure. Nevertheless, event studies are an established method to evaluate the market expectations of future cash flows that might result from organizational changes, such as mergers, joint ventures, or strategic alliances (Amici, Fiordelisi, Masala, Ricci, and Sist 2013; Gleason, Mathur, and Wiggins 2003; Marciukaityte, Roskelley, and Wang 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. However, if markets believe that banks should develop new digital services themselves, the market reaction to alliances with fintechs might even be negative.

H3 (economic value): Announcements of bank–fintech alliances have a positive impact on the market value of the bank.

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 and panel data 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 came from the respective national supervisory authorities and comprises all active banks as of 2017. We chose these four countries because they represent different financial systems: While Canada and the United Kingdom are traditionally considered market-based financial systems, France and Germany are considered bank-based financial systems (Demirguc-Kunt and Levine 1999). Furthermore, the four countries are similar in size, allowing us to provide a comprehensive overview of the respective market. We deliberately decided not to analyze countries with a large fintech market, such as China and the United States, because our results might have been less comprehensive, and our language proficiency (in the case of China)

would not have been sufficient for a rigorous analysis. Finally, these two countries would have been outliers that would have skewed the findings of the empirical analysis (Haddad and Hornuf 2019).

To assemble a comprehensive overview of existing bank–fintech alliances, we used a broad Internet search encompassing four steps. First, we searched all bank websites to find official press releases about alliances with fintechs. The decision as to whether the respective partner is a fintech was based on the definition provided by the Financial Stability Board of the Bank for International Settlements. Second, we investigated the fintech 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 also helped us obtain more information on the respective forms of alliances. To ensure that no alliance was omitted, we carried out a systematic Google search in the fourth step.[3] For coding purposes, an alliance counted as (1) an *investment* if the bank made a minority or majority acquisition and (2) a *product-related collaboration* if it formed a contract-based partnership. To be included in our sample, three additional requirements needed to be met: (1) the alliance must have been announced between January 1, 2007, and January 1, 2018; (2) at least one bank was involved in the alliance together with at least one fintech; and (3) the bank was located in one of the four studied countries; fintech firms, however, could be located anywhere in the world. Our sample consists of 400 banks that formed 500 bank–fintech alliances. Figure 1 presents an overview of the emergence of bank alliances with fintechs by country and year. The figure shows the cumulative number of alliances in each year and evidences that banks from the United Kingdom formed fintech alliances early on. Our data suggest a perceptible increase for all

3 We searched for the name of the respective bank in combination with "fintech," "partner," "alliance," "invest," "acqui," and "collabor" and entered wildcard search symbols such as * in combination with these search terms.

other countries from the year 2013 onward. During an average year, every 10th bank has engaged in an alliance with a fintech. However, there is strong variation among banks, with some initiating up to 51 alliances during the sample period and others initiating none.

- Figure 1 about here -

To investigate which banks collaborate with fintechs and to what extent they do so, we defined two dependent variables: (1) a binary dependent variable *Alliance*, which equals 1 if bank i has made at least one alliance with a fintech in year t and 0 otherwise, and (2) the number of new alliances (*Number of New Alliances*) that bank i has begun in year t. To test Hypothesis 1, our two main explanatory variables are the dummy variables *Digital Strategy*, which equals 1 if bank i has a digital strategy in year t and 0 otherwise, and *CDO*, which equals to 1 if bank i employs a CDO in year t and 0 otherwise. We hand-collected both variables through a systematic analysis of the banks' annual reports and their websites.[4] The year in which a CDO joined the board came from the banks' annual reports, their websites, and LinkedIn profiles. As the core task of a CDO is to design and support technology-driven process changes, the time-varying variable *CDO* provides an indicator of the digital orientation of a bank. We treat the bank as having adopted a digital strategy if it has officially declared a strategy to foster digitalization. More specifically, the time-varying variable *Digital Strategy* indicates whether or not a bank has a well-defined digital strategy. We obtained the variable by analyzing the annual reports of all banks during our sample period. According to our definition, a bank only follows a digital strategy if it has announced an explicit

4 Annual reports and websites were frequently available in English. If the information about the variable *Digital Strategy* was only available in a foreign language, we searched for the French and German equivalents (e.g., *stratégie de numérisation*, *Digitalisierungsstrategie*). We consulted an independent researcher fluent in English, French, and German, who validated the terminology and confirmed that the variable was correctly coded. As "chief digital officer" and its abbreviation "CDO" are internationally established terms, we did not perform additional search or validation for these terms in the respective foreign language.

digitalization-related implementation plan; general statements on the importance of digitalization are not enough. From the year the bank first announced a digital strategy, we presume that it continued with this strategy and coded the variable *Digital Strategy*.

We consider various control variables that have recently been used in the banking literature (Peng, Jeng, Wang, and Chen 2017). These include firm characteristics, such as whether the bank is publicly listed (*Bank Listed*) and a universal bank (*Universal Bank*), and financial indicators, such as the natural logarithm of total assets (*ln(Bank Total Assets)*), the loan-to-assets ratio (*Bank Loan-to-Assets Ratio*), and return on average assets (*Bank ROAA*). General information about the banks, such as balance sheet data, came from the banks' annual reports and the Fitch Connect database. However, we could only collect some information, such as financial data of privately owned banks, if banks were subject to some form of disclosure requirement. Finally, we collapsed the data into a panel dataset for the 2007–2017 period to obtain bank-year observations.

To test Hypotheses 2a and 2b, we focus on our sample of 500 bank–fintech alliances and create the dummy variable *Investment*, which equals 1 if a bank has invested in at least one fintech and 0 if the alliance is characterized by a product-related collaboration. We 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, which serve as our main explanatory variables. In addition to the control variables from Hypothesis 1, we include other variables to control for fintech characteristics: *Fintech Front-End Solution*, which is a dummy variable equal to 1 if a fintech offers front-end solutions and 0 if it offers back-end solutions; *Fintech Headquarter*, which is a dummy variable equal to 1 if the fintech operates in the same country as the partnering bank; *Fintech Number of Patents*, which counts the number of patents the fintech had previously registered; and

Fintech Age, which accounts for the years since the fintech's founding. Table 1 provides detailed definitions of all variables and their sources.

- Table 1 about here -

3.2 Methodology

To test Hypothesis 1, we estimate probit panel regressions. We follow Peng et al. (2017) and also include bank, country, and year fixed effects to minimize the potential bias stemming from differences in, for example, national regulation or general technological trends that occur over time. Considering that many fintechs, such as 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. Furthermore, we include our two main explanatory variables *Digital Strategy* and *CDO* interchangeably in the same regressions because they are strongly correlated (ρ = 0.29) and potentially suffer from multicollinearity. Moreover, they constitute two alternative proxies for the same factor—a bank's strategic orientation in terms of digitalization. In our baseline specification, we estimate the following panel probit model, where $Pr(Alliance_{it} = 1)$ is the probability that a bank *i* has 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 digital strategy or CDO is correlated with 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 panel regression. The baseline equation is

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

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 equation is

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

In line with prior 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 cumulative abnormal returns (CARs) to assess changes in the market valuation of banks after the announcement to establish an alliance with a fintech. We use the market model to calculate abnormal returns (following Brown and Warner 1980, 1985), which is widely used in event studies. To be included in the sample, we required that (1) the date of the first public announcement about the bank–fintech alliance could be uniquely identified and (2) stock price data were available to calculate the returns for a minimum of 46 days before the first press announcement. We manually searched for the International Securities Identification Number of the banks in our sample on the websites of various retail brokers and financial data providers such as OnVista and Finanztreff. We

then extracted stock prices from Thomson Reuters Datastream. After we excluded non-listed firms, 140 alliances with 30 publicly listed banks remained for the period from 2007 to 2017. More specifically, we identified 28 announcements of fintech alliances from Canada (from eight listed banks), 23 from France (from six listed banks), 40 from Germany (from five listed banks), and 49 from the United Kingdom (from 11 listed 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). We estimated the parameters of the market model 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).

4. Empirical results

4.1 Descriptive statistics

Table 2A provides summary statistics for our panel dataset of the 100 largest banks in Canada, France, Germany, and the United Kingdom. During the sample period, 39% of all banks engaged in some form of alliance. The share of banks following a digital strategy is 57%, while just 10% of the banks employ a CDO.[5] Overall, 15% of the banks in our sample are publicly listed, 7% are digital banks, and 40% are universal banks. Figure 2 shows the distribution of fintech alliances by bank size. The 10 largest banks in each country account for slightly more than half the alliances between banks and fintechs in our sample.

[5] These figures do not correspond to those in Table 2A, as they are based on the bank level and the table reports statistics of our panel dataset, in which banks are represented for several years.

- Table 2A and Figure 2 about here -

Table 2B provides summary statistics for the alliance sample covering 500 bank–fintech alliances. We find that 33% of the 154 banks partnering with fintechs made at least a minority investment.[6] Considering only banks that collaborate with fintechs, we find that 76% have a digital strategy and 15% employ a CDO. In the alliance sample, 23% of the banks are publicly listed, 10% are digital banks, and 44% are universal banks.

- Table 2B about here -

Figure 3 provides an overview of the segments in which fintechs that formed a bank–fintech alliance operate and shows that many fintechs operate in the payment services sector. While fintechs generally engage most often in financing (Haddad and Hornuf 2019), this is not part of their core business in our sample, which includes only fintechs that formed an alliance with banks. In comparison with Canada, France, and Germany, a relatively large number of UK fintechs provide bank-level software, such as digital tools for customer relationship management. Furthermore, we could not assign many UK fintechs to one of the predefined segments, indicating that they either offer more diversified services or operate in niche segments.

Figure 4 shows the most common types of bank–fintech alliances. We classified them into four categories: minority investment, majority investment, product-related collaboration, and other forms of alliances. We find that minority investments and product-related collaborations are the two most common alliance types in all four countries, which suggests that comparatively loose forms of alliances are preferred. We find a relatively high number of majority investments in

6 These figures do not correspond to those in Table 2B, as some banks have engaged in multiple alliances and the table reports statistics of our alliance dataset.

France, even though they are still smaller than alliances in the form of minority investments and product-related collaborations.

- Figures 3 and 4 about here -

4.2 Regression results

4.2.1 Establishing alliances

In Table 3, we examine whether a *Digital Strategy* or the employment of a *CDO* is in line with bank–fintech alliances. We find that the coefficients of *Digital Strategy* for regressions (1) and (3) are 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%. The probability of finding at least one bank–fintech allaince is 10% higher if a bank employs a *CDO*. Thus, our results for *Digital Strategy* and *CDO* provide support for Hypothesis 1. Moreover, we find significant, positive coefficients for *Bank Listed* in models (2) and (4) and for *ln(Bank Total Assets)* in model (3), suggesting that the sheer size of a bank is associated with more bank–fintech alliances.

As a robustness check and as a way to exclude large, established fintechs, we ran 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. We find 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, when measuring the dependent variable as a dummy, we obtain exactly the same dataset both with and without the large, established fintechs (this is different for the number of alliances as well as in the cross-sectional analysis).

- Table 3 about here -

Next, we investigate whether *Digital Strategy* and *CDO* are also correlated with the number of fintechs with which a bank collaborates. Table 4 reports the results of the negative binominal regressions. We report incident rate ratios, which can be interpreted as multiplicative effects or semi-elasticities. The coefficients of *Digital Strategy* in models (1), (3), (5), and (7) are positive and statistically significant at the 0.1% level. In economic terms, banks with a digital strategy have three to four times more alliances with fintechs than banks without a digital strategy. The coefficient of *CDO* is positive and statistically significant in all models that include this variable. Banks employing a CDO have two to three times more alliances with fintechs than banks without a CDO. These findings are robust to the exclusion of large fintechs in the sample (regressions (5)–(8)). Overall, our findings indicate that a bank's strategic orientation is positively correlated with the number of alliances with fintechs. The coefficients of *Bank Listed* and ln*(Bank Total Assets)* are statistically significant and have a positive effect in all the regressions. Accordingly, 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 binary dependent variable that classifies the two broad types of alliances, which we denote as *Investment*. This allows us to further investigate what motivates the type of alliance while integrating additional explanatory variables measuring various fintech characteristics. Because some banks have not made an investment in a fintech or engaged in a product-related collaboration but formed another type of partnership, the number of observations in the regressions is somewhat smaller than the overall number of alliances in our alliance sample. As the other types of collaborations were few, we did not run separate analyses for them.

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 indicates that a one-unit change in the employee size category decreases the probability of investments by approximately 10%. This is in line with Hypothesis 2b and our conjecture that banks make investments more often in small firms, which allows them to better control the fintech. However, the coefficients turn non-significant when we exclude large fintechs (regressions (3) and (4)), suggesting that the effect diminishes when only considering fintechs with fewer than 1000 employees. The coefficients of ln*(Bank Total Assets*) are positive and statistically significant at the 1% level in regressions (1) and (2), indicating that, when accounting for 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 we exclude large fintechs, suggesting that the bank's size does not play a role when only small fintech startups are considered. Furthermore, the coefficients of *Universal Bank* are 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, while universal banks seem to benefit more from product-related collaborations.

- Table 5 about here -

To examine whether stock price reactions occurred after an alliance was publicly announced, we calculate cumulative average abnormal returns (CAARs) for different event windows. We find that 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. Thus, at least in the short run, investors perceive alliances with fintechs as having, *on average*, a negative effect on firm value; thus, Hypothesis 3 is rejected. We might interpret this result as indicating that markets believe banks should develop new digital services themselves instead. However, Table 6 reveals that the CAARs are not negative

for all banks and that, in some cases, investors value the public announcement of an alliance. We run ordinary least squares regressions not only on our financial performance measure, CARs, for the short event windows (–1;0), (0;+1), and (–1;+1), as Amici et al. (2013) and Chiou and White (2005) suggest, but also for the longer event window (0;+100) to account for potential momentum effects.

- Table 6 about here -

In unreported regressions, we find that *Digital Strategy* is positive and statistically significant for the (0;+100) event windows. Moreover, digital banks benefit the most from a strategic alliance. That is, the variable *Digital Bank* is positive and statistically significant for most short-term event windows. 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 bank or fintech variables affect bank value when it comes to a fintech alliance.

5. Discussion and conclusions

In this paper, we examined the impact of digitalization in the banking industry by analyzing the bank characteristics that play a role in the alliances between banks and fintech startups. Moreover, we investigated the factors that are relevant for a bank to invest in a fintech rather than entering into a product-related collaboration. Finally, we tested whether announcing a new alliance affects banks' market value.

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

based (Canada and the United Kingdom) 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 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 finding of our study is that fintechs engaging in alliances operate in various segments across the four countries we investigate, with payment services being the most prevalent segment. Given that, overall, most fintechs operate in the financing segment (Haddad and Hornuf 2019), banks seem to benefit most from external technology in the realm of payment services.

Our findings confirm that the implementation of a digital strategy by a bank is positively correlated with both the mere existence and the number of alliances with fintechs. We further find that large, listed, and universal banks are more likely to establish alliances with at least one fintech than 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 in which a bank becomes involved. However, while a digital strategy and a CDO may result in more bank–fintech alliances, we do not claim to have established a causal relationship. Instead, the correlations in our data might be part of the same overall corporate change strategy. Nevertheless, we provide first evidence that a digital strategy, a CDO, and bank–fintech alliances often go hand in hand. Regarding the market effect of publicly announced alliances, we find that announcements of such alliances have a negative effect on the bank's value for short-term windows. As noted previously, this might be an indication that markets believe that banks should develop new digital services themselves rather than engaging in alliances with fintechs.

Our results further suggest that neither a digital strategy nor the employment of a CDO is significantly connected with an investment, as they are in product-related collaborations. Although this finding contradicts our hypothesis and previous literature about board positions (Geiger and North, 2006; Jiang and Li, 2009), we assume that CDOs do not simply focus on acquiring fintechs but also work to develop digitalization expertise in-house. Furthermore, we find that large banks are more likely to become financially engaged in fintech firms. Through a minority investment or a full acquisition in a fintech, banks can often obtain representation on the fintech's board of directors and thereby gain complete or partial control over it. Large banks often set up incubator and accelerator programs to obtain financial stakes in fintech firms early on. We find that banks are also more likely to financially invest in smaller fintechs.

Our work has practical implications for fintech entrepreneurs, banks, and policy makers. Entrepreneurs seeking funds or access to customers may find it worthwhile to engage in an alliance with a bank. The form of collaboration, however, may depend on what is most beneficial for both. In particular, our findings show that entrepreneurs in need of capital may be more successful approaching large banks, because they are more likely to invest in fintechs; by contrast, fintech entrepreneurs who want to stay independent but need to reach new customers may favor smaller and specialized banks, which are more likely to engage in product-realted collaborations. More generally, banks with a clearly defined digital strategy or a CDO are most likely to be receptive to entrepreneurs' interest in collaborating or in receiving an investment.

For banks, it is important to acknowledge that there is an upward trend toward hiring a CDO, which may become increasingly important as digitalization spreads across the different segments of the financial industry. However, according to our analysis most banks still have not recognized the need for a CDO. The necessity to hire a CDO may become more important in the future, as financial

technologies become more mature and the need to engage in alliances more pressing. An increasing reliance on alliances also raises questions about the existing technological infrastructure of banks. To collaborate effectively with a fintech, banks may rely on traditional systems such as SWIFT or need to develop new suitable application programming interfaces.

Finally, our work offers practical implications for policy makers who want to foster an acceleration of the usage of digital technologies in the financial sector. Depending on how policy makers want to shape the financial ecosystem, adopting a restrictive granting practice for bank licenses limits growth opportunities of fintechs as independent entities, because many activities (e.g., taking deposits, extending loans) require such a licence. The restrictive granting of bank licenses would thus lead to an ecosystem that is increasingly based on alliances. This, in turn, may affect the relative stability, profitability, and, thus, the viability of existing banks.

Our analysis also has clear limitations. The first pertains to the point raised previously that while we consider correlations in our analysis, we do not claim causality. It is conceivable that banks establish a CDO position because they plan to form alliances in the near future, which would suggest that the causality can also go in the opposite direction. Future research might uncover an exogenous shock that would help establish a clean identification strategy for empirical work on causality. Second, although we relied on various sources of information to identify alliances, we acknowlege that other sources of information remain secret to the market and that we could not identify all of them. As such, our figures on the number of alliances are lower bounds. Third, our analysis takes the perspective of banks. Complementary research could explore the perspective of fintech startups' incentives to collaborate with banks. The perspective of fintechs is likely to be quite different.

References

Aghion, P., & Bolton, P. (1992). An Incomplete Contracts Approach to Financial Contracting. *The Review of Economic Studies*, *59*(3), 473–494. https://doi.org/10.2307/2297860

Amici, A., Fiordelisi, F., Masala, F., Ricci, O., & Sist, F. (2013). Value Creation in Banking through Strategic Alliances and Joint Ventures. *Journal of Banking and Finance*, *37*(5), 1386–1396. https://doi.org/10.1016/j.jbankfin.2012.03.028

Autio, E., Nambisan, S., Thomas, L. D. W., & Wright, M. (2018). Digital Affordances, Spatial Affordances, and the Genesis of Entrepreneurial Ecosystems. *Strategic Entrepreneurship Journal*, *12*(1), 72–95. https://doi.org/10.1002/sej.1266

Beck, T., Chen, T., Lin, C., & Song, F. M. (2016). Financial Innovation: The Bright and the Dark Sides. *Journal of Banking and Finance*, *72*, 25–51. https://doi.org/10.1016/j.jbankfin.2016.06.012

Borah, A., & Tellis, G. J. (2014). Make, Buy, or Ally? Choice of and Payoff from Announcements of Alternate Strategies for Innovations. *Marketing Science*, *33*, 114–133. https://doi.org/10.1287/mksc.2013.0818

Brandl, B., & Hornuf, L. (2020). Where Did Fintechs Come from, and Where Do They Go? The Transformation of the Financial Industry in Germany after Digitalization. *Frontiers in Artificial Intelligence*. forthcoming.

Brown, S. J., & Warner, J. B. (1980). Measuring Security Price Performance. *Journal of Financial Economics*, *8*(3), 205–258. https://doi.org/10.1016/0304-405X(80)90002-1

Brown, S. J., & Warner, J. B. (1985). Using Daily Stock Returns. *Journal of Financial Economics*, *14*(1), 3–31. https://doi.org/10.1016/0304-405X(85)90042-X

Chiou, I., & White, L. J. (2005). Measuring the Value of Strategic Alliances in the Wake of a Financial Implosion: Evidence from Japan's Financial Services Sector. *Journal of Banking & Finance*, *29*(10), 2455–2473. https://doi.org/10.1016/J.JBANKFIN.2004.09.001

Coase, R. H. (1937). The Nature of the Firm. *Economica*, *4*(16), 386–405. https://doi.org/10.1111/j.1468-0335.1937.tb00002.x

Coase, R. H. (1960). The Problem of Social Cost. *The Journal of Law & Economics*, *3*, 1–44. Retrieved from http://www.jstor.org/stable/724810

Cumming, D. J., & Schwienbacher, A. (2018). Fintech venture capital. *Corporate Governance: An International Review*, *26*(5), 374–389. https://doi.org/10.1111/corg.12256

D'Acunto, F., Prabhala, N., & Rossi, A. G. (2019). The Promises and Pitfalls of Robo-Advising. *The Review of Financial Studies*, *32*(5), 1983–2020. https://doi.org/10.1093/rfs/hhz014

Demirguc-Kunt, A., & Levine, R. (1999). *Bank-Based and Market-Based Financial Systems - Cross-Country Comparisons* (No. 2143). Washington, DC: The World Bank. Retrieved from http://documents.worldbank.org/curated/en/259341468739463577/pdf/multi-page.pdf

European Banking Authority. (2017). *Discussion Paper on the EBA's Approach to Financial Technology (FinTech)*. London. Retrieved from http://www.eba.europa.eu/documents/10180/1919160/EBA+Discussion+Paper+on+Fintech+%28EBA-DP-2017-02%29.pdf

Geiger, M. A., & North, D. S. (2006). Does Hiring a New CFO Change Things? An Investigation of Changes in Discretionary Accruals. *The Accounting Review*, *81*(4), 781–809. https://doi.org/10.2308/accr.2006.81.4.781

Gleason, K. C., Mathur, I., & Wiggins III, R. A. (2003). Evidence on Value Creation in the Financial Services Industries through the Use of Joint Ventures and Strategic Alliances. *The Financial Review*, *38*(2), 213–234. https://doi.org/10.1111/1540-6288.00043

Grossman, S. J., & Hart, O. D. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, *94*(4), 691–719. https://doi.org/10.1086/261404

Haddad, C., & Hornuf, L. (2019). The Emergence of the Global Fintech Market: Economic and Technological Determinants. *Small Business Economics*, *53*(1), 81–105. https://doi.org/10.1007/s11187-018-9991-x

Hagedoorn, J., & Duysters, G. (2002). External Sources of Innovative Capabilities: The Preferences for Strategic Alliances or Mergers and Acquisitions. *Journal of Management Studies*, *39*(2), 167–188. https://doi.org/10.1111/1467-6486.00287

Jacobides, M. G., & Billinger, S. (2006). Designing the Boundaries of the Firm: From "Make, Buy, or Ally" to the Dynamic Benefits of Vertical Architecture. *Organization Science*, *17*(2), 249–261. https://doi.org/10.1287/orsc.1050.0167

Jiang, X. J., Petroni, K. R., & Wang, I. Y. (2010). CFOs and CEOs: Who Have the Most Influence on Earnings Management? *Journal of Financial Economics*, *96*(3), 513–526. https://doi.org/10.1016/j.jfineco.2010.02.007

Jiang, X., & Li, Y. (2009). An Empirical Investigation of Knowledge Management and Innovative Performance: The Case of Alliances. *Research Policy*, *38*(2), 358–368. https://doi.org/10.1016/j.respol.2008.11.002

Klus, M. F., Lohwasser, T. S., Holotiuk, F., & Moormann, J. (2019). Strategic Alliances between Banks and Fintechs for Digital Innovation: Motives to Collaborate and Types of Interaction. *Journal of Entrepreneurial Finance*, *21*(1), 1–23.

Kohtamäki, M., Parida, V., Oghazi, P., Gebauer, H., & Baines, T. (2019). Digital Servitization Business Models in Ecosystems: A Theory of the Firm. *Journal of Business Research*, *104*, 380–392. https://doi.org/10.1016/j.jbusres.2019.06.027

Lerner, J. (2002). Where Does State Street Lead? A First Look at Finance Patents, 1971 to 2000. *The Journal of Finance*, *57*(2), 901–930. https://doi.org/10.1111/1540-6261.00446

Lerner, J., Speen, A., Baker, M., & Leamon, A. (2015). *Financial Patent Quality: Finance Patents After State Street* (No. 16–068). Cambridge, MA. Retrieved from https://www.hbs.edu/faculty/Pages/item.aspx?num=50238

Marciukaityte, D., Roskelley, K., & Wang, H. (2009). Strategic Alliances by Financial Services Firms. *Journal of Business Research*, *62*(11), 1193–1199. https://doi.org/10.1016/J.JBUSRES.2008.07.004

Merton, R. C. (1995). Financial Innovation and the Management and Regulation of Financial Institutions. *Journal of Banking & Finance*, *19*(3–4), 461–481. https://doi.org/10.1016/0378-4266(94)00133-N

Miller, M. H. (1986). Financial Innovation: The Last Twenty Years and The Next. *The Journal of Financial and Quantitative Analysis*, *21*(4), 459–471. https://doi.org/10.2307/2330693

MSCI. (2018). MSCI Germany Index (USD). Retrieved January 14, 2019, from https://www.msci.com/documents/10199/d76361cb-d5a5-4185-97ce-ec5e3dd5bf2e

Navaretti, G. B., Calzolari, G., Mansilla-Fernandez, J. M., & Pozzolo, A. F. (2017). Fintech and Banking. Friends or Foes? *European Economy – Banks, Regulation, and the Real Sector, 2017.2*. https://european-economy.eu/2017-2/fintech-and-banks-friends-or-foes/?did=2045

Peng, J.-L., Jeng, V., Wang, J. L., & Chen, Y.-C. (2017). The Impact of Bancassurance on Efficiency and Profitability of Banks: Evidence from the Banking Industry in Taiwan. *Journal of Banking & Finance*, *80*, 1–13. https://doi.org/10.1016/J.JBANKFIN.2017.03.013

Puschmann, T. (2017). Fintech. *Business & Information Systems Engineering*, *59*(1), 69–76. https://doi.org/10.1007/s12599-017-0464-6

Scott, S. V., Van Reenen, J., & Zachariadis, M. (2017). The Long-Term Effect of Digital Innovation on Bank Performance: An Empirical Study of SWIFT Adoption in Financial Services. *Research Policy*, *46*(5), 984–1004. https://doi.org/10.1016/j.respol.2017.03.010

Teece, D. J. (1986). Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy. *Research Policy*, *15*(6), 285–305. https://doi.org/10.1016/0048-7333(86)90027-2

Teece, D. J. (1998). Capturing Value from Knowledge Assets: The New Economy, Markets for Know-How, and Intangible Assets. *California Management Review*, *40*(3), 55–79. https://doi.org/10.2307/41165943

Vendrell-Herrero, F., Bustinza, O. F., Parry, G., & Georgantzis, N. (2017). Servitization, Digitization and Supply Chain Interdependency. *Industrial Marketing Management*, *60*, 69–81. https://doi.org/10.1016/j.indmarman.2016.06.013

Williamson, O. E. (1981). The Economics of Organization: The Transaction Cost Approach. *American Journal of Sociology*, *87*(3), 548–577. https://doi.org/10.1086/227496

Williamson, O. E. (1991). Strategizing, Economizing, and Economic Organization. *Strategic Management Journal*, *12*, 75–94. https://doi.org/10.1002/smj.4250121007

Yermack, D. (2017). Corporate Governance and Blockchains. *Review of Finance*, *21*(1), 7–31. https://doi.org/10.1093/rof/rfw074

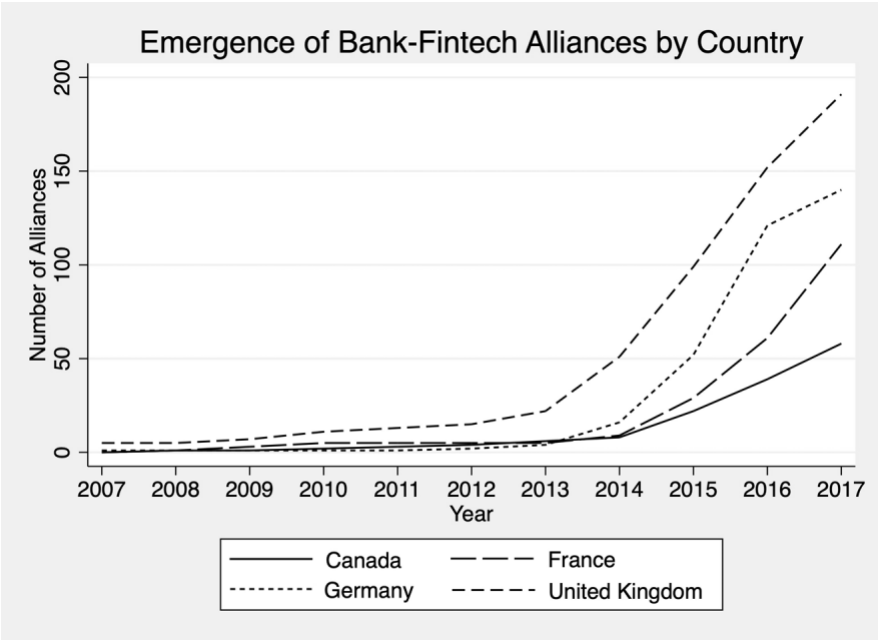

Fig. 1 Emergence of bank–fintech alliances by country and year. The sample includes 500 fintechs from 27 countries collected from 2007 to 2017. The figure shows the cumulative number of alliances in each year, grouped by the banks' home country.

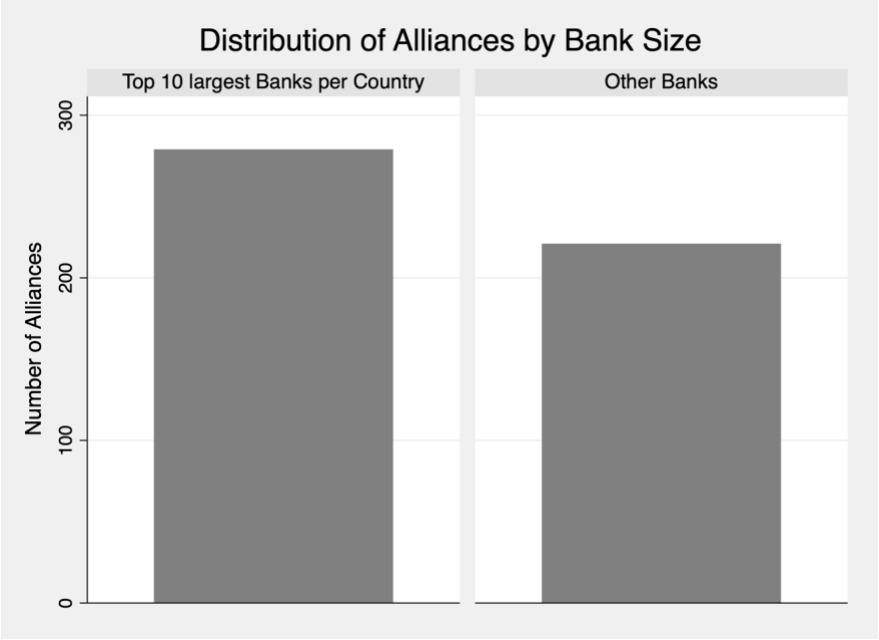

Fig. 2 Distribution of alliances by bank size. The figure shows the cumulative number of alliances for the top 10 largest banks in Canada, France, Germany, and the United Kingdom, compared with the remaining 460 banks.

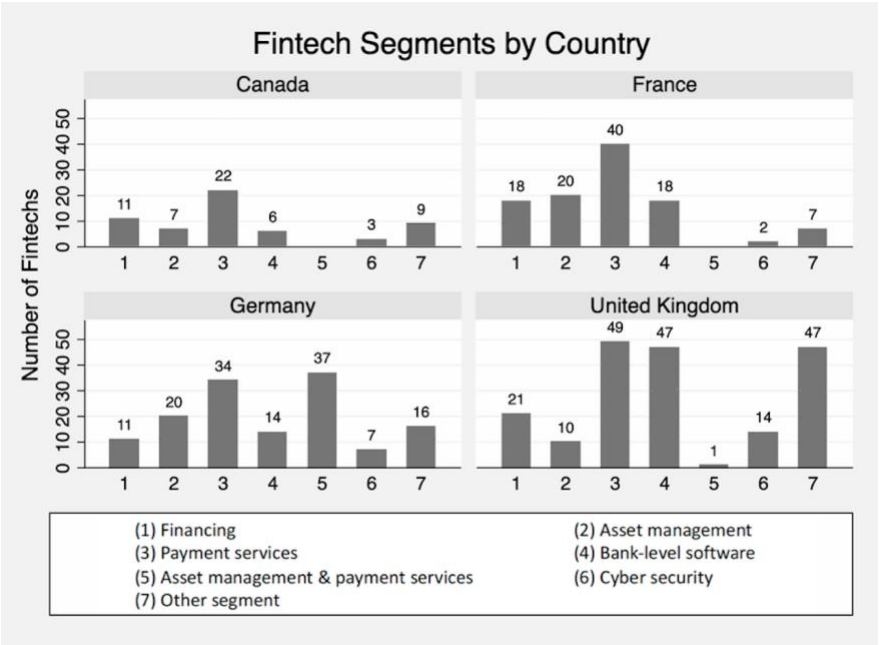

Fig. 3 Frequency of occurrence of bank alliances with fintechs by segment and country. The sample includes 492 identified fintech segments. The bars represent the number of fintechs in each segment and grouped by the banks' home country.

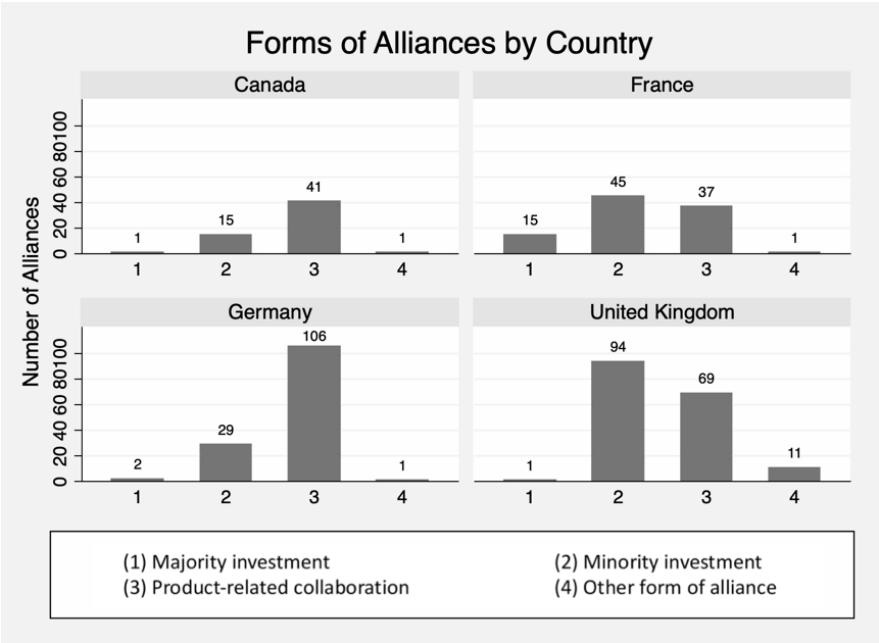

Fig. 4 Frequency of occurrence of interacting fintechs by form and country. The sample includes 469 interacting fintechs from 28 countries collected from 2007 to 2017. The bars represent the frequency of the different arrangements of interaction with banks in Canada, France, Germany, and the United Kingdom.

Table 1 Definitions of variables included in the regression models

Variable name	Definition
Dependent variables	
Alliance (d)	Binary variable equal to 1 if the bank engaged in at least one alliance with a fintech and 0 otherwise. We define alliance as any type of contract- or investment-based interaction between a bank and fintech with the purpose of collaborating. From the year the bank first announced an alliance, we presume that the bank continued with this strategy and coded the variable accordingly. Source: Bank websites, Factiva, Google, Thomson Reuters M&A Database.
Number of New Alliances	Number of fintech alliances for a given bank and year.
Investment (d)	Binary variable equal to 1 if a bank acquired at least a minority stake in a fintech and equal to 0 if the alliance is characterized by a product-related collaboration. Other forms of alliances are excluded for this variable. Source: Bank websites, crunchbase, Factiva, fintech websites, Google, Thomson Reuters M&A Database.
CAR(–X;+Y)	The cumulative abnormal return for the event window (–X;+Y). Event date 0 is the date of the first public announcement of the alliance. In the analysis, we specify different windows. Source: Thomson Reuters Datastream and own calculations.
Bank characteristics	
Bank Listed (d)	Binary variable equal to 1 if the bank is publicly listed in a given year and 0 otherwise. Source: OnVista.
Bank Headquarter (d)	Binary variable equal to 1 if the bank is located in the same country as the headquarters of the bank and 0 otherwise. Source: Crunchbase, Fitch connect, fintech websites.
Bank Loan-to-Assets Ratio	Ratio of a bank's total loans outstanding to its total assets. Source: Fitch connect.
Bank ROAA	Ratio of a bank's return to its average assets. Source: Fitch connect.
CDO (d)	Binary variable equal to 1 if the bank employs a chief digital officer in the year of interest and 0 otherwise. Source: Annual reports, LinkedIn, Bank website.
Digital Bank (d)	Binary variable equal to 1 if the bank is a direct bank without a branch network, offering only remote services via online and telephone banking, and 0 otherwise. Source: Bank websites.
Digital Strategy (d)	Binary variable equal to 1 if the bank announced a clear digital strategy, which entails a roadmap of concrete measures and actions in their its report. From the year the bank first announced a digital strategy, we presume that the bank continued with this strategy and coded the variable accordingly. 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. Source: Fitch connect.
Universal Bank (d)	Binary variable equal to 1 if the bank participates in various banking services and 0 otherwise. Source: Bank websites.
Fintech characteristics	
Fintech Employees (rank)	Range of the fintech's employees. Categories: 1–10, 11–50, 51–100, 101–1000, >1000. Source: Crunchbase, fintech website, LinkedIn.
Fintech Age	Age of the fintech in years in the respective year. Source: Crunchbase, fintech website, LinkedIn.
Fintech Front-End Solution (d)	Binary variable equal to 1 if the fintech offers front-end solutions and 0 otherwise. Source: Crunchbase, fintech website, LinkedIn.
Fintech Headquarters (d)	Binary variable equal to 1 if the fintech is located in the same country as the bank's headquarters and 0 otherwise. Source: Crunchbase, fintech website, LinkedIn.
Fintech Number of Patents	Total number of patents held by the fintech in December 2017. Source: PATSTAT.

(d*)* indicates a dummy variable.

Table 2A Summary statistics of panel data for bank-year observations by the 100 largest banks each in Canada, France, Germany, and United Kingdom from 2007 to 2017

Variable	Mean	SD (Overall)	SD (Between)	SD (Within)	Number of Banks	Number of Observations
Dependent variables						
Alliance (d)	0.12	0.32	0.20	0.25	400	4400
Number of 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
CDO (d)	0.03	0.16	0.10	0.13	353	3871
Bank 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 Headquarter (d)	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

(d) indicates a dummy variable.

Table 2B Summary statistics of deal-level data for alliances identified between banks and fintechs in Canada, France, Germany, and United Kingdom from 2007 to 2017

Variable	# Obs.	Mean	Median	Std. Dev.	Minimum	Maximum
Dependent variables						
Investment(d)	455	0.44	0	0.50	0	1
Explanatory variables						
Digital Strategy (d)	470	0.86	1	0.35	0	1
CDO (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 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 Headquarter (d)	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 Headquarter (d)	493	0.65	1	0.48	0	1
Fintech Number of Patents	500	1.67	0	8.49	0	158
Fintech Age	456	5.67	4	6.41	0	45

(d) indicates a dummy variable.

Table 3 Panel data analysis for the dummy variables *Digital Strategy*, *CDO*, and *Alliance*

	(1)	(2)	(3)	(4)
	Full sample			
	Dependent variable: Alliance (d)			
Explanatory variables				
Digital Strategy (d)	0.060***		0.077***	
	(0.018)		(0.021)	
CDO (d)		0.095*		0.072
		(0.043)		(0.042)
Bank Listed (d)	0.062	0.099**	0.054	0.090*
	(0.048)	(0.038)	(0.045)	(0.040)
Digital Bank (d)	0.003	0.044	0.078	0.077
	(0.044)	(0.042)	(0.050)	(0.072)
Universal Bank (d)	0.028	0.036	0.040*	0.035
	(0.020)	(0.025)	(0.021)	(0.020)
Bank Headquarter (d)	0.001	0.011	0.006	0.025
	(0.034)	(0.025)	(0.046)	(0.032)
ln(Bank Age)	0.011	0.013	0.018	0.027**
	(0.013)	(0.013)	(0.013)	(0.010)
ln(Bank Total Assets)			0.013***	0.009
			(0.004)	(0.005)
Bank Loan-to-Assets Ratio			-0.033	0.003
			(0.044)	(0.039)
Bank ROAA			-0.145	-0.318
			(0.390)	(0.310)
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 χ^2	37.77	77.91	139.71	92.21
Prob > χ^2	0.000	0.000	0.000	0.000

The 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 bootstrapped standard errors in parentheses. All variables are defined in Table 1. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1 % level. (d*)* indicates a dummy variable.

Table 4 Panel data analysis for the variables *Digital Strategy*, *CDO*, and *Number of Partnerships*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full sample				*Excluding large fintechs*			
	Dependent variable: Number of Alliances							
Explanatory variables								
Digital Strategy (d)	4.097***		3.133***		4.791***		3.555***	
	(1.074)		(0.839)		(1.485)		(1.029)	
CDO (d)		2.721***		1.945**		2.815***		1.810*
		(0.673)		(0.416)		(0.845)		(0.466)
Bank Listed (d)	2.679***	4.061***	1.913**	2.703***	3.529***	5.160***	1.953*	2.715**
	(0.554)	(1.018)	(0.481)	(0.748)	(0.942)	(1.550)	(0.554)	(0.895)
Digital Bank (d)	1.418	1.946	2.174**	2.225	1.597	2.477*	2.019	2.295*
	(0.561)	(0.865)	(0.649)	(0.910)	(0.764)	(1.015)	(0.792)	(0.793)
Universal Bank (d)	1.715*	1.719**	1.534	1.506	1.663*	1.682*	1.445	1.397
	(0.382)	(0.348)	(0.360)	(0.327)	(0.406)	(0.393)	(0.352)	(0.466)
Bank Headquarter (d)	0.876	1.003	0.814	0.944	0.739	0.967	0.761	0.996
	(0.265)	(0.333)	(0.239)	(0.372)	(0.281)	(0.326)	(0.225)	(0.364)
ln(Bank Age)	1.112	0.171	1.144	1.213	1.183	1.253*	1.121	1.213
	(0.116)	(0.093)	(0.116)	(0.127)	(0.142)	(0.124)	(0.119)	(0.129)
ln(Bank Total Assets)			1.283***	1.248***			1.357***	1.338***
			(0.061)	(0.056)			(0.072)	(0.071)
Bank Loan-to-Assets Ratio			0.706	0.961			0.871	1.105
			(0.277)	(0.386)			(0.420)	(0.480)
Bank ROAA*10^2			0.876**	0.876*			0.859**	0.899*
			(0.044)	(0.049)			(0.043)	(0.046)
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 χ^2	344.79	458.02	516.57	917.83	491.83	311.20	1501.03	1151.03
Prob > χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The 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 bootstrapped standard errors in parentheses. Models 1–4 use the full sample; models 5–8 exclude fintechs with more than 1000 employees or fintechs that were more than 10 years old at the time of the alliance. All 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. (d*)* indicates a dummy variable.

Table 5 Cross-sectional regression results for *Investment* versus *Product-related Collaboration*

	(1)	(2)	(3)	(4)
	Full sample		*Excluding large fintechs*	
	Dependent variable: Investment (d)			
Explanatory variables				
Digital Strategy (d)	-0.069		-0.078	
	(0.083)		(0.104)	
CDO (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 Listed (d)	0.107	0.132	0.160	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 Headquarter (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 Headquarter (d)	-0.143**	-0.138**	-0.094	-0.084
	(0.055)	(0.053)	(0.060)	(0.059)
Fintech Number of 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 R^2	0.273	0.285	0.268	0.285
Wald χ^2	51.362	58.935	57.687	58.797
Prob > χ^2	0.000	0.000	0.000	0.000

The table presents the results of a probit regression. The coefficients show the average marginal effects, and standard errors are clustered by banks (in parentheses). Models 1 and 2 use the full sample; models 3 and 4 exclude fintechs with more than 1000 employees or fintechs that were more than 10 years old at the time of the alliance. All variables are defined in Table 1. * denotes significance at the 5% level, ** at the 1% level, and *** at the 0.1% level. (d) indicates a dummy variable.

Table 6 CAARs for bank–fintech alliances

				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						

The table reports descriptive statistics of CARs for various event windows. The sample includes 140 alliances by 30 publicly listed banks for the 2007–2017 period. 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 parameter's 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.