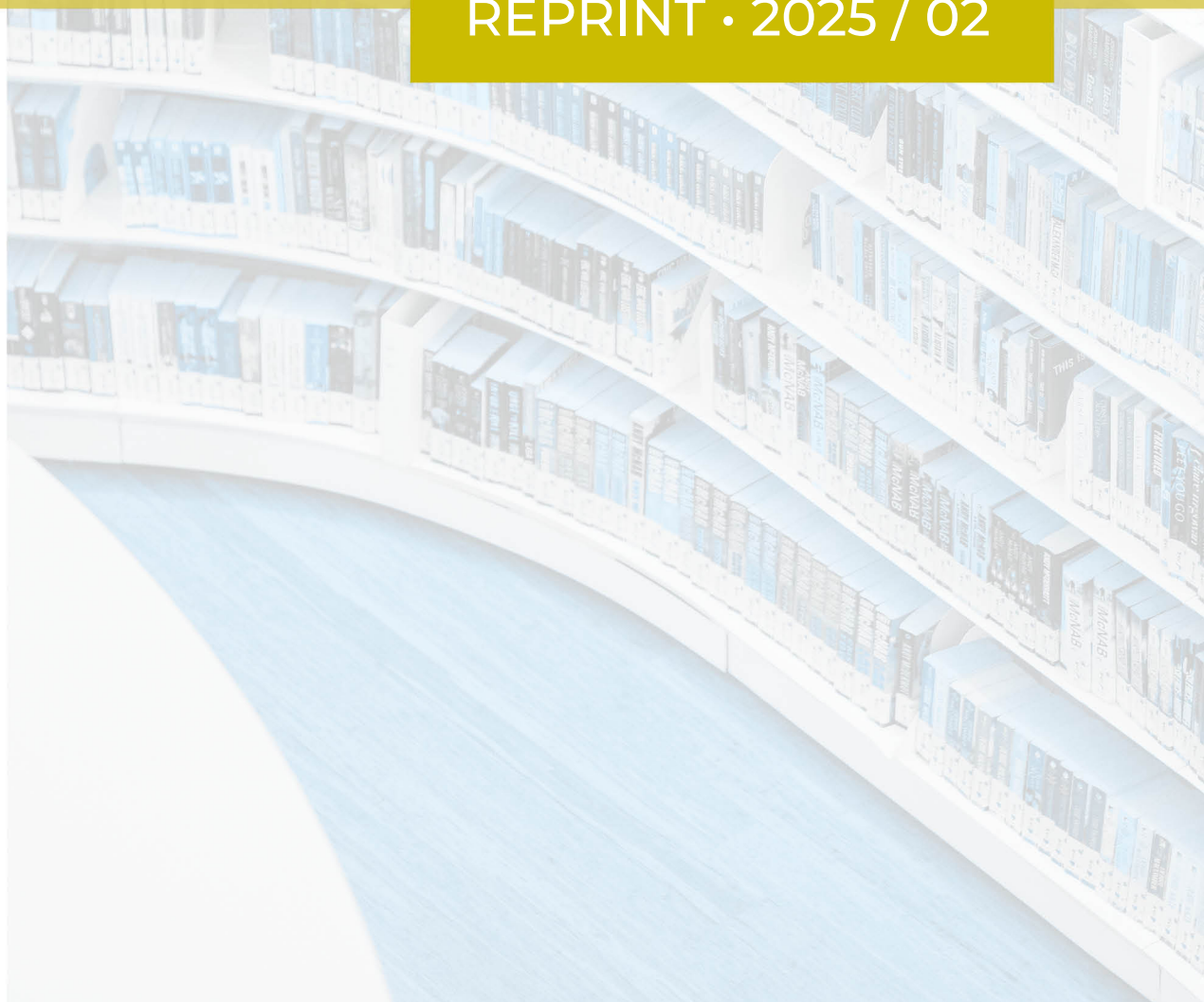


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Is FinTech Eating The Bank's Lunch?

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ABSTRACT:

This paper investigates the impact of FinTech firms on the performance of traditional financial institutions (FIs). The existing literature reveals an ongoing debate on whether new FinTech firms act as complements or substitutes to traditional FIs. We examine this by utilizing a database that includes over 10,000 FIs and data on digital finance activities across 57 countries. Our findings support the substitution hypothesis, showing that FinTech presence reduces the profitability of incumbent FIs due to reduced interest margins and elevated costs. In response, banks attempt to adapt by extending loans and boosting non-interest income, however, these efforts are insufficient to fully offset the decline in profits. Our study also reveals that various FinTech business models, such as Peer-to-Peer (P2P) and Balance Sheet lending, have varying effects on cooperative versus large commercial banks, with the latter benefiting more from the evolving competitive landscape. The findings also suggest that FinTech presence has a greater adverse effect on FIs in countries with more inclusive, competitive, profitable, and developed financial systems. Interestingly, however, traditional FIs in countries with stronger regulatory frameworks appear to benefit from the expanding influence of FinTech firms.

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1. Introduction

Digital technologies are reshaping financial services through advances in mobile telecommunications, artificial intelligence (AI), machine learning, cloud services, and distributed ledger technology. These advances have led to the rise of FinTech, defined as “new business models, applications, processes, or products with an associated material effect on the provision of financial services” (FSB, 2017). Among these, FinTech finance models—such as digital lending and capital raising—have become globally significant, using digital platforms to offer lending products and attract investors. Despite regulatory crackdowns in China, FinTech finance volumes have steadily increased. Although currently modest at around 2 percent of total credit in major markets, rapid growth is anticipated (World Bank, 2022). Projections estimate the global FinTech lending industry will reach \$4.9 trillion by 2030 (Allied Research, 2021). Furthermore, investments in FinTech platforms have surged, with the total value rising to \$217 billion in 2019 from \$4 billion in 2012 (Statista, 2022).

Within this landscape, an ongoing debate revolves around whether new FinTech firms act as complements or substitutes for traditional financial institutions (FIs). One side of the debate argues that FinTech firms can enhance the performance of incumbent FIs. For instance, Tang (2019) examines the U.S. consumer credit market and demonstrates that FinTech platforms can complement banks by offering smaller loans due to their ability to reduce the fixed costs of loan origination. Likewise, complementarity can manifest itself as FinTechs target underserved and/or less creditworthy borrowers—a strategy known as bottom fishing (Beaumont, Tang, and Vansteenberghe, 2022; Jagtiani and Lambie-Hanson, 2021; de Roure, Pelizzon and Thakor, 2021; Jagtiani and Lemieux, 2018). Incumbents can also enhance their efficiency and product offerings through partnerships, acquisitions, or the development of their own financial technologies (Thakor, 2020; Petralia et al., 2019; Navaretti et al., 2018). In addition, incumbents can effectively maintain their competitiveness in the market. For instance, Chen, Wu, and Yang (2019) demonstrate that financial industry leaders who invest significantly in their own innovation can mitigate much of the adverse effects stemming from FinTech competition. Recent evidence from China also indicates that the adoption of FinTech solutions by banks not only enhances operational efficiency but also creates more appealing business models for customers (Wang, Xiuping, and Zhang, 2021).

The other side of the debate contends that FinTech's presence negatively impacts the performance of incumbent FIs. This perspective emphasizes greater competition, leading to a substitution effect. For example, there is evidence indicating that FinTech competition places downward pressure on the profitability of FIs. In the context of the U.S. home mortgage market, the IMF (2022) demonstrates that FinTechs directly compete with banks, significantly reducing banks' interest income from mortgages. Using a sample of Latin American banks, Bejar et al. (2022) reveal that banks in countries with a higher FinTech presence experience a greater reduction in interest income. This competitive advantage is attributed to factors such as more streamlined and efficient application processes. Buchak et al. (2018) emphasize that FinTech lenders provide convenience for borrowers, while Fuster et al. (2019) demonstrate that FinTech platforms can process applications 20 percent faster than other lenders in the US mortgage lending sector. Buchak et al. (2018) and Gopal and Schnabl (2022) provide added evidence supporting the substitution effect: in response to tighter regulatory requirements following the 2008 financial crisis (including changes to capital requirements), the void created by reduced bank lending to small and medium-sized enterprises (SMEs) was filled by lending from Fintech firms.

Despite the significance of the ongoing debate, there are relatively few empirical studies exploring the impact of FinTech presence on the profitability of incumbent FI. Most of the existing research has focused on specific countries, such as China and the United States, and has examined only small samples of banks operating in

niche segments like consumer and SME lending or the residential mortgage market (IMF, 2022; Lv, Du and Liu, 2022; Lee et al., 2021; Wang, Xiuping and Zhang, 2021; Phan et al., 2020). Consequently, the empirical literature in this area is still limited.

This paper addresses this gap in the literature by investigating the impact of FinTech presence on the performance of incumbent FIs. Our study examines two competing hypotheses: whether the presence of FinTech improves the profitability of FIs (complementarity effects) or has a negative effect on profitability (substitution effects). Additionally, we aim to understand the underlying mechanisms driving this impact by examining key indicators such as (net) interest margins, the share of non-interest income, overhead costs, as well as loan and deposit dynamics.

To achieve this, we use a comprehensive cross-country database that encompasses over 10,000 FIs and data on digital finance activities, including digital lending and digital capital-raising activities across 57 countries. By leveraging this extensive dataset, we can provide robust insights into the relationship between FinTech and profitability. Moreover, we explore the influence of different FinTech business models on various types of banks. Our analysis also demonstrates that the relationship between FinTech and the profitability of incumbent FIs varies depending on country-specific conditions, such as the level of financial development and the strength of the regulatory framework. By examining these dimensions, our study provides valuable insights into the nuanced dynamics between FinTech and incumbent FIs, highlighting the diverse effects across markets and bank types.

The main finding of our study is an adverse impact of greater Fintech presence on incumbent FIs' performance, supporting the substitution hypothesis. In fact, estimates suggest that a 1 percent increase in FinTech transaction volumes can reduce incumbents FI's return on equity (ROE) and return on assets (ROA) by up to 0.6 and 0.2 percentage points individually. Given sample averages of 4.2 and 0.5 for ROE and ROA, respectively, these statistically significant impacts are also economically meaningful. Regarding the underlying channels, the negative impact on FI profitability is primarily driven by reduced interest income and increased costs. In addition to compressed interest rate margins, this deterioration in income is partly due to banks losing access to cheaper funding sources such as deposits. In response, banks seem to adapt by extending loans and exploring other financial services to boost fees and commissions. However, these efforts are insufficient to fully offset the losses incurred from the decline in net interest margins.

Our analysis further indicates that different FinTech models, such as Peer-to-Peer (P2P) lending and Balance Sheet lending, have varying effects on FI performance. Cooperative banks tend to experience greater profit deterioration from both models, while (larger, more complex) commercial banks benefit from partnering with P2P platforms, as suggested by the positive impact on their non-interest income flows. Additionally, we find that the impact of FinTech presence on incumbents varies depending on the characteristics of the countries they operate in. Countries with more inclusive, competitive, profitable, and developed financial systems are more susceptible to the negative effects of FinTech competition. However, and importantly, in countries with robust regulatory standards, incumbents benefit from increased FinTech penetration. This finding suggests that well-designed regulations can foster a level playing field, enabling new FinTech firms to thrive while simultaneously protecting incumbent FIs from potentially uneven competitive practices.

The remainder of the article is structured as follows. Section 2 discusses the development of the two hypotheses. Section 3 describes the sample and data sources. Section 4 presents the econometric approach. Section 5 discusses the main findings. Section 6 describes the robustness checks. Section 7 concludes and provides policy implications.

2. Hypothesis Development

Our conceptual framework builds upon the empirical literature exploring competition within the financial system and its implications for bank performance. Numerous studies have examined the relationship between market concentration and profitability, providing valuable insights into this area. For instance, Mirzaei, Moore, and Liu (2013) conducted a study analyzing the impact of market structure, such as the 5-firm concentration ratio, on bank profitability in both emerging and advanced economies. They assessed profitability indicators such as return on assets (ROA) and return on equity (ROE), finding that higher market power corresponds to increased bank profitability in advanced economies. In the European banking sector, Maudos and de Guevara (2004) demonstrated that reduced market power and concentration lead to declining margins. In contrast, Demirgüç-Kunt and Huizinga (1999) provide an alternative view of how market structure influences bank profitability. Specifically, they demonstrate that lower market concentration leads to lower margins and profits for banks when controlling for differences in bank activity, leverage, and the macroeconomic environment.

We build upon this existing body of research by investigating how the entry of FinTech firms influences financial sector competition and, thereby, bank profitability. In our conceptual framework, we present two competing hypotheses: Complementarity and Substitution effects.

2.1 The Complementarity Hypothesis: FinTech presence enhances the incumbent's performance

Under the complementarity hypothesis, we anticipate incumbents will collaborate with FinTech firms in a mutually constructive manner, including via partnerships. These partnerships may take the form of mergers and acquisitions, outsourcing segments of the transaction process, or providing funding to FinTech platforms. A 2022 study in the U.S. revealed that nearly two-thirds of banks and credit unions have engaged in at least one FinTech partnership in the past three years, with 35 percent investing in FinTech firms (Synctera, 2022). Such partnerships enable incumbents to expand their customer base into previously untapped segments beyond traditional channels, thereby enhancing profitability through increased lending as the share of loans to new customers rises (as captured by the loan-to-asset ratio, for example). Additionally, FIs can increase their interest income due to a greater share of deposits, which tends to lower funding costs. Incumbents can also generate higher non-interest income as new customers and activities generate fee and commission-based financial services. FinTech firms also have an incentive to partner with incumbent FIs to benefit from the established trust and credibility of traditional banks, utilize banks' expertise in navigating complex regulatory environments, and, for instance, co-developing new products and services by combining FinTech innovation with banking experience.

Incumbents have also made substantial investments in information technology to meet customer expectations and adapt to the growing presence of FinTech firms in the market (U.S. Department of the Treasury, 2022; Modi et al., 2022). This strategic approach allows incumbents to reduce operating costs and enhance overall efficiency. Incumbent FIs can emulate the operational efficiencies demonstrated by FinTechs, a phenomenon known as the "demonstration effect." This distinct but complementary channel could yield similar outcomes as direct partnerships. Evidence already indicates that over the past five years, IT spending by banks in North America has steadily risen, reaching \$115 billion, with a focus on new investments rather than maintenance (U.S.

Department of the Treasury, 2022). The study also revealed that digital banking capabilities are considered the top priority, closely followed by security.

In summary, under the complementarity hypothesis, we expect a positive relationship between FinTech activities and profitability (as measured by ROE, ROA, net interest margins, NIM, and non-interest income), lending, and deposit growth, as well as a negative relationship with overhead costs.

2.2 Substitution Hypothesis: FinTech presence reduces the incumbent's performance

According to the substitution hypothesis, incumbent FIs may face significant challenges in maintaining their market share due to competition from FinTech firms. These incumbents are likely to experience difficulties in retaining existing customers or expanding into new markets. The disruptive business models and innovative technologies introduced by FinTech firms offer distinct advantages, such as streamlined loan provision through efficient screening of potential borrowers and faster processing of loan applications compared to incumbents (Hau et al., 2021; Berg et al., 2020; Fuster et al., 2019). Despite variations across countries and an evolving regulatory landscape, FinTech firms generally face less stringent regulatory scrutiny compared to incumbent FIs and, consequently, can benefit from greater flexibility regarding the products they can offer and the customers they can target.

Empirical evidence suggests that amid shifts in regulations, such as the implementation of higher capital requirements, traditional banks may reduce their lending activities. This reduction in lending can potentially drive customers towards FinTech firms, which offer alternative financing sources (Gopal and Schnabl, 2022; Tang, 2019; Buchak et al., 2018). As a result, incumbent FIs may experience a decline in lending and deposits, leading to higher funding costs, compressed margins due to competitive pressures, and lower non-interest income, reflecting a decrease in financial services rendered.

Competition from FinTech can also push incumbent FIs into riskier segments. Indeed, Elekdag, Emrullahu, and Ben Naceur (2024) find that greater FinTech presence is related to heightened risk-taking. Some FIs may attempt to compensate by increasing non-interest income through an expansion into non-traditional areas.⁸ Additionally, traditional FIs might invest in new digital technologies, increasing upfront costs without necessarily yielding medium-term efficiency gains. These costs are likely to be compounded by legacy systems and large branch networks (OECD, 2020). The perceived competitive threat from FinTech might trigger early action ("anticipation effect"), with the degree of preparedness and effectiveness of these efforts varying across traditional FI and countries.

In summary, under the substitution hypothesis, we expect adverse implications for traditional FI profitability, lending, deposit growth, and efficiency in the face of growing FinTech activities.

⁸ For example, incumbent FIs may start offering loans to customers with limited lower credit scores, higher risk profiles, and/or limited credit histories, possibly secured by unconventional collateral (inventory, equipment).

2.3 The Differential Effect of FinTech Business Models on Incumbent FIs' Performance

We also examine how the relationship between FinTech firms and the profitability of incumbent FIs varies depending on the specific FinTech business models and the types of FIs involved. Among the various FinTech business models, we focus on the P2P and Balance Sheet lending business models because they have gained significant traction in recent years (as will be discussed in the next section).

2.3.1 P2P Lending

In general, P2P lending platforms facilitate a matching service between borrowers and investors who provide the necessary funding. As this lending model has evolved, it has relied on partnerships with traditional banks to a greater extent. The platform verifies borrower information, assigns credit ratings, and refers the completed application package to a partner bank, which then provides the loan to the borrower (CCAF, 2021; FSB, 2017; FDIC, 2015). This approach is particularly favored in certain countries due to regulatory restrictions on non-bank institutions issuing loans. Additionally, traditional banks are incentivized to collaborate with P2P lending platforms to access customer segments that are otherwise challenging due to capital requirements, regulatory compliance, and security concerns (FDIC, 2015). P2P lending platforms typically generate revenue by charging fees to both borrowers and investors. These investors can be individuals or institutions, including banks and other financial entities, as well as non-bank institutions.

We anticipate that an increased presence of P2P lending models will yield stronger complementarity effects, enhancing the performance of incumbent FIs. This should be reflected in increased profits from expanded lending and deposit growth, as well as reduced overhead costs.

2.3.2 Balance Sheet Lending

The Balance Sheet lending platform closely resembles a traditional non-bank credit intermediary, capable of providing loans but not legally permitted to accept deposits (CCAF, 2021). This type of platform manages the entire loan transaction process, including collecting borrower applications, assigning credit ratings, advertising loan requests, connecting borrowers with investors, originating loans, and servicing loan payments (CCAF, 2021; FSB, 2017; FDIC, 2015).⁹ Balance Sheet lending platforms secure financing through debt or equity and include the loans they issue on their own balance sheets (Baba et al., 2020).

We expect that an increased presence of Balance Sheet lending will lead to stronger substitution effects, resulting in reduced profits for incumbent FIs. This should be reflected in lower lending and deposit growth, as well as increased overhead costs.

2.3.3 Evolving Business Models in FinTech Lending: From P2P to Balance Sheet and Beyond

⁹ An example of such model is *Credibly*, a leading FinTech platform in lending to SMEs. Since its inception in 2010, *Credibly* has provided over \$2 billion in funding to small and medium-sized businesses across the United States (Credibly, 2023). *Credibly* works with borrowers throughout the entire underwriting, funding, and servicing process and relies on funding from venture capital firms and other institutional investors.

There are also FinTech platforms that employ a combination of different business models rather than exclusively relying on either the P2P or Balance Sheet model. Some platforms initially operate as P2P lenders, providing a matching service between borrowers and investors. However, as they grow and establish trust, they may transition to a Balance Sheet model. This transition entails not only referring loan applications to partnering banks but also originating loans themselves by obtaining funding from institutional investors for a fee (Baba et al., 2020). It is noteworthy that some platforms that fall outside the scope of our study have taken a further step by obtaining a banking license. This strategic move allows them to directly access lower-cost deposit funding, thereby eliminating the need for partner banks in their operations.¹⁰

2.3.4 Types of FIs

This study also aims to examine whether the impact of FinTech business models varies across different types of banks. In particular, we assess how P2P lending and Balance Sheet lending platforms impact the profitability of cooperative banks and commercial banks differentially. We hypothesize that cooperative banks may be more vulnerable to FinTech competition due to their smaller size and limited resources. These banks may struggle to afford the necessary IT investments or justify such expenditures given their lack of scale economies. Consequently, they may find it challenging to meet customer expectations, particularly among younger generations, who are more inclined to use digital banking services and may not have strong attachments to community-oriented institutions (Coelho et al., 2019). In contrast, commercial banks are better equipped to absorb pressures from FinTech competition. Due to their larger size, these banks are better positioned to partner with FinTech companies, engage in mergers and acquisitions, or invest in their own IT infrastructure, benefiting from economies of scale.

3. Data and summary statistics

To examine the relationship between FinTech competition and the profitability of FIs, we combine three different datasets for our analysis. First, data on FinTech transactions are collected from the Global Alternative Finance data repository hosted by the Cambridge Center for Alternative Finance (CCAF) for a sample of 57 countries with annual data over 2012-2020 (please refer to Internet Appendix III for a full list of countries). Second, we acquire balance sheet and income statement data for 10,167 FIs from the Bureau van Dijk Orbis database. This database provides information on banks and non-banks globally, sourced from publicly available data sources. Third, we gather country-level macroeconomic data and various structural indicators from publicly available sources to further enrich our analysis.

3.1 FinTech

¹⁰ Such an example is *Lending Club*, one of the first P2P lending platforms in the U.S., helping more than 4 million members receive over \$70 billion in personal loans (Lending Club, 2023). In 2021, *Lending Club* acquired Radius Bank and became the first public U.S. neobank and subsequently closed their P2P side of the business. Their drive to become a bank came from the high funding costs of working with institutional investors. Similarly, *Zopa*, a British-based FinTech company began as the world's first P2P lending platform in 2005. In 2020, *Zopa* gained a full banking license offering deposit and savings accounts in addition to their lending arm and by end of 2021 they closed their P2P lending side of the business (Zopa, 2023).

Our measure of FinTech transactions encompasses country-level digital finance activities, such as digital lending and digital capital raising, that have emerged outside the incumbent banking systems and traditional capital markets, primarily conducted online (CCAF, 2021). Digital lending, commonly associated with P2P lending and Balance Sheet lending activities, has been the dominant form in the alternative finance market. These activities refer to non-deposit-taking platforms that facilitate online credit to individuals, businesses, or other entities from individual lenders or institutional investors.

Other digital capital-raising activities, though smaller in scale, involve investments by individuals or institutions in unlisted shares or securities issued by a business, typically a startup, or in providing funding to a project, individual, or business without the expectation of a monetary return. For further details on these models, please refer to Internet Appendix IV.

Figures 1-4 illustrate key trends in FinTech developments. FinTech volumes experienced significant growth until 2017 (Figure 1), after which they declined, primarily due to a decrease in volume from China. However, market developments in China and the rest of the world have diverged. Local market developments and regulatory changes in China led to a substantial decline in volumes and its global market share. In contrast, the US and Canada, followed by the UK, comprise 76 percent of the total market share, emerging as the largest regional alternative markets in 2020 (Figure 2). P2P lending remains the largest business model when including China in our analysis (Figure 3). However, when excluding China, the growth of FinTech transactions is driven by both P2P lending and Balance Sheet lending (Figure 4).

Insert Figure 1 about here

Insert Figure 2 about here

Insert Figure 3 about here

Insert Figure 4 about here

3.2 Financial Institutions

Balance sheet and income statement data for 10,167 FIs were obtained from the Bureau van Dijk Orbis database. This database provides comprehensive information on banks and non-banks globally, utilizing publicly available data sources. To capture the domestic effects, we primarily use unconsolidated statements (95 percent of our observations) since they provide a more detailed view of the financial activities and performance of individual banks within their respective markets. Unconsolidated statements are preferred as they exclude other activities and sources of income from parent companies or subsidiaries (Albertazzi and Gambacorta, 2009; García-Herrero, Gavilá, and Santabárbara, 2009; Valverde and Fernandez, 2007). Nonetheless, in cases where only consolidated statements are available, we use the consolidated statement to avoid information loss (Micco, Panizza, and Yañez, 2007).

Our sample of FIs consists of two groups: banks and non-banks, representing 90 percent and 10 percent of the observations, respectively (see Appendix II). Within banks, approximately 80 percent are cooperative banks. Although larger in number, they are smaller in size (with average assets of \$373 million) relative to commercial banks (with average assets of over \$20 billion). Commercial banks tend to be more profitable when compared to cooperative banks, both in terms of ROA and ROE.

Commercial banks also display a higher Net Interest Margin (NIM) of 5.4 percent compared to cooperative banks' NIM of 4.6 percent, indicating more efficient interest income generation relative to their interest expenses. The loan-to-asset ratio for cooperative banks is marginally higher at 54.4 percent compared to 50.1 percent for commercial banks, suggesting a marginally greater emphasis on lending activities.

Regarding the deposit-to-liabilities ratio, commercial banks show a higher ratio of 61.6 percent compared to 60 percent for cooperative banks, reflecting a stronger reliance on deposits for funding. Non-interest income is notably higher for commercial banks at 3.1 percent compared to 1.2 percent for cooperative banks, indicating greater diversification of income sources beyond traditional interest income.

Finally, commercial banks demonstrate a lower cost-to-income ratio of 64.5 percent compared to 81.8 percent for cooperative banks, highlighting their superior operational efficiency and better cost management practices.

3.3 Macroeconomic and other control variables

Country-level macroeconomic data and various structural indicators are collected from publicly available sources, including the International Monetary Fund (IMF) WEO, World Bank Governance Indicators, World Development Indicators, Haver, and the Global Financial Development Database. These data encompass factors such as GDP growth, policy rate, inflation, bank concentration, financial system Return on Equity, stock market turnover, credit-to-GDP ratio, regulatory quality, government effectiveness, and internet penetration. For more on the definitions of the variables and their descriptive statistics please refer to Appendix I and Internet Appendix I.

4. Econometric Approach

Our empirical research is motivated by recent research estimating determinants of bank performance (Elekdag, Malik, and Mitra, 2020; Djalilov and Piesse, 2016; Dietrich and Wanzenried, 2011; García-Herrero, Gavilá and Santabárbara, 2009; Athanasoglou, Brissimis and Delis, 2008). These scholars have studied the effect of bank-specific, as well as industry-specific and macroeconomic determinants on measures of bank performance.

Guided by our conceptual framework and these empirical studies, we initially propose a parsimonious baseline specification, estimated using fixed effect panel regression:

$$PER_{b,c,t} = \alpha + \beta_1 FinTech_{c,t} + \gamma X_{b,c,t} + \delta W_{c,t} + Other_{b,c,t} \quad (1)$$

Where $PER_{b,c,t}$ denotes the profitability ratios (ROE and ROA) and relevant income (NIM, Loan-to-Asset, Deposit-to-Liabilities, and Non-Interest Income) and cost components, winsorized at the 1 percent level to mitigate the impact of outliers, for bank b , in country c , in year t ; $FinTech_{c,t}$ the log measure¹ of country-level FinTech transactions in year t ; the vectors $X_{b,c,t}$ and $W_{c,t}$ encompass the bank-specific, cyclical, and structural determinants; $Other_{c,t}$ Includes bank-fixed effects and a residual term assumed to be not cross-sectionally correlated. The vector $X_{b,c,t}$ controls for size (log (Total Assets)) and capital (Equity to Total Assets ratio). The vector $W_{c,t}$ includes cyclical and structural determinants such as GDP growth, inflation, policy rate, and 5-bank asset concentration. For more on the definitions of the variables and their descriptive statistics please refer to Appendix I and Internet Appendix I.

Our plausible expectations for our baseline specification, which were discussed in the conceptual framework, would be as follows in the case of profitability (using ROE as an example):

$$H1: \frac{\partial ROE}{\partial FinTech} > 0 \rightarrow \text{Complements: FinTech presence enhances the incumbent's profitability.}$$

$$H2: \frac{\partial ROE}{\partial FinTech} < 0 \rightarrow \text{Substitutes: FinTech presence worsens incumbent's profitability}$$

Next, we consider two FinTech models, such as P2P lending and Balance Sheet lending in our analysis. Therefore, the specification would be modified as follows:

$$PER_{b,c,t} = \alpha + \beta_1 FinTechBusinessModel_{c,t} + \gamma X_{b,c,t} + \delta W_{c,t} + Other_{b,c,t} \quad (2)$$

Our expectations for the modified specification:

$$H1: \frac{\partial ROE}{\partial P2P} > 0 \rightarrow \text{Complements: P2P lending enhances incumbent's profitability.}$$

$$H2: \frac{\partial ROE}{\partial BS} < 0 \rightarrow \text{Substitutes: Balance Sheet lending reduces the incumbent's profitability}$$

Our analysis also considers the role of country and bank-specific characteristics. In this case, the specification would be modified as follows:

$$PER_{b,c,t} = \alpha + \beta_1 FinTech_{c,t} + \beta_2 \omega_{b,c,t} + \beta_3 FinTech_{c,t} * \omega_{b,c,t} + \gamma X_{b,c,t} + \delta W_{c,t} + Other_{b,c,t} \quad (3)$$

We measure how each of these factors influences the FIs' performance ratios:

¹ For brevity, we use the label "FinTech" in referring to the natural logarithm of the FinTech in the remainder of the paper.

$$\frac{\partial PER}{\partial FinTech} = \beta_1 + \beta_3 * \omega_{b,c,t}$$

where $\omega_{b,c,t}$ denotes the different *Country-specific characteristics* such as Stock Market Turnover, Credit Depth (Private Credit to GDP), and Bank Account Ownership; *Financial System and Industry features* such as Commercial Bank Profitability (Return on Equity) and Bank concentration; *Institutional characteristics*: Regulatory Quality and Government Effectiveness. For completeness, we also look at *Bank-specific characteristics* such as Solvency (Z-Score), Non-Performing Loans (NPLs), and Total Capital Ratio. These moderator variables are constructed as dummy variables that enable the differentiation of observations based on whether they fall below or above their median value. For instance, in the case of low bank concentration, a value of 1 indicates values below the median, and 0 represents values above the median. Similarly, concerning high stock market turnover, a value of 1 indicates values above the median, and 0 signifies values below the median. By splitting the observations into two groups based on their median, the model can account for potential nonlinearities and differing relationships that exist between FinTech and the performance of FIs. For more on the definitions of the variables and their descriptive statistics please refer to Appendix I and Internet Appendix I.

5. Results

5.1 Baseline model results

We now turn our attention to the main results, which are presented in Table 1. The table presents the impact of our primary FinTech variable on profitability measures (ROE and ROA) and metrics that shed light on the underlying transmission channels: Net Interest Margin (NIM), the share of Non-Interest Income, as well as the Loan-to-Asset, Deposit-to-Liabilities, Non-Interest Income, and Cost-to-Income ratios. The results indicate a significant and negative effect of FinTech on the profitability measures of incumbent FIs (ROE and ROA). The estimated coefficients suggest that a 1 percent increase in FinTech transaction volumes leads to a reduction of 0.09 percentage points in incumbent FI's ROE and 0.02 percentage points in ROA, respectively. These effects are non-negligible, considering that the median values of ROE and ROA in our sample are 4.2 percent and 0.5 percent, respectively. Thus, our findings support the substitution hypothesis, which suggests that increased competition from the growing presence of FinTech adversely affects the profitability of incumbent FIs. Notably, as discussed in the robustness section, additional results from complementary approaches indicate an even greater impact of growing FinTech activity on FI profitability. These findings are consistent with the results of other studies examining the effect of FinTech competition on the profitability ratios of incumbent banks. These results are in line with Katsiampa et al. (2022) and Phan et al. (2020), which show that the profitability of traditional Chinese and Indonesian banks, respectively, diminishes owing to the entry of fintech firms into the financial sector.

5.1.1 Channels

An analysis of the transmission channels reveals a negative and statistically significant impact on the Net Interest Margin (NIM), a critical component of bank profitability. This effect is particularly noteworthy given the average growth rate of FinTech volumes during the period 2012-2020 (excluding China), which stands at 70 percent. Such rapid growth in FinTech competition has exerted considerable pressure on the income of FIs. Due to data limitations, we are unable to separately analyze Interest Revenue and Interest Expense. However, we can examine the Deposit-to-Liabilities ratio, which has shown a decline. Since deposits are typically the cheapest

source of funding for a bank, this decline suggests that elevated funding costs are likely eroding NIM. This inference highlights the significant impact that rising FinTech competition has on traditional banks' cost structures and overall profitability.

Our findings are consistent with recent empirical research examining the impact of the increasing presence of FinTech on interest income. Bakker et al. (2023) find that FinTech competition is related to a reduction in the net interest margin of banks in EMDEs and Latin America and the Caribbean by 0.2 to 2.7 percent. The IMF (2022) demonstrates that a higher market share of FinTechs is related to a decline in interest income. Bejar et al. (2022) also show that incumbent banks in countries with a significant FinTech presence have experienced larger reductions in NIMs.

Furthermore, FinTech appears to negatively affect the Cost-to-Income ratio. This may be due to IT investments necessitated by the pressures from FinTechs, which the presence of outdated legacy technology may exacerbate.

Concurrently, we observe an increase in the Loan-to-Assets ratio and Non-Interest Income. A higher Loan-to-Assets ratio suggests that the presence of FinTech may be compelling banks to engage in riskier lending practices to offset losses from declining NIM. This finding is supported by Elekdag, Emrullahu, and Ben Naceur (2024), who find that FinTech increases FI's risk-taking.

Additionally, FinTech seems to positively influence Non-Interest Income, indicating that FinTech competition has driven incumbent FIs to explore new revenue streams. However, it is important to note that this effect is relatively small compared to the median value of Non-Interest Income in our sample, which is 1.99 percent. This indicates that while FinTech's presence encourages diversification of income sources, the overall impact on Non-Interest Income remains modest.

In conclusion, FinTech reduces the profitability of incumbent FIs. However, the underlying channels indicate a more nuanced picture. Costs increase and NIM deteriorates, partly due to banks losing access to cheaper funding sources. In response, banks attempt to adapt by extending loans and exploring other income sources. Nevertheless, these efforts are insufficient to fully offset the losses incurred from compressed margins and increased competition. This highlights the significant challenges that traditional FIs face in maintaining profitability in the rapidly evolving financial landscape driven by FinTech innovation.

Insert Table 1 about here

5.2 Effect of FinTech Business Models on Incumbent's Performance

We now examine the impact of FinTech business models on the different types of FIs. The results are presented in Tables 2 and 3.¹² Initially, we consider the more numerous cooperative banks and then the larger commercial banks.

Our estimations indicate that cooperative banks are especially vulnerable to profit deterioration caused by both P2P and Balance Sheet lending business models.¹³ Specifically, our coefficients suggest that a 1 percent increase in P2P lending transactions leads to a 0.3 percentage point decrease in incumbent cooperative banks' ROE. Similarly, a 1 percent increase in Balance Sheet lending transactions results in a 0.2 percentage point decrease in ROE. These impacts are notable, considering that the median ROE for cooperative banks in our sample is 3.8 percent.

Our findings also reveal that the lower profits of cooperative banks can be attributed to reduced NIM and higher costs. Similar to overall results, the reduction in NIM is partly due to cooperative banks losing access to cheaper funding sources such as deposits. In response, these banks attempt to adapt by extending loans and exploring other income sources; however, these efforts do not sufficiently compensate for the losses incurred from compressed margins and increased competition. It is possible that FinTech platforms, leveraging new technologies, have achieved economies of scale and expanded their reach to wider geographical areas compared to cooperative banks that may also face challenges in affording the necessary IT investments (Coelho et al., 2019; Al-Muharrami and Hardy, 2013). These constraints can limit lending opportunities and undermine the overall profitability of cooperative banks, as supported by our results.

¹² Note that we have also conducted separate estimations to gauge the impact of other FinTech activities, specifically digital capital raising activities, on various types of FIs. However, the outcomes of these estimations have not been included in this presentation due to the relatively modest scale of these transactions when contrasted with the P2P and Balance Sheet lending models (see Figure 3 and Figure 4). Likewise, our analysis has considered BigTech as a separate entity in our estimations. However, the findings pertaining to BigTech have not been showcased owing to its more limited global coverage compared to FinTech, and because the data does not include the breakdown of distinct business models.

¹³ To recognize that cooperative banks may encompass a range of banks, including institutions that may not be profit-oriented, we controlled for bank ownership (including because majority of publicly owned banks have mandates that extend beyond maximizing profitability). Our baseline results maintain their significance. Results may be available upon request.

Furthermore, FinTech platforms may be targeting the same untapped customer segments that cooperative banks aim to serve. Empirical evidence suggests that FinTech lenders tend to penetrate underserved areas. Studies have shown that FinTech borrowers have fewer tangible assets (Beaumont, Tang, and Vansteenberghe, 2022) and that FinTech market share increases in areas with higher loan denial rates and lower consumer credit scores (Jagtiani and Lambie-Hanson, 2021).

In contrast, our analysis indicates that commercial banks are better positioned as the impact of FinTech on profitability measures appears to be insignificant. This resilience may be due to several factors. First, commercial banks tend to have a larger size compared to cooperative banks in our sample, which may provide them with certain advantages and resources to withstand the challenges posed by FinTech competition. Second, commercial banks typically have a wider geographical reach and offer more sophisticated products, which may help them retain a competitive edge.

Moreover, our results indicate that the presence of P2P lending has a positive effect on the non-interest income of commercial banks. This suggests that commercial banks may benefit from partnering with P2P lending platforms, potentially expanding their (non-interest) revenue streams through collaborative efforts.

However, it is worth noting that commercial banks may face challenges when it comes to the Balance Sheet lending model, as it seems to have a negative impact on their NIM. Although the impact may not be as severe as in the case of cooperative banks, it still poses a potential challenge to the profitability of commercial banks.

Insert Table 2 about here

Insert Table 3 about here

5.3 Effect of FinTech based on selected country and bank-specific characteristics

We now examine how different country and bank-specific characteristics can affect the relationship between FinTech competition and incumbent FIs' profitability. The results, presented in Tables 4 and 5, show that the profitability of incumbents is negatively affected in markets with lower bank concentration, higher stock market turnover, higher credit depth, higher financial inclusion, and higher commercial bank profitability at the country level. Lower bank concentration suggests fewer barriers to entry (Beck, Demirgüç-Kunt and Levine, 2006) for new FinTech firms. Likewise, higher stock market turnover and credit depth indicate more competitive and developed financial systems (Beck, De Jonghe, and Schepens, 2013; Čihák et al., 2013; Demirgüç-Kunt and Levine, 1996), which implies fewer barriers to entry, more sophisticated investors, and access to highly skilled talent. These factors are crucial for the success of FinTech firms while posing a threat to the profits of incumbent institutions. Additionally, a profitable banking sector may indicate greater market power (Lloyd-Williams, Molyneux, and Thornton 1994; Berger and Hannan 1989; Gilbert 1984) while at the same time a greater demand for financial services overall, creating opportunities for FinTech companies to enter the market and expand their customer base, thereby threatening the profits of incumbents. Overall, these findings suggest that FinTech firms are attracted to more competitive, inclusive, profitable, and developed financial systems.

Conversely, FIs with relatively stronger regulatory standards seem to benefit from increased penetration of FinTech. Our findings demonstrate that the profitability of incumbents in countries with high regulatory quality and government effectiveness is positively impacted by FinTech competition. This suggests that well-designed regulations can establish a level playing field (Kaufmann, Kraay, and Mastruzzi, 2010), enabling new FinTech companies to thrive while protecting incumbents from uneven competitive practices.

At the institutional level, incumbents with a lower risk profile, including lower non-performing loans (NPLs), a lower probability of insolvency, and higher capital are more susceptible to the adverse profitability implications related to the presence of FinTech. These findings align with our expectations that incumbent institutions with these characteristics would be more risk-averse and less inclined to lend (Corbae and D'Erasmus, 2014; Dietrich and Wanzenreid, 2011; Goddard, Molyneux and Wilson, 2004). FinTech firms can capitalize on this situation by serving as substitutes for traditional bank lending (Gopal and Schnabl, 2022; Tang, 2019; Buchak et al., 2018).

Insert Table 4 about here

Insert Table 5 about here

6. Robustness Checks

To validate the previous findings and ensure their reliability, we conducted several robustness checks, as presented in Appendix III and Internet Appendix II. Initially, we examined the impact of FinTech transactions relative to the overall economy and financial system (Appendix III Table 1, columns 3-6). The results indicate that when scaling the new FinTech explanatory variables to GDP and the total assets of the incumbents in our sample, the findings remain broadly consistent with the baseline estimation. Additionally, we expanded our analysis to include the larger ecosystem of alternative finance transactions, specifically incorporating the BigTech credit transactions compiled by Cornelli et al. (2022). The results presented in Appendix III Table 1, columns 7-8 demonstrate that our combined FinBigTech explanatory variable continues to have a significant negative effect on the profitability measures of our incumbents, leading to lower income and lower costs while exhibiting a positive effect on non-interest income. Following Beck, De Jonghe, and Schepens (2013), we also augment our baseline regressions by including variables that capture the revenue mix (share of non-interest income to total income), provisioning ratio (loan loss provisions-to-assets) and loan-to-asset ratio to help better account for differences in business models given the comprehensive nature of our dataset, which includes over 10,000 different FIs of varying types. As shown in Appendix III Table 1 (columns 9-10), the relationship between FinTech and profitability measures remains consistent.

We acknowledge the potential for endogeneity issues, including concerns related to reverse causality, omitted variable bias, and simultaneity. For instance, consider the case of reverse causality, wherein the entry of FinTech into a country might be influenced by the level of competition in the local market, thus directly impacting the observed profitability. To address these potential endogeneity concerns, we employed a Two-Stage Least Squares (2SLS) approach (Internet Appendix II, Tables 1 and 2), which involved using valid instrumental variables. Our instrument set included measures such as internet penetration, along with two novel exogenous measures: $FinTech_{-c,t}$ represents the sum of all FinTech transactions in our sample, leaving out country c and $RegInstFund_{-c,t}$ represents the sum of regional Institutional Funding, leaving out country c .

By incorporating internet penetration as a control variable, we effectively accounted for variations in internet accessibility across different countries. Our underlying assumption was that a higher proportion of the population with internet access would likely correlate with increased FinTech transactions, and conversely. Moreover, the inclusion of $FinTech_{-c,t}$ as an instrument allowed us to isolate and thoroughly examine the impact of FinTech transactions occurring beyond a specific country's borders. This approach helped mitigate potential biases that might arise from factors like mergers, acquisitions, or partnerships between FinTech entities and established institutions within the country. Additionally, our control for institutional investor funding was imperative, considering that FinTech platforms often rely on financial support from institutional investors.

The first-stage results (Internet Appendix II, Table 1) indicate that our instrumental variables are strongly correlated with the endogenous variable (FinTech). Tests on the validity of the instruments confirm that the relevance and validity of our instruments remain strong. The results from the second-stage regressions (Internet Appendix II, Table 2) are broadly robust relative to the baseline estimation.

To tackle the challenges posed by endogeneity and the presence of unobserved differences among banks, we adopted a two-step Generalized Method of Moments (GMM) approach (Internet Appendix II, Table 3), drawing from the methodologies outlined by Arellano and Bover (1995) as well as Blundell and Bond (1998). This method effectively addressed potential biases originating from dissimilar corporate governance structures, latent

variables, and the unique characteristics of our dataset—comprising a limited number of time periods but a substantial number of individual institutions. The outcomes yielded through this methodology retained their significance and robustness in comparison to the baseline estimates.

Importantly, the complementary GMM estimates suggest a larger impact of FinTech on FI profitability. The GMM estimates are 0.9 and 0.2, respectively, for the ROE and ROA specifications. This suggests that a 1 percent increase in FinTech volumes could reduce ROE and ROA by up to 0.9 and 0.2 percentage points, respectively. Given the sample averages of 4.2 percent for ROE and 0.5 for ROA, the estimates are economically material and suggest a sizeable potential impact.

To account for temporal dynamics (Internet Appendix II, Table 4), we introduced a dummy variable to capture the impact of Covid-19 and introduced time-fixed effects in separate estimations. Additionally, we incorporated two new control variables to capture global and country market sentiment and risk perception. Specifically, we have added VIX3M, an annual global measure of the 3-month implied volatility of the S&P 500 Index options, and the MSCI Country Index, which measures the performance of the large and mid-cap segments of the equity market. These adjustments produced consistent results across various performance metrics.

Moreover, we revisited our model with a balanced sample (Internet Appendix II, Table 5), a move aimed at controlling for the influence of mergers and acquisitions. This involved retaining institutions that held complete information for all five performance ratios (ROE, ROA, NIM, Non-Interest Income, and Cost-to-Income ratios) throughout the 2012-2020 timeframe. The results showed considerable consistency and robustness compared to the baseline estimation.

Similarly, we explored the incorporation of lagged explanatory variables (Internet Appendix II, Table 5) to address potential autoregressive effects, drawing inspiration from the work of Pesaran and Shin (1999). These modifications yielded outcomes closely aligned with the baseline estimates.

Furthermore, given the substantial contribution of China, the U.S., and the UK to the overall FinTech transaction volumes within our sample, we performed separate regression analyses (Internet Appendix II, Table 5) by excluding each of these countries individually. Notably, the results from these analyses continued to exhibit significance and robustness in relation to the baseline estimates.

7. Conclusions and Policy Implications

This paper aims to provide insights into the impact of emerging FinTech firms on the performance of established FIs. We identify three key findings. First, our analysis reveals a negative influence of FinTech presence on profitability, driven primarily by lower income and increased costs. This deterioration in profits is partly due to lower interest margins and banks losing access to cheaper funding sources (such as deposits). In response, banks attempt to adapt by extending loans and exploring other (non-interest) income sources. However, these efforts are insufficient to fully offset the losses incurred from compressed margins.

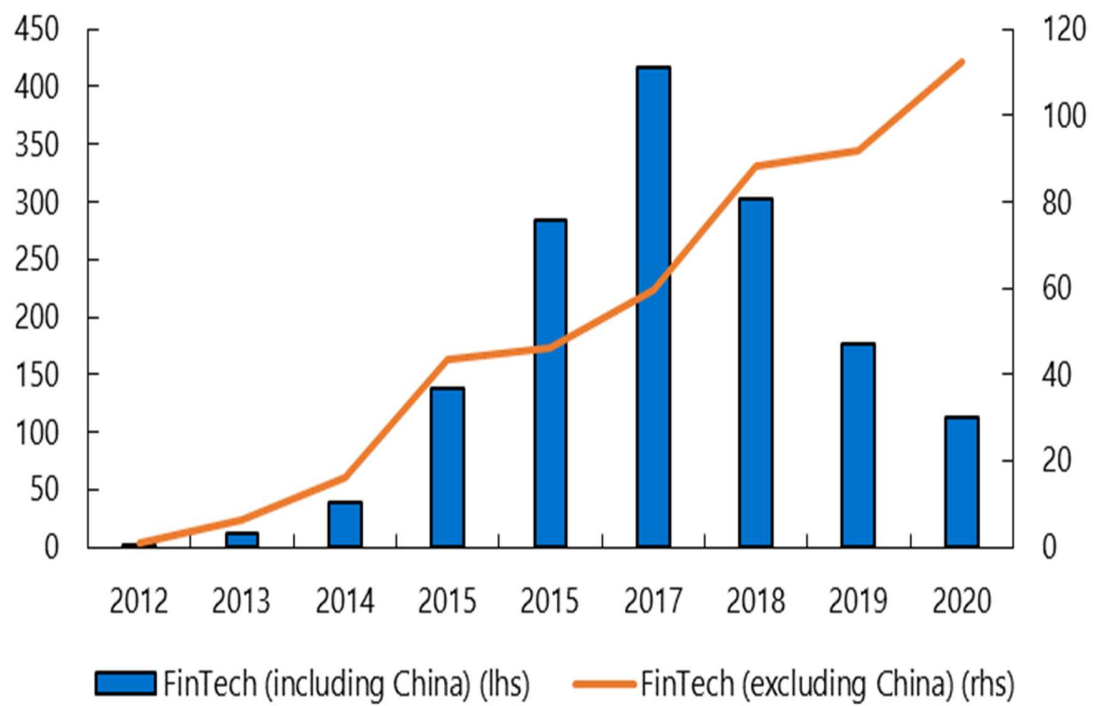
Second, when analyzing the effects of different FinTech models, namely P2P lending and Balance Sheet lending, on various types of FIs, our results indicate that cooperative banks are particularly susceptible to profit deterioration from both models, in contrast to larger (and more complex) commercial banks. This suggests that commercial banks are better positioned to benefit more from partnering with P2P platforms.

Third, we highlight the evolving relationship between FinTech presence and FI profitability, conditional on diverse country and institutional characteristics. At the country level, we demonstrate that FinTech activity is attracted to more competitive, inclusive, profitable, and developed financial systems. Meanwhile, incumbents in countries with stronger regulatory standards gain advantages from increased FinTech penetration. This indicates that well-designed regulations can foster a level playing field, enabling new FinTech firms to thrive while simultaneously protecting incumbent FIs from potentially uneven competitive practices.

These findings emphasize the need for continuous monitoring of FinTech development and its impact on all segments of the financial system. While the entry of new FinTech platforms has brought about benefits such as improved efficiency in financial service delivery, increased competition, and enhanced access to finance, it also poses challenges to incumbent FI by eroding their market share and limiting profit margins. Consequently, banks may face difficulties in building capital buffers necessary to absorb losses and maintain solvency. Moreover, incumbents may resort to riskier lending and investment activities to preserve their market share and boost profits. Striking the right balance between promoting financial innovation and mitigating systemic risks becomes crucial for regulators.

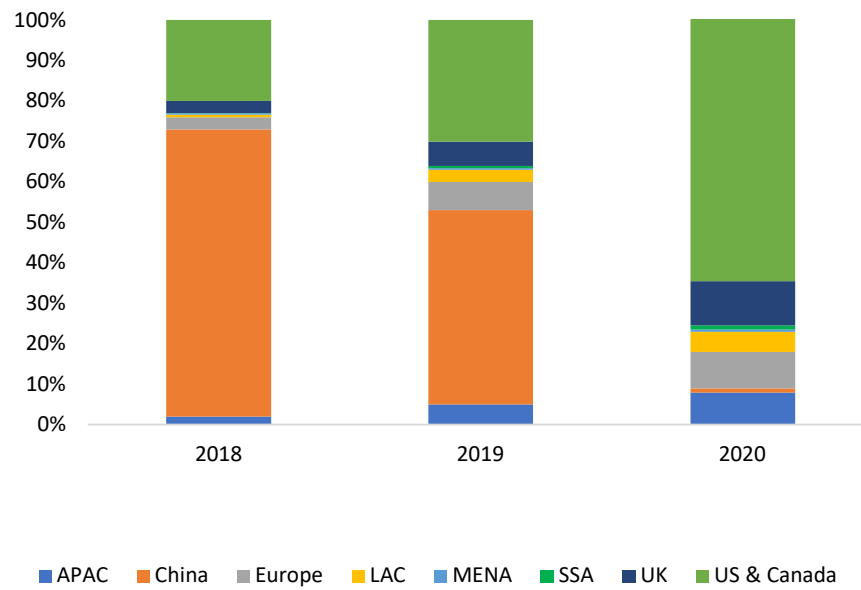
To achieve this balance, specific recommendations could be considered to broaden the regulatory scope and create a more level playing field. These include reviewing and redesigning licensing regimes to encompass new types of service providers within the regulatory framework where appropriate, implementing more robust capital, liquidity, and operational risk management requirements that match the risks posed by different FinTech business models, and strengthening the regulatory framework and supervision for smaller, less technologically advanced incumbents who may be more vulnerable to FinTech competition. In addition, incumbents can take measures to adjust their business models by enhancing cost efficiency, diversifying income sources, consolidating operations, improving internal governance, and addressing problem loans.

Figure 1. FinTech finance volumes (in US\$ billions)



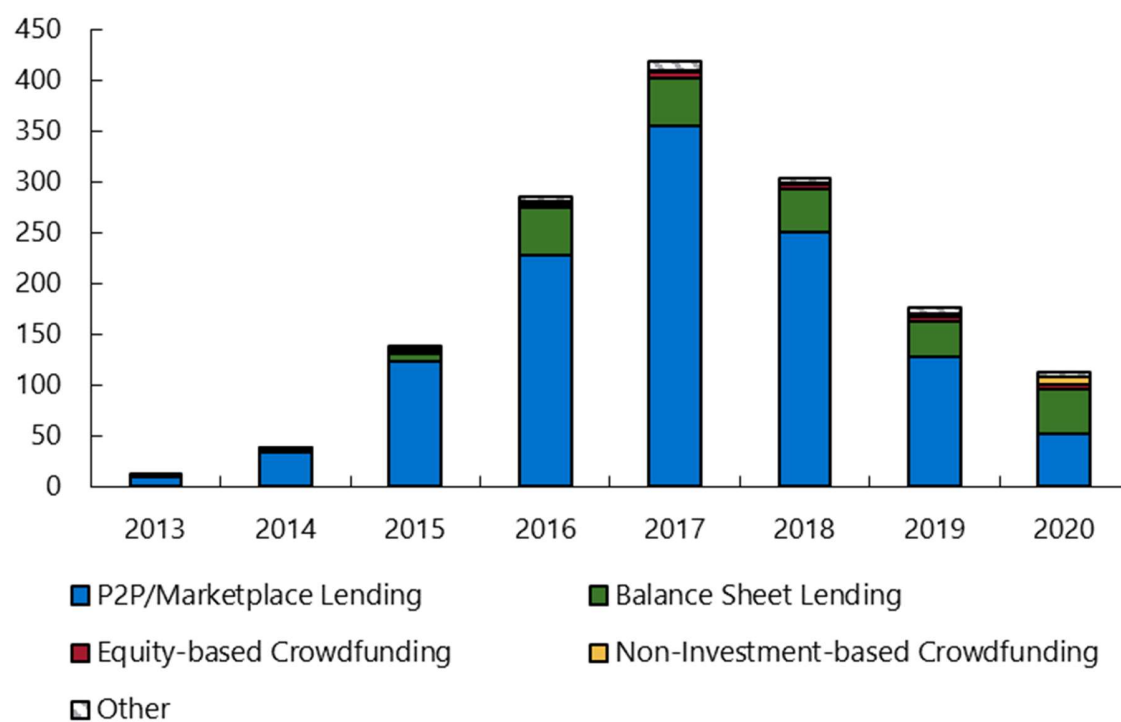
Source: Authors' calculations using CCAF (2021) Database

Figure 2. FinTech Market Share (in percent of total share)



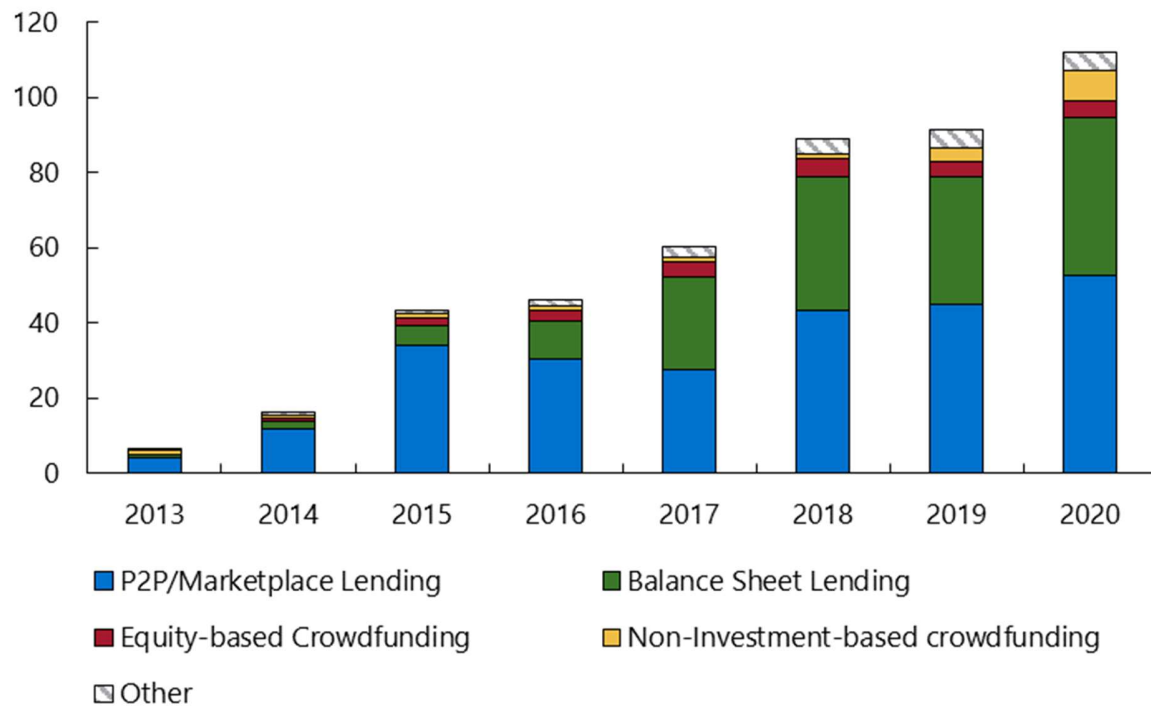
Source: Authors' calculations using CCAF (2021) Database

Figure 3. FinTech finance volumes by model (including China, in US\$ billions)



Source: Authors' calculations using CCAF (2021) Database

Figure 4. FinTech finance volumes by model (without China, in US\$ billions)



Source: Authors' calculations using CCAF (2021) Database

Table 1: Baseline Model Regressions 1/

Variable	(1) ROE (percent)	(2) ROA (percent)	(3) NIM (percent)	(4) Loan-to- Assets (percent)	(5) Deposits-to- Liabilities (percent)	(6) Non-Interest Income (percent)	(7) Cost-to- Income (percent)
FinTech (log units)	-0.090*** (0.011)	-0.025*** (0.002)	-0.028*** (0.003)	0.171*** (0.027)	-0.002*** (0.000)	0.011*** (0.003)	0.136*** (0.029)
Size (log assets)	3.212*** (0.418)	0.730*** (0.088)	-0.099 (0.128)	-2.375*** (0.306)	-0.005** (0.002)	-0.515*** (0.151)	-9.447*** (1.220)
Equity-to-assets	0.110*** (0.022)	0.043*** (0.005)	0.038*** (0.010)	0.034** (0.014)	-0.001*** (0.000)	0.017** (0.007)	-0.099* (0.052)
GDP growth	0.229*** (0.016)	0.036*** (0.003)	0.039*** (0.006)	0.741*** (0.014)	-0.002*** (0.000)	0.011** (0.005)	-0.412*** (0.037)
Inflation	-0.186*** (0.053)	-0.057*** (0.012)	-0.049** (0.021)	0.195*** (0.030)	-0.000 (0.000)	0.026 (0.019)	-0.14 (0.100)
Policy rate	0.242*** (0.043)	0.102*** (0.011)	0.193*** (0.022)	-0.073*** (0.027)	-0.001*** (0.000)	0.007 (0.015)	-0.550*** (0.076)
Concentration	-0.007 (0.008)	-0.003* (0.002)	0.004 (0.003)	0.035*** (0.007)	-0.000*** (0.000)	0.010*** (0.003)	0.077*** (0.019)
N	79,523	79,701	79,438	70,328	68,153	79,666	79,384
Rho	0.68	0.78	0.91	0.60	0.33	0.91	0.76
Adjusted R-squared	0.02	0.04	0.04	0.10	0.04	0.01	0.03
F-statistics	45.30	53.22	56.11	595.10	143.90	14.02	41.27
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Source: Authors calculations.							
1/ This table presents the estimations obtained using the Eq.(1) baseline regressions. Robust standard errors for heteroscedasticity appear in parentheses.							
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.							

Table 2: Effect of FinTech Business Models on Performance Measures Across Cooperative Banks 1/

Variable	(1) ROE (percent)	(2) ROA (percent)	(3) NIM (percent)	(4) Loan-to- Assets (percent)	(5) Deposits-to- Liabilities (percent)	(6) Non- Interest Income (percent)	(7) Cost-to- Income (percent)	(8) ROE (percent)	(9) ROA (percent)	(10) NIM (percent)	(11) Loan-to- Assets (percent)	(12) Deposits- to- Liabilities (percent)	(13) Non- Interest Income (percent)	(14) Cost-to- Income (percent)
P2P Lending (log units)	-0.333*** (0.048)	-0.128*** (0.010)	-0.111*** (0.022)	0.537*** (0.049)	-0.002*** (0.000)	0.019 (0.014)	0.676*** (0.128)							
Balance Sheet Lending (log units)								-0.192*** (0.032)	-0.091*** (0.008)	-0.142*** (0.013)	0.351*** (0.029)	-0.002*** (0.000)	0.018* (0.009)	-0.094 (0.085)
Size (log assets)	4.905*** (0.419)	1.161*** (0.087)	0.207 (0.178)	-4.470*** (0.322)	-0.013*** (0.002)	-0.254 (0.165)	-12.84*** (1.086)	5.400*** (0.453)	1.248*** (0.093)	0.351* (0.188)	-4.912*** (0.374)	-0.009*** (0.002)	-0.296* (0.176)	-11.21*** (1.286)
Equity-to-assets	0.381*** (0.048)	0.082*** (0.012)	0.081*** (0.016)	0.053** (0.025)	-0.002*** (0.000)	-0.002 (0.011)	-0.602*** (0.108)	0.461*** (0.054)	0.092*** (0.014)	0.080*** (0.016)	0.087*** (0.030)	-0.002*** (0.000216)	-0.002 (0.0106)	-0.630*** (0.122)
GDP growth	0.158*** (0.014)	0.019*** (0.003)	0.017*** (0.006)	0.016*** (0.016)	-0.003*** (0.000)	0.011*** (0.004)	-0.478*** (0.036)	0.173*** (0.016)	0.017*** (0.003)	-0.010 (0.007)	1.049*** (0.018)	-0.003*** (0.000)	0.007 (0.005)	-0.515*** (0.044)
Inflation	-0.091* (0.052)	-0.115*** (0.012)	-0.309*** (0.025)	1.185*** (0.066)	-0.001*** (0.000)	-0.017 (0.016)	0.282** (0.112)	0.097* (0.057)	-0.051*** (0.011)	-0.254*** (0.020)	0.837*** (0.054)	-0.001*** (0.000)	-0.022 (0.026)	-0.259*** (0.086)
Policy rate	0.287*** (0.040)	0.180*** (0.013)	0.404*** (0.029)	-0.532*** (0.048)	-0.001*** (0.000)	0.011 (0.021)	-1.150*** (0.091)	0.117*** (0.044)	0.132*** (0.012)	0.436*** (0.034)	-0.334*** (0.047)	-0.001*** (0.000)	0.029 (0.024)	-0.775*** (0.081)
Concentration	0.023* (0.012)	0.016*** (0.002)	0.013* (0.007)	0.179*** (0.012)	-0.001*** (0.000)	-0.002 (0.005)	0.189*** (0.026)	0.028 (0.021)	0.007*** (0.002)	0.007** (0.003)	0.388*** (0.022)	-0.002*** (0.000)	0.003 (0.004)	0.241*** (0.037)
N	52.026	52.035	52.030	51.469	51.421	52.039	52.015	48.047	48.056	48.053	47.894	47.855	48.060	48.038
Rho	0.77	0.88	0.94	0.80	0.63	0.89	0.82	0.79	0.89	0.95	0.85	0.68	0.91	0.78
Adjusted R-squared	0.04	0.09	0.12	0.19	0.07	0.01	0.06	0.04	0.09	0.16	0.21	0.08	0.01	0.06
F-statistics	62.85	80.59	176.80	861.10	254.40	21.86	142.50	60.08	75.62	198.20	899.00	332.90	26.33	160.40
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Authors calculations.
1/ This table presents the estimations obtained using the Eq.(2) baseline regressions. It presents the differential effect of selected FinTech business models on the different performance measures for the Cooperative Banks included in our analysis. Robust standard errors for heteroscedasticity appear in parentheses.
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.

Table 3: Effect of FinTech Business Models on Performance Measures Across Commercial Banks

Variable	(1) ROE (percent)	(2) ROA (percent)	(3) NIM (percent)	(4) Loan-to- Assets (percent)	(5) Deposits-to- Liabilities (percent)	(6) Non- Interest Income (percent)	(7) Cost-to- Income (percent)	(8) ROE (percent)	(9) ROA (percent)	(10) NIM (percent)	(11) Loan-to- Assets (percent)	(12) Deposits- to- Liabilities (percent)	(13) Non- Interest Income (percent)	(14) Cost-to- Income (percent)
P2P Lending (log units)	-0.049 (0.047)	-0.015 (0.011)	0.007 (0.024)	-0.053 (0.037)	0.000 (0.000)	0.061*** (0.017)	0.286** (0.119)							
Balance Sheet Lending (log units)								-0.075 (0.076)	-0.012 (0.015)	-0.061*** (0.023)	-0.153*** (0.056)	-0.000 (0.001)	0.023 (0.032)	0.449*** (0.149)
Size (log assets)	2.151*** (0.703)	0.647*** (0.140)	-0.122 (0.131)	-1.333*** (0.436)	-0.004 (0.003)	-0.257 (0.268)	-7.790*** (2.240)	4.080*** (0.853)	0.846*** (0.201)	-0.733* (0.410)	-1.995*** (0.645)	-0.014** (0.006)	0.467 (0.662)	-8.370** (3.542)
Equity-to-assets	-0.005 (0.031)	0.017** (0.008)	0.035** (0.014)	0.050* (0.027)	-0.002*** (0.000)	0.013 (0.012)	0.206** (0.091)	0.082* (0.043)	0.023 (0.015)	0.019 (0.026)	0.048 (0.056)	-0.002*** (0.000)	0.023 (0.029)	0.017 (0.188)
GDP growth	0.485*** (0.048)	0.083*** (0.011)	0.075*** (0.017)	0.365*** (0.036)	-0.001*** (0.000)	-0.010 (0.016)	-0.412*** (0.116)	0.609*** (0.064)	0.097*** (0.0143)	0.062*** (0.0178)	0.369*** (0.0460)	-0.002*** (0.000377)	0.024 (0.0238)	-0.577*** (0.142)
Inflation	-0.180* (0.098)	-0.0483* (0.028)	0.130* (0.076)	0.00391 (0.063)	0.00158** (0.001)	0.118** (0.054)	-0.429** (0.201)	-0.425*** (0.129)	-0.073* (0.038)	0.327*** (0.121)	-0.117* (0.070)	0.002** (0.001)	0.185** (0.090)	-0.123 (0.218)
Policy rate	0.128* (0.076)	0.043** (0.020)	0.042 (0.042)	-0.131* (0.068)	-0.001* (0.001)	0.046 (0.040)	0.014 (0.150)	0.252*** (0.090)	0.075*** (0.026)	0.019 (0.047)	-0.099 (0.077)	-0.001 (0.001)	0.031 (0.050)	-0.053 (0.181)
Concentration	0.082*** (0.023)	0.013*** (0.004)	-0.027*** (0.009)	0.052** (0.020)	0.000 (0.000)	0.007 (0.006)	0.083 (0.066)	0.085** (0.038)	0.017** (0.009)	-0.004 (0.011)	0.052 (0.036)	-0.000 (0.000)	-0.005 (0.010)	0.197 (0.181)
N	7,762	7,855	7,809	7,335	7,196	7,842	7,786	4,153	4,220	4,191	4,110	3,993	4,215	4,179
Rho	0.66	0.68	0.79	0.34	0.23	0.85	0.67	0.81	0.78	0.80	0.57	0.49	0.89	0.74
Adjusted R-squared	0.04	0.04	0.04	0.03	0.02	0.04	0.04	0.08	0.06	0.08	0.06	0.04	0.04	0.03
F-statistics	16.74	10.12	17.25	22.28	9.46	4.18	5.96	16.85	8.29	9.92	19.45	12.93	2.40	3.94
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Authors calculations.
1/ This table presents the estimations obtained using the Eq.(2) baseline regressions. It presents the differential effect of selected FinTech business models on the different performance measures for the Commercial Banks included in our analysis. Robust standard errors for heteroscedasticity appear in parentheses.
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.

Table 4: Effect of FinTech on Profitability of FIs based on selected Bank and Country-specific characteristics 1/

Variable	(1) ROE (percent)	(2) ROA (percent)	(3) ROE (percent)	(4) ROA (percent)	(5) ROE (percent)	(6) ROA (percent)	(7) ROE (percent)	(8) ROA (percent)	(9) ROE (percent)	(10) ROA (percent)
FinTech (log units)	-0.034 (0.024)	-0.024*** (0.005)	-0.080*** (0.012)	-0.025*** (0.003)	-0.068*** (0.012)	-0.023*** (0.003)	-0.068*** (0.012)	-0.021*** (0.002)	-0.093*** (0.011)	-0.025*** (0.002)
belowMedian_Concentration	1.415*** (0.471)	0.020 (0.098)								
Fin*belowMedianConcentration	-0.070*** (0.020)	-0.002 (0.004)								
aboveMedian_StockMarketTurnover			0.709 (0.476)	0.159 (0.103)						
Fin*aboveMedianStockMarketTurnover			-0.042* (0.022)	-0.006 (0.005)						
aboveMedian_CreditDepth					2.875*** (0.399)	0.456*** (0.083)				
Fin*aboveMedianCreditDepth					-0.140*** (0.018)	-0.020*** (0.004)				
AboveMedian_ROE							0.880** (0.436)	0.333*** (0.094)		
Fin*aboveMedianROE							-0.059*** (0.020)	-0.016*** (0.004)		
aboveMedian_RegulatoryQuality									-6.936*** (2.068)	-1.088 (0.718)
Fin*aboveMedianRegulatoryQuality									0.316** (0.144)	0.088* (0.053)
Size (log assets)	3.221*** (0.419)	0.733*** (0.089)	3.126*** (0.428)	0.734*** (0.092)	3.163*** (0.421)	0.737*** (0.090)	3.091*** (0.417)	0.720*** (0.089)	3.222*** (0.409)	0.730*** (0.088)
Equity-to-assets	0.112*** (0.022)	0.044*** (0.005)	0.108*** (0.022)	0.044*** (0.005)	0.108*** (0.022)	0.044*** (0.005)	0.248*** (0.015)	0.043*** (0.005)	0.112*** (0.021)	0.044*** (0.005)
GDP growth	0.225*** (0.016)	0.036*** (0.003)	0.237*** (0.015)	0.036*** (0.003)	0.242*** (0.015)	0.036*** (0.003)	0.248*** (0.015)	0.038*** (0.003)	0.228*** (0.015)	0.036*** (0.003)
Inflation	-0.187*** (0.053)	-0.057*** (0.012)	-0.188*** (0.054)	-0.057*** (0.012)	-0.211*** (0.054)	-0.060*** (0.012)	-0.196*** (0.054)	-0.059*** (0.012)	-0.189*** (0.054)	-0.057*** (0.012)
Policy rate	0.254*** (0.043)	0.103*** (0.011)	0.226*** (0.044)	0.103*** (0.011)	0.259*** (0.042)	0.106*** (0.011)	0.235*** (0.043)	0.102*** (0.011)	0.245*** (0.043)	0.103*** (0.011)
Concentration			-0.003 (0.008)	-0.003* (0.002)	-0.003 (0.008)	-0.003 (0.002)	-0.005 (0.008)	-0.002 (0.002)	-0.006 (0.008)	-0.003* (0.002)
N	79,949	80,129	79,523	79,701	79,523	79,701	79,523	79,701	79,523	79,701
Rho	0.68	0.78	0.68	0.78	0.68	0.78	0.67	0.77	0.68	0.78
Adjusted R-squared	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04
F-statistics	47.25	50.27	45.85	50.90	47.43	47.22	55.57	55.47	40.56	42.84
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Source: Authors calculations										
1/This table presents the estimates obtained using Eq.(3). We augment the baseline specification to consider the role of bank-, industry-, and country -specific variables that equal unity if its value is above or below the sample median. Robust standard errors for heteroscedasticity appear in parentheses.										
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.										

Table 5: Effect of FinTech on Profitability of FIs based on selected Bank and Country-specific characteristics 1/

Variable	(1) ROE (percent)	(2) ROA (percent)	(3) ROE (percent)	(4) ROA (percent)	(5) ROE (percent)	(6) ROA (percent)	(7) ROE (percent)	(8) ROA (percent)	(9) ROE (percent)	(10) ROA (percent)
FinTech (log units)	-0.096*** (0.011)	-0.025*** (0.002)	-0.081*** (0.013)	-0.021*** (0.003)	-0.082*** (0.011)	-0.021*** (0.002)	-0.100*** (0.012)	-0.023*** (0.002)	0.038 -0.055	0.010 -0.008
aboveMedian_GovernmentEffectiveness	-21.14*** (2.986)	-2.036*** (0.556)								
Fin*aboveMedianGovernmentEffectiveness	1.513*** (0.207)	0.144*** (0.037)								
aboveMedian_AccountOwnership			1.923* (1.065)	0.018 (0.180)						
Fin*aboveMedianAccountOwnership			-0.088* (0.046)	-0.000 (0.008)						
belowMedian_NPL					4.512*** (0.739)	1.416*** (0.164)				
Fin*belowMedianNPL					-0.157*** (0.037)	-0.057*** (0.008)				
aboveMedian_RiskTaking							2.054*** (0.486)	0.921*** (0.115)		
Fin*aboveMedianRiskTaking							-0.064*** (0.021)	-0.035*** (0.005)		
aboveMedian_Capital									2.988*** (1.122)	0.745*** (0.176)
Fin*aboveMedianCapital									-0.119** (0.054)	-0.031*** (0.008)
Size (log assets)	3.246*** (0.397)	0.734*** (0.086)	3.143*** (0.456)	0.750*** (0.098)	3.212*** (0.420)	0.736*** (0.089)	3.260*** (0.425)	0.749*** (0.091)	2.501*** (0.335)	0.469*** (0.065)
Equity-to-assets	0.115*** (0.021)	0.044*** (0.005)	0.092*** (0.022)	0.043*** (0.006)	0.112*** (0.022)	0.044*** (0.005)	0.106*** (0.022)	0.042*** (0.005)		
GDP growth	0.227*** (0.015)	0.036*** (0.003)	0.210*** (0.018)	0.040*** (0.004)	0.227*** (0.016)	0.036*** (0.003)	0.226*** (0.015)	0.035*** (0.003)	0.220*** (0.015)	0.033*** (0.003)
Inflation	-0.191*** (0.054)	-0.057*** (0.012)	-0.189*** (0.055)	-0.053*** (0.012)	-0.183*** (0.053)	-0.056*** (0.012)	-0.183*** (0.053)	-0.056*** (0.012)	-0.194*** (0.053)	-0.061*** (0.012)
Policy rate	0.246*** (0.043)	0.103*** (0.011)	0.231*** (0.046)	0.106*** (0.012)	0.226*** (0.043)	0.096*** (0.011)	0.232*** (0.043)	0.098*** (0.011)	0.256*** (0.043)	0.108*** (0.011)
Concentration	-0.009 (0.008)	-0.003* (0.002)	-0.003 (0.008)	-0.004** (0.002)	-0.004 (0.008)	-0.002 (0.002)	0.001 (0.008)	-0.000 (0.002)	-0.010 (0.008)	-0.005** (0.002)
N	79,523	79,701	63,468	63,638	79,523	79,701	79,523	79,701	79,523	79,754
Rho	0.68	0.78	0.67	0.75	0.69	0.78	0.69	0.78	0.63	0.74
Adjusted R-squared	0.02	0.04	0.02	0.04	0.02	0.05	0.02	0.05	0.02	0.03
F-statistics	47.44	43.9	26.4	34.85	45.22	50.95	46.45	50.9	40.98	42.29
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Source: Authors calculations										
1/This table presents the estimates obtained using Eq.(3). We augment the baseline specification to consider the role of bank-, industry-, and country -specific variables that equal unity if its value is above or below the sample median. Robust standard errors for heteroscedasticity appear in parentheses.										
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.										

Appendix I. Variable Names, Definition and Sources

Table 1: Variable Names, Definitions and Sources

Variable	Description	Source
Dependent variables		
ROE	Return on Equity (%) = Net Income/Equity	Bureau van Dijk Orbis
ROA	Return on Assets (%) = Net Income/Assets	Bureau van Dijk Orbis
NIM	Net Interest Margin (%) = Interest Income-Interest Exp/Interest-earning assets	Bureau van Dijk Orbis
Loan-to-Assets	Change in Loan to Assets (%)= Loans/Total Assets	Authors calculations using Bureau van Dijk Orbis database
Deposits-to-Liabilities	Change in Deposits to Liabilities (%)= Total Customer Deposits/Total Liabilities	Authors calculations using Bureau van Dijk Orbis database
Non-Interest Income	Non-Interest Income to Average Assets (%) =Non-Interest Income/Average Assets	Bureau van Dijk Orbis
Cost-to-Income	Cost to Income ratio (%) = Operating Exp./Operating Income-Non-Operating Income	Bureau van Dijk Orbis
Explanatory variables		
FinTech	Log of (Total volume of digital lending and capital raising activities in US\$)	Cambridge Center for Alternative Finance (2021)
FinBigTech	Log of (Total volume of FinTech and BigTech lending activities in US\$)	Cornelli et al. 2022
P2P Lending	Log of (Total volume of P2P lending activities in US\$)	Cambridge Center for Alternative Finance (2021)
Balance Sheet Lending	Log of (Total volume of Balance Sheet lending activities in US\$)	Cambridge Center for Alternative Finance (2021)
FinTech-to-Assets	FinTech as a share of total assets in our sample of FIs (%)	Authors calculations using Bureau van Dijk Orbis and CCAF(2021) databases
FinTech-to-GDP	FinTech as a share of GDP (%)	Authors calculations using IMF WEO (2023) and CCAF(2021) databases
Bank-controls		
Total assets	Log of (Total Assets)	Bureau van Dijk Orbis
Equity-to-Asset ratio	Equity to Total Assets (%)	Bureau van Dijk Orbis
Macro-controls		
GDP growth	GDP, at constant prices, percent change (%)	IMF WEO Database (2023)
Inflation	Annual percentage of average consumer prices (%)	IMF WEO Database (2023)
Policy rate	Central Bank Policy rate (%)	Haver Database
Bank concentration	Assets of five largest banks to total bank assets (%)	Global Financial Development Database (2022)
Other Robustness Controls		
Non-Performing Loans (NPL)	Non-Performing Loans to Gross Loans (%)	Bureau van Dijk Orbis
Total Capital Ratio	Total Capital Ratio (%)	Bureau van Dijk Orbis
Risk-taking Z-Score	Distance from insolvency: $(ROA+E/A)/s(ROA)$, where $s(ROA)$ is the standard deviation of ROA.	Authors calculations using Bureau van Dijk Orbis data
Loan Loss Provisions to Net Interest Revenue	Loan Loss Provisions to Net Interest Revenue (%)	Bureau van Dijk Orbis data
Revenue Mix	Revenue Mix (%) = Other Operating Income/Operating Income	Authors calculations using Bureau van Dijk Orbis data
Stock Market Turnover Ratio	Total value of shares traded during the period divided by the average market capitalization for the period. (%)	Global Financial Development Database
Private credit to GDP	The financial resources provided to the private sector by domestic money banks as a share of GDP (%).	Global Financial Development Database
Bank return on equity	Commercial banks' after-tax net income to yearly averaged equity (% , after tax).	Global Financial Development Database
Bank account ownership	The percentage of respondents who report having an account at a bank or another type of financial institution, or report personally using a mobile money service in the past year (%).	Global Findex Database
Regulatory quality	Ability of government to implement sound policies that promote private sector development -Percentile rank (0-100)	World Governance Indicator
Government effectiveness	Quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies- Percentile rank (0-100)	World Governance Indicator
VIX3M (index)	The Cboe 3-Month Volatility Index SM (VIX3M)- a constant measure of 3-month implied volatility of the S&P 500 Index options.	Bloomberg Database
MSCI (index)	Country Index designed to measure the performance of the large and mid cap segments of the equity market.	Bloomberg Database
Instrumental Variables		
Internet penetration	Individuals using the Internet (% of population)	World Governance Indicator
Regional Institutional funding	Regional Institutional Funding provided to FinTech platforms to support investment strategies or portfolio diversification for institutional investors or their clients.	Authors calculations using CCAF(2021)
FinTech (-c, t)	Total volume of FinTech transactions in all countries except the country under consideration.	Authors calculations using CCAF(2021)

1/ This table presents the list, description, and data sources of the variables included in the estimations.

Appendix II. Bank-specific characteristics

Table 1: Bank-specific characteristics 1/

Financial Institution	Institutions	Total Assets (in billions, US\$)	ROE (percent)	ROA (percent)	NIM (percent)	Loan-to- asset (percent)	Deposit-to- liabilities (percent)	Non-Interest Income (percent)	Cost-to- Income (percent)
All	10,167	5.0	4.9	0.8	5.3	54.3	59.5	2.2	77.3
Banks	9,198	3.0	4.5	0.7	4.8	54.4	61.1	1.5	78.8
Commercial Bank	1,409	20.0	7.0	0.9	5.4	50.1	61.6	3.1	64.5
Cooperative Bank	7,151	0.4	4.0	0.7	4.6	54.4	60.0	1.2	81.8
Non-Banks	969	26.2	9.2	1.9	10.8	53.1	33.0	9.1	62.7

Source: Authors calculations using Bureau van Dijk Orbis database.

1/ This table reports the averages of key financial metrics for the total set of institutions included in our sample and a subset consisting of banks, highlighting differences in asset size, profitability, income and overhead costs measures.

Appendix III. Robustness Checks

Table 1: Baseline and Robustness Checks 1/

Variable	(1) ROE (percent)	(2) ROA (percent)	(3) ROE (percent)	(4) ROA (percent)	(5) ROE (percent)	(6) ROA (percent)	(7) ROE (percent)	(8) ROA (percent)	(9) ROE (percent)	(10) ROA (percent)
FinTech (log units)	-0.090*** (0.011)	-0.025*** (0.002)								
FinTech to Assets			-0.321** (0.153)	-0.177*** (0.037)						
FinTech to GDP					-0.144 (0.160)	-0.221*** (0.038)				
FinBigTech (log units)							-0.090*** (0.011)	-0.025*** (0.002)		
Loan Loss Provisions to Net Int. Revenue									-0.064*** (0.005)	-0.011*** (0.001)
Loan-to-Assets ratio									0.090*** (0.006)	0.017*** (0.001)
Revenue Mix									0.001*** (0.000)	0.000*** (0.000)
Size (log assets)	3.212*** (0.418)	0.730*** (0.088)	2.974*** (0.388)	0.686*** (0.082)	2.929*** (0.384)	0.676*** (0.081)	3.304*** (0.420)	0.747*** (0.088)	3.157*** (0.449)	0.678*** (0.095)
Equity-to-assets	0.110*** (0.022)	0.043*** (0.005)	0.103*** (0.021)	0.042*** (0.005)	0.103*** (0.021)	0.042*** (0.005)	0.101*** (0.021)	0.042*** (0.005)	0.104*** (0.023)	0.046*** (0.006)
GDP growth	0.229*** (0.016)	0.036*** (0.003)	0.241*** (0.016)	0.038*** (0.003)	0.243*** (0.016)	0.038*** (0.003)	0.236*** (0.015)	0.038*** (0.003)	0.180*** (0.016)	0.025*** (0.003)
Inflation	-0.186*** (0.053)	-0.057*** (0.012)	-0.144*** (0.052)	-0.049*** (0.011)	-0.133*** (0.052)	-0.046*** (0.011)	-0.173*** (0.052)	-0.052*** (0.011)	-0.145*** (0.052)	-0.051*** (0.012)
Policy rate	0.242*** (0.043)	0.102*** (0.011)	0.202*** (0.041)	0.091*** (0.010)	0.205*** (0.042)	0.094*** (0.010)	0.235*** (0.039)	0.097*** (0.01)	0.219*** (0.040)	0.100*** (0.010)
Concentration	-0.007 (0.008)	-0.003* (0.002)	-0.009 (0.008)	-0.004** (0.002)	-0.011 (0.008)	-0.005** (0.002)	-0.007 (0.008)	-0.004* (0.002)	-0.018** (0.008)	-0.005*** (0.002)
N	79,523	79,701	79,523	79,701	79,523	79,701	79,948	80,126	76,525	76,619
Rho	0.68	0.78	0.66	0.76	0.66	0.76	0.68	0.78	0.71	0.79
Adjusted R-squared	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04	0.12	0.13
F-statistics	45.30	53.22	46.26	53.88	49.79	54.18	46.37	53.47	84.64	74.77
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Authors calculations

1/This table presents the estimations obtained using the baseline and robustness regressions. Columns (1) and (2) report the baseline estimates obtained using Eq.(1). In columns (3) to (10) we consider alternative measures of the FinTech variable: scaling it by the total assets of the FIs included in our sample (columns 3-4); scaling it by GDP (columns 5-6) or combined with BigTech transactions (columns 7-8). In columns (9) and (10), we augment our baseline regression by including variables that capture the revenue mix (share of non-interest income-to-total-income), provisioning ratio (loan loss provisions-to-assets) and loan-to-asset ratio following Beck, De Jonghe, and Schepens (2013). Robust standard errors for heteroscedasticity appear in parentheses.

Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.

Internet Appendix

I. Summary statistics and correlation matrix

Table 1: Summary Statistics of Main Regression Variables

Variable	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
Dependent variables							
ROE (percent)	4.9	9.2	-47.7	1.4	4.2	8.1	51.0
ROA (percent)	0.8	2.1	-9.5	0.2	0.5	1.0	14.3
NIM (percent)	5.0	7.1	-1.7	2.2	3.1	4.3	59.5
Loan-to-Assets (percent)	-0.1	6.1	-23.1	-2.9	0.0	2.8	24.8
Deposits-to-Liabilities (percent)	0.0	0.0	-0.2	0.0	0.0	0.0	0.2
Non-Interest Income (percent)	2.0	5.2	-0.6	0.4	1.0	1.7	55.1
Cost-to-Income (percent)	76.8	25.2	5.2	64.9	78.4	89.1	216.5
FinTech							
FinTech (in billions, US\$)	22.4	33.3	0.0	0.1	4.4	42.7	356.8
FinBigTech (in billions, US\$)	25.9	54.7	0.0	0.1	4.5	43.7	600.2
P2P lending (in billions, US\$)	15.0	25.9	0.0	0.1	8.7	25.6	327.3
Balance Sheet lending (in billions, US\$)	11.7	12.5	0.0	0.6	5.3	23.3	36.7
FinTech-to-Assets (percent)	0.2	0.9	0.0	0.0	0.1	0.3	164.9
FinTech-to-GDP (percent)	0.1	0.2	0.0	0.0	0.1	0.2	3.4
FinTech (log units)	20.9	4.1	7.2	18.3	22.2	24.5	26.6
FinBigTech (log units)	21.1	4.1	7.2	18.5	22.2	24.5	27.1
P2P lending (log units)	21.3	3.2	9.3	18.7	22.9	24.0	26.5
Balance Sheet lending (log units)	21.5	2.8	6.2	20.2	22.4	23.9	24.3
Bank-controls							
Total assets (in billions, US\$)	5.4	61.5	0.0	0.0	0.1	0.6	3990.0
Total assets (log units)	11.6	2.6	-1.0	9.8	11.4	13.2	22.1
Equity-to-Asset ratio (percent)	16.1	17.1	-971.7	9.0	11.6	16.3	101.3
Macro-controls							
GDP growth (percent)	1.5	2.7	-11.1	1.3	2.2	2.5	25.3
Inflation (percent)	2.4	3.0	-2.1	1.3	1.8	2.4	53.5
Policy rate (percent)	2.3	4.3	-0.8	0.1	0.6	2.4	59.3
Concentration (percent)	59.3	18.1	31.9	46.8	47.6	74.2	100.0
Other Robustness Controls							
Non-Performing Loans (percent)	9.0	24.6	0.0	1.2	3.5	9.2	984.5
Total Capital Ratio (percent)	141.7	16120.2	-5240.1	14.6	18.2	24.9	2369797.0
Risk-taking Z-Score	1.36E+13	3.72E+15	-42.8	30.6	64.7	138.8	1.01E+18
Loan Loss Provisions to Net Interest Revenue (percent)	11.2	38.2	-990.1	0.9	6.0	14.5	993.0
Revenue Mix (percent)	27.1	207.8	-26022.2	12.1	24.9	35.6	53076.7
Stock Market Turnover Ratio (percent)	106.3	57.6	0.3	67.8	108.5	148.0	480.3
Private credit to GDP (percent)	140.6	58.5	10.2	82.1	175.7	184.7	258.5
Bank return on equity (percent)	8.6	7.5	-194.9	6.0	9.7	11.5	41.1
Bank account ownership (percent)	0.9	0.2	0.2	0.9	0.9	0.9	1.0
Regulatory quality (index)	80.2	18.3	13.9	76.4	87.7	91.8	100.0
Government effectiveness (index)	81.0	18.6	10.6	72.6	90.5	91.9	100.0
VIX3M (index)	18.6	4.7	13.4	15.7	17.5	18.5	30.7
MSCI (index)	1903.5	1692.4	25.9	969.6	1846.8	2464.8	15495.4
Instrumental Variables							
Internet penetration (percent)	76.7	15.4	4.0	71.4	81.0	88.5	100.0
Regional Institutional funding (log units)	5.8	1.7	-0.9	4.9	5.3	6.8	10.7
FinTech (-c, t) (log units)	24.8	1.9	18.9	24.0	25.4	26.2	26.8

Source: Authors calculations.

1/ This table presents summary statistics for the main regression variables used in the analysis. The statistics include the standard deviation, minimum, first quartile, median, third quartile and maximum values.

Table 2: Correlation Matrix of Main Regression Variables 1/

Variables	ROE (percent)	ROA (percent)	NIM (percent)	Loan-to- Assets (percent)	Deposits-to- Liabilities (percent)	Non-Interest Income (percent)	Cost-to-Income (percent)
FinTech (log units)	-0.080***	-0.102***	-0.158***	-0.003	0.041***	-0.087***	0.152***
FinBigTech (log units)	-0.078***	-0.100***	-0.155***	-0.006	0.031***	-0.078***	0.142***
FinTech-to-Assets (percent)	0.024***	0.015***	0.016***	-0.019***	-0.006	0.007**	-0.022***
FinTech-to-GDP (percent)	0.013***	-0.022***	-0.096***	-0.045***	0.004	-0.041***	-0.035***
Total assets (log units)	0.200***	-0.003	-0.214***	0.038***	-0.008**	-0.008**	-0.405***
Equity-to-Asset (percent)	0.020***	0.402***	0.392***	-0.039***	-0.074***	0.231***	-0.067***
GDP growth (percent)	0.045***	-0.033***	-0.132***	0.246***	-0.090***	-0.038***	-0.031***
Inflation (percent)	0.109***	0.182***	0.357***	-0.045***	-0.015***	0.144***	-0.108***
Policy rate (percent)	0.176***	0.275***	0.471***	-0.043***	-0.042***	0.171***	-0.160***
Concentration (percent)	0.122***	0.186***	0.244***	-0.007*	-0.055***	0.137***	-0.264***
Non-Performing Loans (percent)	-0.101***	-0.060***	0.182***	-0.070***	0.013*	0.084***	0.048***
Total Capital Ratio (percent)	0.007	0.007	0.008	-0.016**	0.003	-0.002	0
Risk-taking Z-Score	-0.002	-0.001	-0.003	0	-0.009**	-0.001	0.003
Loan Loss Provisions to Net Interest Revenue (percent)	-0.188***	-0.141***	0.079***	-0.032***	0.027***	0.040***	-0.101***
Revenue Mix (percent)	0.010***	0.010***	-0.024***	-0.003	0.001	0.060***	-0.014***
Stock Market Turnover (percent)	-0.083***	-0.110***	-0.213***	0.058***	0.066***	-0.128***	0.135***
Private credit to GDP (percent)	-0.140***	-0.224***	-0.383***	-0.026***	0.069***	-0.184***	0.263***
Bank return on equity (percent)	0.099***	0.092***	0.121***	0.049***	-0.043***	-0.010***	-0.003
Bank account ownership (percent)	-0.155***	-0.208***	-0.429***	0.028***	0.020***	-0.105***	0.161***
Regulatory quality (index)	-0.180***	-0.277***	-0.480***	0.056***	0.011***	-0.150***	0.233***
Government effectiveness (index)	-0.171***	-0.288***	-0.546***	0.062***	0.003	-0.149***	0.207***
VIX3M (index)	-0.034***	-0.035***	-0.016***	-0.281***	0.113***	-0.009***	0.026***
MSCI (index)	0.026***	0.022***	0.070***	-0.066***	0.002	-0.040***	0.014***
Internet penetration (percent)	-0.102***	-0.151***	-0.287***	-0.037***	-0.011***	-0.055***	0.136***
Regional Institutional funding (-c,t) (log units)	0.009**	-0.009**	-0.064***	0.076***	-0.078***	0.079***	-0.164***
FinTech (-c, t) (log units)	0.028***	0.065***	0.111***	0.072***	-0.092***	0.045***	-0.077***
Source: Authors calculations.							
1/ This table presents the Pearson Correlation Matrix for the main regression variables.							
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.							

II. Robustness Checks

Table 1: First-Stage IV Regression Results 1/

Variable	FinTech (log units)	FinTech (log units)	FinTech (log units)
Internet (percent)	0.232*** (0.002)		
Regional Institutional Funding (-c,t) (log units)		0.375*** 0.008	
FinTech (-c, t) (log units)			1.693*** (0.008)
Size (log assets)	1.076*** (0.091)	0.543*** (.083)	0.475*** (.062)
Equity-to-assets	0.032*** (0.004)	0.006** (.003)	0.006** (.003)
GDP growth	0.045*** (0.002)	-0.031*** (.002)	-.339*** (.003)
Inflation	-0.498*** (0.027)	-0.063*** (.006)	-.210*** (.008)
Policy rate	0.363*** (0.016)	-0.175*** (.006)	-.149*** (.007)
Concentration	0.041*** (0.002)	0.024*** (.002)	-.003* (.002)
N	79,453	56,862	79,480
Sanderson-Windmeijer multivariate F test	18357.04	2193.38	47220.16
Prob > F	0.000	0.000	0.000
Underidentification test			
Kleibergen-Paap rk LM statistic Chi-sq(1)	4429.22	1658.79	8207.49
P-value	0.000	0.000	0.000
Weak identification test			
Cragg-Donald Wald F statistic	20385.43	10396.58	1.40E+05
Kleibergen-Paap Wald rk F statistic	18357.04	2193.38	47220.16
Weak-instrument-robust inference			
Anderson-Rubin Wald test Chi-sq(1)	28.75	24.99	131.37
P-value	0.000	0.000	0.000
Stock-Wright LM S statistic Chi-sq(1)	47.78	43.43	210.85
P-value	0.000	0.000	0.000
Bank Fixed Effects	Yes	Yes	Yes
Source: Authors calculations.			
1/This table presents the estimates obtained from conducting the first stage regressions for the three distinct instrumental variables: Internet penetration; Regional Institutional funding provided to FinTech firms except the country under consideration and the Total volume of FinTech transactions in all countries except the country under consideration. Robust standard errors for heteroscedasticity appear in parentheses.			
Note: *, **, and *** denote statistical significance at 10, 5, and 1 percent level, respectively.			

Table 2: Second-Stage IV Regression Results 1/

[illegible]

Table 4: Baseline and Robustness Checks 1/

[illegible]

III. List of Countries included in the Sample

Table 1: List of Countries included in the Sample 1/

Number	Country	Total Alternative Finance Volume 2012-2020 (in billions, \$US)	Total Alternative Finance Volume 2012-2020 (% of GDP)
1	China	1,018.00	6.9
2	United States	315.7	1.5
3	United Kingdom	58	2.2
4	Brazil	7.7	0.5
5	Netherlands	6.1	0.7
6	France	5.8	0.2
7	Germany	5.8	0.2
8	Australia	5.7	0.4
9	India	5.6	0.2
10	Korea, Rep.	5.2	0.3
11	Indonesia	4.5	0.4
12	Italy	4.4	0.2
13	Japan	4.1	0.1
14	Canada	3.1	0.2
15	Israel	2.6	0.6
16	Singapore	2.4	0.7
17	Spain	2.2	0.2
18	Chile	1.9	0.8
19	Finland	1.7	0.6
20	Mexico	1.6	0.1
21	New Zealand	1.6	0.8
22	Sweden	1.5	0.3
23	Poland	1.5	0.2
24	Ghana	1.1	1.7
25	Colombia	1.1	0.4
26	Latvia	1	3
27	Ukraine	1	0.6
28	Hong Kong	0.8	0.2
29	Armenia	0.8	6.4
30	Estonia	0.7	2.4
31	Russian Federation	0.7	0
32	Georgia	0.6	3.7
33	Kazakhstan	0.5	0.3
34	Denmark	0.5	0.2
35	Zambia	0.5	2.8
36	Ireland	0.4	0.1
37	Belgium	0.4	0.1
38	Switzerland	0.4	0.1
39	Peru	0.4	0.2
40	Czech Republic	0.3	0.1
41	Philippines	0.3	0.1
42	Moldova	0.3	2.9
43	Malaysia	0.3	0.1
44	Argentina	0.3	0.1
45	United Arab Emirates	0.3	0.1
46	Kenya	0.3	0.3
47	Slovenia	0.3	0.5
48	Uganda	0.2	0.6
49	Norway	0.2	0.1
50	Tanzania	0.2	0.3
51	Austria	0.2	0
52	Vietnam	0.2	0.1
53	Bulgaria	0.2	0.3
54	Albania	0.2	1.1
55	South Africa	0.1	0
56	Romania	0.1	0
57	Nigeria	0.1	0

Source: Authors calculations using CCAF(2021) database.
1/ This table lists 57 countries along with their total alternative finance volume from 2012 to 2020, both in billions of US dollars and as a percentage of GDP. The countries are ranked by the volume in billions of US dollars.

IV. Digital lending and capital raising activities

Table 1: Digital Lending and Capital Raising Business Models and Definitions

Digital Lending Business Models	
P2P/Marketplace Lending	Individuals or institutional funders provide a loan to a consumer borrower, business borrower, or secured against a property, commonly ascribed to off-balance sheet lending.
Balance Sheet Lending	The platform entity provides a loan directly to the consumer borrower, business borrower, or secured against a property, ascribed to on-balance sheet nonbank lending.
Invoice Trading	Individuals or institutional funders purchase invoices or receivables from a business at a discount.
Securities	Debt-based: Individuals or institutional funders purchase debt-based securities, typically a bond or debenture, at a fixed interest rate. Mini-bonds: Individuals or institutions purchase securities from companies in the form of an unsecured bond which is 'mini' because the issue size is much smaller than the minimum issue amount needed for a bond issued in institutional capital markets.
Consumer Purchase Finance/BNPL	A buy now/pay later payment facilitator or Store Credit solution.
Digital Capital Raising Business Models	
Equity-based	Individuals or institutional funders purchase equity issued by a company; provide equity or subordinated debt financing for real estate; purchase securities from a company, such as shares or bonds, and share in the profits or royalties of the business.
Non-Investment based	Backers provide funding to individuals, projects or companies in exchange for non-monetary rewards or products. Donors provide funding to individuals, projects or companies based on philanthropic or civic motivations with no expectation of monetary or material. Interests and/or other profits are re-invested (forgoing the interest by donating) or provides microcredit at lower rates.
Source: CCAF (2021)	

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